Global Telemedicine and eHealth Updates: Knowledge Resources

Vol. 3, 2010

Editors

Malina Jordanova and Frank Lievens

ISfTeH
International Society for Telemedicine & eHealth

Preface

The third volume of the series "Global Telemedicine and eHealth Updates: Knowledge Resources", is now in your hands.

With 136 papers from over 50 countries, the book presents a collective experience of experts from different continents all over the world. Papers reveal various national and cultural points of view on how to develop and implement Telemedicine/eHealth solutions for the treatment of patients and wellbeing of citizens.

Year after year the series "Global Telemedicine and eHealth Updates: Knowledge Resources" provides a glimpse and summarizes the most recent practical achievements, existing solutions and experiences in the area of Telemedicine/eHealth.

Brought to life by contemporary changes of our world, Telemedicine/eHealth offers enormous possibilities. The technological solutions are available and ready to be implemented in healthcare systems. Telemedicine/eHealth services are advancing and acceptable to both patients and medical professionals. If carefully implemented, taking into account the needs of the community, Telemedicine/eHealth is able to improve both access to and the standard of healthcare, and thus to close the gap between the demand for affordable, high quality healthcare to everyone, at any time, everywhere, and the necessity to stop the increase in healthcare budgets worldwide.

Telemedicine/eHealth is already a must, a fantastic challenge for the future, but it must be based on cooperation and coordination at all possible levels. It requires networking and planning, readiness to learn from others, and avoiding re-inventing the wheel. The main challenge is to be sure that available options are used optimally and in a coordinated manner as to ascertain that the desired effects do come true and the resources are indeed not diverted away from basic needs.

We are convinced that this book will provide useful information to those who are preparing to introduce Telemedicine/eHealth in their regions or countries. It will allow them to rely on the experience of others and will make them aware of the benefits and problems that were encountered during and after implementation of systems or services, and as such help them to avoid mistakes and reduce potential problems.

Yet, it is necessary to underline that:

- The content of the book is divided in chapters covering various areas of eHealth;

- Chapters and papers in each chapter are arranged alphabetically;
- The original style of the authors was kept as much as possible;
- "How", "Where", "When" and if possible "How Much" – are only part of the questions that authors are trying to answer.

We hope that everyone involved in Telemedicine/eHealth will find this book not only interesting, but valuable as well.

Enjoy your reading!

Editors

Malina Jordanova, MD, PhD
Educational Program Coordinator, Med-e-Tel
Solar-Terrestrial Influences Institute, Bulgarian Academy of Sciences
Bulgaria

Frank Lievens
International Coordinator, Med-e-Tel
Board Member, Secretary and Treasurer of International Society for Telemedicine & eHealth (ISfTeH)
Belgium & Switzerland

Editors gratefully acknowledge the work of all reviewers that dedicated lots of efforts, time and high expertise, and with their valuable advice, supported both authors and editors in the process of selecting, correcting and preparing for publication all papers included in this book.

Content

Preface iii

eHealth: Efficient, Ethical and Sustainable **1**

A Model Framework for Understanding Telecare and Telehealth 2
M. Fisk
A Success Story in Remote Diagnostics: Better Results with Significantly Lower Costs 6
T. Hakkarainen, L. Toivonen
Acceptance of Telemedicine: The Case of Emergency 11
S. Kreucher, J. Lohmeier, K. Laryionava
Applying Standards in Cross-sector Communication for an Integrated Health Environment 16
H. Demski, C. Hildebrand, A. Brass, S. Jedamzik, R. Engelbrecht
Developing a Low Cost and High Effectiveness Telehealth Implementation Methodology in Minas Gerais, Brazil 20
M. B. M. Alkmim, F. Leles, M. Pena, V. Alfenas, R. M. Figueira, A. L. P. Ribeiro
French e-Health Policy 26
N. Ferraud-Ciandet
Implementation of SNOMED CT® in Telemedicine and eHealth to Standardize Telemedical Record Documentation for Interactive Communication with the Electronic Health Record 30
G. A. Brox, J. L. Huston
Small Reflexion on Standardization and e-Health 36
B. Salgues, M. Blanchard
Telemedicine Applications in Body-related Technologies: Ethical Issues 40
K. Laryionava, D. Groß, S. Kreucher
The Economic Impact of Using Telehealth on Primary Care on the Municipal Budget in the State of Minas Gerais, Brazil 46
R. M. Figueira, M. B.M. Alkmim, F. E. Campos, A. L. P. Ribeiro
The Role of Quality and Quality Management Systems in Telemedicine 51
M. Lindlar

eHealth: How to Close the Healthcare Gap in Developing Countries **55**

A New Model for eHealth Capacity Development in Africa 56
M. Mars
A Sustainable Approach for eHealth in Emerging Countries 60
S. Y. Y. D. Wickramasinghe, D. Wijethilake, V. Dinusha, S. Saatviga, S. M. K. D. Arunathilake, G. P. Seneviratne, P. K. M. Thilakarathna, P. Mahanamahewa, K. R. P. Chapman
Brazil Telehealth Program in the Amazon Region: Brazilian Strategy to Reach Isolated Populations 64
A. E. Haddad, M. C. Skelton-Macedo, C. Costa, P. E. Souza, C. L. Wen, F. E. Campos
Change Management in Web-based eHealth Solution 69
D. Wijethilake, Y. Wickramasinghe, D. Vatsalan, S. Sudahar, S. Arunathillake, G. Seneviratne, K. Chapman, K. Thilakaratne
Development of Specialist Teleconsulting System for Primary Health Care in Armenia: A Pilot Telemedicine Project by the Armenian Association of Telemedicine (AATM) 73
G. V. Chaltikyan, A. E. Avoyan, D. L. Gasparyan, R. Hovhannissyan
Public Health Awareness in a Closed Work Setting: Can SMS Text-messaging builds on the Current Communication Media Strategy Progress? 77
H. van Beijma, B. Addy, B. Hoefman
Telemedicine Projects: An Essential Need for Developing Countries 79
S. Warrier
Telemedicine Solutions in Tanzania: Experiences on How to Overcome Barriers for Successful Implementation 83
N. P. Moens
Wellness – Disrupting the Healthcare Ecosystem 87
L. Rajkumar

eLearning **91**

Challenges and Opportunities of Implementing eHealth Solutions in Developing Countries: Case Studies in East Africa Include Telepathology and Medical Education Programs 92
Z. M. Talib, A. R. Sohani, V. Vyas, B. S. V. Prasad, Z. Moloo, S. Sayed, S. Jivaji, N. Ramzan, S. Walani
e-Learning: Education in the Prevention in AIDS/STI in Andean Region and Caribbean 97
L. Murrugarra, F. Samalvides, L. Soto, P. Prieto, D. De la Cruz, E. Murrugarra, O. Becerra, Gotuzzo

mLearning for Continuing Medical Education in Peru: A Mid-term Evaluation 100
M. Zolfo, V. Suarez, C. Kiyan, D. Iglesias, I. de Waard, J. Echevarria, L. Lynen
New Technologies Applied to Education Maneuver Training Basic Cardiopulmonary Resuscitation for Medical Staff 105
F. S. Collet e Silva, R. Pires, L. Serpa, C. Oliveira
Participation of Undergraduate Nursing Students in Online Discussion Forums about Endocrine Physiology 107
E. M. L. Rangel, I. A. C. Mendes, A. Mazzo, L. M. M. Alves, S. Godoy, M. A. Trevizan
Public Superior Education of Majority with Quality and Excellence 111
M. H. Petrich; N. Dinsmann, M. Guillaumet, G. Bill, L. Scopetta
Simulated Case Based In Decision: An Useful Method to Teach and Evaluation People in Health Care 114
F. S. Collet e Silva, N. D. Mori, R. S. Poggetti, S. Rasslan, C. L. Wen
Tele-Health in Americas: Project for Making up a Tele-Health Network in the Region 117
M. H. Petrich, N. Dinsmann, M. Guillaumet, G. Bill, L. Scopetta

Electronic Health Records 120

Analysis of Current Technologies and Devices for Mobile Data Capture: A Qualitative Usability Study for Comparison of Data Capture via Keyboard, Tablet PC, Personal Digital Assistant, and Digital Pen and Paper 121
R. Boldt
Benefits of a National Electronic Radiological Record 125
A. Jahnen, C. Pruski, H. Bouzid, N. Jerusalem, R. Krippes, U. Roth, S. Benzschawel, C. Back
Diakonie-Pflege Verbund Berlin: Digital Pen and Paper Technology Helps Improve Social Care Services for Home Care Provider in German Capital 129
R. Boldt
Electronic Health Records as a New Dimension of User Profiles in Recommender Systems 133
M. López-Nores, Y. Blanco-Fernández, J. J. Pazos-Arias
Health Data Management with an Archetype Driven EHR System in Low Resource Environments (EHRFlex) 137
A. Brass, D. Moner, C. Hildebrand, M. Robles
IT Infrastructure for National Electronic Health Records in 141

Luxembourg – Acceptance Occurs When Benefits Outweigh Disadvantages
S. Benzschawel, H. Zimmermann, M. Da Silveira, U. Roth, A. Jahnen
New Paradigms for Patient Record Sharing with Privacy, Ease of Use and Compliance with Emergency Situations: Case of the French Nonprofit System Sanoia.com 146
A. M. Selamnia, H. Servy
Portable Access to Electronic Medical Data in PCS*CARE 150
M. Citavy, R. Trzicky
Prototype System Supporting Modular, Stack-Oriented Personal Healthcare Services 154
T. Clark, R. Krzyminiewski
Using Digital Pen and Paper to Improve Electronic Care Record Keeping, Boosting Productivity, Accountability and Quality of Social Care 160
P. Ericson
Using Digital Pen and Paper to Improve Provision and Management of Home Care in Sweden 163
M. Edenståhl

e-Mental Health: Enhancing Mental Health Services through Information and Communication Technology 165

Biofeedback, Virtual Reality and Mobile Phones for the Treatment of Generalized Anxiety Disorder 166
F. Pallavicini, D. Algeri, A. Gorini, C. Repetto, G. Riva
Client-centered Design of Technology to Support Mental Health 171
G. Doherty, D. Coyle, M. Matthews, J. Sharry
Do Patients with Severe Obesity Overestimate or Underestimate Their Body Size? 176
G. Aguayo, M. Larcelet, M. Vaillant, C.B. Pull
Experiences of Telerehabilitation on Articulation Disorders for Children 180
A. Hosokawa
Internet Addiction and Facebook 183
M. Stojakovic
Introduction to LifeGuide: Open-source Software for Creating Online Interventions for Health Care, Health Promotion and Training 187
S. Williams, L. Yardley, M. Weal, G. Wills
Migrating Virtual Worlds to the Internet and Mobile Platforms 191
B. K. Wiederhold, L. Kong, M. D. Wiederhold

Tele-rehabilitation of COPD Patients across Sectors 198
B. Dinesen, B. M. Ege, C. Nielsen, O. Grann, E. Toft, O. K. Hejelsen, S. K. Andersen
Virtual Psychological Support: User's Personality Characteristics 203
M. Jordanova, R. Bojinova, L. Vasileva

Home Care and Assisted Living 207

A Context-aware Tele-homecare System for Senior Citizens 208
S. Nourizadeh, Y. Q. Song, J. P. Thomesse, C. Deroussent
E-technologies for e-Health and Assistance for loss of Autonomy: The Important Role of University Networks through International Joint Degrees 213
L. Billonnet, E. Desbordes, J-M. Dumas, B. Lapotre
High Signal Resolution Pulsoximeter in Home Care Telemonitoring 217
R. Krzyminiewski
Home Automation for the Service to the Person: An Economic Stake in the Local and National Craft Market 222
S. Cherat, J. Chignac, E. Desbordes, M. Denis-Gay, L. Billonnet, J-M. Dumas
Home Healthcare – Target Group Specific Access to Telemedical Services 226
A. Mertens, J. H. Dornberg, D. Dünnebacke
Identifying New Market Opportunities in Telecare and Telehealth 232
K. Lethbridge
Information System Architecture for Home-Care Workflow Management 236
R. Bastide, S. Zefouni, E. Lamine, H. Pingaud
Technical Solutions for the Accessibility of Web Sites: A Current Preoccupation for the Disabled Persons 241
F. Coëffic, G. Terrier, M. Lanique, L. Billonnet, E. Desbordes, J-M. Dumas
Tele-emergency, Teleconsultation and Telehomecare in Belo Horizonte: The Experience of a Brazilian City with Important Incorporation of Telehealth Resources 245
M. G. Teixeira, S. M. G. Ferreira, N. R. de Queiroz, E. M. N. de Pinho e Medeiros, R. T. Campos, A. de F. dos Santos
Telehealth for Hospice and Palliative Care in the Home © 249
D. A. Randall

International Telemedicine and eHealth Initiatives and 254

Developments

Application of the Delphi Method for Consensus Building on Factors of Success and Failure in the Brazilian National Telehealth Project – Minas Gerais Cluster 255
A. de F. dos Santos, C. Souza, S. F. Santos, M. Nascimento, M. Schutze, H. J. Alves
Conceptual Framework for a Comprehensive eHealth Evaluation Tool 261
S. Khoja, H. Durrani, U. Piryani, R. E. Scott
Developing eMedical Records for Telemedicine: The Experience of Mongolia 266
Kh. Mungun-Ulzii, D. Mungunchimeg, D. Patte, E. Sevin, S. Becquerel
eHealth – Realities and Perspectives 270
E. T. Kldiashvili
Establishment of a Multicentre Telecardiology Project in State of Rio Grande do Sul, Brazil: A Report about Academic Participation 274
R. Timm, B. Lacerda, T. Almeida, R. Kalil, V. Portal, A. Sparenberg
mHealth Solution in Bulgaria 278
P. Mihova, I. Pendjurov, J. Vinarova
Model of Electronic Health Record for Gynecology Practice in Bulgaria 282
P. Mihova, I. Pendjurov, J. Vinarova, D. Asenova
Optimized Representations of X-ray Images 286
V. *Gueorguiev, I. Evgeniev*
Polish Telemedicine Society Heading 2010 291
W.M. Glinkowski, M. Pilch-Kowalczyk, M. Widanka, P. Wójcik, S. Piórek, R. Mężyk, R. Sitnik, M. Nejman, Z. Kotwica, J. Pietryka, A. Wojciechowski
Progress in Preparations for Launching Telemedicine and eHealth Initiatives in Armenia: A Report on Recent Activities by the Armenian Association of Telemedicine (AATM) 295
G. V. Chaltikyan, A .E. Avoyan, D. L. Gasparyan, R. H. Hovhannissyan, T. E. Hakobyan, K. Vardanyan
State-of-the-Art in Telemedicine-Telehealth in Slovenia 300
D. Rudel, M. J. Fisk
Systematic Review of the Use of Telehealth in Asian Countries: Analysis of Outcomes 305
H. Durrani, S. Khoja, S. Ansari, R. E. Scott
Telemedical Aspects of Long-Term Eco-Medical Researches 310

O. Orlov, E. Bersenev, A. Berseneva, A. Chernikova, R. Baevsky
The Evidence for Telemedicine: Recent Trends and Expectations 315
R. C. Merrell
Toward the Implementation of Integrated eHealth Solution: The Luxembourgish Experience 320
M. Da Silveira, F. Wisniewski, C. Pruski

Medical Informatics 325

A Horizon Scanning System for Identifying New Telehealth Innovations 326
S. J. Blackburn, P. A. Cudd, M. S. Hawley
An Integral Solution for Hospital Information System 331
I. Evgeniev, V. Trifonov, V. Gueorguiev
Artificial Intelligence Techniques in the Diagnosis of Breast Cancer: A Case Study 336
M. Caramihai, I. Severin, W. Rae, A. Blidaru, H. Balan, V. Balanica
CeRC Story-Game Engine: An Open Source Technology to Power Story Based Investigation Games 341
D. Farrell, P. Kostkova, L. Lazareck, D. Weerasinghe
Cloud Computing in Healthcare: An Authorization Perspective 346
V. Koufi, F. Malamateniou, G. Vassilacopoulos
Enabling Collaborative eHealth Research Using Web 2.0 Tools 351
M. Szomszor, D. Weerasinghe, P. Kostkova, G. Jawaheer
Generating Structured Patient Data via Automatic Analysis of Free Medical Text 356
D. Tcharaktchiev, S. Boytcheva, I. Nikolova, E. Paskaleva, G. Angelova, N. Dimitrova
How to make eProtocol? 360
L. Daragó, A. Jávor
Information and Communication in Medicine through On-Line Advanced Solutions 364
A. Alexandru, C. S. Alecu
TNHSP - TamilNadu Health Systems Project Successful Implementation of HMIS across Government Hospitals 369
S. Vijayakumar, P. K. A. Babu, K. Rao
The Approach to Individualized Teleconsultations of Patients with Arterial Hypertension 372
F. T. Adilova, N. A. Ignat'ev, Sh. F. Madrakhimov
The Peculiarities of Clinical Information in Light of the Novelty Brought by e-Health: A Review of Some Italian Projects 376

G. Rinaldi, L. Carnevali, A. Gaddi, L. De Mattè, P. Busca
Virtual Epidemiology – Application of Information Technologies for Creation and Management of Epidemiology Medical Information Program and Databases 381
E. Kldiashvili, A. Burduli
WikiFood: Establishment of an Online Information Portal for Patients with Food Allergies 386
R. Herbst, N. Rösch, A. Arens-Volland, F. Feidert, R. Mösges

Mobile eHealth 390

Building Virtual Care Communities Supporting Elderly Socialization and Independent Living by Integrating Mobile Wireless ICT Based Services 391
E. Christodoulou, G. Samaras, E. Polydorou, C. Tsiourti, M. Belk
In-Flight Pathologies and Medical Emergencies Assisted By Centro Internazionale Radio Medico (CIRM) 396
F. Amenta, I. Grappasonni, A. DiDonna, F. Sibilio
Integrating Mobile Data with GIS for Strategic Diseases Control in Public Health 400
P. P. Escobar, M. Santiago, M. Del Fresno, J. Massa
Managing Health Information on Mobile Devices 405
C. Tessier
mHealth: Bridging the Health Divide 407
K. Ganapathy
The Automobile: A Source of Inspiration for the Intelligent eHealth Environment and the Assistance to the Person 412
M-N. Dokhelar, D. Lesage, O. Bouya, L. Billonnet, E. Desbordes, J-M. Dumas
The mHealth Revolution 416
C. P. Waegemann
The Use of a Psycho-technology Mobile Application in a Mindfulness-based Post-intervention Program for Women with Fibromyalgia 418
M. Quintana, M. Esther Rincón

Open Source Software in Health Care 421

Borboleta and SaguiSaúde - Open Source Mobile Telehealth for Public Home Healthcare 422
G. Duarte, R. Correia, P. Leal, H. Domingues, F. Kon, R. Kon, J. E.

Ferreira
Exploration of Open Development Principles for Telehealth Service Platforms 427
P. A. Cudd, S. Judge
Improving Health Technology Management: Development of a Model for the Implementation of an Essential Information System for Medical Devices in Low- and Middle-Income Countries 432
C. Zaugg, M. Raab
Information on Open Source Solutions in Healthcare - the OSSHealth Repository 437
H. Demski, C. Hildebrand, A. Jossif, R. Engelbrecht
Ligne de vie 441
Ph. Ameline, J. F. Brûlet, A. Gibily, Ch. Hambourg
Open Collaborative Health 445
A. Altuna, J. M. López
OpenEMPI: An Extensible, Open Source Enterprise Master Patient Index 450
O. Pentakalos, Y. Xie
Open-source and Healthcare: Key Factors for the Transfer of R&D Results into Healthcare Solutions 455
D. Martin, C. Moll, A. Jahnen, N. Rösch
Stratification of FOSS Communities Specialized in the Provision of eHealth Systems and Technologies 459
R. Pawelzik
Technological Frameworks for Mobile Home Health Care 462
M. Hoeller, T. Karopka

Telecardiology 4 **67**

A Framework for the Integration and Homogeneous Management of Electrocardiography Formats 468
J. D. Trigo, A. Kollmann, A. González, D. Hayn, A. Alesanco, G. Schreier, J. García
AMEDS and PMHS: Technical Innovations for Improvement of Medication Adherence and General Health Care 473
A. A. Calbo, L.van Dijk
Cross-border Home-monitoring of Heart Failure Patients in Luxembourg and North Rhine-Westphalia 478
N. Rösch, P. Harpes, S. Kohler, C. Moll, D. Wagner, R. Beckers, T. Feige, B. Gräfe, O. Wagner, M. Werner, H. Körtke
Improving Automated External Defibrillators Usage with 482

Telecommunication Solutions – A Pilot Project for European Agglomerations
A. Cacko, M. Grabowski, K. J. Filipiak, G. Opolski
Is It Possible to Optimize Treatment of Patients with Acute Coronary Syndrome Using Telemedicine? – A Kardionet Solutions 487
M. Grabowski, R. Rudowski, J. Sierdziński, A. Cacko, G. Opolski, M. Niezgódka
Multiclass Classification of Heart Rate Patterns for Identification of Sleep Stages Using Computational Grids 491
A. Varoneckas, G. Varoneckas, A. Zilinskas
Telecardiology in Clinical Practice: A One Decade Experience 496
V. D Moga, M. Moga, R. Avram, T. Ciocarlie, L. Bosneag
Telemedicine Using the Example of Practical Models of Health Care with Cardiovascular Disease 500
H. Körtke, T. Feige, O. Wagner, A. Fliedner, N. Mirow, J. Gummert
Ten Years of a Tele-ECG System in the State of Rio Grande do Sul/Brazil: From a Regional Project to a Multipoint Network 503
A. Sparenberg, R. Kalil, V. Portal
The Experience of Integration between a University Telehealth Center and the Public Health Sector: Achieved Results 509
C. Souza, G. C. e Penna, M. C. B. Melo, R. M. Torres, H. J. Alves
Web Based Database for the Assessment of Effectiveness of Thromboembolic Prophylaxis in Orthopaedic Surgery: Preliminary Study 513
W. M. Glinkowski, A. Górecki

Telemonitoring **517**

A Virtual Research Environment (VRE) to Support Sharing and Collaboration in Internet Intervention Projects 518
S. Williams, L. Yardley, G. Wills, S. Samangooei, L. Gilbert
Advanced Telemedicine System of Systems for Remote Monitoring of Patients and Elderly People 523
V. Petcu, A. Petrescu, I. Nastase
Alpha System: A Multi-parameter Remote Monitoring System to cover the Requirements of a Polymorbid Aging Population 528
I. Kósa, I. Vassányi, Z. Butsi, B. Végső, T. Dulai, Gy, Kozmann
An Agent-Based System for Meta-Monitoring 532
S. Trouilhet, A. Rammal, N. Singer, J-M. Pecatte
Auricular Electrical Stimulation (P-STIM) for Insomnia Treatment Using Remote Control 537

J. C. Szeles, G. Varoneckas, E. Kaniusas
Competence Telenetwork for Consultations, Education and Management of Eye Diseases in the Primary Care Environment 542
A. Paunksnis, V. Barzdziukas, S. Kopsala, M. Paunksnis, I. Laurinaviciene, A. Maciulis
Formative Second Opinion: Qualifying the Primary Health Care in Brazil 546
A. E. Haddad, M. C. Skelton-Macedo, E. D. Castro-Filho, V. Abdala, R. P. Andrade, F. E. Campos
Monitoring System of Assessment of Energy Expenditure to Human in Free-living Condition by Mean of Information and Communication Technologies 551
L. J. R. Lopez, D. G. Goroso
Open Health Assistant, a Solution Designed to Support the Evolution of Clinical Practice and Prevention, Transferring Diagnosis and Therapy to the Patients' Homes 556
J. Román Miralles, A. Altuna Palacios
Pharmacoepidemiology of Drug Prescription on Board Ships Assisted by Centro Internazionale Radio Medico (CIRM), the Italian Telemedical Maritime Assistance Service (TMAS) 559
F. Amenta, I. Grappasonni, M. Mancini, F. Petrelli, F. Sibilio
Postural Telediagnostics for Elderly Remote Access to 3D Data and Its Assessment 564
W. M. Glinkowski, J. Michoński, R. Sitnik, B. Glinkowska, M. Witkowski
Telemedicine Perspectives of Managing Crew Health during Lunar/Martian Extravehicular Activity and Physiological Monitoring of Sorties on the Surface of other Celestial Bodies 568
S. N. Filipenkov
Telemonitoring of Weight and Physical Activity: Efficacy in Obese Humans and in Patients with Diabetes Mellitus Type 2 574
C. Luley, A. Blaik, S. Westphal, M. Bruhnke
The Brazilian Telemedicine University Network RUTE 578
W. Coury, L. A. Messina, J. L. Ribeiro Filho, N. Simões

Telesurgery **583**

Monitoring of Patient's Condition, Actions of Anaesthesiologist and Surgeon in the Operating Room over the Internet 584
E. Flerov, I. N. Sablin, O. Broytmann, Sh. Batchayev, A. Bankov
http://tele.med.ru : Our Solution to Web Integration of Information in 588

Cardiac Anesthesia
A. Bankov, Sh. Batchayev, E. Flerov, I. Sablin, O. Broytmann
Telemedical Systems for the Support of Regional Healthcare in the Area of Trauma 592
M. Kosiedowski, C. Mazurek, K. Slowinski, M. Stroinski, K. Szymanski, J. Weglarz
Telenursing – First Experiences with Mobile Phones for Wound Healing Monitoring (Role of Nurses) 597
W. M. Glinkowski, A. Saracen
The Remote Range of Motion Measurement Using Still Images Transfer and Freeware Angle Measurement Tool: Preliminary Report 601
W. M. Glinkowski, K. Krawczak, D. Cabaj, B. Glinkowska
Traumastation, a Telemedicine Tool 605
D. Rizou, I. Sachpazidis, L. Salvatore

eHealth: Efficient, Ethical and Sustainable

A Model Framework for Understanding Telecare and Telehealth

M. J. Fisk
Telecare Services Association, United Kingdom
malcolm.fisk@dsl.pipex.com

Abstract: **The development of telecare and telehealth technologies and services has been compromised by different understandings of their role. The different understandings follow the growing experience of providers in relation to varying user needs – whether for the lifestyles of younger or the frailties of older people. The different understandings relate to divergent professional experiences and the differential use of labels for telecare and telehealth services. This paper argues the case for a shared understanding linked to the need to pursue the objective of personal well-being – where social and health interventions both contribute. A model framework is offered to facilitate that shared understanding.**

Introduction

The shape of future services that carry the labels 'telecare' and 'telehealth' remain uncertain. What is clear, however, is that there is confusion about these labels or terms; and that there is some different use of labels in support of particular professional perspectives. The clearest difference in the labels relates, it is argued, to the social and healthcare dimensions of care – with the social care professionals being adherents to the term telecare, and healthcare professionals using the term telehealth.

These labels or terms do not, however, stand alone. There are the related terms such as telemedicine and eHealth (both assuredly on the telehealth side of any equation); and a growing recognition of the role of social alarms and other devices as 'assistive technologies'. The terms eHealth (embracing services that facilitate the communication of health information often between clinicians and other health professionals) and assistive technologies (helping people, whether or not they are service users, to undertake activities and/or compensating for disability) provide us with what are the main broad categories that can encapsulate many of the other terms. This gives us a 'background' on which we can superimpose and consider other terms. The overlap between eHealth and assistive technologies then becomes the main battlefield for competing understandings.

Context

The range of telecare and telehealth applications is now becoming clearer. A typology for telehealth was presented at the 2009 Med-e-Tel Conference [1]. This included the social care elements that are generally embraced by the term 'telecare'. It broadly speaking subdivided telehealth applications in relation to health conditions (where certain technologies were typically used); and the extent to which users could decide for themselves regarding the services and technologies they accessed. There was, in addition, a nod towards some of the issues around technology intrusiveness that has subsequently been well explored by Schermer [2].

The three areas cited for telehealth applications in the earlier typology were (a) responses and event recognition; (b) medication compliance or concordance; and (c) the monitoring of well-being. Ensuing experience means that we can now expand these areas as follows. At least three of these now characterise many 'telecare' services and are directly supportive of the health aspect of well-being:

- Response and event recognition (including use of social alarms, fall detectors and seizure detectors);
- Medication compliance (including use of pill dispensers and automated prompting);
- Disease management (including use of vital signs monitors - notably for users with long-term conditions);
- Care management (including use of activity monitoring to monitor well-being and assess user needs);
- Health and fitness (including use of telephone and video consultation and dialogue in relation to lifestyles, health and motivational coaching); and
- Enhancing the home (including use of environmental controllers and home adaptations such as those relating to access and lighting).

Two of the above areas, viz. disease management and health and fitness, echo the Continua Health Alliance's 'personal telehealth domain'. These would have contributed to 'monitoring of well-being' [3]. Four of the above telehealth areas have been, furthermore, offered as the framework for developing a European code of practice for telehealth services within a project titled 'TeleSCoPE'. This project, lead by the Health Design and Technology Institute at Coventry University, commences in 2010.

Towards a Model Framework

The typology above implies a role for telecare and telehealth that embraces a range of users - including young people (e.g. for whom there might be a perceived need for support in adopting or maintaining more appropriate lifestyles); and older and frail people (the main recipients, to date, of telecare and telehealth.

New to the list of identified areas is 'care management' – reflecting the need for recognition of a further contributor to health and overall well-being. More challengingly from the point of view of traditional service frameworks, the new typology gives a pointer to the importance of the home to personal well-being - through its design, lighting and accessibility. Such matters have been poorly discussed in the context of telecare and have been largely absent from debates about telehealth.

And though not indicated in the six 'areas', there is the need to recognise the role of free-standing technologies for which the 'tele' (communication) element is a matter between the user and the device itself – i.e. with no information necessarily being passed on to a third party. Such devices are as easily recognised (or more so) as 'assistive' rather than being concerned with health. What was, therefore, seen as a telehealth framework should arguably be recast as a framework that also embraces telecare and, indeed, could carry the telecare rather than the telehealth label. With such an understanding in mind we can begin to build on the earlier suggestion that identified eHealth and assistive technologies as the background within which services and technologies concerned with well-being can be further developed and a shared understanding achieved.

In adding to that background, the exact positioning of activities that carry particular labels is, of course, open to challenge. It seems appropriate, however, that both telemedicine and telehealth are firmly within the area labelled 'eHealth' and that social alarms are within the area labelled 'assistive technologies'. But it can be argued, social alarms are also embraced by eHealth and that at

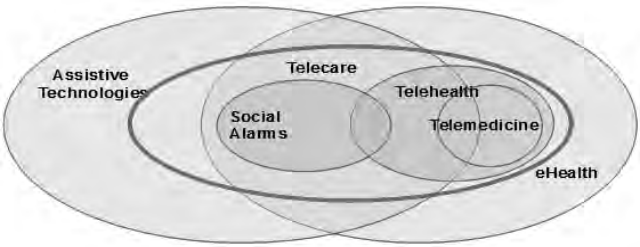


Figure 1

least some element of telehealth is embraced by social alarms. This is in recognition of the health support role played by social alarms and the sensor devices that are linked to them. It is, furthermore, that range of services associated with social alarms that has quickly adapted to the more all embracing title of 'telecare' – this being regarded as indicative of the changes to services that follow from their having a role that is more than just being concerned with response and event recognition.

The proposed framework is, therefore, as illustrated overleaf. It makes a claim for the title 'telecare' to cover the whole of the overlapping area between eHealth and assistive technology. It calls for recognition of the broader meaning of care – one that relates to personal well-being.

Conclusion

The language and labels used by professionals within the social and healthcare sectors have contributed to misunderstandings concerning the nature of telecare and telehealth. This paper has offered a framework for understanding - first through an appraisal of the areas covered by 'telehealth', and then by reference to the way that telecare underpins personal well-being, including health.

The point regarding the objectives of services and technologies to deliver in relation to personal well-being appears to justify a perspective where the term telecare should carry some pre-eminence, and be focal to a shared understanding, albeit that telehealth needs to be recognised as important within it.

References

[1] M. J. Fisk "A Dilemma in the Delivery of Telecare and Telehealth at the Health and Social Care Interface" Paper to Medetel – The International Conference for eHealth, Telemedicine and Health ICT, Luxembourg April 1-3, 2009.

[2] M. Schermer "Telecare and Self-Management: Opportunity to Change the Paradigm" Journal of Medical Ethics, 35, pp. 688-691. 2009.

[3] F. Wartena, J. Muskens, L. Schmitt "Continua: The Impact of a Personal Telehealth Ecosystem" Paper to Institute of Electrical and Electronics Engineers International Conference on eHealth, Telemedicine and Social Medicine, Cancun February 1-7, 2009.

Malcolm Fisk is Chair the Telecare Services Association (TSA) that represents over 350 telecare and telehealth service provider and supply sector organisations. He is on the Editorial Board of the Journal of Assistive Technologies and is widely published in this and related areas. He leads the Coventry University team in the TeleSCoPE project that will develop a European code of practice for telehealth services. As Managing Director of Insight Social Research Ltd. Malcolm is currently engaged in contracts concerned with domiciliary care, telehealth, visual impairments, support services for children and families, and developments at the interface of health and social care.

A Success Story in Remote Diagnostics: Better Results with Significantly Lower Costs

T. Hakkarainen, L. Toivonen[2]
[1]Remote Analysis Ltd, Konalantie 6-8 B, FI-00370 Helsinki,
timo.hakkarainen@remoteanalysis.net; lauri.toivonen@hus.fi
[2] Department of Cardiology, Helsinki University Hospital,
Haartmaninkatu 4, FI-00290 Helsinki

Abstract: **This paper describes how the need for a telemedicine specialist consultation service in Finland was identified, explains how the service is implemented, presents how the service helps public health care to reduce costs and discusses the benefits gained. Until now, more than 20 000 specialist reports have been channeled to over 130 practices around the country.**

Introduction

In Finland, municipalities are obliged by law to arrange healthcare for their inhabitants. There are 342 municipalities and their population varies from less than 1 000 up to 580 000. Because of this wide range in population size, the opportunities of municipalities to provide primary care and specialized medical care for the inhabitants differ significantly.

Primary healthcare is delivered at health centers employing mainly general practitioners and nurses who provide most day-to-day medical services. In larger municipalities health centre operations are arranged by the municipality itself whereas smaller municipalities have formed joint municipal organizations to perform the task economically and to secure the required level of medical expertise.

When a general practitioner suspects that a patient needs specialized care, the patient will typically be referred to the secondary care sector. Secondary and tertiary care is provided in hospitals, through outpatient and inpatient departments. The secondary level consists of 15 central hospitals and around 40 other smaller specialized district hospitals. The tertiary level is a network of five university teaching hospitals where the most specialized care is given. All these hospitals are maintained by federations of municipalities, i.e. hospital districts.

Since municipalities are legally required to finance the healthcare, the cost of secondary care will eventually be shared among municipalities. Municipalities negotiate on the provision and costs of services with their

hospital district annually. However, municipalities may feel powerless to influence the costs and provision of hospital care. In many cases, they are not able to utilize the medical, economic and other skills necessary for arranging services in the most efficient manner. As financial situation changed, municipalities started showing an interest in controlling specialized care costs and planning annual budgets more accurately. [1, 2]

Although the access to care and quality of healthcare are of high standard in Finland, there have been incidents where patients are not adequately referred to specialized care. Waiting times for referrals in the secondary care are typically long and high costs of specialized care are passed on to the municipalities. On the other hand, health centers seldom have facilities or skills for special diagnostic examinations.

Based on the above observations, the emergence of new ambulatory diagnostic devices, and their acceptance and scientific approval [3], an innovative remote analysis service was launched at the end of 2002 as a joint venture between renowned medical specialists, innovative IT professionals and business administration professionals. The service was first introduced with the polysomnography sleep test but was gradually expanded to include another five diagnostic services, including 24-h ECG-registration, 24-h Ambulatory Blood Pressure Monitoring, and Spirometry Consultation.

Telemedicine diagnostics services

Operating model

The remote analysis service operator equips the medical practices with the registration devices free of charge, thus, no initial investment is required. Deployment takes place in less than 30 minutes via a PC and Internet access. The initial two month test phase includes a few specialist reports free of charge with no obligation to continue services. Charges are based on the actual use that arises from the number of delivered reports. In case the number of registrations remains below the annual minimum of 10 registrations over the four-year contract period a nominal fee will be charged.

A nurse hooks up the registration device on a patient. The registration takes place over a 24-hour period (or overnight in case of the polysomnography) during the patient's daily life. On the following day, the patient returns the device. Thereafter the nurse uploads the registered data without the patient's personal identification data to the remote server over a secure connection. The data is checked for accuracy by technicians and then

forwarded to the specialist for interpretation and analysis. The leading specialists in the field rank analyze the data and write a report to be returned

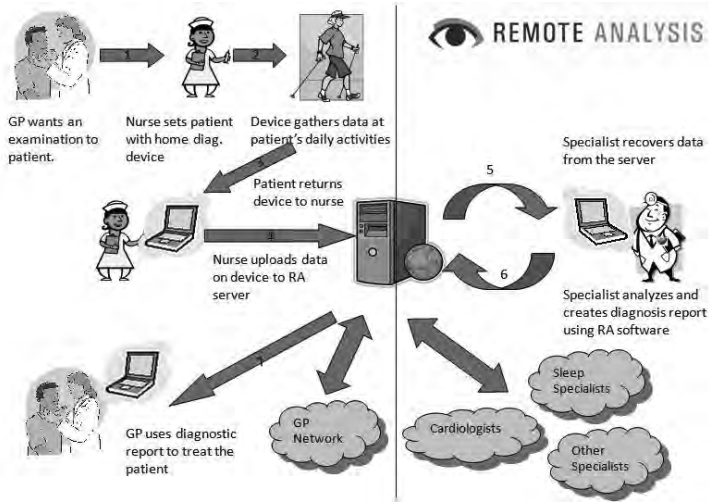


Figure 1. The remote analysis operating model

promptly for download at the practice's interface.

Demand of telemedicine services

Since the introduction of this service, the number of reports has grown progressively. In 2009, more than 8 000 specialist reports were channeled to about 130 health centers, private clinics, occupational health units, hospitals and laboratories. Based on the demand during 2007 – 2009, the estimated number of reports to be delivered in 2010 will exceed 9 500. To this date, approximately every third district health centre in Finland uses this service.

Discussion

The ease, speed, flexibility, and cost-effectiveness of the described approach are obvious. Patients benefit from prompt diagnosis: testing can be initiated in patients' daily activities as soon as the GP has ordered a test.

The attending physician gets a consultation report with treatment recommendations from the special experts of the field. Often the patient can be treated in the nearest health centre. Patients and specialists benefit as they no longer have to travel to meet each other and queues to secondary

care shorten as only patients requiring secondary care treatment will be referred.

The cost of a typical outpatient appointment in a secondary care unit accounts at least several hundreds of Euros whereas the cost of a telemedicine specialist consultation is only a fraction of that. The costs of specialized care can be controlled by using telemedicine in diagnosis and treatment of patients in the primary care. By reducing the number of referrals via screening, they also reduce the burden and resource utilization in specialized hospital districts. Lately, district hospitals have taken similar steps to set up a process model to provide consultation to GPs prior to

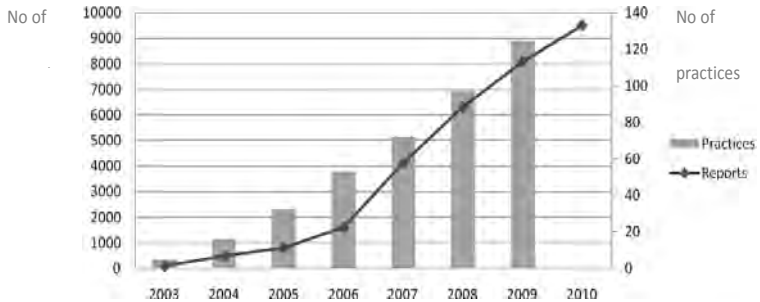


Figure 2. The number of reports and practices using the

accepting any referrals from health centers. Financially, it is also noteworthy that no heavy investment or complicated implementation project are required to set up the functional remote analysis system. Moreover, operating costs are low, as charges are tied to actual usage.

Conclusion

The diagnostics service offered by Remote Analysis Ltd has changed the traditional division of work between primary and secondary care in Finland. This private enterprise initiative has contributed to public health by improving access to diagnosis, shortening queues to secondary care and reducing costs. Taking into account the unique features of each national health care system this service can be applied globally.

References

[1] J. Järvelin, Health Care Systems in Transition, Finland, Vol. 4 No. 1 2002, ed. by A. Rico and T. Cetani, European Observatory on Health Care Systems, pp. 24, 62, 76

[2] U. Idänpään-Heikkilä, Contracting as a steering method in hospital district and health centre units and in the work of their doctors, Helsinki, Stakes, 2007 (in Finnish)
[3] P. Tiihonen, Novel Portable Devices for Recording Sleep Apnea and Evaluating Altered Conciousness, Kuopio, Kopijyvä, 2009, pp. 22-24, 55-62.

Timo Hakkarainen joined Remote Analysis Ltd in 2008 and he works as Marketing Director. Prior joining his current team he held managerial and executive positions since 15 years in the service industry and human re-sources development. He has graduated with a M.Sc.(Econ.) degree from Turku School of Economics and with a LL.B. degree from University of Turku, Finland.

Professor Lauri Toivonen works as Chief Physician in the Cardiac Arrhythmia Division on the Department of Cardiology in University Hospital, Helsinki, Finland. His scientific interest is focused on cardiac risk assessment, inherited cardiac arrhyhmias and cardiac pharmacology. He has been the leading cardiologist in collaborative research program in Biomedical Engineering Laboratory in Helsinki University of Technology. Toivonen is author of more than 200 original scientific articles. He has collaborated with Remote Analysis Ltd since 2005.

Acceptance of Telemedicine: The Case of Emergency

Sabrina Kreucher, Jens Lohmeier, Katsiaryna Laryionava
Institute for History, Theory and Ethics in Medicine at RWTH Aachen University, Wendlingweg 2, 52074 Aachen, Germany
skreucher@ukaachen.de

Abstract: **This paper deals with the acceptance of telemedicine in emergency cases and possible ethical issues which may occur. Therefore we explore the pilot scheme "Med-on-@ix". It consists of a special ambulance vehicle which allows for an additional Tele-Emergency-Doctor to advice and assist the emergency doctor on location. In this context five of the so-called "Tele-Doctors" involved have been interviewed about the technologies' functioning and possible ethical issues.**

Introduction

More and more, telemedicine proves to be an important field in medical healthcare. Meanwhile several examples can be found worldwide for the application of telemedicine services in standard as well as emergency cases, e.g. the Internet portal "Medgate" in Switzerland or "The Flying Doctors" in Australia. In the light of possible advances of medical treatments and the demographical changes Germany has to follow the impulse of telemedicine: absence of medical professionals, especially in the countryside, which leads to longer dead-times in emergency cases, higher costs, and an increasing number of emergency cases demand new solutions [1,2].

The new telemedical service "Med-on-@ix" is a project, which deals with the problems named above. The pilot scheme takes place in Aachen, Germany. It concludes a specially equipped ambulance vehicle which allows an additional "Tele-Emergency-Doctor" to advice and assist the emergency doctor on location.

In the framework of the project "Gender-related Acceptance, Usability and Ethics in New (Medical) Technologies (AC-TEC)" the acceptance of this telemedical service has been analysed taking into account different perspectives, such as emergency doctors, ambulance officers, patients etc. The aim is to identify issues from the point of view of all participants. As a first step we interviewed the emergency doctors about the acceptance of the new technologies involved in the ambulance vehicle and considered the

following questions: which main issues are identified by the doctors, especially considering ethical aspects? Which conflicts emerge? Is there more need for action to avoid the rejection of telemedicine on the part of the executive group of persons, and where?

The pilot scheme "Med-on-@ix"

The central point of the new project is an additional, special control centre, where a skilled emergency doctor (Tele-Doctor) is situated to support the emergency doctor during an operation. The Tele-Doctor receives every medical data of the patient directly from the scene of emergency via wireless data transfer. The doctor and paramedics on location use headsets to communicate with the Tele-Doctor, a special ECG to transfer the vital signs, a special tablet PC to do the documentation and a video camera in the ambulance vehicle to take pictures from the scene. The Tele-Doctor has access to this information in the control centre and has the possibility to consult databases etc. in order to consult the emergency doctor and to contact the hospital remotely any time to provide required assistance. The intention is to improve the medical therapy and to disburden the emergency doctor from organisational tasks [3-4].

The project started in 2007 and is, after several preliminary stages, in its test phase since the beginning of December 2009.

In the future, it is being considered to establish these special ambulances vehicle without an emergency doctor on board so that the "Tele-Doctor" undertakes the diagnosis on his own. This kind of emergency medial aid is meant to be used in areas of structural weakness where doctors are missing and long dead-times must be reduced.

Methods

For the following findings five of the Tele-Doctors have been interviewed (in total there are nine doctors in the team). The prerequisite for becoming a Tele-Doctor is three years of clinical experience.

The structured interviews took approximately 20 minutes and contained questions about the techniques' functioning and possible ethical issues, e.g. changes in communication, actions and patients' confidence to this novel medical service.

Discussion

On average most of the Tele-Doctors had about six to eight days of service at the control centre and the same number of operations with the

new ambulance. The cases varied, there were standard cases in which a presence emergency doctor had not been necessary up to risky operations like a multiple trauma; yet most of them were not life-threatening.

Technical disfunctioning of the new technologies and the detailed handling caused the main problems during this first two month period. Every Tele-Doctor reported technical problems, mainly referring to the tablet PC or the transmitting box. Additionally, the use of the technologies was unfamiliar to the doctors although they had had trainings prior to their service, as one doctor mentioned: "In the beginning the handling was certainly unfamiliar so that it [the technologies] was an additional load at first. Now, during the last shifts, I am more experienced and it is no longer an additional load; instead, in some cases it was a benefitting experience to have the chance to consult with someone." It emphasises that a professional and enduring training is necessary to guarantee the quality of the treatment and to avoid the release of additional stress for the patient and the doctor her/himself.

Moreover, it was reported that the patients themselves did not express any displeasure concerning the technologies. Most of them realised the headset but the doctors on location always explained what they were doing: "It was always noticed [by the patient] and you have to tell them because otherwise they wonder to whom you are talking to." Even with the camera there were not any problems: "Not once has a patient objected after having been asked if she would allow pictures or video recording to be taken." The doctors referred that only one person out of one hundred they dealt with had not given her consent for taking those pictures. It seems that the camera does not provoke further questions and that the patient feels comfortable with it. One doctor added that the case of emergency has a "favourable" effect on the patients noticing the technical devices: "You do not find yourself on an emergency vehicle once a week. When you are in one for the first or second time you do not care if the monitor is fabricated by Philips or someone else or if a tablet PC is hanging on the wall. You just do not notice." In the situation of the pilot scheme one benefits from the negligence of the patient. It remains to be answered how the patients react when they comprehend the whole setting: will it complicate the treatment and slow down the operation?

When asked for ethical issues the doctors named the possible economization of emergency doctors and therewith a downsizing of the treatment's quality and jobs. One doctor pointed out that this is a problem especially considering other emergency doctors who still have to be

convinced of the project: "The more someone knows how important an emergency doctor on location can be the more she/he is afraid that a dangerous rationalisation will take place although this is exactly what the project is not about. But it is definitely the major problem." None of the Tele-Doctors see ethical problems when referring to the conflict of the present study and the case of emergency. Their certainty is based on the dual supply they offer at the moment: "I do not see any problem between the study and cases of emergency because right now we offer an oversupply. To evaluate the technologies there are two doctors to examine the patient – sometimes even in cases when there would be usually no doctor at all." At this point two questions arise. Firstly: to what extent does the problem of distributive justice play a role? Secondly: the aim of the pilot scheme is to install a Tele-Doctor connected to an ambulance who redundantises the usual emergency doctor appearing at the location - in this case, can the diagnosis be warranted?

Conclusion

Overall the interviews showed the need of a better usability for the Tele-Doctors and better transfer of information for successors: it seems like conflicts only emerge if information is lacking. On part of the doctors ethical issues did not prove to be a considerable problem, although it can be said that practice on the technologies and awareness training has to be done to guarantee the project's success in the long term.

Ethical questions regarding the patients from the Tele-Doctor’s point of view did not arise. Hence further research is necessary to identify related ethical issues, which might have been remained unnoticed. The next few months of the project will be evaluated to reveal potential existing ethical problems.

The patients' experiences as well as their perception of this novel medical service and technology will be studied as a next step with the following questions: how did they feel about the presence of the Tele-Doctor and the new technologies? Did it cause any additional stress or discomfort? What do they think about the concept of Med-on-@ix in general? Do they realise a potential conflict between study and emergency case?

Acknowledgement

The interviews were hold in German. The quotes have been translated by the authors.

The authors thank the emergency doctors for their time and willing to give us an interview and the team of "Med-on-@ix" for their support in general.

References

[1] W. Martin, "Arbeitsmarkt für Ärztinnen und Ärzte: Der Ärztemangel nimmt weiter zu", Deutsches Ärzteblatt 105 (16), 2008 (www.aerzteblatt.de/archiv/59845)

[2] T. Kopetsch, "Bundesärztekammer-Statistik: Ärztemangel trotz Zuwachsraten", Deutsches Ärzteblatt 103 (10), 2006 (www.aerzteblatt.de/archiv/50480)

[3] M. Skorning et. al., "E-Health in der Notfallmedizin - das Forschungsprojekt Med-on-@ix", Anaesthesist 58, pp. 285-292, 2009

[4] M. Skorning et. al., "Med-o@ix: Aachener Forschungsprojekt zur Verbesserung der Patientenversorgung in lebensbedrohlichen Situationen", in A. Jäckel, "Telemedizinführer Deutschland", Bad Nauheim 2009, pp. 323-326.

Sabrina Kreucher studied Sociology, German Literature and History at RWTH Aachen University, Germany and the University of Nottingham. Since 2009 she has worked at the Institute for History, Theory and Ethics of Medicine at RWTH Aachen University, first on the project "Death and dead bodies" and, from September 2009 on on the project "Gender-related Acceptance, Usability and Ethics in New (Medical) Technologies" (AC-TEC). Her interests include new medical technology and its impact on society as well as telemedicine and its possible ethical issues

Applying Standards in Cross-sector Communication for an Integrated Health Environment

H. Demski[1], C. Hildebrand[1], A. Brass[1], S. Jedamzik[2], R. Engelbrecht[3]
[1] Helmholtz Zentrum München, German Research Center for Environmental Health, demski@helmholtz-muenchen.de
Ingolstädter Landstraße 1, 85764 Neuherberg, Germany
[2] GOIN Regional Health Network, Oberer Grasweg 50, 85055 Ingolstadt, Germany
[3] National ProRec Centre, Glaslweg 33, 85737 Ismaning, Germany

Abstract: **Integrated care is based on interdisciplinary and cross-sector attendance of a patient. Seamless communication of relevant information is an important prerequisite thereof. ByMedConnect applies the standard EN 13606 that specifies an information architecture for electronic health record exchange and will evaluate it in medical routine. The project enables health care professionals to seamlessly exchange relevant data needed at the various focus points within the shared care scenario. Therefore, a communication solution is developed that follows an adaptable, interoperable and thus also internationally applicable European approach.**

Introduction

The advanced level of healthcare that is prevalent nowadays is demanding a high degree of specialization. This is reflected in the integrated care paradigm that is based on interdisciplinary and cross-sector attendance of a patient. Seamless communication of relevant information is an important prerequisite thereof. Unfortunately there is still a lack of data exchange between the various partners involved in healthcare [1]. Direct and prompt communication between regional care providers could improve the continuity of care. The heterogeneity of system environments and missing standards for data exchange are challenges that have to be met [2]. Therefore, ByMedConnect [3] develops and demonstrates a communication solution based on the EN 13606 standard for electronic health record exchange [4]. The Continuity of Care Record (CCR) of ASTM [5] is used to trigger the definition of the medical content to be transferred.

State-of-The-Art

In Germany the exchange of information in health care is mainly done on paper, which is transported via the patient himself, the post or by fax. For certain events like e.g. referral and hospitalizations obligatory paper forms are used. In order to document the results of an examination or a stay in the hospital doctors' letters are posted. These are varying much in level of detail and length and lack a common design.

This rather antiquated scheme longs for improvement, but incompatibility of systems and the divers styles of documentation impede a general solution for electronic communication up to now. Digital data exchange is still limited to laboratory results and reimbursement. However radiological practices have started to hand over pictures of the examinations to the patients on CD-ROM instead of bulky folders.

Method

The standard EN 13606 addresses the heterogeneity of system environments and specifies information architecture for electronic health record exchange that can be used to map data from different systems to a single comprehensive representation. A reference model is introduced that defines generic building blocks for aggregation of health record components and for collecting the context information required to meet ethical and legal requirements. A hierarchical structure is used to accommodate these, reflecting the organisation of medical records. This makes sure that the meaning of the information is preserved when records are communicated.

This strictly generic representation is complemented by Archetypes that define the medical concepts and ensure semantic interoperability that is needed for precise and reliable interpretation of data. Archetypes deliver meta-data that consistently define the divers, complex and frequently changing concepts in clinical practice and, thus, facilitate the setup of semantic interoperable electronic health records [6].

Besides the technical implementation, the definition of medical content, to be transported, is important. The CCR will be used as a starting point since it defines a lean and application-oriented dataset that gives a brief summary on the relevant data of a health record. Health professionals were heavily involved in its development and it is already used in a lot of applications in the USA. ByMedConnect advances this pre-work and collects requirements and ideas with health professionals to adapt the data set to the German health environment.

System Architecture

A communication module is developed that provides the functionality needed for data exchange. It will be realized as independent software that reuses existing interfaces to the legacy. This way already captured data can be integrated in the transfers. EN 13606 provides structures for health record exchange, but doesn't define how information can be extracted out of routine systems. Approaches for the mapping of schemes of existing data to archetype definitions have been published [7-8]. Based on this a transformation module will be developed that is able to import data from the systems in place and to convert them to the standardized format.

A runtime environment for archetypes will be created that enables navigation within content, display of different views and data entry, storage and export. A generic and modular system is aimed for that does not assume fixed data schemas, but supports the constantly evolving needs of the users.

Transmission takes place on a secure network for direct and prompt communication between the care providers where only authorized participants can retrieve temporary supplied data related to a treatment.

Conclusions and Future Work

The project enables health care professionals to seamlessly exchange relevant data needed at the various focus points within the shared care scenario. This contributes to increase the efficiency and quality of care within an integrated health environment [1]. As information is provided in standardised form, usage is not limited to a semantically interoperable exchange between legacy systems, but the connection of add-on applications (e.g. decision support or personal health record) is enabled [9]. If such applications are provided with standardized data, they do not need to be adapted to the manifold system environments anymore, but can be used in a "plug-and-play" fashion.

ByMedConnect has started to collect requirements and ideas with health professionals to adapt the CCR to the needs of the regional health network. A set of communication packages that reproduce and complement the conventional documents will be compiled for exchange within the electronic network. The transformation module reduces the effort for addition of further systems to the network. As every contribution out of a legacy system is converted to a normalised representation, each individual system needs to do the mapping only once, instead of repeating this process for every different system that gets connected.

ByMedConnect develops a standard-based communication solution that will be demonstrated at a pilot implementation within the GOIN Regional

Health Network in Ingolstadt. The pilot will be evaluated in detail regarding the support of continuity of care, the usability and acceptance by users and the implementation of standards in practice.

In Germany, a common telematic eHealth infrastructure is still missing. Until a national platform is in place, ByMedConnect will use an independent solution for communication. Experiences and results can be easily transferred later on since an adaptable, interoperable and thus also internationally applicable European approach is followed.

Acknowledgment

ByMedConnect is a project sponsored by the Bavarian State Ministry of the Environment and Public Health.

References

[1] EC Pilot on eHealth indicators: Benchmarking ICT use among General Practitioners in Europe, Final Report, page 8 http://ec.europa.eu/information_society/eeurope/i2010/docs/benchmarking/gp_survey_final_report.pdf

[2] Report from the CEN/ISSS eHealth Standardization Focus Group, "Current and future standardization issues in the eHealth domain: Achieving interoperability" www.i2-health.org/ehealth-iop/eHealthStandardizationExecutive%20summaryFinalversion2005-02-21.pdf

[3] ByMedConnect Project, http://www.ByMedConnect.de

[4] EN 13606 – CEN standard, "Electronic health record communication"

[5] ASTM E2369, Standard Specification for Continuity of Care Record (CCR), ASTM International, West Conshohocken, 2006

[6] Garde S, Hovenga E, Buck J, Knaup P, "Expressing Clinical Data Sets with openEHR Archetypes: A Solid Basis for Ubiquitous Computing", International Journal of Medical Informatics 76 (S3), 334-341

[7] D. Moner Cano, J. A. Maldonado Segura, D. Boscá Tomás et al. "Archetype-Based Semantic Integration and Standardization of Clinical Data", 28th Anual International Conference IEEE Engineering in Medicine and Biology, New York (2006)

[8] C. Rinner, T. Wrba, G. Duftschmid, "Publishing relational medical data as prEN 13606 Archetype compliant EHR extracts using XML technologies", Tagungsband der eHealth 2007 – Medical Informatics meets eHealth; Vienna, pp. 35 – 39, 2007.

[9] Semantic Interoperability for Better Health and Safer Healthcare, http://ec.europa.eu/information_society/activities/health/docs/publications/2009/2009semantic-health-report.pdf

Hans Demski, Dipl. Ing. (UAS); Hans Demski read electrical and communications engineering at the University of Applied Sciences, Regensburg. From 1995 – 1997 he was programmer at Ganshorn Medical Electronics; since 1997 he has been employed as software developer at the Helmholtz Zentrum München - German Research Center for Environmental Health. His activities concentrate on developments towards the electronic health record: computer based documentation systems, standards for eHealth, secure electronic communication and telemedicine. He managed the technical implementation of several local and european research projects in the field of medical informatics.

Developing a Low Cost and High Effectiveness Telehealth Implementation Methodology in Minas Gerais, Brazil

M. B. M. Alkmim[1], F. Leles[2], M. Pena[1], V. Alfenas[1], R. M. Figueira[3], A. L. P. Ribeiro[1]
[1]Telehealth Center, University Hospital UFMG, beatriz@hc.ufmg.br
Av. Alfredo Balena, 110,sala 105, Belo Horizonte – MG, 30.130-100 Brazil
[2] Health Department of the State of Minas Gerais
[3]School of Engineering UFMG

Abstract: **To reduce inequality ensuring health access and quality to the population of Minas Gerais, a Brazilian state with large dimensions and contrasts, the State Heal th Depar tment decide to use ICT to su pport the Family Health Progr am creating the Telehealth Network of Minas Gerais, connecting University and remote villages in the state. Starting as a Pilot Pro ject in 200 5, it reached 22 9 co nnected v illages in April/2009. T o conso lidate telehealth in the Sta te, in July/2009 it w as created the *Tele Minas Saúde* extending the Network to additional 328 municipalities. A new methodology had to be devel oped for implementation the ser vice for these villages in a shor t period of ti me and impr oving th e use of teleconsultations with lo wer co st. All these objectives were achieved. The success of the methodology is due to the identification of barriers to telehealth an d confronting the problem by discussing it with transparency and involvement of all actors, preparing the villages to incorporate ICT in its health system.**

Introduction

Minas Gerais is a Brazilian state of large dimensions: has the largest number of municipalities (853), second Brazilian state in population (19.8 millions) and fourth in territorial extension (586,528 km^2) and significant contrast of living condition expressed by the Human Development Index varying from 0.568 to 0.773. In this scenario, the Health State Plan 2008-2011 was developed by the State Health Department (SES/MG) with the objective to reduce inequality ensuring health access of the population and improving the quality of services. In this sense, Minas Gerais has the largest number of teams of Family Health Program. Presently there are 3,983 teams in operation, covering 69,2% of the total population. However, even with a reasonable coverage, there are still problems of quality in services, particularly in relation to the principle of being the Primary Health Care: the

gatekeeper of the health system, coordinating patient referral to specialists and monitoring the services. To overcome this challenge, using Information and Communication Technologies (ICT) a Telehealth Center connecting University and villages to offer specialized health services was created. It started as a Pilot Project in 2005 (Phase I) connecting 82 villages through the Telehealth Network of Minas Gerais [1]. It was successively expanded: in June/2007 to 50 villages (Phase II) and by end of 2008 to another 97 sites (Phase III) totalizing in April/2009 229 villages. Although teleconsultations were also offered, telecardiology was then the main activity. Consolidating the actions of Telehealth, in July/2009 it was created the *Tele Minas Saúde* extending the Network to 328 municipalities (Phase IV). It was them decided to promote the use of teleconsultations. To fast expand the network (from 8/2009 to 3/2010) and to promote the use of teleconsultations, a new implementation methodology had to be developed. The objective of this work is to present this methodology and the results obtained.

Implementation Methodology

The implementation process used for the previous 229 sites had a long sequence of events before using the Network: specification and purchase of equipment, a visit to each village, training at the hospital and equipment delivery. Implementations had the focus on telecardiology since cardiovascular diseases are the main cause of deaths in Brazil. This methodology had to be used because the use of Internet and IT for health care was almost nothing in those villages. In the last years this situation has changed and implementation methodology had to be reviewed.

The new implementation methodology was developed based on the concepts of *readiness* (the degree to which an organization is ready to participate and succeed in telehealth), previously used by various authors [2-3]. The basic concept was to prepare the villages to use telehealth, discussing clearly its advantages, disadvantages, barriers and risks. Using this concept, a new methodology was developed with focus on (i) implementation in a short period of time, (ii) to improve the use of teleconsultations and (iii) to decrease the implementation cost.

A research to detect the main barriers to the use of teleconsultations in the 229 villages identified two organizational factors: training and time devoted specifically for teleconsultations. This study provided subsidies to reformulate the methodology to increase the use of teleconsultations.

The new implementation process structured in a partnership with the Health State Department consists in 4-hour regional meetings involving 10

to 15 villages from the same administrative district. Fundamentals of telehealth and economical aspects [4] are presented as well as training on teleconsultations. Group discussions to identify the barriers to telehealth are promoted to produce an action plan for each village. An important modification is the involvement not only of clinical and IT personal as before, but also municipal authorities (mayors and health secretaries), administrative staff, FHP health agents and members of the community. Previous users of the system were also invited to present the problems and advantages they have found. In these occasions, an award for the best regional user is granted. At the end of the meeting, an evaluation of the methodology was done to subside future improvements. A telehealth implementation guideline [5], containing all information to support the service, is distributed to the participants.

Immediately after this meeting, the clinical staff is able to use teleconsultations from equipments available in the village (basically a computer connected to Internet). Equipment delivery necessary for telecardiology (ECG exams) is done in a second phase when only the personal involved (doctor, nurse and IT technician) comes to the university hospitals for training.

Results

Compared to the previous implementation process used for Phase I to III, the new methodology applied on Phase IV brought significant improvements in terms of use of the system and costs. Fig. 1 shows the evolution of the number of teleconsultations after each implementation phase. Different of the previous implementations, the use of teleconsultations on Phase IV starts almost immediately after the training. In fact, some of the villages start using teleconsultations on the next day after training. Table I presents a comparison between the necessary time for implementation and number of people involved in the four phases and Table II shows implementation costs (travel expenses, consumables and personal costs) for all implementations phases.

Discussion

The use of the new methodology has reached its objectives: immediate use of teleconsultations, rapid implementation and cost reduction. The main factor of success is the correct approach to the organizational problems identified previously. Involvement of health professionals, managers and

community, motivation, discussion about benefits and difficulties and how to overcome them are important tools contributing to the results.

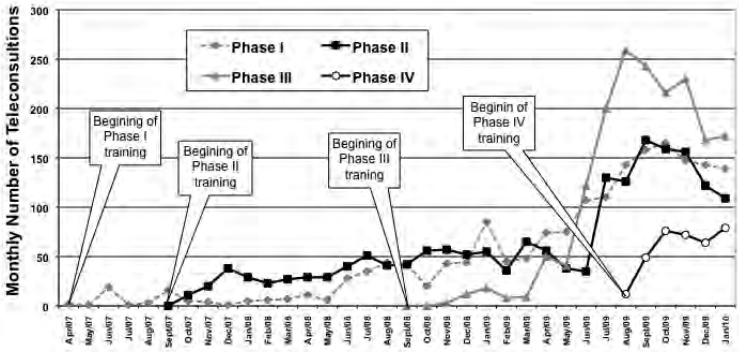


Figure 1 – Evolution of the number of teleconsultations after each implementation phase

Table I – Comparison of performance indicators for each implementation phase at the Telehealth Network of Minas Gerais, Brazil

Phase	Number of Villages	Implem. time (month)	Villages per month	Persons trained	Persons trained per village	Persons trained per month
I	82	7	11,7	NA	NA	NA
II	50	8	6,3	105	2,1	13,1
III	97	8	12,1	293	3	36,6
IV(*)	194	7	27,7	2,917	15	416,7

(*) Until Januarv/2010

Table II – Cost related to travel, consumables and personal for implementation

Phase	Number of Villages	Cost (US$/village)
I	82	2,200
II	50	3,900
III	97	1,900
IV	328	300

The same methodology applied to previously implemented villages, also participating in the meetings, promoted sudden increase on the number of teleconsultations.

Another very impressive effect of the new methodology is on the implementation cost. Implementation costs depends on two main factors:

number of sites and duration of the process. Therefore, the control variable for implementation cost is number of sites implemented per month. There is a clear correlation on these two variables as it can be seen from Fig.2.

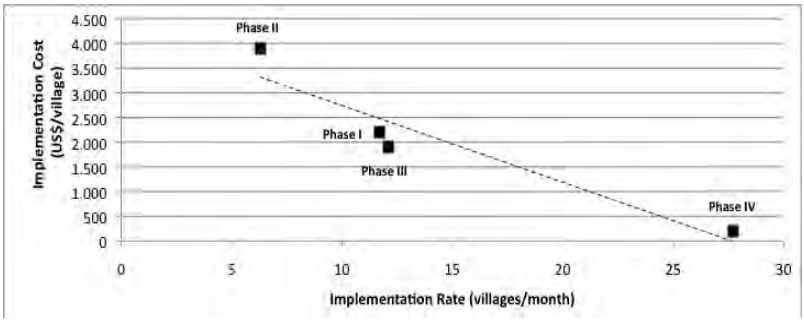


Fig.2 – Effect of implementation rate on implementation cost at the Telehealth Network of Minas Gerais, Brazil

Conclusion

The success expanding telehealth system with low cost and high utilization depend primarily on identification of barriers. The second step is to confront the problem by discussing it with transparency and involvement of all actors, preparing the villages to incorporate telehealth in its health system.

References

[1] M. B. Alkmim et al. Success Factors and Difficulties for Implementation of Telehealth System for Remote Villages: Minas Telecardio Project Case in Brazil. Journal of eHealth Technology and Application, Special Issue dedicated to eHealth Applications for the Benefit of Rural and Remote Areas, 5, 3, pp. 197-202, September 2007.

[2] P. Jennett et al. Organizational readiness for telemedicine: implications for success and failure. Journal of Telemedicine and Telecare, 9, S.2, pp. 27-30, 2003.

[3] P. Jennett et al. The Essence of Telehealth Readiness in Rural Communities: An Organizational Perspective. Telemedicine and e-Health, 11, 2, pp. 137-145, 2005.

[4] H. Durrani, S. Khoja, A systematic review of the use of telehealth in Asian countries. Journal of Telemedicine and Telecare, 15, pp. 175-181, 2009.

[5] M. B. Alkmim et al. Guia de Implementação de Serviços de Telessaúde. Secretaria de Estado de Saúde de Minas Gerais, 2009, p. 147.

Maria Beatriz Moreira Alkmim is doctor at the University Hospital of Federal University of Minas Gerais (UFMG) where heads the Telehealth Center, specialized in teleassistance and serving more than 600 municipalities to support the Primary Care and Family Health Program. She is graduated in Medicine from UFMG (1979), residency in Clinical Pathology and specialization course in Hospital Management. She works in Telemedicine and Telehealth since 2001 and is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry. Main areas of expertise are the application of Information and Communication to health, administrative and financial management of Telehealth, implementation and monitoring of large scale Telehealth projects. In 2008 she was awarded with the Health! Editora Abril prize in the category Health of the Heart.

Renato Minelli Figueira is graduated in Metallurgical Engineering (1975) with a Master degree in Metallurgical Engineering (1977) by Federal University of Minas Gerais (UFMG), Brazil. He has also a Ph.D. degree in Materials Engineering by the Massachusetts Institute of Technology (1983) and a MBA in Finance by UFMG (1994). Presently is Professor at the Department of Metallurgical Engineering and Materials – UFMG working on industrial system management. Collaborates since 2007 with the University Hospital of UFMG at its Telehealth Center working on economical aspects of telehealth.

French e-Health Policy

Nathalie Ferraud-Ciandet
Grenoble Ecole de Management, 12 rue Pierre Sémard, BP 127, Grenoble, 38003 Cedex 01, France
nathalie.ferraud-ciandet@grenoble-em.com

Abstract: **This paper gives an update of the French e-Health Policy from 2002 to 2010 concerning: patient rights, health ICT standards, personal medical record, e-Health governance and replace it in the global framework of national healthcare reforms.**

Introduction

Your goal is to point some recent legal developments of telemedicine's framework in France. The following subjects are presented hereafter: patient rights, health ICT standards, personal medical record, e-Health governance, and financial aspects.

Patient Rights

The Medical Privacy Act of March 4, 2002 details the ownership rights of the patient to his or her data. The transmission of personal information is authorized only between health professionals treating the same patient, and only with patient's prior consent (article L1110-4 of the Public Health Code) [1].

Health ICT Standards and Personal Medical Record

The legal framework is the Healthcare Insurance Act of August 2004 (articles 32, 33, 34 and 67 related to telemedicine).

This act also provides for the creation of the Personal Medical record (Dossier Médical Personnel - DMP) which will facilitate the continuity of care. A special structure (Public Interest Group) was created in 2005. It is dedicated to design, supervise and organize the deployment of the DMP (Article L 161-36-1 of the Public Health Code) [2].

This structure has been dissolved in November 2009 and replaced by the Agency for Shared Information Systems in Healthcare (Agence des Systèmes d'Information Partagés de Santé – ASIP Santé). This is a milestone in French health reforms of health information systems governance. The reforms seek to consolidate the public management process and thereby encourage the development of health information

systems compatible with telemedicine and electronic health records. ASIP Santé's function is to develop health and medico-social information systems, and it has therefore begun developing security provisions (including identification, authentication, signatures and encryption) and promoting public confidence. ASIP Santé will also create a national information systems framework in consultation with all healthcare stakeholders.

The Pharmaceutical Record

This professional tool is developed on the basis of the DMP by the National Council of Pharmacists (Article L 161-36-4-2 of the Public Health Code) [3]. It aims at centralizing data on all medicines dispensed to each patient, and, subject to strict confidentiality conditions, to make it accessible from any pharmacy. The Pharmaceutical record will allow pharmacists to fight drug induced accidents and redundant healthcare [4].

New Global Plan for the Hospital Sector

The Hospitals, Patients, Health, territories Law (or Bill Bachelot) is the first stage of the Hospital 2012 Plan, launched by French President Sarkozy, which aims at revamping of the French health care system. The bill aims for guarantee a better and equal access to care for all French people, whatever their geographic location [5].

Article 78 amended the French Public Health Code: Article L6316-1 of the Public Health Code confirms telemedicine's legal basis.

Governance of e-Health

In January 2009, President Sarkozy declared that telemedicine is a national priority. Prime Minister Fillon asked legislator Pierre Lasbordes to make national policy recommendations. In November 2009, the French Representative formulated 15 recommendations in his report to the Ministry of Health on e-Health development [6]. He pointed the need for a global governance of e-Health and proposed the creation of an inter-ministerial delegation under the supervision of the French Ministry of Health.

The report also plans e-Health development towards a 5 years national calendar. The fist implementation phase (2009 – 2011) has already started: the Lasbordes report was adopted before the Social Security Finance Law Project for 2010 so that this latter would take it into account. Indeed, article L 612-3 of the French Social Security Code was modified to reflect

telemedicine development. The report contains 15 recommendations concerning many issues such as:

1. Recommendation that the French national Social Security reimburse telemedicine;
2. Recommendation that business model studies be executed as soon as possible;
3. Projection that France would need to spend around €1 billion per year to set up telemedicine, but that savings would cover costs.

Positive outcomes are the sanitary gap's reduction and the possibility to keep patients at home, as well as a better use of emergencies systems, a better access to health for disabled and elderly people but also prisoners…

To reach these goals, many conditions have to be met such as a new legal framework, the creation of convenient healthcare rate settings, health professionals' long life learning, the adoption of an innovative industrial policy, and a national communication plan…

The Regional Health Agencies will play a major role in e-Health governance. They will be operating from April 2010.

Financial Aspects

In December 2009, the Parliament adopted the Social Security Finance Law for 2010 (Projet de loi de financement de la sécurité sociale). Article 78 allows health professionals to receive remuneration for telemedicine medical procedures [7].

This text was first introduced at the French National Assembly thanks to a governmental amendment. Indeed, for the last ten years, the Government has, every year, presented its policy on social security to Parliament through the discussion of the social security finance laws and Parliament has debated these policies. It makes a decision on the revenue forecast and the expenditure targets for social security, which in fact deals with financial sums greater than those of the State budget. The procedures for the examination of finance bills by the National Assembly are different from those concerning ordinary bills. They are laid down in constitutional provisions which are supplemented by two institutional laws.

This law facilitates, only on the case of telemedicine, the sharing of medical fees between health professionals. A health professional may charge a medical procedure for which he/she is not allowed to do. As a result, article L4113-5 (V) of the Public Health Code was amended.

It also authorizes one exception to the physical presence requirement of both patient and general physician for the consulting to be reimbursed, in

the event of an e-Consulting (new article L162-3 (V) of the French Social Security Code). His/her presence is not anymore necessary for the medical procedures to be paid by the Health Insurance.

This measure will neither allow the invoicing of separated fees for a given consulting (for the doctor who is in front of the patient and the remote one); nor the invoicing of phone consulting.

The Upcoming Government Order

A government order will give a list of telemedicine medical procedures, their implementation conditions and financial coverage. It will be adopted in compliance with the bill Bachelot.

The government order project reminds that many telemedicine practices belong to basic legal rules. In the public sector, financements will be based on rates. While in the private sector, there may be some medical procedures but lump sum would be more convenient for the treatment of patients' chronicle diseases [8].

References

[1] Medical Privacy Act n°2002-303 of March 4, 2002. Official Journal of the French Republic, March 5, 2002, p. 4118, text n°1.

[2] Healthcare Insurance Act, n°2004-810 of August 13, 2004. Official Journal of the French Republic, n°190, August 17, 2004, pp. 14598.

[3] Law n°2007-127 of January 30, 2007. Official Journal of the French Republic, n°27, February 1st, 2007, p. 1937, text n°1.

[4] Decree n°2008-1326 of December 15, 2008. Official Journal of the French Republic, n°0293, December 17, 2008, p. 19237.

[5] Hospitals, Patients, Health, Territories Law, n° 2009-879 of July 21, 2009. Official Journal of the French Republic, N°0167, July 22, 2009, p. 12184.

[6] P. Lasbordes, "La télésanté : un nouvel atout au service de notre bien-être - Un plan quinquennal éco-responsable pour le déploiement de la télésanté en France", Report to the Prime Minister, La Documentation française, Paris, Oct. 2009, p. 247.

[7] Social Security Finance Law for 2010, n° 2009-1646 of December 24, 2009. Official Journal of the French Republic, N°0300, December 27, 2009.

[8] TICsanté, "Télémédecine: focalisation des acteurs sur le décret d'application", December 10, 2009, Online Edition: http://www.ticsante.com

Implementation of SNOMED CT® in Telemedicine and eHealth to Standardize Telemedical Record Documentation for Interactive Communication with the Electronic Health Record

G. A. Brox, J. L. Huston
Independent Healthcare Consultants; Scarborough YO11 2AQ, United Kingdom, jangeorg@yahoo.com

Abstract: **SNOMED CT® (SCT) is a machine readable coded clinical terminology which can be bound into standardized electronic health record (EHR) data representational model formats. SCT terms are currently being developed for telemedicine applications, particularly for eHealth-enabled monitoring devices that are capable of reporting clinical findings. A limited number of 'quasi'-standards currently exist for technical aspects of telemedical record documentation but none have been adopted internationally. Examples are provided to illustrate how these standards could be used in telemedicine to allow clinicians to access and communicate patient data via these devices.**

Introduction

Standards for clinical recording of patient care have always been an important issue for accurate communication among the health care providers. Accurate documentation impacts quality of care and patient safety in health care delivery, regardless of recording format [1]. With the growth of telemedicine in the 1990s, telemedical records were identified as the weak link in telemedicine [2], citing issues of privacy, security, accountability, and other medicolegal concerns [3-4]. A Telemedical Record Model was proposed in 1997 to bring these issues to the forefront [5] but a 1998 survey found that these were not a top priority for telemedicine programs in the US at that time [6-7].

With the introduction electronic devices that collect, report, and retrieve patient data, the need to accurately document those data is even more critical. Various standards have been discussed for use in telecare including MPEG for digital images and secure access as well as the use of SNOMED CT (**S**ystematized **No**menclature of **Med**icine – **C**linical **T**erms) for costing [8-11]. The implementation of the machine-readable medical terminology SNOMED CT for communication via the electronic health record (EHR) will help to address some of these telemedical record documentation issues.

Terms Defined

What is meant by eHealth?

The term eHealth was created in 1999, and refined in 2003, to describe the combined use of electronic communication and information technology in the health care sector [12-13]. The term includes digital data which are transmitted, stored and retrieved electronically for clinical, educational and administrative purposes, both at the hub and remote sites. In this paper, the term is used in the context of eHealth-enabled devices such as Point of Care (PoC) monitoring devices, used in nurse-led practices for surveillance of patients with chronic disorders and for carrying out procedures such as laboratory and cardiovascular testing.

What is SNOMED CT?

SNOMED CT (SCT) is a clinical terminology based on approximately 40 years of research and development which started as a coded vocabulary for pathology and broadened to include all clinical specialties. From 2002, SNOMED RT (Reference Terminology) was fused with Read codes and Read CTV3 (Clinical Terms v3), a terminology developed by the United Kingdom, to form SNOMED CT. SCT was originally developed and distributed by the College of American Pathologists and is now maintained by the International Health Terminology Standards Development Organization in Denmark (www.ihtsdo.org). Presently, SCT is distributed every six months as an International release as well as National releases for each of the member countries [14].

Telemedical Record Documentation Scenarios

Since SCT is a coded ***and*** machine readable terminology that can be put into a framework using Health Level 7 version 3 (HL7v3) as an embedding format [15][16], there is a need to receive the message by binding the terminology into standardized EHR data representational model formats such as openEHR (www.openehr.org/download/software.html). The binding of SCT can easily be achieved by creating 'Archetypes' using an Archetype editor software that fits with the openEHR structure (e.g. www.oceaninformatics.com). Examples of ways that SCT could be applied in telehealth settings are described below.

Telehealth Scenario 1 - In telepsychiatry, a telemedicine video conference involves a 'classic psychiatric interview,' during which important findings and observations are made, which lead to an appropriate treatment plan for the patient. These results must be consistently documented in the patient's telemedical record. Once the interview is documented, additional

technologies could run in the background to identify clinical findings and procedures, provided that an agreed standard clinical language is used. An example of these technologies which has the ability to encode SCT directly into the EHR is a product called 'SnoCode3' from Medsight Informatique based in Canada (www.medsight-info.com).

Telehealth Scenario 2 - In settings where PoC devices are used for patient surveillance, such as in home care, plug-in devices may be operated by a nurse or even the patient, with data being uploaded directly to a telemedicine hub. These could include blood pressure cuff measurements, body weight measurements, simple blood glucose measurements, or simple one lead ECG surveillance devices to detect cardiac arrhythmias. Use of some of these devices would require training to accurately prepare samples such as blood versus serum sample input or 12-lead ECG requiring the correct application of electrodes.

Examples of Potential Standards to be Implemented

Examples of organizations which are implementing technical standards for Telemedicine and eHealth include Continua HealthCare Alliance which certifies eHealth devices using a number of electronic connectivity standards to ensure interoperability [17][18]. Another organization, DoCoBo, offers standards for the architectural structure of its Telemedicine and eHealth Hub based on the European Data Protection Directive (www.docobo.co.uk/ArticlePage.aspx?articleId=6&topParentId=7).

Requirements for use of SNOMED CT in eHealth devices

Of the 19 Concepts which make up the hierarchical structure of SCT, the following five Concepts and their subtypes would be relevant in a telecare setting: 1) Clinical Findings, 2) Observable Entities, 3) Procedures and Qualifiers and their defining Attributes, 4) Attributes as part of the Linkage concept (e.g. linking a clinical finding and procedure), and 5) Qualifiers (measurements such as dimensions and proportions) and their defining reading values. The use of these SCT Concepts requires that the terminology be embedded in HL7v3 (xml-type) in order to be able to send messages in a single agreed format. Further requirements would include:

- 'Clinical Findings' would be embedded into a HL7v3 syntax as an HL7 CD (Concept Description) Data type

- 'Observable Entities' would require post coordinated expressions, which consist of at least these 3 components: members of the Observable Entity Concept, a clinical or pathology Procedure, and a

Measurement Value Qualifier. Every component must be linked to each other with appropriate (sanctioned or allowable) SCT Attributes as members of the Linkage Concept. The entire SCT post coordinated expression would then need to be nested into a given HL7v3 xml syntax as a HL7 CD Data Type. Refer to Examples in Table 1.

Table 1 Example Two Types of Concepts Encoded as SNOMED CT Terms

'Clinical Finding'	*SCT Identifier and Description*
Compatible with bundle bunch block	6374002 | bundle branch block and/or 164909002 | ECG: left bundle branch block 164907000 | ECG: right bundle branch block|
'Observable Entity'	*SCT Using Post Coordinated Syntax*
Blood pressure reading Systolic pressure = 120mmHg Diastolic pressure = 80 mmHg	386457009 |surveillance: remote electronic |:{363702006|has focus|=46973005|blood pressure taking |,363705008|has definitional manifestation|=407554009|sitting systolic blood pressure|,((259018001|mmHg|=120 |)}AND{363705008|has definitional manifestation|=407555005|sitting diastolic blood pressure|,(259018001|mmHg|= 80|)))}

These examples also show how SCT could help refine the predefined clinical finding even further depending on the real meaning of the predefined reports which are already in the ECG device. As these types of reports would reoccur frequently, the encoded terms could be stored in the ECG device itself and then embedded into an HL7v3 format to transmit to the telemedicine hub.

Conclusion

SNOMED CT is not 'just another coding system' but it also is only a part of the solution to address the requirements for effective documentation in electronic telemedical records. SCT on its own is incomplete as it cannot be directly used to support Clinical Information Systems without additional enabling software. However, SCT can be used to serve as a basis for providing effective messaging services, clinical decision support, and reporting activities. The process of embedding SCT, as described here,

would enable implementation to meet the real and perceived needs of users in managing patient data in the telemedical record.

References

[1] J. L. Huston. "The Need for Mandatory Clinical Recording Standards," Clinical Medicine, vol. 4(3), pp. 255-257, 2004.

[2] J. L. Huston. "Telemedical Records: The Weak Link in Telemedicine,"Journal of AHIMA, vol. 67(6), pp. 69-71, 1996.

[3] J. L. Huston. "Telemedical Records: Documentation, Legal, and Privacy Concerns," In Confidence, vol. 6(4), pp. 1-4, 1998.

[4] J. L. Huston. "Telemedical Record Documentation," Topics in HIM, vol. 19(3), pp. 59-65, 1999.

[5] J. L. Huston. "A Telemedicine Record Model," J. of Telemedicine and Telecare, vol. 3(S1), pp. 86-88, 1997.

[6] J. L. Huston. "Telemedical Record Documentation: A Preliminary Survey," Journal of Telemedicine and Telecare, vol. 5(1), pp. 6-8. 1999.

[7] J. L. Huston. "Managing Telehealthcare Information," Journal of Healthcare Information Management, vol. 13(4), pp. 49-58, 1999.

[8] G. Brox, J. Huston. "The Impact of MPEG-4 Standard on Electronic Reporting for Mobile Multimedia Patient Records," J. Telemedicine and Telecare, 8(S2), pp. 115-117, 2002.

[9] G. A. Brox, and J. L. Huston. "The Application of the MPEG-4 Standard on Telepathology Images for Electronic Patient Records: A Comparative Analysis," Journal of Telemedicine and Telecare, vol. 9 (S1), pp. 19-21, 2003.

[10] G. A. Brox. "MPEG-21 as an Access Control Tool for the NHS Care Records Service," Journal of Telemedicine and Telecare, vol. 11(S1), pp. 23- 25, 2005.

[11] G. A. Brox, and J. L. Huston. "Using SNOMED CT® in Casemix for Determining Costs in Pathology Services," Med-e-Tel 2008, Luxembourg. ISSN: 1818-9334. Ed.: M Jordanova, F Lievens; Section 18: *Efficiency in eHealth*, pp. 566-571, 2008.

[12] H. Oh, C. Rizo, M. Enkin, and A. Jadad. "What is eHealth (3): A Systematic Review of Published Definitions," Journal of Medical Internet Research, vol. 7(1), p. e1, 2005.

[13] J. Mitchell. "From Telehealth to e-health: The Unstoppable Rise of e-health," Canberra, Australia: Commonwealth Department of Communications, Information Technology and the Arts, 1999.

[14] SNOMED CT User Guide. Edited by the International Health Terminology Development Organization (IHTSDO) Copenhagen, Denmark, 2009 www.ihtsdo.org

[15] E. Cheetham, et al. "Using SNOMED CT in HL7 Version 3; Implementation Guide: 1.6.5 SNOMED CT, 1.6.3 Clinical Statements," Release 1.3, 2007, https://svn.connectingforhealth.nhs.uk/svn/public/nhscontentmodels/TRUNK/ref/HL7/terminfo.htm#TerminfoAppendRefsHl7

[16] G. Schadow, P. Biron, L. McKenzie, G. Grieve, and D. Pratt. "HL7 Version 3 Standard: Data Types – Abstract Specification," Release 1, 2.6 Concept Descriptor (CD), 2007 www.hl7.org/v3ballot2007sep/ html/infrastructure/datatypes/datatypes.htm#contents

[17] Continua Certification Version 1.0; Continua Health Alliance, 2009 www.continuaalliance.org/static/cms_workspace/Continua_Certification_Public.pdf

[18] L. Dunka, et al. "Point-of-Care Connectivity; Approved Standard -Second Edition," CSLI Document POCT1-A2, Clinical Laboratory Standards Institute, vol. 26(28), 2006 www.clsi.org/source/orders/free/ poct1-a2.pdf

Georg Brox has a broad medical background with specialist degrees in Histopathology and Cytopathology, as well Accident and Emergency Medicine. In the UK, he has worked with the National Health Service in the development of the electronic health record (EHR) as a clinical evaluator of software vendors, as a Senior Clinical Software Design Engineer, and as a Casemix Consultant. He has served as a Subject Matter Expert in SNOMED CT for a number of projects in Canada and has been an active member of several working groups of the IHTSDO (International Health Terminology and Standards Development Organization). Dr Brox has co-authored numerous publications on the topics of SNOMED CT, telepathology standards, EHR, and casemix costing for pathology services using SNOMED CT as well as co-authoring an online course in SNOMED CT for the Ohio Health Information Management Association.

Huston has over 35 years experience in Health Information Management (HIM), both in academia as a Professor in the USA as well as direct involvement in healthcare delivery in both the USA and UK. She most recently served as Manager of Clinical Coding Services at The Royal Marsden Hospital in London. Dr Huston has been involved in telemedicine and telecare since serving as a Telemedicine Evaluation Research Associate at the University of Kentucky in the mid-1990s and she became a member of the Telemedicine and eHealth Section of the Royal Society of Medicine in 1998. Dr Huston has authored numerous publications on a variety of topics concerning documentation of patient care including security and medicolegal issues in the electronic health record and telemedical records, HIM training requirements, and recently co-authored an online course in SNOMED CT for the Ohio Health Information Management Association.

Small Reflexion on Standardization and e-Health

Bruno Salgues, Melanie Blanchard
Institut Telecom, 46, rue Barrault, 75634 Paris Cedex 13, France,
bruno.salgues@institut-telecom.fr; melanie.blanchard@it-sudparis.eu

"You know the annoying fortune of this word of standardization. What is not standardization? I standardize, you standardize, etc… let's try to detect some significant points in all that." (Michel Foucault)

The first definition of "standard" is the representation of a statistical average. A thing is regarded as normal if it is presented in an identical way for the majority of a population. The standard comes from a frequency. The first normality thus concerns more psychological aspect.

In the second definition, the ideal standard plays a role of attraction and conformity. The standard serves here or must be used as object of imitation, to do or reproduce something, to delegate, it's the description of a process. We will not treat in this text the first normality but only the second, as it intervenes in technological processes of production of goods and services, associated, or in organizations. In this text, we will constantly get back and forth between standards, associated goods and organizations.

Different Types of Standards and Visions

Standard can be considered on a managerial or organisational point of view. But it is also a tool of communication or an engineering practice. Why do we then want to standardize, is it to describe various forms of standards, anthropological, technical or conversational?

Organisational, Communicational, Engineering visions

When one is interested in standards, three visions are proposed: organisational, communicational, and engineering. Catherine Loneux (2005) considers an **organisational a pproach**. The NATO's "STANAG 2517" is perfectly in this organisational vision. It proposes an army model of organization for health on line. As an example, the system described within the framework of this standardization is simple and consists of a "Group Consultation" which studies the patient problems. According to the case importance, this authority makes the choice to direct the patient towards a specialized group, or simply send an email to a person of reference. The mail will be treated 24h/24 everyday, within 5 hours.

For the Forum Continua or the mHealth Alliance, **the communication** is an essential factor. The events organized by Continua generally gather more

than 1400 participants, mainly industrials. The Rockefeller foundation, the Foundation of the United Nations and the Vodafone foundation announced the common creation of a mHealth Alliance to facilitate the innovations in the broad sense and to ensure a maximum of developments in the field of mobile health or "mHealth". If the communication suggested by Continua is rather in the field of marketing, the mHealth Alliance considers the exchange aspect. The forum delivers labels and certifications. Within the framework of marketing actions, only certified actors have the right to use the logo "Continua". Thus the mHealth alliance wishes to implement a platform to develop study cases, allow exchanges between the various actors and improve health care via mobile phones.

For engineer s, standardization is between objectivation and inter-subjectivation. It is often a question of industrializing the production of a resource whose limits are accepted jointly. Thus, the standard is represented by a series of engineering activities. One can only regret the weakness of standardization actions in this field apart from the actions carried out by the International Telecommunication Union.

The anthropological Standard Versus Technical Standard

Catherine Loneux proposes to distinguish the anthropological standard from the technical standard. The anthropological standard is not built, it is spontaneous and according to the approach of Hayek, it is essential to regard them as such. To include/understand them, it is necessary to take into account the cognitive structures. On the other hand, the technical standards are built and obey desired forms. The anthropological approach of the standard can lead to an analysis in terms of handling. On the other hand, there are activities of writing which become easy to handle, therefore, to put in the performativity of the activities of handling can be legitimate. The standard will be essential. This idea is in the line of the writings of Fraenkel (2006).

The standards suggested by the forum CONTINUA or the STANAG of NATO consist in technical standards, the approach suggested by the mHealth Alliance is connected to an anthropological standard.

Standards and Forms

Christian Le Moënne puts the question of the standard and his form. Standards were invented starting from their modes of propagation. It is interesting to note that each case is present in E-health.

Standards, Writings and Professions

Several research difficulties can arise in a context of practice professionalization: writing, regulation and organizations. First, when one considers structural rule matters, they can be supports (Grosjean and Lacoste, 1998), a simple setting for documents (Péne, 1996), or standardization acts in products (Pontille, 2006). The second consists in knowing how the writing of the standard can be a means of legitimating a profession or an organization. The third difficulty is to know how the profession contents were negotiated, whether the profession is new or has already been modified. Later, we will address the role of standards in organizations and in particular their influences on trades. Then, we will position standards in practices and other documents. Lastly, we will wonder about practical aspects.

Modes of propagation	Example
Law	Communication "Com(2008) 689" of the European Commission
Innovation	M-health Alliance
Market	Forum CONTINUA
Soldier	STANAG 2517

Organisational Consequences

The knowledge industry raises digitalization issues and its exploitation in terms of risks for personal freedoms, and standards matters for the transactions exchange and traceability. These issues are particularly important whether we consider a collaborative or cooperative mode. In this context of full transformation, the standard will be the translation of an organisational evolution in progress. It raises the question of actors' migration from a participative mode to a contributively mode. The question of the participative innovation passes by a standardized management of the data and management by project. The mHealth alliance considers a co-operation mode as it wants to develop new technologies while working with partners to obtain the necessary data for problem solving and communication improvement during natural disasters.

What Does that Prove…? Initially, there is no Ideal Organization

e-Health is an example of this knowledge industry. This document does not study the standardization influence on cleavages between production, dissemination and conservation of knowledge, nor on the value chain it

generates. Should we integrate this influence in a standardization process or does that concern other approaches? E-Health is the perfect example of an industry that creates traceability. Two practical aspects raised our attention.

The emerging debates on the various shapes of digital medical files in different countries raise controversies in regards to numerical intellectual property. This specific subject will have to be seriously investigated in a near future. Even the specific name of the digital medical file was prone to debates. These digital data constitute useful knowledge for health professionals and a significant commercial value for companies such as insurers, but also for some employers. The question is then to know what data should figure in the process of standardization.

The "monitoring of remote people" is badly necessary and essential to defer the hospital to the house but also requires reinventing the hospital management. Used technologies in this case will also enter the hospital itself in the same process. New professions will thus emerge from the knowledge industry. New workers will have to position themselves in front of the management team and healthcare professionals. They will, thus, need intensive training. Should they also be integrated in a standardization process?

References

[1] C. Loneux, "International Readings of the concept of normalcy at Michel Foucault", in Knight Y and Loneux C (ED), Foucault with work, coll. Exchanges, 3RD, 2005.

[2] Mr. Grosjean, Mr. Lacoste, Communication and Collective Intelligence. Work at the Hospital.PUF, Paris, 1999.

Telemedicine Applications in Body-related Technologies: Ethical Issues

Katsiaryna Laryionava, Dominik Groß, Sabrina Kreucher
Institute for History, Theory and Ethics in Medicine, RWTH Aachen University, University Hospital, Wendlingweg 2, 52074 Aachen, Germany
klaryionava@ukaachen.de

Abstract: **telemedicine has recently started playing an increasing role in body-related technologies. The aim of this study is to identify key ethical iss ues raised by telemedicine application in various types of these technologies. Firstly, it dist inguishes them a ccording to their degree of invasive ness into the hum an body (e.g., attac hed/wearable, penetrating, and im plantable de vices). Fur thermore, the stu dy identifies alre ady existing and potential telemedicine applicati ons of body-related technologies as well as their risks and benefits. It concludes with a disc ussion of the e thical implicati ons and social consequences of telemedic al concepts for those technol ogies regarding the grade of their obtrusiveness and the purpose of use.**

Introduction

Due to advances in micro/ nanotechnology, mobile and wireless telecommunications and data treatment, telemedicine has recently started playing an increasing role in body-related technologies. These technologies can be worn, attached, or fully incorporated into the human body [1]. In conjunction with telemedicine, they enable continuous real-time monitoring of a patient's vital information and health parameters 24 hours a day. On one hand, telemedicine in body-related technologies offers a large benefit to patients and caregivers alike. It promises to provide a higher quality of care, especially to high-risk patient groups such as elderly people and chronically ill patients. It can contribute to support of pre- and post-hospital health services, provide better follow-up of patients by offering help for prevention and early detection of diseases, as well as to assist in managing healthy life style. Last, but not least of the advantages is lowering of overall costs as a result of fewer hospital visits to the doctor's office. Despite the many promising benefits of telemedicine application in body-related technologies, its usage raises not only medico-legal, but also considerable ethical concerns both on the individual and the societal level.

Attached or Wearable Devices

Attached or wearable devices, which are worn outside the body, can be voluntarily removed by the patient. They provide a non-invasive or minimal invasive monitoring method used in telemedicine (so called "*Smart Wearable Health Systems*" (SWHS) [2]). The individual's vital signs, i.e., cardiac frequency, as well as sensorial, emotional and cognitive reactivity can be monitored remotely.

SWHS include micro sensors, wearable computing (e.g., wrist devices), as well as "intelligent biomedical clothing" (IBC) [3]. Examples of non-invasive attached/wearable devices for continuous monitoring of physiological parameters are:

"Wrist Monitoring De vice" (WMD) [4], worn on the patient's wrist, gathers vital information from the sensors and transmits it to a remote telemedicine centre. It enables monitoring heart rate, blood pressure, oxygen blood saturation, and skin temperature;

"Clothes for Tele-Assistance in Medicine" (VTAM) [5] is an example of wearable textiles. It integrates textiles with biomedical sensors and mobile telecommunications and enables transition of physiological information (cardiac and breathing frequency, temperature).

The observed trend in the market is changing from wearable electronics to multifunctional smart fabrics, which can allow also monitoring of the biochemical data in the future. Although it will enable more accurate evaluation of a person's health condition, e.g., by analysing body fluid constituents, the required incorporation of sensors into the human body for this purpose will make this technology more invasive.

Penetrating Devices

Penetrating devices which are placed into the fat tissue or under skin, for example, require ongoing body penetration, but can be relatively easily removed. One example of such technology is a telemetry glucose sensor. It is designed to be implanted under the skin of the diabetic patient in order to continuously measure blood glucose level. Integrated within a telemedicine system, glucose-level, insulin infusion data and patient therapeutic decision-making can be supervised remotely by a doctor. A further example is VeriChip, a subdermal, RFID device. It can provide medical data as well as the local positioning of the individual.

Embedded Technology

Embedded devices (totally implantable devices) such as **a** pacemaker or implantable cardioverter defibrilator (ICD) are completely incorporated as a part of the body and become permanent and irreversible. Integrated into the telemedicine system, the implanted device communicates automatically with a home receiver connected to the internet, which is stationed in the patient's home. This then transmits encrypted data to the physician, which allows monitoring of cardiac status, remote patient follow-up, the device's functions and programming. The heretofore rapid technological advances have also lead to increasing functions that the device can offer, e.g., performing a wide range of medical tests.

Ethical Aspects: Privacy, Date Protection and Security

Telemedical devices transmit data that are very sensitive to the individual. Therefore, the question of the security of this information is a relevant issue regarding privacy and data protection. Many of these devices use GSM mobile communications, Bluetooth, and RFID, all of which have undisclosed security problems. Another issue is that using RFID systems by body-related technologies can be abused to allow unauthorized tracking of the individuals. Due to such technologies certain individuals may be unwillingly located via GPS.

Moreover, implantable devices accessible via digital networks can also be misused. As a result of unauthorized access, there can be severe consequences with implantable devices such as with the ICD (e.g., change device settings, including ordered shock applications) [6].

Thereby, informed patient consent is necessary when such technologies are to be used for health purposes. This information should not only reveal benefits and health risks, but also risks that such devices could be used to trace people or acquire access to sensitive information without the authorization of the person in whom the devices are inserted [7].

Autonomy and Human Dignity

Wearing or implantable devices, in some cases, might raise ethical challenges to human dignity and autonomy, especially when patients no longer have the ability to make judgements or individual choices [8]. Using tracking bracelets or implantable chips equipped with Global Positioning System Technology (GPS) to monitor the movement of elderly Alzheimer's and dementia patients, as well as tracking mentally ill patients is ethically controversial.

Quality of Care and Risk-benefit Considerations

The use of telemedical application, especially in implantable devices and biosensors, raises questions about the quality of care patients will receive. As far as implantable devices with telemedicine application (e.g., pacemaker or ICD) are concerned, the following question arises: can remote monitoring offer a similar quality of information acquisition compared to usual doctor visits? Furthermore, implantable devices for remote monitoring of cardiac function for patients without a pacemaker or ICD indications or implantation of biosensors raise ethical issues concerning risk-benefit considerations (possible benefits against implantation potential risks).

Body-perception and Self-concept

A further consideration is the intrusiveness of such technologies. Often one experiences a psychological difference after a device penetrating the skin has been embedded versus one which has been attached externally to the body. The skin has always been a border for one's personal space, and breaching it can constitute a profound invasive violation of not only the body, but also the person's core. Such technologies, already per se, include concerns, which can be even more intensified by telemedicine application and may contribute to this invasive violation. For example, when tracking and monitoring patient functions using bundled chips, one might percept the implantation of a microchip as "bodily invasion", which includes the possibility of further risks of "privacy invasion" [9].

These worn or implanted devices can be challenging to the integrity of the patient's body and self-concept. Although it is not uncommon for one who must wear an external device to experience fewer problems than one who has it inside the body, nevertheless, it can cause some problems for the individual**.** A technological gadget may be perceived as obtrusive, which results in negative impact on bodily integrity.

Further psychological problems of telemonitoring on the individual level might be worry, insecurity, dependence, and loss of control that, in turn, can have a negative influence on coping with diseases. Such technologies, e.g., smart wearable textiles, can be perceived as a reminder of the illness. In addition to self-scrutiny, what others may think is also important to one's self-esteem. Patients who have such a device may have been stigmatized by others for needing such assistance.

Aspects from a Societal Perspective

On the societal level, advances in these technologies challenge the anthropological core of the individual. Through these technologies integrated into the human body, the body itself becomes integrated, or "wired" [10] into information and telecommunications network; hence individuals are becoming "networked". This can have impact on the understanding of the individuals' autonomy and dignity as well as the understanding of human body.

Conclusions

The insertion of multifunctional devices, attached or implanted within the human body, with telemedicine application will become increasingly common in future medical practices. Advances in micro/ and nanotechnology together with progress in wireless communication, will lead to the development of more powerful miniaturized implantable devices, e.g., implantable biosensors, or even ingestible devices (e.g., "smart pill"). It follows, then, that rapid ongoing developments in telecommunication technology applied directly to the human body should be carefully evaluated. Our daily lives are being pervaded with these applications. They require continuous monitoring and increasing awareness of ethical and social implications, as they are implanted in our bodies or are worn on them [11].

References

[1] S. Courtney et al., "The Bodily Incorporation of Mechanical Devices: Ethical and Religious Issues (Part 1)," in *Cambridge Quarterly of Healthcare Ethics*, Vol. 16 (2), pp. 229-239, 2007.

[2] . Lymberis, "Wearable Health Systems and Applications: The Contribution of Information and Communication Technologies," in Proceedings of the IEEE, 17-18 Jan., pp. 4149 – 4152, 2006.

[3] A. Lymberis, and S. Olsson, "Intelligent Biomedical Clothing for Personal Health and Disease. Management: State of the Art and Future Vision," in Telemedicine Journal and e-Health, Vol. 9, (4), pp. 379-286, 2003.

[4] P. Lukowicz et al., "AMON: A wearable medical computer for high risk patients," in Proc. ISWC 2002, 6th Int. Symp. Wearable Computers, pp. 133–134, 2002.

[5] N. Noury et al, "VTAMN - A Smart Clothe for Ambulatory Remote Monitoring of Physiological Parameters and Activity," in 26th IEEE-EMBS2004, San Francisco, 1-5 Sept, pp. 3266 – 3269, 2004.

[6] H. Burri, and D. Senouf, "Remote monitoring and follow-up of pacemakers and implantable cardioverter defibrillators," in Europace, Vol.11(6), pp. 701 – 709, 2009.

[7] S. Rodotà, and R. Capurro, (eds) "The ethical aspects of ICT implants in the human body," Opinion of the European Group on Ethics in Science and New Technologies, Luxembourg, 2005.

[8] M.J. Fisk, “Telemedicine, New Technologies and Care Management,” (editorial) in Int J Geriatr Psychiatry Vol.12, pp. 1057-1059, 1997.
[9] K. A. Bramstedt, “When microchip implants do more than drug delivery: Blending, blurring, and bundling of protected health information and patient monitoring”, in Technology and Health Care, Vol. 13 pp. 193–198, 2005.
[10] K.A. Bauer, “Wired Patients: Implantable Microchips and Biosensors,” in Patient Care, in Cambridge Quarterly of Healthcare Ethics, Vol. 16 (3), pp. 281-290, 2007.
[11] K S. Rodotà, and R. Capurro, (eds) “The ethical aspects of ICT implants in the human body,” Opinion of the European Group on Ethics in Science and New Technologies, Luxembourg, 2005.

Katsiaryna Laryionava studied Social Sciences in Gießen, Germany. Since 2009 she has worked at the Institute for History, Theory and Ethics of Medicine (RWTH Aachen University) on the project "Gender-related Acceptance, Usability and Ethics in New (Medical) Technologies (AC-TEC)." Her interests include telemedicine, new medical technology and its impact on society and human body, as well as acceptance of new technologies.

The Economic Impact of Using Telehealth on Primary Care on the Municipal Budget in the State of Minas Gerais, Brazil

R. M. Figueira[1], M. B.M. Alkmim[2], F. E. Campos[3], A. L. P. Ribeiro[1]
[1]School of Engineering UFMG Bl.II, Sala 2642, Av. Antônio Carlos, 6627
31.270-901 Belo Horizonte, MG - renatominelli@ufmg.br
[2]Telehealth Center, University Hospital UFMG
[3]SGTES, Brazilian Ministry of Health

Abstract: **Several advantages of using telehealth have been presented, principally in remote and isolated areas. However the economic argument of reducing health care costs is not so evident and depends strongly on a particular situation. Costs reduction is an important argument to convince municipal administrators to adopt telehealth. A methodology to evaluate such savings was developed and applied to a village in the Telehealth Network of Minas Gerais, Brazil. The results show that savings of 12% on municipal health budget are achieved. Important factors for the economic balance are the efficiency of telehealth, the number of referrals and the isolation level of the village.**

Introduction

The State of Minas Gerais in Brazil has a large territorial dimension (586.528 km², equivalent to France territory) and a population of 19 M inhabitants living in 853 cities with wide social, economical, cultural, geographical and infra-structural contrasts [1]. Within this context, the State of Minas Gerais Health Department and the Ministry of Health gave financial support to create a telehealth program to support the primary care in remote and isolated villages in the state. Starting in 2006 as a pilot project coordinated by the University Hospital of Federal University of Minas Gerais (HC/UFMG) in 82 villages, it is planned to reach 607 villages by April/2010. Until December/2009, the Telehealth Network of Minas Gerais has delivered 300,000 ECGs, 6,000 teleconsultations and 9,600 urgency supports to these villages. In order to support government decision to expand the project, it was necessary to develop a cost/benefit analysis. The objective of this work is to present this methodology through an application example showing the impact of telehealth on the municipal budget of a specific village.

Methodology

An important argument to convince municipal administrators to support the implementation of telehealth is to demonstrate that it can reduce the costs in health care decreasing the number of referrals. To demonstrate the savings on referrals, two types of information are necessary: those related to the cost to refer the patient and those relative to the number of refer. These two types of information were collected at a specific village during the period from January to July/2008, the first one at the accounting department and the second one at the municipal health department. Of course the use of telehealth cannot reduce 100% of referrals. It is possible to classify them in two categories: consultations and exams that are impacted by telehealth, and delivery/urgencies/hospitalization that are not affected. Also, in the first category not all of them can be avoided by telehealth because even after a teleconsultation some of the patients still have to be referred. Therefore additional information regarding the efficiency of telehealth, defined as the percentage of referrals that are avoided by telehealth, was collected at the Telehealth Center information system.

Characteristics of the Village

The example to be presented here is from the village Machacalis located in the northeast part of the state of Minas Gerais at 620 Km. from Belo Horizonte (state capital) with a total area of 329 km². Its population as of 2007 was 6,855 living mainly in rural area. The city belongs to the region of Mucuri River Valley, considered one of the poorest of the state. It has Municipal Human Development Index 0.637 ranking 772 out of 853 municipalities in the state (2000) and a life expectancy of 63 years [1]. The GDP in 2007 was US$ 15M resulting in a *per capita* income of 2,200 US$/year. [2].

Referral Costs

The cost related to referral is the patient displacement cost covered by municipal health authorities. Part of this cost is salaries of administration staff and drivers and costs related to vehicles used for transportation of patients (fuel, tires, maintenance, insurance, taxes, depreciation, capital cost and rental). Since the population in those villages has low income, they usually receive a pocket money for daily expenses. Telephone and Internet costs are related to exam and consultation appointments with specialists made by the municipality. In Brazil all patients have the right to be attended in the public health system without cost. However due to the high demand for these services, the municipal health authority establishes, together with other villages, a health consortium where expenses with salaries, exams, etc.

are shared. Another alternative found by some of the villages is a contract with private clinics or hospitals.

Since telehealth will not reduce all referrals, to evaluate the savings it was considered only the variable referral cost because at least part of the infrastructure has to be kept after implementation of the service.

Results

Table I – Machacalis's Annual Budgets in 2008

Annual Municipal Budget (US$)	3.365.556
Annual Health Budget (US$)	716.091
% Health Budget	21,3%

Table I shows the values of Machacalis' budgets in 2008. It can be seen that the village has a health expenditure *per capita* of only 104 US$/year. Machalis usually send its patients to four cities as can be seen on Table II with a weighted average travel distance of 155 Km. Table III shows the monthly averaged referral costs. Referral cost corresponds to 28,7% of the health budget.

The average efficiency of telehealth activities in Machalis in the period of January to July/2008, measured through the Telehealth Center information system, was 95.7%.

Table II – Number of referrals and respective distances

Local of reference	Aguas Formosas	Teófilo Otoni	Governador Valadares	Belo Horizonte	Total
Distance (Km)	25	170	290	670	155(*)
# Consultations/Exams	5,5	169	2,5	13	190
# Delivery/Urgencies/Hospitalization	74	55	1	0	130
Total of referrals	80	224	4	13	320

(*) weighted average distance

Table III – Monthly averaged referral costs in Machacalis

Fixed cost (US$/month)	4.554,20
Variable cost (US$/referral)	39,24
Total cost (US$/month)	17.129,54
Total cost (US$/referral)	53,50

Considering the numbers shown on these tables it is possible to calculate the monthly savings from telehealth due to reduction of referrals as 39.24 US$/referral x

190 referrals/month x 0.957 = 7,135 U$$/month

Discussion

The literature has shown a series of advantages resulting from the use of telehealth [4-5]. However, the economic argument for using the telehealth is not so evident [4, 6-7]. Also most of economic analysis in telehealth is highly dependent on a specific situation making difficult a preliminary assessment of a particular case. For the specific situation found in Machacalis, the use of telehealth reduces referral costs by 85,620 US$/year, corresponding to 12% of health budget.

However, independent of the situation, important factors affecting the economic balance are the efficiency of telehealth in reducing the number of referrals, the number of referrals and the distances for referral. In this sense, the telehealth center should provide to its customers different tools to resolve the case without the patient displacement, thereby increasing its efficiency. Acting on those high-demand specialties will also promote the economic balance. Finally, it is also clear that the savings will be proportional to the level of isolation of the village.

Conclusion

Although the use of telehealth in isolated and remote villages as in the northeast part of the State of Minas Gerais has many advantages, a strong argument to convince the municipal administrators to support it is the savings resulting from referral that can be avoided. In a typical village in the poorest region of the State of Minas Gerais, due to the high number of referrals and the long distances, these savings are particularly important because the relative high amount spent on referrals. Another important parameter to promote the economic balance is the high efficiency of the telehealth in reducing the number of referrals.

References

[1] http://www.ibge.gov.br/cidadesat

[2] http://www.fjp.gov.br/index.php/servicos/81-servicos-cei/58-produto-interno-bruto-de-minas-gerais

[3] R. M. Figueira,; M.B.M. Alkmim, A.L.P. Ribeiro; M. Pena, F. E. Campos, Implementation and Maintenance Costs for a Telehealth System in Brazil. Med-e-Tel 2008 The International Educational and Networking Forum for eHealth, Telemedicine and Health ICT Global Telemedicine and eHealth Updates: Knowledge Resources. Vol. 1, 2008, p 354-358. Editors: Malina Jordanova, Frank Lievens. ISSN 1998-5509.

[4] M. Kifle, V. W.A. Mbarika, P. Datta. Interplay of cost and adoption fo telemedicine in Sub-Saharan Africa: The case of tele-cardiology in Ethiopia. Inf Syst Front, v.8, p.211-233, 2006.

[5] M. Nerlich et al. Teleconsultation Practice Guidelines: Report from G8 Global Health Applications Subproject 4. Telemedicine Journal and e-Health, 8, 4, pp. 411-418, 2002.
[6] D. Hailey, P. Jennett. The Need for Economic Evaluation of Telemedicine to Evolve: The experience in Alberta, Canadá. Telemedicine Journal and e-Health, 10, 1, pp.71-76, 2004.
[7] N. M. Hjelm. Benefits and drawbacks of telemedicine. Journal of Telemedicine and Telecare, 1, 2, pp. 60-70, 2005.

Maria Beatriz Moreira Alkmim is doctor at the University Hospital of Federal University of Minas Gerais (UFMG) where heads the Telehealth Center, specialized in teleassistance and serving more than 600 municipalities to support the Primary Care and Family Health Program. She is graduated in Medicine from UFMG (1979), residency in Clinical Pathology and specialization course in Hospital Management. She works in Telemedicine and Telehealth since 2001 and is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry. Main areas of expertise are the application of Information and Communication to health, administrative and financial management of Telehealth, implementation and monitoring of large scale Telehealth projects. In 2008 she was awarded with the Health! Editora Abril prize in the category Health of the Heart.

Renato Minelli Figueira is graduated in Metallurgical Engineering (1975) with a Master degree in Metallurgical Engineering (1977) by Federal University of Minas Gerais (UFMG), Brazil. He has also a Ph.D. degree in Materials Engineering by the Massachusetts Institute of Technology (1983) and a MBA in Finance by UFMG (1994). Presently is Professor at the Department of Metallurgical Engineering and Materials – UFMG working on industrial system management. Collaborates since 2007 with the University Hospital of UFMG at its Telehealth Center working on economical aspects of telehealth.

The Role of Quality and Quality Management Systems in Telemedicine

M. Lindlar
German Aerospace Center, Institute of Aerospace Medicine,
markus.lindlar@dlr.de
Linder Hoehe – Building 24, 51147 Cologne, Germany

Abstract: **The proof of quality of services and or products gains in importance not only in the medical sector. To provide objective evidence of quality more and more health care providers on various medical fields establish quality management systems (QMS) in their institutions. Especially EN ISO 9001:2000 certified QMS are widespread for instance in hospitals, doctor's practices or in companies producing medical devices. The proof of quality very often is a precondition requested by principals prior to conclude a contract or to place an order. Objective: Regarding the evolving role of telemedicine in the health care system worldwide and it's claim to deliver at least equivalent or even better quality than the standard services it is expected that quality and quality management systems are considered already when developing products or services. Methods: A survey of publications about telemedicine has been conducted on the databases of PubMed and the Telemedicine Information Exchange (TIE) to gain an overview of the role of quality in general and especially of quality management systems. Catchwords in this research were "Telemedicine or Telehealth or E-Health or Telemonitoring" in combination with "Quality" and "Certification or Guidelines or Pathways or Management or ISO 9001" Results: Only 202 publications matched the search criteria. 108 of them described studies on feasibility of telemedical applications. 72 publications described telemedical applications established in medical care. 35 of all publications dealt with the optimization of processes. Only 10 of them analyzed established applications considering quality aspects. 2 different publications described one and the same teleradiological application certified following EN ISO 9001:2000. One publication described a QMS following the SixSigma standard. Conclusion: A first interpretation of the results, keeping in mind the spread of QMS not only in the medical sector, leads to the assumption of a distortion of results caused by the study design. In fact many publications are**

published in an early stage of development of a telemedical application. For this reas on the study foc used on well established telemedic al applications. But a random research in the Worldwide Web delivered a similar trend like PubMed and TIE research. Thus it can be assum ed that QMS stil l do not pl ay a similar role in telemedicine like in other sectors of medical care.

Introduction

Quality is defined as the conformance with requirements. This applies to products as well as to services produced or provided by companies or service providers respectively. The requirements are defined by the customers themselves. In the healthcare sector products are e.g. medical devices or pharmaceuticals. Medical services could be e.g. medical examinations or (tele)-medical applications. The main services or core processes of hospitals which in general are medical service providers are diagnostics, treatment and rehabilitation. The level of quality of these services corresponds to the grade of customer retention. The better the service quality the more patients return to the hospital the next time medical support is needed. Quality management systems include the identification and definition of processes and their requirements in a first step followed by the elaboration of standard operating procedures and a continuous process of improvement. To maintain quality an increasing number of service providers, not only in the medical sector, decide to implement quality management systems (QMS) to control and improve their processes. In Germany medical institutions like hospitals, doctor's practices or rehabilitation centers from 2010 on are committed to implement QMS and to improve them continuously [1]. Various types of QMS exist where the ones following the standard EN ISO 9001:2000 are widespread in the medical sector, not only in Germany. Further standards for QMS are e.g. EFQM [2], SixSigma [3], KTQ [4] or JCAHO [5].

Objective

Telemedicine claims to be an alternative to standard medical treatment delivering at least the same or even better results. As mentioned above an increasing number of medical service providers implements QMS to standardize and improve their processes. Against this background, it is of interest to identify whether quality and quality management systems play a major role in the field of telemedicine as well.

Methods

A literature research has been conducted on the databases of the U.S. National Library of Medicine (PubMed) and the Telemedicine Information Exchange (TIE). Only telemedical applications established in medical care where included in the analysis because QMS are irrelevant in feasibility studies or discontinued projects. Catchwords in the research were "telemedicine OR telehealth OR e-health OR telemonitoring" in combination with "quality" AND "certification OR guidelines OR pathways OR management OR ISO 9001". The term “telemonitoring” has been selected because the monitoring of vital parameters of elder or chronically ill patients is a widespread service in telemedicine especially in the field of ambient assisted living (AAL). The term “certification” is of interest as QMS have to be certified by an independent assessor.

Results

202 publications matched the search criteria. 141 were found on the PubMed portal of the U.S. National Library of Medicine. In the database of the Telemedicine Information Exchange 61 publications matched the query. 108 publications described studies about new applications or limited projects. 72 publications analyzed established applications in the field of patient care. The topics of 22 papers were neither studies nor running services. 35 publications dealt with quality aspects of telemedical applications. The papers of 20 telemedical services reported to be integrated in patient care discussed quality aspects.

Only 2 different publications described one and the same teleradiological service certified following EN ISO 9001:2000. One publication described a QMS following the SixSigma standard which is more statistically and not process oriented (table 1).

Table 1

	PubMed	TIE	total
Search criteria	141	61	202
Studies	47	61	108
Projects	52	20	72
Quality aspects all	23	12	35
Quality aspects services	13	7	20
QMS	1	1	2

Discussion

A first superficial analysis of the results leads to the assumption that QMS do not play a significant role for telemedicine service providers. But that interpretation could miss some facts out. On one hand telemedical services could be just one part of a complex product portfolio offered by a company which could run a QMS including all, the telemedical and non-telemedical processes. But in this case it is surprising that only 2 publications of established telemedical services describe the embedding in a QMS. Keeping in mind the spread of QMS not only in the medical sector, at least a few references to QMS of the publishing institution should be present. On the other hand a distortion of results caused by the study design – QMS cover companies not services – does not explain the rare results when performing similar random queries in the worldwide web.

Summing up the results quality management systems still do not play a similar role in telemedicine like in other sectors of medical care or business in general.

Quality management systems following the EN ISO 9001:2000 standard can be established in almost every company irrespective of the fact the company is manufacturing products or providing services. In the field of telemedicine 2009 the Association for Electrical, Electronic & Information Technologies (VDE) developed application rules for telemonitoring[6] basing on EN ISO 9001:2000 in cooperation with leading telemonitoring service providers, a promising step for quality in telemedical care in the future.

References

[1] http://www.pressebox.de/pressemeldungen/tuev-sued-ag/boxid-190748.html

[2] European Foundation for Quality Management, www.efqm.org

[3] Motorola University, What is Six Sigma, http://www.motorola.com/content.jsp?globalObjectId=3088

[4] Kooperation für Transparenz und Qualität im Gesundheitswesen, www.ktq.de

[5] The Joint Commission, www.jointcommission.org

[6] VDE Initiative MikroMedizin, VDE-Anwendungsregeln für TeleMonitoring - Qualitätsmanagement ISO 9001:2000 - Aufbau | Ablauf | Fallbeispiele, Frankfurt/Main, 2007, ISBN 978-3-00-022879-7

Lindlar studied Medicine in Ancona (Italy) and Bonn (Germany). After his work as medical assistant he specialised in Medical Informatics. From 1997 to 2002 he worked as research associate at the Institute for Health Economics and Clinical Epidemiology at the University of Cologne where he received his MD with a dissertation on the costs and benefit of robotics and telemedicine. Since 2002 he works as research associate and quality representative at the Institute of Aerospace Medicine of the German Aerospace Center. He is board member of the German Society for Health Telematics (DGG e.V.)

eHealth: How to Close the Healthcare Gap in Developing Countries

A New Model for eHealth Capacity Development in Africa

M. Mars
Dept of TeleHealth, Nelson R Mandela School of Medicine,
University of KwaZulu-Natal, South Africa. mars@ukzn.ac.za

Abstract: **The need to develop human capacity in the field of ehealth in Africa has been identified by both the medical informatics and telemedicine communities. There is a shortage of people with the necessary skills to teach and train people in eHealth in Africa. This paper reports the background to the development of a new model for the ehealth capacity development, based on the concept of developing the capacity to develop capacity in Universities.**

Introduction

Sub-Saharan Africa (SSA) faces a disproportionate burden of disease, a shortage of healthcare professionals and limited funds for healthcare provision.[1] Information and communications technologies (ICTs) are seen as a potential means of addressing aspects of the problem: by facilitating and improving timely health data acquisition, interpretation, dissemination and storage; facilitating healthcare delivery through telemedicine; and enabling education over distance. While the potential benefits of ICT in health appear obvious, integration of ICT in healthcare has been slow. There are many reasons for this in SSA, including lack of infrastructure, high connectivity costs, illiteracy and computer illiteracy, restrictive telecommunication legislation, lack of eHealth policy and lack of human capacity in the field of eHealth. Internet penetration in SSA is ~4.5%.[2]

While there may be political will to introduce eHealth in Africa, there are few people trained in medical informatics or telemedicine in Africa and few with experience in implementing ehealth solutions in resource poor settings. This deficiency has been identified by various organisations and endeavours such as the American Medical Informatics Association's Global Partnership Program, the African Academic Public Health Informatics Alliance and the International Society for Telemedicine and eHealth's basic telemedicine training programme are attempts to address this. There is need to find new models of eHealth capacity development for the developing world and SAA in particular.

Objectives

This paper reviews an eleven year experience of working towards Medical Informatics capacity development in South Africa and sub-Saharan Africa funded by Fogarty International Center Training Grants and the NIH. Drawing from this experience, a new approach built on the concept of "developing the capacity to develop capacity" is outlined.

Review

Phase 1: 1999-2004

The University of Natal, and Tufts Medical School in Boston, received a Fogarty International Center Training Grant to develop medical informatics capacity in Africa. Five students and staff were sent to the USA for training at master's level and annual training workshops were held in South Africa. While the workshops raised awareness of medical informatics, there was insufficient capacity and experience amongst the attendees to develop any projects on return to their home countries. Two conference attendees were returned to Durban for a year to take degree courses in information technology, not available in their home country.

The return on investment of sending people to the US was limited as the environments to which they returned were not supportive. To further develop capacity, a part-time coursework Masters programme in Medial Informatics was developed for computer scientists and health professionals. Although part-time, students were required to spend 3 weeks in Durban at the start of each semester. Faculty from MIT, Harvard and Tufts came to South Africa to teach some of the MI specific modules.

What did we learn from this? The needs and expectations of the health professionals were different to those of the computer science graduates, which caused tensions. The model of a residential block at the beginning of each semester was problematic for health professionals, as they had difficulty being away from work. While all health professionals expressed satisfaction with their medical informatics education, their newly gained knowledge was not exploited by their employers.

Phase 2: *2005-2009*

A second Fogarty Training Grant was received to developing medical informaticians to support research in the Southern Africa. The curriculum was restructured, setting up a fulltime coursework Masters and Postgraduate Diploma programme for IT graduates and a part-time MPH with specialisation in Medical Informatics for health professionals. Recruiting students proved difficult because of the shortage of suitably qualified

graduates and the lack of career paths in medical informatics. Students from several African were brought to Durban for full-time tuition. While significantly cheaper than sending them to the US the model is not sustainable without external funding.

A partnership was formed with the School of Information Systems and Technology (IS&T) at the University. Their graduates complete either a Bachelors or an Honours degree in Commerce and IT. Nine of their graduates were enrolled in the fourth intake. In addition, two of the MI modules were incorporated into the IS&T Honours programme. Thirty students have taken these modules, raising awareness of the MI programme, with eleven students subsequently entering the masters programme.

Phase 3: *2009-2013*

A further Fogarty Training Grant was received to build capacity development. Ideally students should receive MI training in their home country, but this is not possible because of the shortage of academic capacity in MI in Africa. A new model based on initial sharing of teaching and curricula with other African Medical Schools has been developed. It involves educating both academic staff and students, thereby enabling partner institutions to "develop the capacity to develop capacity", with the end goal being the establishment of sustainable academic medical informatics departments at partner institutions The existing postgraduate programmes in MI at University of KwaZulu-Natal are being offered in a collaborative manner to partner institutions in Uganda, Mozambique, Zimbabwe and South Africa by ICT based distance education using desktop videoconferencing, supported by an electronic learning management system. Staff at partner institutions will be expected to act as local mentors and take specific modules themselves to build local teaching capacity.

The ICT distance learning model is based on 10 years' experience of teaching other courses by interactive distance learning in South Africa using ISDN and IP based videoconferencing (VC). Videoconferencing into Africa is expensive and other solutions ranging from an open source low bandwidth desktop VC programme DimDim to Skype have been used At times combinations of VC technologies been used concurrently.

Discussion

This new model will address only part of the far larger problem of capacity development in medical informatics in SSA. There are several other important aspects of capacity development that need to be addressed.

Medical informatics is not seen as a career path. There is need to involve local and national Ministries of Health in medical informatics training programmes so that training and research projects are relevant and add value to the Ministries of Health. At the same time advocacy is needed to develop posts and career paths in MI within ministries.

Medical informatics training is needed for all levels of health workers. This is based on the observation of the lack of a "culture of data acquisition" in many health systems around Africa. Health workers responsible for data gathering and capture do not necessarily understand why they have to capture data and why it must be captured accurately. Many also have limited understanding of data interpretation, down to the level of not being able to read a graph or interpret tables. Training needs to address data capture, data interpretation, system maintenance, system development, research, planning and management.

There is often limited capacity and experience within governments in developing countries to formulate appropriate MI policy and strategies within the constraints of small budgets. Specific short courses need to be developed to address this.

The problems of capacity development for medical informatics will require many different interventions. The development of a consortium of African Universities sharing curricula and teaching through distance education is one possible solution. A similar model is being explored for telemedicine capacity development in Africa.

Acknowledgement

This work was funded by Fogarty International Center Training Grants for Informatics Training for Global Health.

References

[1] World Health Organization. World health report 2006: working together for health. Geneva: WHO Press; 2006.

[2] International Telecommunications Union. Information society statistical profiles 2009. Africa. http://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-RPM.AF-2009-PDF-E.pdf

Maurice Mars is Professor and Head of the Department of TeleHealth at the Nelson R Mandela School of Medicine, University of KwaZulu-Natal, where he was previously Professor and Head of the Department of Physiology. His department initiates telemedicine and tele-education services and he has established postgraduate programmes in both Telemedicine and Medical Informatics. Mars serves on the joint WHO Global Observatory for eHealth and U21 Global eHealth Policy Committee, chairs the ISfTeH's Education Working Group and serves on the Editorial Board of the Telemedicine and eHealth Journal.

A Sustainable Approach for eHealth in Emerging Countries

S. Y. Y. D. Wickramasinghe[1], D. Wijethilake[1], V. Dinusha[1], S. Saatviga[1], S. M. K. D. Arunathilake[1], G. P. Seneviratne[1], P. K. M. Thilakarathna[1], P. Mahanamahewa[2], K. R. P. Chapman[3]
[1] University of Colombo School of Computing, yvonne.dilini@gmail.com
NO: 35, Reid Avenue, Colombo 007, Sri Lanka
[2] Faculty of Law, University of Colombo, Colombo 007, Sri Lanka
[3] District General Hospital, Chillaw, Sri Lanka

Abstract: **This ar ticle de monstrates how eHe alth solutions c an be sustainably implemente d in emerging countries bas ed on the pi lot project ViduSuwa (htt p://www.vidusuwa.com) deplo yed wit hin the Sri Lankan Hospital System.**

Introduction

A healthy life style paves way to a successful livelihood. Good health allows people to utilize and expedite their natural talents and develop new skills, leading to a well-off living. The vision of the Ministry of Healthcare & Nutrition in Sri Lanka states "A healthier nation that contributes to its economic, social, mental and spiritual development" [1]. Nevertheless governments in developing regions find it difficult to improve health services offered to their citizens due to various reasons such as financial difficulties of patients, geographical dispersion of health institutes and lack of qualified health professionals.

The development of Information Technology (IT) has started to bring the human living standards into a new sophisticated era. The paperless virtual capabilities of IT can be effectively utilized in Health Systems in emerging regions. Such initiatives can easily address the resource anomalies enabling a consistent service for patients irrespective of the geographical dispersion. Usage of mobile eHealth system to support telemedicine in rural and/or in emergency situations had been established successfully in India, Japan, and Russian Federation enabling last mile connectivity [8].

Facets of eHealth Sustainability

Sustainable deployment of eHealth solutions in emerging regions necessitate to consider numerous factors such stakeholder interests, technology provisions, economic conditions, legislations, etc [2].

Stakeholder Interests

People centricity plays a crucial role in ensuring the sustainability of any IT solution. Well tailored Health Information Systems intended for patients and health institutes provide greater incentives for health workers to actively contribute enabling a better service for patients [3], [5][6].

Therefore a background analysis should be performed to verify, whether a selected health institute is capable of applying an eHealth solution in terms of the Health Institute staff. A sound change management strategy should be utilized to eliminate/reduce political resistance of the stakeholders [4]. The following activities can be utilized to synergize the efforts of service providers and staff of health institutes:

- Interviews - The consent of the head of the health institute and staff members can be captured.
- Questionnaires - Structured questionnaires can be utilized to comprehensively analyze the user interest for an eHealth solution and the level of IT literacy.
- Training Sessions – IT training sessions can be conducted to provide/improve the IT literacy of the staff.
- Assessments – Based on the assessment-results, staff can be categorized to carry out tasks pertaining to eHealth job roles such as data entry, system administration, etc.
- Prototypes - eHealth solution should be demonstrated to the staff at regular intervals to create the feeling of ownership of the system among the staff members.

Technology Provisions

Sustainability of an eHealth solution greatly relies on its technological features. eHealth tools for data entry and retrieval, including voice recognition, digital images, video clips, are some of the technological features that could be incorporated to a Medical Information System [7]. The procurement/development and maintenance of Technological components should be assessed well in terms of:

- Hardware – Hardware should be chosen depending on the financial provisions for procurement and maintenance, quality of service (QoS), effective repair/maintenance, interoperability and extensibility.
- Software – It is advisable to use open source technologies for both system and application software as lack of financial support persists in

acquiring and maintaining Licensed Software in emerging regions. Architectures should be standardized, modularized and flexible.

- Infrastructure - Budgetary allocations for procurement and maintenance of server space, internet connectivity and electricity should be allocated.

Economic Conditions

Electronically enhanced healthcare promises to reduce costs, improve quality and efficiency and treat more patients with the same resources. An EU project "eHealth Impact" has demonstrated that eHealth can provide enormous financial benefits – if the technology is properly implemented [9]. However, the implementation and the running cost of eHealth solutions should be given great importance in order to sustain at an emerging country. The following guidelines can be followed for economic sustainability:

- Assessing the average cost disparity between a patient receiving the conventional healthcare services from a patient receiving eHealth services where the travel distance and the travel set to constant. The calculated value should be a positive value in order to instigate the eHealth solution
- Following standard procurement procedures to purchase the hardware equipment at the lowest price with less maintenance cost.
- Using open source technologies for system and application software.
- Using a low cost service provider for internet connectivity.
- Assessing the total implementation cost including procurement and development costs to check the financial feasibility of the implementing the eHealth solution.
- Calculating the average monthly cost estimation pertaining to hardware maintenance, connectivity charges, electricity bill payment and employee wages (optional).

The authorities of the health institutes should be able to manage the implementation and maintenance costs under their budgetary allocations. Otherwise a revenue generation model should be put in place to compensate the expenditure to sustain an eHealth solution such as charging a lesser fee; an average patient would incur in receiving conventional healthcare services.

Legislations

The Legal liabilities covered under eHealth and Medical Information initiatives through three clusters of issues: Privacy, confidentiality, and security issues; Product & service liability and consumer protection; and Trade and competition aspects of eHealth [10]. For example a patient may want to know his/her legal responsibility in being exposed to the current

medical condition and disclosing it to the rest of the world [11]. Therefore it is crucial to implement an eHealth Policy, Terms & Conditions and Disclaimer forms for both patients and the system users.

Conclusion

In a nutshell eHealth solutions will significantly empower health systems in improving the healthcare services offered to patients. Sustainability of eHealth solutions in emerging countries could be achieved by emphasizing on the appropriate stakeholder interests, economic conditions, technology provisions and legislations. In conclusion, a more healthy population enabled by eHealth solutions would catalyze the development processes of emerging countries.

Acknowledgment

A special thank to the World Bank for the financial assistance offered via Information and Communication Technology Agency (ICTA), Sri Lanka.

References

[1] Ministry of Healthcare & Nutrition Sri Lanka, Viewed on 10th October, http://www.health.gov.lk

[2] Europe's Information Society, Business Models for eHealth, Viewed on 23rd December 2008, ec.europa.eu/information_society/newsroom/cf/itemdetail.cfm?item_id=4108

[3] V.N. Stroetmann, J. P. Thierry, K. Stroetmann, A. Dobrev, eHealth for Safety Impact of ICT on Patient Safety and Risk Management, Viewed on 23rd December 2008, http://www.ehealth-for-safety.org

[4] D. Wijethilake et al. Change Management in Web-based eHealth Solutions, 2010, in press

[5] ICT Results, Getting eHealth to live up to its promise, Viewed on 23rd December 2008, cordis.europa.eu/ictresults/index.cfm/section/news/tpl/article/BrowsingType/Features/ID/88642

[6] eHealth Risk, eHealth Business Risk, Viewed on 23rd December 2008, http://ehealthrisk.blogspot.com/2007/08/ehealth-business-risk.html

[7] An Examination of How Broadband Services Enhance Health Care In America, eHealth and America's Broadband Networks, US Internet Industry Association, August 14, 2007, Viewed on 24th December 2008, http://www.usiia.org/pubs/eHealth.pdf

[8] Building eHealth Services in Developing Countries, Asia Pacific Telemedicine Initiative, 21st Pacific Science Congress, Okinawa Japan, 16 June 2007, Viewed on 24th of December 2008, http://www.pacificscience.org/pdf/APTdeclarationPSC21.pdf

[9] eHealth Impact, Study on Economic Impact of eHealth, Viewed on 23rd December 2008, http://www.ehealth-impact.org/index.htm

[10] eHealth Study of the Month, Legally eHealth, February, 2007, Making clear the legal and regulatory context of eHealth, viewed on 23rd December 2008

[11] A. Ognianov, eHealth ERA Towards the Establishment of a European e-Health Research Area, Viewed on 24th December 2008, www.ehealth-era.org/database/documents/ERA_Reports/Bulgaria_country_report_final_07-03-2007.pdf

Brazil Telehealth Program in the Amazon Region: Brazilian Strategy to Reach Isolated Populations

A.E. Haddad[1], M.C. Skelton-Macedo[2], C. Costa[3], P.E. Souza[4], C.L. Wen[5], F.E. Campos[6]

[1]Education in Health Management Department, Brazilian Ministry of Health, Brazil, aehaddad@gmail.com

[2]SLMandic; FOUSP Teledentistry Center; OPAS; São Paulo, Brazil marycskelton@gmail.com

[3]UEA; Amazonas Telehealth Center, Brazil, cleinaldocosta@uol.com.br

[4]UFAM; Amazonas Telehealth Center, pedroeliassouza@gmail.com

[5]FMUSP Telemedicine Discipline, Brazil, chaolung@terra.com.br

[6]Education and Labor in Health Management Department, Brazilian Ministry of Health, Brazil, deges@saude.org.br

Abstract: **The state of Amazonas is the largest state of Brazil, with main access by boat and air. Land access is done by few roads because of the difficult geography and constant rainfall (rainforest). Connectivity is one of the factors that hinder access to information science and the region, especially in the North area of the Amazon River. Health care in remote Amazonian isolated populations have been provided with support from the Telemedicine Brazil, which joined in 2007 the regional initiative of the Telemedicine, which opened in 2004 [1]. The program established the Amazon National Center for Telehealth and connection points in the countries that have had connectivity (44 municipalities with 48 units of connection in December 2009). The Center is responsible for maintaining experts to attend to requests for second opinion of connection points. The answers are developed and structured based on the best clinical and scientific evidence. This structure of response is called Formative second opinion, as it implies qualification of professionals and technicians of the Primary Health Care Strategy distributed by Family Health. In December 2009 the Center has reached the record of 712 applications for Second Opinion. According to the data of coverage by Family Health Strategy, only 6.25% of the municipalities are not covered, while 21.87% have full coverage of the strategy. Other 21.87% of municipalities have coverage equal to or greater than 75%. With the support of the Telehealth Program Brazil is expected to reach full coverage of the state in 2012, with professional and technical qualification through the Second Opinion Formative, reducing the distance, costs and unnecessary referrals, extending the assistance, its quality and solving in primary health care, participating actively in the condition of fixing the health care professional in remote and isolated areas.**

Introduction

Brazil occupies an area of 47% of the territory of South America with continental dimensions (8 514 876.599 km2) and a population of 191,480,630 inhabitants. It is the fifth most populous nation, despite having one of the lowest population densities (21.96 km 2), with a concentration of population in the coastal area. What makes this data is the internalization of large population and areas of vacant land primarily in the forest. The country has the fifth largest in the world, with the eighth world economy and the first in Latin American. It is in 39th place on the quality of life and where it meets every 15 to 20% of global biodiversity, with 3.6 million km^2 occupied by rainforest. It is structured by the division in 26 states and one Federal District.

The State of Amazonas, despite being the largest state of Brazil (1,558,987 km^2) has only 62 municipalities, with main access by boat and air. Land access is done by few roads in the light of the difficult geography and constant rainfall (rainforest). Removal of a patient has a high cost due to the need of air transport in many situations and the distances to be traveled (city of Parintins: $ 5,000.00. The city is about 369 km from the capital. For the city of Santo Antonio do Içá the cost is $ 10,000.00, as it is of 888 km from the capital in a straight line, and 1199 km by river). The Amazon has a population of 3,341,096 inhabitants and a density of 2.05 inhabitants/km^2, with the largest areas of vacant land in the region and country. Its boundaries include the South American countries Peru, Colombia and Venezuela.

About the health of populations, the Brazilian constitution determines this as the right of all citizens and the duty of the state, but regional characteristics determine many challenges to people receive quality care to health. The strategy of the Health System - SUS, created by the 1988 Constitution stipulated that the Brazilian population has access to public service. This system includes the centers and health centers, hospitals (including university laboratories, blood banks, services, Surveillance, Epidemiological Surveillance, Environmental Monitoring, foundations and research institutes).

The Primary Health Care (SUS) is supported by Family Health Strategy – ESF, by teams (1 doctor, 1 nurse, 1 dentist, 1 nurse and a dental assistant and 1 community worker). The teams made visits to a number of families. The concern for professional and technical qualifications of the clinical staff ESF moved the Ministry of Health to bring together the initiatives in telemedicine in the country, thus creating the Brazil Telehealth Program,

which has built a virtual library bringing together the applications of Second Opinion of the Family Health Teams [1].

Strategy

The health care of the remote Amazonian isolated populations have been provided with support from the Telemedicine Brazil in the Primary Health Strategy for the Family, who in 2007 joined the regional initiative of the Telemedicine, which opened in 2004. The program established the National Center for Telehealth at the University of Amazonas State - UEA, with support from the Federal University of Amazonas - UFAM, responsible for establishing connection points in the Basic Health Units – UBS, in municipalities that already have connectivity [2].

The Center is responsible for maintaining experts to attend to requests for second opinion of the connection points, whose requests are answered elaborately structured and based on the best clinical and scientific evidence. This structure of response is called Formative Second Opinion, as it implies qualification of professionals and technicians of the Primary Health Care Strategy distributed by Family Health teams. All answers given on this form is collected in a Virtual Library of Primary Health Care (VHL-APS) in which it can find direct evidence for research by the Family Health Teams, in addition to news, themes, and shared documents for the core operating. Areas of attention include the following themes: Dermatology, Otolaryngology, Orthopedics, Psychiatry, Surgery, Ophthalmology, Dentistry, Medicine and Cardiology.

Connectivity is one of the factors that hinder access to information science and to the region, especially in the north area of the Amazon River, because of the difficulty of wiring under the river water of large current. The Center of Amazonas signed an amendment to the tele-education project of the University of the State of Amazonas (UEA) for the purchase of 50 antennas and a satellite carrier for the Telehealth Program Brazil in effort to implemented the connectivity. Based on these acquisitions was possible to establish an implementation schedule of more 12 municipalities (34 municipalities were covered by the program until September 2009, in December 2009 the number reached 44 municipalities).In addition to actions on the ground, the Center for Telehealth Amazon relies on the cooperation of the Navy through the Vessel Assistance Hospital Oswaldo Cruz, with a team of 4 medical officers, 15 dentists and 2 squares nurses/pharmacists. The ship is equipped with VSAT antenna for direct contact with the core team on the ground and makes a schedule of 40 days

visiting coastal communities, making calls and sending cases and images for the Center to issue a Formative Second Opinion.

Results and Conclusions

On December 2009 the Telehealth Center of Amazonas recorded 712 applications for Formative Second Opinion, with an average of 1.14 requests per point of Telehealth. It registered 188 tele-education activities in the same period. This operation currently covers 157 ESF, attended by 48 points of connection in Basic Health Units in 44 municipalities. The structured responses are presented in the form of FAQs on the program portal, mounted so as to also allow free access to literature relevant to Primary Health Care (Virtual Health Library on Primary Health Care - www.telessaudebrasil.org.br).

The Brazil Telehealth Program in support of the Family Health Strategy depends on the population coverage by this program to fulfill its role. According to the data coverage of Family Health Strategy, only 6.25% of the municipalities are not covered, while 21.87% have full coverage of the strategy. Other 21.87% of municipalities have coverage equal to or greater than 75% (Dec 2009).

With the support of the Telehealth Program Brazil is expected to reach full coverage of the Strategy of Family Health in the state in 2012, with professional and technical through the Second Opinion Formative, reducing the distance, costs and unnecessary referrals, increasing the assistance, its quality and solving in primary care, participating actively in the condition of fixing the health care in remote and isolated areas [2]. To take forward this major will require commitment of state and municipal governments to improve the connectivity of populations, enabling the consolidation and sustainability of the program [3].

References

[1] Brazil Telehealth Program, at www.telessaudebrasil.org.br, accessed on Feb 2010.

[2] Telessaúde Brasil em apoio à Estratégia de Saúde da Família: análise do Estado do Amazonas, accessed on http://telessaude.bvs.br/tiki-download_file.php?fileId=1154, Feb 2010.

[3] H.S. Ruchlin; M.L. Finkel; E.G. McCarthy; K.L. White. "The efficacy of second-opinion consultation programs: A cost-benefit perspective In: K.L. White; J. Frenk; C. Ordoñez Carceller; J.M. Paganni; B. Starfield. Health services research: An anthology. Washington, D.C, Pan Américan Health Organization, 1992. pp.757-771, tab. (PAHO. Scientific Públication, 534).

Ana Estela Haddad
Professor of Pediatric Dentistry - FOUSP
Manager of Education in Health Management Department
Brazilian Ministry of Health
Esplanada dos Ministérios, Brasília - Brazil
aehaddad@gmail.com

Mary Caroline Skelton Macedo
Professor of Endodontics – SLMandic
Teledentistry Center of FOUSP
OPAS/Brazilian Ministry of Health Consultant in Telehealth
marycskelton@gmail.com

Cleinaldo Costa
Professor at UEA – Amazonas State University
Amazonas Telehealth Center Coordinator
cleinaldocosta@uol.com.br

Pedro Elias Souza
Professor at UFAM – Amazonas Federal University
Amazonas Telehealth Center Coordinator
pedroeliassouza@gmail.com

Chao Lung Wen
FMUSP Telemedicine Discipline
São Paulo Telehealth Center
chaolung@terra.com.br

Francisco Eduardo de Campos
Education and Labor in Health Management Secretariat
Brazilian Ministry of Health
deges@saude.org.br

Change Management in Web-based eHealth Solution

D. Wijethilake[1], Y. Wickramasinghe[2], D. Vatsalan[3], S. Sudahar[4], S. Arunathillake[5], G. Seneviratne[6], K. Chapman[7], K. Thilakaratne[8]
[1]University of Colombo School of Computing,
dulindrawijethilake@gmail.com
NO: 35, Reid Avenue, Colombo 07, Sri Lanka
[2]District General Hospital, Chillaw, Sri Lanka

Abstract: **This paper presents change management strategies utilized in the web-based eHealth solution: ViduSuwa (http://www.vidusuwa.com) which was implemented to provide specialized healthcare consultation services via internet.**

Introduction

The healthcare domain is a field, which constantly changes, due to technological innovations as well as business process revisions. Apart from that, skilled work force is considered one of the most expensive and valued resources in any healthcare institute. Effective adaptation to new techniques by healthcare workers increases the productivity of the healthcare institute that ultimately enables the provision of a good quality healthcare service to patients.

Change Management is the process, tools and techniques to manage the people aspect of change to achieve the most successful outcomes when a new technology or process is being introduced into an organization or a system. The objective of using change management for eHealth solutions is to assist people to adopt the desired change efficiently. The sooner the change is fully utilized in a healthcare institute a better service would be provided to the patients in no time [1].

Background

In coming up with an optimal change management strategy for ViduSuwa, a thorough study about the existing literature was carried. This enabled to identify the important theories, which should be considered for the deployment of a web-based eHealth solution. These theories include, the Seven eDistinctive Components [3], the 5C Model [4], and the McKinsey's 7S Model [5]. After conducting an empirical analysis by applying these

theories on ViduSuwa, we came up with a set of activities that should be carried out to effectively introduce a web-based eHealth solution that would in return offer the maximum benefit to the system stakeholders.

The Seven eDisctinctive Components

When considering the human factor in this context, it is important to consider the seven "eDistinctive" components, considered to be missing in most of the projects. The seven "eDistinctive' components are; Need Assessment, eHealth readiness assessment, Integration, Change Management, Policy, Rigorous pre-planned evaluation, Privacy impact assessment.

The 5C Model

According to Prof. Peter Drury's 'eHealth in Developing Countries: a framework', there are five vital components to be addressed when implementing an eHealth solution in the developing countries called 5Cs framework. The components include Context, Content, Connectivity, Capacity Building, and Community Development. It is very important to address every component in the framework in order to make this effort successful. Each component carries a significant role in the society and if one fails, the whole project will become a failure.

The McKinsey's 7S Model

The McKinsey's 7S Model consists of the seven components Strategy, Structure and Systems, Skills, Staff, Style and Shared Values which should be considered in managing change and transformation efforts within an organization. The importance of these components is:

- Strategy – In response to changes in the external environment
- Structure - Specialization and co-ordination in terms of strategy, organization size and diversity
- Systems - Formal and informal procedures that support the strategy and structure
- Style / Culture - Organizational Culture in terms of dominant values and beliefs, and norms and Management Style
- Staff – Human Resource Management
- Skills – Distinctive competencies
- Shared Values - Fundamental concepts on which a business is built

Pilot Project

This research is in accordance with the eHealth pilot project, ViduSuwa: A Mobile eHealth Solution for Patients living in Emerging Countries [2]. ViduSuwa was implemented in two Sri Lankan hospitals: Base Hospital,

Maarawila & District Hospital, Dankotuwa that stresses on enhancing the mobility of Health Care Services. Thus, ViduSuwa is designed to make specialized healthcare services available in rural areas in emerging countries by connecting a medical Consultant (whom would be geographically located in a place of his choice) with a patient in a rural area assisted by a doctor.

Change Management in ViduSuwa

The Change Management Process utilized in ViduSuwa consists of three phases:

- Change Management Readiness
- Application of Change Management
- Re-assessing Change Management efforts

Change Management Readiness

Prior to initiating any Change Management practices, it is essential to identify the organization and the changes that will take place in the organization. Hence, the business model [6] designed in the project is used to identify and analyze the organizational readiness with the 7S model being used to identify the factors of change in the organization.

This would check not only the technical readiness of an organization to adopt a new change, but also the other factors which define how successfully an organization could accept new changes and adapt to it. These factors would cover the organization's technical capabilities as well as the organizational provisions with respect to integration, policies, evaluation.

Application of Change Management

Change management strategy should be formed based on the outcome of Change Management Readiness. We used a participatory approach throughout the project where selected medical staff from both hospitals got involved in decision making from the initiation to the end of the project.

This group formed the change management team. The group consisted of medical & surgical consultant, two heads of the hospitals, doctors and nurses, who would act as change agents and Subject Matter Experts (SMEs) where they would provide others with necessary expertise.

Re-assessing Change Management Efforts

Final phase of the Change Management Strategy was to re-assess the change management efforts and to identify certain bottlenecks or drawbacks if any.

This was carried out by a series of surveys, which were collected at the beginning of the project as well as at the end of the project. Furthermore, a

set of interviews conducted with medical specialists, system users, and patients to get their feedback on how they feel about the new change of the traditional health system.

Feedback was collected and analyzed for the re-assessment of change management effort. Suggestions and modifications were documented and the required changes were applied on to the system.

Conclusion

The change management process adhered in ViduSuwa brought about promising results. The system users showed a significant attitude change towards the new system before and after the change management process was completed. System Users were enthusiastic in taking the ownership of the system and suggesting future changes. In fact, the System Users became the driving force behind ViduSuwa. Hence, the process can be used in web-based eHealth applications successfully. Moreover, ViduSuwa was accredited by both international and local award ceremonies [7], [8].

Acknowledgment

We would like to thank the World Bank and Information and Communication Technology Agency (ICTA), Sri Lanka for financial assistance and Sri Lanka Telecom for server space in deploying ViduSuwa.

References

[1] R. E. Scott, 'A Business Case Approach to eHealth Sustainability', Viewed on 25th December 2008, http://www.mrc.co.za/conference/satelemedicine/Scott1.pdf

[2] Saatviga et al., ViduSuwa: A Mobile Telemedicine Solution for patients in Emerging Countries, eAsia 2009, Colombo, Sri Lanka, 2009.

[3] Encouraging Innovation-Friendly Procurement in eHealth, eHealthNews.eu, Viewed 24th December 2008, http://www.ehealthnews.eu/content/view/1097/27/

[4] National eHealth Program, Viewed on 24th December 2008, http://www.ehealth.scot.nhs.uk/wp-content/documents/ehealth-procurement-strategy-template-v1-01.doc

[5] Value Based Management.net, 2009, McKinsey 7-S Model. [Online] (Updated 10 Dec 2009) Available at: http://www.valuebasedmanagement.net/methods_7S.html

[6] Wickramasinghe et al, BudhuDas: An eHealth Business Model for Emerging Countries, 2010 (in press).

[7] National Best eContent Award-Winners, Available :http://nca.nenasala.lk/index.php?option=com_content&view=article&id=54&Itemid=60

[8] Manthan Award South Asia, Available: http://www.manthanaward.org/section_full_story.asp?id=839

Development of Specialist Teleconsulting System for Primary Health Care in Armenia: A Pilot Telemedicine Project by the Armenian Association of Telemedicine (AATM)

G. V. Chaltikyan, A. E. Avoyan, D. L. Gasparyan, R. H. Hovhannissyan
Armenian Association of Telemedicine (AATM), info@armtelemed.org
5/19 Mashtots Ave., Yerevan 0015, Armenia

Abstract: **The project describes development of a pilot telemedicine system for primary community health care in rural areas in Armenia. The purpose is to establish and operate a telemedicine connection between a primary health care facility in remote rural location (*"Referral Site"*) and a health center in Yerevan (*"Consult Site"*), for provision of tele-consulting services by selected medical and surgical specialists in Yerevan. Armenia has relatively developed primary health care network; however, shortage of specialist physicians in rural areas, as well as financial constraints frequently hamper maintaining appropriate quality of care at community levels. As a result considerable number of patients from rural areas seek specialty health care in large urban centers, mostly in Yerevan, which is associated with significant direct and indirect costs, and frequently results in delays in diagnosis and initiation of treatment. The project by Armenian Association of Telemedicine (AATM) aims at delivering specialty distant consultations to patients and primary care workers in remote locations via usage of Information and Communication Technologies. The project will utilize existing primary care facility, telecommunication link and commercial PC-based medical stations equipped with necessary hardware and software. The pilot telemedicine system will consist of one referral station at a community primary health center, and one consult station at selected facility in Yerevan. The system will operate the following workflow: patient presents to the referral site; minimum necessary data are collected by primary care physicians with the aid of medical peripheral devices; data are transferred to the consult site via high-speed Internet connection, both in real-time and store-and-forward formats; specialist reviews the data, and consults the patient and primary care physician on diagnosis and management. During the pilot period and upon completion thereof, a series of systematic assessments will be conducted, evaluating project's feasibility and impact on primary health care. Based on experience with comparable projects in other countries, it is expected that the system will allow reducing by 60-70% patients' visits to remote specialists, allowing timely diagnosis, improving treatment outcomes,**

increasing patients' satisfaction and community primary health care workers' education, reducing health care costs, and contributing to overall development of target rural community. Major partners in this project are Ministry of Health of Republic of Armenia, USAID/Armenia – Primary Health Care Reform (PHCR) project, TMD Systems (US-based company producing telemedicine equipment and solutions), Union of Information Technology Enterprises (UITE), Armenian Medical Association (ArMA), and Symotec (local telemedicine producer). AATM has successfully completed the background and preparatory stage of the project, and is ready to begin necessary installations to launch the connection.

Background

Telemedicine (TM) has emerged as an important tool to improve medical assistance at the level of Primary Health Care (PHC). Tele-consultations allow patients presenting to the PHC facility, or being managed by PHC personnel (a family physician, a general practitioner, or a nurse practitioner) to obtain specialty medical advice and assistance which is otherwise inaccessible locally. It allows to save costs and efforts required for transferring patient to specialty care facility, and most importantly, to avoid unnecessary delays in diagnosis and treatment. No less important benefits of TM in primary health care are related to community primary health workers' practice. Direct tele-consultation between the community health worker and a relevant hospital specialist can reduce professional isolation and provide opportunities for continuing education to the community health practitioner.

Armenia has relatively extensive primary care infrastructure and potential. Recent efforts by the Government and Ministry of Health, backed by considerable support from external funding resources (such as USAID and World Bank programs), have resulted in improved functionality of the primary care system, and better overall performance. At the same time, community health care facilities are facing shortage of specialist physicians, while health care workers in rural communities are insufficiently exposed to contemporary means of continuing professional development. Availability of specialty tele-consulting would decrease need for patients to travel considerable distance to obtain a specialty consult, assist in delivering timely care to the poorest and most underserved subsets of local population, and provide cost-effective opportunity to deliver up-to-date professional knowledge to primary care personnel in remote rural areas.

All above described makes developments of TM applications in Armenia an especially important perspective, with significant potential to stimulate

local primary health care systems, to overcome current inequities in specialty health care and continuous medical education, and to tackle present disparities between metropolitan and rural communities.

Project Goal and Objectives

The goal of the project is to establish and operate a Telemedicine system (System) utilizing high-speed Internet connection (Connection), between one selected primary community health care facility in rural location in Armenia (Referral Site) and one dedicated tele-consultation center in Yerevan (Consult Site), capable of providing the following key features:

- Direct tele-consultations to patients presenting in the Referral Site, by specialists based at the Consult Site, in the following specialties: cardiology, pulmonology/respiratory medicine, endocrinology, rheumatology, gastroenterology, dermatology, neurology, general surgery, urology, gynecology, ENT, and pediatrics;
- Tele-consultations to primary care physicians at the Referral Site discussing relevant patients' information and providing contemporary Continuing Medical Education (CME) content in verbal, electronic or printed format, where appropriate, in the above listed specialties;
- Integration of presenting patients' medical data into basic Electronic Health Records (EHR) incorporated within the System, for storage, subsequent review and analysis, and assessment of the System's functionality and feasibility.

Project Design and Methodology

The basic operational phase of the Project should include the following:

Setup of the Referral Site: Primary health care facility in rural area; Referral Station; Referral Site personnel (nurses and physician).

Setup of the Consult Site: Dedicated facility in Yerevan; Consult Station; personnel (technical staff); available consultant specialists; scheduled tele-consultation hours.

Setup of the Connection between the Referral Site and the Consult Site: High-speed Internet connection provided by the selected Internet Service Provider(s).

Organization, Operation, Management and Workflow Control: Patients' presentation to the Referral Site; data collection by primary care physicians with the aid of medical peripheral devices; data entry into electronic health records; data transfer to the Consult Site in both real-time and store-and-forward formats; reviews of the data by specialist physician; specialty

consultation of the patient and primary care physician on diagnosis and management; synchronization between the two Sites' workflows.

Assessment and Dissemination of the Outcomes of the Project: Recording and assessment of the Project's outcomes; reporting to health care authorities, medical society, and lay public; necessary media coverage.

Expected Outcomes of the Project

Based on experience with comparable projects in other countries, it is expected that the system will allow reducing by 60-70% patients' visits to remote specialists, allowing timely diagnosis, improving treatment outcomes, increasing patients' satisfaction and community primary health care workers' education, reducing health care costs, and contributing to overall development of target rural community.

Project Implementation and Collaboration

Armenian Association of Telemedicine (AATM) – leading local non-governmental organization in the field, completed preparatory stages of the project, and proceeded to necessary installations to launch the Project. Our major prospective collaborators and supporters in this Project are: Ministry of Health, Primary Health Care Reform (PHCR) project by USAID, TMD Systems (major US-based company producing telemedicine equipment and solutions), Union of Information Technology Enterprises (UITE), Armenian Medical Association (ArMA), and Symotec (local telemedicine company).

Georgi V. Chaltikyan, President of AATM
Associate Professor of Surgery, Department of Surgery #2, Yerevan State Medical University , Republican Medical Center "Armenia".

Armen E. Avoyan, Vice-President of AATM
Associate Professor of Urology, Department of Urology YSMU, Clinic of Urology, Republican Medical Center "Armenia".

Davit L. Gasparyan, General Secretary / Treasurer
Associate Professor of Obstetrics/Gynecology, Head of Gynecology Department, Medical Center "Kanaker-Zeytun", Yerevan, Armenia

Ruben H. Hovhannisyan,
Associate Professor of Urology, Department of Urology YSMU, Head of the Adult Urology Service, Arabkir Joint Medical Center, Yerevan, Armenia

Public Health Awareness in a Closed Work Setting: Can SMS Text-messaging build on the Current Communication Media Strategy Progress?

Hajo van Beijma[1], Barbara Addy[2], Bas Hoefman[3]
[1]Text to Change, Reinaert de Vosstraat 13, 1055 CL Amsterdam, The Netherlands. hvanbeijma@texttochange.com
[2]Health Initiatives for the Private Sector (HIPS) Project, Kampala, Uganda. baddy@emg-hips.com
[3]Text to Change, Reinaert de Vosstraat 13, 1055 CL Amsterdam, The Netherlands, bhoefman@texttochange.com

Issues

Text to Change together with HIPS, Uganda conducted an mHealth project whose major aim is to work with the Uganda Business Community to increase access to health information and services for employees, their families and surrounding communities.

A need was realized to explore a strategy that utilizes mobile messages to disseminate health messages as a way of addressing most of the barriers to information access among the various groups. The program aimed to explore whether SMS text messaging can be used as an effective means to improve communication and disseminate information between workers and employers. Between June and September 2009, HIPS, Uganda partnered with Text to Change (TTC) a communication agency to develop and pilot the first work place based SMS mobile messaging program in Uganda. The program was piloted in three companies, 1. Kinyara Sugar, 2. Kakira Sugar Works and 3. Kasese Cobalt Company Limited (KCCL).

Programme Description

Mobile telephone numbers of those interested in the program were collected with the help of peer educators and built into the program. These individuals received messages at the start of the program. If one wanted to opt in or out of the program, he or she would simply type in “Kakira yes” or “Kakira stop” respectively then send to 8181.

Messages were accessed on a variety of networks such as MTN, ZAIN and UTL. The messages focused on Medical Male Circumcision, Family

Planning, HIV Counselling and Testing, HIV discordance and Being Faithful.

Text to Change developed the communication platform and translated the messages.

Lessons learned

- The findings of this project suggest potential use of SMS text-messaging at workplace
- Employees can respond to their messages while working so company time is saved.
- Information on service outlets like outreaches can be received promptly through the SMS strategy.
- SMS messages help to reinforce information already received from other communication approaches.

Next steps

- HIPS and Text to Change will expand the program to reach eight companies
- The framework will be revised so that respondents get automated answers
- There will be greater mobilization especially the women whose participation in the pilot phase was low.

Telemedicine Projects: An Essential Need for Developing Countries

Sujata Warrier
N. G. Acharya and D.K. Marathe College, Subhash Nagar, Chembur, Mumbai, India
Department of Sociology, University of Mumbai, India

Abstract: **This paper aims at reviewing the urgent need of cost effective programmes like telemedicine project in the developing countries. The telemedicine projects can be implemented as a part of public health programme. The telemedicine projects undertaken by Narayana Hrudayalaya and Rabindra Nath Tagore International institute of cardiac sciences (RTIICS) Kolkata, Amruta hospital Kochi, All India Institute of medical sciences New Delhi, Tata Cancer Research Institute Mumbai, can be the model of telemedicine projects being undertaken in India.**

Background of the Problem

Health is considered as a main responsibility of the state thus health of the people is usually taken care of by the govt. of that particular state of the nation.

In India although many public health care programmes were undertaken under the British rule, of course, we did achieve, but it was quite less and not as per the expectation. The beneficiaries were a few middle class and the upper class. A large proportion of people who lived in villages and remote areas could not get much through these health programmes. Family Planning Programme, Mother and Child Care Programme, Epidemics Control Programme and many other environment protection programmes were undertaken by the India's public health department. In spite of all these measures good health is a distant dream for many in developing countries like India. On one side we have displays of high Tech medical care and use of state of art medical Technologies in five star deluxe facilities. These facilities are available but they are utilized by the minority rich, upper class who stay in urban areas. On the other side we have poor who cannot afford good health care. Despite several growth oriented policies adopted by the govt., widening economic regional and gender disparities are posing challenges for the health infrastructure, medical manpower and other health reasons.

Meeting of the Health Challenges by using Telemedicine

IT Revolution, the introduction of ICT and the phenomena of globalization have changed the entire work setup of various organizations. The introduction of ICT (Information and Communication Technologies) in health has been a great boon for the patients of remote and inaccessible areas of the world.

Telemedicine in India

The escalating health care cost and the challenge of taking modern Medicare to all rural and remote areas is possible only with this type of an electronic revolution in health care. Asia heart foundation and Narayana Hrudayalaya has made use of information and communication revolution under the leadership of various state govt. to provide specialty healthcare services in various remote and rural locations in India and other developing countries. These two organizations have partnered with the supportive govt. of West Bengal and Tripura, a remote hilly state in the north eastern part of India and the govt. of Karnataka which is located on the western edge of the Deccan plateau.

About 14 hospitals from different areas of Karnataka have been linked up with telemedicine networking of Narayana Hrudayalaya. Similarly govt. hospitals of Siliguri and Bankura are connected with Rabindranath Tagore International institute of Cardiac sciences in Kolkata. The telemedicine offices of both the super specialty health centers are working 24x7. The telemedicine networking of both the hospitals come under the umbrella team of Asia heart foundation.

Dr. Devi Prasad Shetty popularly known as “The Electronic Doctor” and “King of Hearts” is the chairman of Narayana Hrudayalaya. As on today about 84 Hospitals from district and taluka levels across the country and many others from the rest of the world have been linked up with the services of Narayana Hrudayalaya and are availing the services totally free of cost. Video conferencing is arranged between the patients of remote areas and the experts of super specialty health centers. The general physicians from the govt. hospitals coordinate the discussions.

Findings of the study

The sample consisted of cardiac patients.

Socio-graphic Features of the Telemedicine Patients

About 75% of the patients under study were married and belonged to the middle and higher age group. About 62% belonged to the age group of 51 to 80.

Level of Satisfaction

Majority of the patients were satisfied with the telemedicine consultations. No one complained of any communication gap between the patients and the Doctors of super specialty health centre. From the sample under study 54% of them did not go for any kind of treatment to any other Doctor for their health problems. They felt a sense of closeness and said could express themselves freely with the Doctor. Majority of them felt that telemedicine should not be replaced by any other kind of treatment / consultation.

Affordability

Telemedicine services are found to be affordable. Majority of them said they could easily afford this type of consultation.

Telemedicine Satisfies the Emotional Requirement of the Patients

The patients felt very close to the Doctors even though they were very far. The patients from the remote areas could not believe that they were talking to the Doctor from city.

Telemedicine Helps in Culture and Knowledge Enrichment

Most of the Doctors who were interviewed said they gained knowledge. According to them telemedicine helped them to perform extra ordinary tasks. Doctors, Nurses or anybody else could enhance knowledge with the help of telemedicine.

Bridging the Digital Divide

According to all the Doctors, Technicians, Directors of Health under study, Telemedicine bridges the digital divide. The patients had never used internet in their life before using the telemedicine facility. Telemedicine made the people to come closer to the city dwellers.

Telemedicine Helps in Disaster Management

Many serious patients have been handled during the natural disasters with the help of telemedicine.

Community Development and Nation Development

According to all the Doctors under study, telemedicine is great communities reach activity. It can bring about community development and nation development.

Reaching the unreached

All the cardiac care units (CCU's) of the remote ends are located in the areas which are far away from the main city. In such places where there are no good hospitals, the patients get good diagnosis and reliable treatment.

Create Employment Opportunities

According to the Doctors and Technicians under study Telemedicine activities create more job opportunities in the health care setups.

Conclusion

Thus I would like to say that in many developing countries like India, it may not be that advisable to open many new hospitals in villages and remote areas but telemedicine connectivity will bring the city, village and remote areas close to each other. It will save unnecessary health expenditures. It will encourage public private partnerships. It will also bring the Academicians, Doctors, policy makers and the common people to work together for the noble cause of good health. Thus I emphasize on the urgent requirement of telemedicine projects in the developing countries.

Sujata Warrier is a Senior Lecturer from N. G. Acharya and D. K. Marathe College, Mumbai. I am taking the lectures of Foundation Course in this college since last 21 Years for the students of First Year B.A / B.Com / B. Sc and Second year B. Sc students. Presently I am doing my PhD Work on Social Implications and Functions of ICT (Information and Communication Technologies) in public health under the guidance of Dr. B. V. Bhosale, Reader, Dept. of Sociology, University of Mumbai, India. I am working on Karnataka Telemedicine Project for my PhD. I am handling the health centre of our college.

Telemedicine Solutions in Tanzania: Experiences on How to Overcome Barriers for Successful Implementation

Nicolaas P. Moens
Int. Institute for Communication and Development (IICD), www.iicd.org,
P.O. Box 1586, 2502 AN, The Hague, The Netherlands, nmoens@iicd.org

Abstract: **Telemedicine is of tremendous importance in a world with a scarcity of health workers and increasing demands on the health care system. Three major problems are barriers to its wider use: 1) the integration of telemedicine in current practices; 2) the development of an appropriate business case; and 3) scalability These barriers and the way to overcome are discussed based on the experience with the development of telemedicine in Tanzania, followed by an explanation of how a participatory approach contributes to eHealth strategy development.**

Introduction

Information and communication technology (ICT) is able to deeply influence a data intensive sector like health care. But the number of successful pilots in Sub-Saharan Africa is limited and scalability is a problem [1]. In this paper, experiences with developing telemedicine in Tanzania are shared.

Approach to eHealth

A definition of eHealth is "*Systems of human and technical component that accept, store, process, output and transmit digital data in support of health care both at the local site and at distance*".

Recognizing ICT applications as socio-technical constructs, makes clear that particularly in a development setting, the traditional information systems approach lacks explanatory value). Therefore, it is important to "construct" local ICT applications. This is conceptualized as generating ICT-based innovations in the local context.

IICD elaborated the Round Table (RT) process as a participatory and multi-stakeholder process to generate locally owned ICT applications that are relevant for development. The RT process lasts four to seven years. The ideal-type currently consists of three development cycles: (1) participatory multi stakeholder workshop to generate annotated ideas for prototypes of

ICT applications relevant to local needs, (2) capacity building, formulation and implementation of ICT applications including user feedback and (3) the integration of the ICT applications at organizational and sector level. The RT process is an operationalisation of Constructive Technology Assessment and proved effective [1].

The Telemedicine Project

Telemedicine was one of the themes identified during the RT workshop on ICT for health organised by the Tanzanian Ministry of Health and Social Welfare (MOHSW) and facilitated by IICD in February 2005. At that time the Evangelical Lutheran Church in Tanzania (ELCT) was interested in this field, but first concentrated on health management information systems. ELCT owns 23 hospitals, 5 paramedical institutions, over 160 dispensaries and health centres in mostly rural areas with few doctors.

In 2007, ELCT started a small (Euro 100,000) telemedicine project with the support of IICD and the financial assistance of CORDAID. Its main aim was to enable medical doctors to address special cases, for which they have little time and lack knowledge. The project started with an easy to use tool: iPath [7]. iPath is a platform for storage and forwarding content and uses limited bandwidth. Doctors from participating hospitals received training and were equipped with cameras in order to make use of the new tool.

Evaluation

The project was evaluated after 18 months. By that time 39 hospitals participated in the project (100 medical workers) and 333 consultations had been made.

The outcomes showed that most respondents consider telemedicine to be useful. Of the doctors 43 % used less than 10 minutes to make the history and questions, 43 % between 11 and 20 minutes. But a limited group (18%) used iPath daily. The majority used it weekly or monthly. Digital photos were widely used and considered to be helpful and even essential for radiology, cytology and dermatology. Almost all users (93%) were satisfied with the time for receiving answers. Most were also satisfied with the quality of the answers. Despite the good results, only half of the hospitals adopted some form of telemedicine in the regular practices.

Against expectations little use was made of available medical materials for reference both off-line and on-line available. What did happen though, was that llessons learnt where shared with other health organizations. To

support this learning the ELCT, IICD and CSSC established the National Telemedicine Platform.

Analysis and Way Forward

Telemedicine is an ICT based innovation in the Tanzanian context. For a proper analysis of its success the diffusion theory of innovations of Rogers [2] distinguishing five aspects influencing the speed of diffusion is interesting to use:

1. Perceived relative advantage to whatever it replaces;
2. Compatibility with existing values, behaviour, structure etc.;
3. Simplicity; can the innovation easily be understood;
4. Its usability for try-outs;
5. Visibility of the effects of the innovation.

The telemedicine project scores well on (4) and (5). Simplicity (3) is already more difficult if the technical environment poses problems for the organization of the working place and procedures. Skills also play a role. The perceived relative advantage (1) only works out in terms of professionalism like patient care and continuous learning. However, professionalism is a challenge. The perceived advantage is negative in terms of income and work pressure. Compatibility (2) is also less easy fulfilled. It requires openness to innovation and the ability to redefine status and position with regard to telemedicine.

Based on these experiences, three lines of action were developed:

- To make a further differentiation between (1) consultations between medical doctors, (2) consultation between a hospital and the clinics that relate to it and (3) provision of services like radiology.
- To analyze the existing barriers and obstacles.. Problem analysis was followed by a brainstorm about possible solutions. For example a) to stimulate the integration in work practices, to use group sessions for sense-making with technology, to deploy respected coaches that assist in developing the competences to make best use of telemedicine; b) to allow billing for telemedicine consultations, to negotiate with insurance companies, to lobby with government for inclusion of telemedicine in the financing mechanism and by searching for certification; c) to strengthen

competition by making patients / communities more aware about the potentials; and d) to include telemedicine in education.

- To integrate telemedicine in the eHealth strategy.

In conclusion, telemedicine is a radical innovation with high potential, especially in a resource scarce setting. Like most innovations, the price-performance is low in early stages and hence most practitioners disregard it. But as the socio-technical configuration evolves, cost lowers, critical support is gained among decision makers; it will become part of health care.

References

[1] N. P. Moens, L. Gast, J.E.W. Broerse and J.F.G. Bunders. "Initiating a Constructive Technology Assessment approach to ICT planning in Developing Countries: Evaluating the Roundtable workshop," Information Technology for Development, vol16 (1) forth coming. Online since September 2009.

[2] E.M. Rogers. The diffusion of innovations, 4thed. New York: Free Press, 1995.

Wellness – Disrupting the Healthcare Ecosystem

Luke Rajkumar
Larsen &Toubro Infotech Limited, luke.rajkumar@lntinfotech.com
Godrej Eternia A, 3 Mumbai-Pune Road, Shivajinagar –Pune-411005

***Abstract*: Thi s paper hi ghlights the roles of tr aditional and ne w Healthcare e ntities where emergence of wellness is disrupting the operations of st akeholders i n b usiness and IT enable ment areas. The emphasis lies on the eHe alth technology pl atforms to ad dress th e challenges of this wellness disruption.**

Introduction

Healthcare Ecosystems are in many cases unique to different geographies. The roles played by these entities while at philosophical are level similar, may be different across varying scales depending on federal controls and dominant market trends.

All the Healthcare entities ultimately provide services to individual human beings. One of the underlying reasons for causing distress in most Healthcare ecosystems is the perception of these entities of the consumer of Healthcare services. The striking note here is the similarities of such perceptions across the globe, a quick look at a consolidated view:

- Medical Care Providers – Patient
- Funding Mechanisms – Members, Citizens, Customers, Users, Insured, Payee, Enrollee
- Drug Manufacturers & Discoverers – Consumer, Subject, Patient
- Medical Device Manufacturers – Customers, Patients, Consumers

The moot point is that all these perceptions are internal looking. The paradigm shift that is happening is driven by the need of the consumer for these services aka the individual human being. None of us want to be treated for any ailment, pay money for any or such treatment either directly or through taxes, Consume drugs related to medical recuperation or use Medical devices for such treatment.

The stakeholders of the Healthcare Ecosystems are grappling with fitting Wellness within their gamut of operations. The first disruption that has emerged is that an entire new set of Actors have joined the Healthcare Ecosystems in different geographies. These include Fitness centres, Coaches, Alternative treatment, Spiritualism and far more.

This disruption is multiplied by enablement ancillaries that have a direct, quick and pervasive influence on the consumer. These enablers include Information Technology, Communication Channels and of course the Internet.

The humongous availability of Information and the continued drive to amass more is driven by the capabilities to connect and analyze from multiple perspectives. The first impact of this conundrum shift is just being seen, the turf war is heating up. We are beginning to see as to how the roles of the entities in the ecosystem are changing.

- Health Insurers are embracing Wellness as means of prevention whereby the frequency of visits to care providers are reduced, and the length of contact shortened. And as means to achieve this they are revisiting their Network relationship, hiring medical professionals and partnering with the New Actors

- Technology companies are moving beyond the roles of Enablers, they are publishing content, analyzing information, setting up collaboration platforms all with an intent making the consumer "smarter" thereby changing the elective and Wellness related decision making processes

The need to examine the Wellness Disruption is immediate; else the process of healing the fractured Healthcare ecosystem is going to be hampered by creation of new silos. The first step to prevent the creation of such silos is to focus on IT strategies that allow for remote care, TeleHealth/Telemedicine and communication to seamlessly to converge and allow for creation of interoperable systems.

Technology – An Enabler

Technology must be leveraged to provide scale, reduce errors and seamless interoperability to address the paradigm shift of focus from Sickness to Wellness.

Telemedicine and/or eHealth infrastructure facilitates the same. Home-based projects encounter barriers of cost and inadequate infrastructure. Health care advocates must work actively in the federal, state, and local public and private sector levels to address the shortcomings and develop cost effective partnerships with other community-based organizations to build network links to facilitate telemedicine-generated services to the home, where the majority of health care decisions are made.

The major push in designing, planning, assessing, configuring, treating, monitoring and promoting wellness programs is to improve Health Outcomes, Productivity, Lower the cost of health expenditure and

ultimately reduce health utilization. While promoting Health and Wellness initiatives/programs a Consumer Engagement Framework alongside Telemedicine or eHealth infrastructure with Patient Centered services is needed to bring Care to Individuals/Groups.

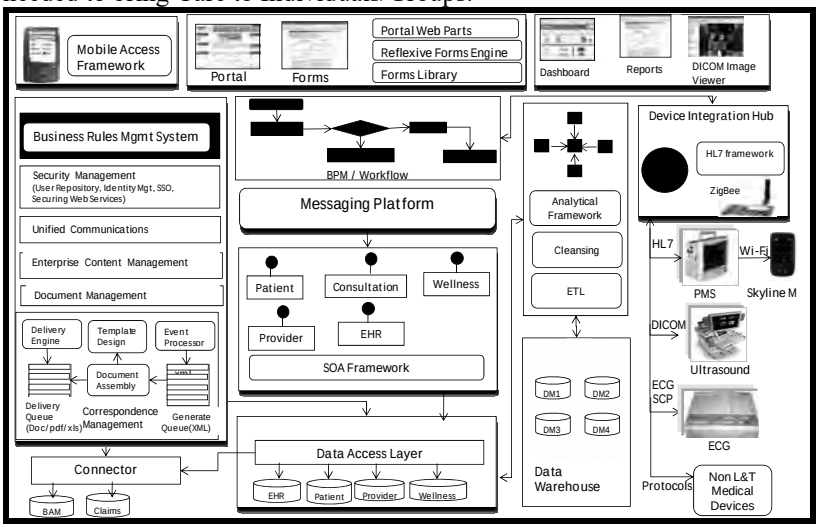


Fig.1. A Typical Architecture of eHealth & Wellness Applications

Fig. 1 depicts an eHealth and Wellness application Architecture Reference [1] which could be the backbone for addressing Consumer centric Wellness solutions. Such collaborative application frameworks are designed to provide scalable and versatile infrastructure to support communication between a Consumer (s), Care Provider (s), Funding agencies, mobile devices, medical devices and back-end servers and network information.

The framework helps to address some critical issues in the complex patient encounter system like flexibility, seamless metadata and data transmission, and interoperability among a number of disparate systems. Like any application, such a framework may face challenges in terms of plans for data capture, storage and transmission; and issues such as handling variable APIs and the utilization of clinical standards. And then the question arises whether any cost-effective framework utilizing user-friendly and interoperable mobile applications can be devised and adapted for the health and wellness domain?

A case example involves ECG measurement wherein data from the monitoring device is sent to an application residing on a central server and massaged into desired formats and standards for either live or offline

interpretation by a cardiologist, who reads the report in the context of the patient's medical record and returns his/her analysis to the application.

The details of the test, its transmission and its outcome are recorded with the necessary clinical standards and made available as part of the patient record which in return help the care provider to plan, design, configure, float specific wellness programs and monitor the patient closely.

The Applications can range from monitoring a person's heart rate while working on the treadmill in a fitness club to transmitting a patient's telemetry reading to a nurse via internet. There is a wide variation in terms of clinical conditions that can be monitored, how often they should be monitored and whether they should be monitored real time or periodically.

In this model, the patient requiring care maybe at a remote location, typically at home from where he/she can connect to a wide range of home care applications which send relevant data to the central server. This central server is in turn accessible to the referring physician who can remotely monitor and diagnose the patient. Data exchange is done using standard communication protocols like HL7 Reference [2].

The action expected from the physician as a result of such monitoring is to make a clinical decision on whether the patient requires immediate hospitalization, urgent doctor visit, continued monitoring. The judgement on which patients can be put into a continuous remote monitoring mode instead of hospitalization is also the prerogative of the physician. For such types of models to get operationalized changes to the format of interaction between patient and provider is necessary. Homecare applications are positioned to become a source of data from both the Electronic and Personal Health Record. These instances are enabling care to patients at their door steps. Such web enabled applications allow the Patients to access and updates their PHR irrespective of their geographic locations.

References

[1] L&T Medical manufacturing, Infotech and Embedded system Initiatives

[2] HL7 standards and its implication within the eHealth framework -http://www.hl7.org/

Luke Rajkumar has 20+ years of experience in IT and Healthcare spanning Payer, Provider and Medical Device sectors. His expertise covers various International markets including the US, European and Asian markets across multiple roles. His current focus areas include Innovation in Healthcare, Remote care & Telemedicine, Collaboration between different entities and the Impact of Wellness across the Healthcare ecosystem. As the Head of Healthcare Practice at L&T Infotech, he conceives architects and builds solutions for Healthcare industry from perspectives that address current and future needs. He also plays consulting and advisory roles that helps customers address challenges. He is also the 'Business Strategy Advisor' of L&T Insurance Company Limited's Health Insurance Business Unit.

eLearning

Challenges and Opportunities of Implementing eHealth Solutions in Developing Countries: Case Studies in East Africa Include Telepathology and Medical Education Programs

Z. M. Talib[1], A. R. Sohani[1], V. Vyas[2], B. Satya Vara Prasad[3], Z. Moloo[4], S. Sayed[4], S. Jivaji[5], N. Ramzan[1], Salimah Walani[1]
[1]Remote Access for Health Professionals, Washington, DC, USA; [2]Aga Khan Hospital, Dar es Salaam, Tanzania; [3]Aga Khan Hospital, Kisumu, Kenya; [4]Aga Khan University Hospital, Nairobi, Kenya; [5]Aga Khan Hospital, Mombasa, Kenya

Abstract: **Remote Access for Health Professionals (RAHP) is a collaboration between a group of health professionals in the United States and a network of hospitals in East Africa, which seeks to utilize ehealth solutions to improve health care services and provide educational support for health professionals. The projects of the RAHP have demonstrated the unique challenges and opportunities of utilizing telemedicine solutions in the context of developing countries. Our most successful initiative is a regional telepathology network established between 4 hospitals in East Africa, one of which is a tertiary care university hospital, another is a large city hospital and two smaller community hospitals, with limited access to specialty services. With the utilization of multiheaded microscopes, digital cameras and the iPath online platform, the telepathology program has greatly improved the diagnostic capacity and educational opportunities of the hospitals. The success of this program has demonstrated that a successful, effective and affordable telemedicine program in the developing world can be established with simple equipment, a user-friendly online platform, and committed partners. Simultaneously, the RAHP attempted a medical education program providing asynchronous modules for health professionals which were not successful for a number of reasons, including inadequate internet connectivity, lack of local monitoring, and limited relationship between the students and teachers. For hospitals in the developing world, telemedicine can help fill critical gaps in diagnostic abilities and provide much-needed educational opportunities for isolated health professionals. However, successful initiatives must take into consideration the unique challenges of working in resource-poor settings.**

Introduction

Given the global shortage in the health workforce, emphasis needs to be placed on enabling the existing workforce to perform better. Training for the health workforce can be provided continuously, intermittently or through distance education [1]. The latter is known to improve clinical skills, attitudes and confidence and is particularly useful in reaching isolated professionals in resource-poor settings [2]. Remote Access for Health Professionals (RAHP) seeks to utilize eHealth solutions to improve health care services and provide educational support for health professionals in the developing world. Comparison of the RAHP telepathology and medical education programs illustrates the unique challenges and opportunities of utilizing telemedicine solutions to provide remote support to health care workers in developing countries.

In particular, the practice of pathology in the developing world presents a number of challenges in terms of limited resources, shortage of trained personnel and limited continuing education programs [3]. As a pilot project in the area of pathology, RAHP established a telepathology program between a hospital in the United States (US) and one in Tanzania, a country of 38 million served by only 15 pathologists, with extremely limited access to ancillary diagnostic testing.

Opportunities for continuing education are limited for health care providers in developing countries. To address this need, the RAHP developed a distance education program to provide 3-week courses to health care professionals using asynchronous threaded discussions online.

The experiences of these 2 programs highlight critical factors that must be considered in designing effective eHealth solutions in developing countries.

Materials and Methods

For the telepathology pilot program, a multiheaded microscope and digital camera were donated to an 80-bed Tanzanian multispecialty hospital with an average of 800 pathology specimens per year. Two local pathologists were given onsite training on image acquisition. Static images were uploaded to the iPath telepathology server. Pathologists in the US reviewed images and posted responses on the website. After 1 year, the project was expanded to include 3 additional hospitals in Kenya (including a tertiary-care university hospital housing a pathology residency program and an oncology unit) affiliated with the same health care network.

The medical education program was designed using a customized online platform for asynchronous, threaded discussions. Physicians working in

academic medical centers in the US were recruited to conduct online courses for a minimum of 3 weeks. Course participants worked at an urban hospital in Tanzania and included resident physicians enrolled in a graduate medical education program and nurses. Residents were instructed by their program director to spend 1 hour each week logging onto the website, reading the assigned material and participating in the threaded discussion. Three courses were initiated, 2 for residents and 1 for nurses.

Results

During the initial 5 months of the telepathology pilot program, 15 cases were submitted for online consultation in several subspecialty areas. Static images enabled a complete or partial diagnosis in 12 cases (80%). Among the 8 partially diagnostic and 3 non-diagnostic cases, factors precluding a definite diagnosis included absence of confirmatory immunohistochemistry or flow cytometry, technical artifacts and non-technical issues. Responses posted to completely and partially diagnostic cases included a diagnosis, discussion of the differential diagnosis, and publications about the entity. Upon expansion of the program, the number of cases posted more than doubled, from an average of 3 to 7 per month. Local pathologists have commented on cases originating from other hospitals and occasional challenging cases in the areas of tropical medicine and infectious disease have been posted for purely illustrative purposes. In addition, the 5-headed teaching microscope installed at the tertiary care hospital is used daily for intra- and interdepartmental teaching conferences.

Among the 3 courses offered in the medical education program, 6 residents participated during the first week of the course on chronic cough. By the second week, only 3 residents remained and by the third week, no participants were left. The second course covered the basics of chest X-rays and initially had 8 residents participating, which dropped off to 3 residents in the second week. The third forum, targeted at nurses with several of the residents participating, had 9 participants during the first week. This waned to 2 nurses during the second week and none during the third week.

Discussion

The RAHP telepathology program has demonstrated that a successful telemedicine program in the developing world can be established with simple equipment, a user-friendly online platform, initial onsite training, committed local partnerships and ongoing technical support. We found that, despite the absence of a real-time interface with dynamic whole-slide

imaging [4], static digital images can adequately provide both diagnostic and educational support to pathologists practising overseas. Based on our pilot study, factors precluding a definite diagnosis are mainly technical and may be overcome by additional training or building local capacity for basic ancillary testing. Our telepathology program illustrates that providing academic medical centers in the developing world with teaching equipment, such as multiheaded microscopes, may foster greater collaboration among different specialists within the same hospital. In addition, giving affiliated health care institutions access to shared technology can lay the foundation for a regional diagnostic support network.

In contrast, the RAHP medical education program demonstrated the inherent challenges in providing educational support from a distance. Despite adequate computer access, well-developed courses, clinically relevant topics, motivated faculty and an initial burst of enthusiasm from participants, all 3 forums were abandoned when participation dropped off. Several reasons were cited in discussions with senior personnel at the host institution, including slow internet connectivity, lack of monitoring and enforcement by supervising physicians, and conflicting patient care responsibilities. Students were also only minimally accountable to their teachers, as the participants and faculty met for the first time online.

Seeking low-cost, effective means of providing educational support for isolated and inadequately trained health care personnel is essential as we seek to address the global shortage of human resources in health care. The RAHP telepathology program demonstrates the opportunity of providing meaningful diagnostic and educational support to vested partners with simple hardware and software. The RAHP medical education program highlights the importance of ensuring robust internet connectivity, a locally driven system of monitoring, and personal relationships between students and teachers, all of which may provide greater assurances of success.

Acknowledgments

Support for the RAHP programs was generously provided by the Aga Khan Foundation USA and the Massachusetts General Hospital, Boston.

References

[1] World Health Organization. “World Health Report 2006: Working together for health,” Geneva, WHO Press, 2006.

[2] R. Flores, J. Robles, B. R. Burkhalter. Distance Education with Tutoring Improves Diarrhea Case Management in Guatemala,” Int J Qual Health Care, pp. 47-56, 2002.

[3] H. Benediktsson, J. Whitelaw, I. Roy. "Pathology Services in Developing Countries: A Challenge," Arch Pathol Lab Med, vol. 131, pp. 1636-1639, 2007.

[4] D. C. Wilbur, K. Madi, R. B. Colvin, et al. "Whole slide imaging digital pathology as a platform for teleconsultation: a pilot study using paired subspecialist correlations," Arch Pathol Lab Med, vol. 133, pp. 1949-1953, 2009.

Zohray Talib, is Assistant Professor of Medicine at George Washington University (GWU) and Associate Program Director of the GWU Internal Medicine Residency Program in Washington, DC. She received her medical training at the University of Alberta in Canada and completed residency training at GWU.

Aliyah Sohani, is the Medical Director of the Core Hematology Laboratory and staff hematopathologist at the Massachusetts General Hospital (MGH) in Boston. She received her medical training at Harvard Medical School and completed her pathology residency and fellowships in surgical pathology and hematopathology at the MGH. Her research interests include identifying novel pathologic parameters in lymphoma diagnosis and prognosis.

Veena Vyas, is a Clinical Pathologist and Head of Department of Pathology at the Aga Khan Hospital in Dar es Salaam, Tanzania. She received her medical and graduate training at MGM Medical College in Indore, India.

Bursala Satya Vara Prasad is a Resident Pathologist at Aga Khan Hospital in Kisumu, Kenya. He received his medical training at Nizams Institute of Medical Sciences, Hyderabad, India. Has served as Consultant Pathologist at the Apollo Hospital and Assistant Professor at Andhra Medical College, both in Visakhapatnam, Andhra Pradesh, India. His clinical and research interests include fine needle aspiration and haematopathology.

Zahir Moloo is the Regional Clinical Director of the Pathology Department at the Aga Khan University Hospital, East Africa and a Consultant Histopathologist at the Department of Pathology at Aga Khan University Hospital in Nairobi, Kenya. He has previously served as Chief of Pathology at Toronto East General Hospital in Ontario, Canada.

Shahin Sayed is a Consultant Histopathologist and Program Coordinator at the Department of Pathology at the Aga Khan University Hospital in Nairobi, Kenya. She received her medical and pathology training at the University of Nairobi. Her clinical and research interests include renal, breast, gastrointestinal and hematolymphoid pathology.

Shamina Jivaji is a Consultant Histopathologist and Cytopathologist at the Aga Khan Hospital in Mombasa, Kenya. She received her medical and pathology training at the University of Nairobi. Her clinical and research interests include fine needle aspiration, breast cytopathology, and thyroid and gastrointestinal pathology.

Nizar Ramzan is a Diplomate of the American Board of Internal medicien and Gastroenterology and lives in Scottsdale, Arizona

Salimah R. Walani received her public health training at Harvard School of Public Health and is currently Assistant Professor at Felician College, Lodi, NJ. Her academic interests include, nursing workforce, international heallth and healthcare systems

e-Learning: Education in the Prevention in AIDS/STI in Andean Region and Caribbean

L. Murrugarra[1], F. Samalvides[1,2], L. Soto[2], P. Prieto[3], D. De la Cruz[2], E. Murrugarra[1], O. Becerra[4], Gotuzzo[1,2]
[1]Instituto de Medicina Tropical Alexander von Humboldt– UPCH, Peru
[2]Universidad Peruana Cayetano Heredia, Peru
[3]Fundacion CTIC, Spain
[4]Ministerio de Educacion, Peru

Introduction

The use of information and communications technologies (ICT) complements other Information Education and Communications (IEC) campaigns designed to reach youth. The same technology resources: e-mail, CD-ROMs, listserves and the World Wide Web that can link HIV/AIDS /STI, educators around the world, also holds great promise for reaching youth, who typically embrace the use of the technology for entertainment, learning and communication when given access to these resources.

Several recent reports have provided highlights on the use of ICT to combat HIV/AIDS/ STI.

Objectives

- To promote campaign and education on AIDS / STI
- To promote the use of the technology among young people, as interchange form, breaking with the existing prejudices around these methods
- To increase participation of youth and youth-led organizations in ITU's regional and global activities
- To increase the possibilities of the young people to like agents of the development in the communities.

Picture 1: Education in Indigenous People

Beneficiaries

- Schools in rural and urban areas who have access to the internet
- Networks of HIV-positive people
- Specific information on characteristics of the beneficiaries will be collected and compiled as part of the documentation.

Picture 2: ICT in the Universities

Picture 3: Sexual education

Challenges

ICT has the potential for 'leapfrogging' in developing countries to accelerate the development of the young as well as of adult generations, to empower them to access and to use information, which was for long a barrier, to learn faster and eventually to stimulate local entrepreneurship for the benefit of their local communities. Hopefully, early linkages between the impact of investing in the livelihood development of young people through empowerment and education can be demonstrated, thus lowering the HIV/AIDS / STI, infection rate among young people through economic empowerment of the youth. In order to decrease their risk of AIDS / STI, infection today, it is essential that youth receive education about HIV, obtain condoms and clean needles when needed, and have access to health and rehabilitative services.

Conclusion

- The effective use of the technology would have to contribute to reinforce diverse forms of youthful participation. Special measures will be due to adopt to connect to the young people in rural regions, considering that the fast advances in the matter of wireless technology have done possible to surpass to a reasonable cost the physical obstacles that represented the distance and the topography, and that during long time limited the development of the infrastructure of the telecommunications in the rural regions.
- It would have to be centered in increasing to the campaign in schools and universities. It is urgent to enable the professors and to grant technical and pedagogical endorsement to them.
- To harness the educational directors and, the development of materials, resources that promote the active participation in the educative space in the prevention of HIV/AIDS and that are generated within the framework of the education.
- It is essentially tried to conform human networks, with the support of the Tics that motivate and harness, in dynamic and systematic form, the

interaction between the people, who fortify the generation, dissemination and exchange of information and knowledge based on the professional objectives, institutional and social in each context in individual

- Is indispensable to generate the bases for the establishment of strategic alliances between the public institutions and participant organizations of the civil society with a view to the implementation of joint initiatives or to the collaboration in concrete actions in strategies for the prevention of HIV/AIDS in the region doing use of the ICT.

Picture 4: Work Group

- The adoption of measures would be due to encourage to facilitate the access to the Internet and to increase in general the knowledge of the ICT.

Acknowledgments

I would like to kindly acknowledge the many representatives from government, the private sector, and the academia who contributed their time, expertise and/or knowledge to help us. Special thanks are made to the following persons: Eduardo Gotuzzo, Paco Prieto, Oscar Becerra, Walter Fust, Rinalia Abdul and Alfonso Molina.

L. Murrugarra is a Nurse Technician, Bach. Systems Engineerings, has a Certificate in Social Proyects and has more than fifteen years of experience in Technologies of the Information and Communication (ICT). She is member of the Global Society of Knowledge (GKP), Member of Mondialogo, Member of HIFA2015. She's integrated the Multisectorial Commission at the moment for the Development of the Society of the Information in the Peru (CODESI). Author in differents articles national and international. Speaker National and International. Official Delegation of Peru: in the World-wide Summit of the Society of the Information made in Geneva 2003 and Tunez 2005. Her qualities include dedication, professionalism, ability to work as a team ability to independently and good interpersonal relations. Among her interests are research in ICT.

mLearning for Continuing Medical Education in Peru: A Mid-term Evaluation

M. Zolfo[1], V. Suarez[2], C. Kiyan[1], D. Iglesias[3], I. de Waard[1], J. Echevarria Z.[3], L. Lynen[1]
[1]Institute of Tropical Medicine, Nationalestraat 155, 2000 Antwerp, Belgium, mzolfo@itg.be
[2]National Institute of Health, Lima, Peru
[3]Institute of Tropical Medicine Alexander Von Humboldt, Av. Honorio Delgado 430, Lima 31, Peru

Abstract: **Health c are workers have indicated the need for an autonomous mobile solu tion t hat w ould ena ble acc ess to the l atest medical information for lifelong learning with low cost material and to exchange field cases with peers through social media.**
We hereby present a mid-term evaluation of an innovative approach to healthcare w orkers' tra ining with utiliza tion of mo bile techno logy a s personal learning environment in the field of HIV/AIDS care in Peru.

Introduction

Many developing countries are moving towards the use of distance learning programs, avoiding peripheral health stations being left unmanned, because of health care workers studying out of stations, for short or long training programs: mobile technology offers a unique possibility to reach these workers at the point of care and even out in the field [1-3].

In order to facilitate physicians involved in HIV/AIDS care in Peru to access the state-of-the-art in HIV treatment and care the Institute of Tropical Medicine Alexander von Humboldt in Lima (IMTAvH) and the Institute of Tropical Medicine (ITM) in Antwerp set up in 2008 an educational mobile platform allowing access to the latest medical information for continuing medical education (CME).

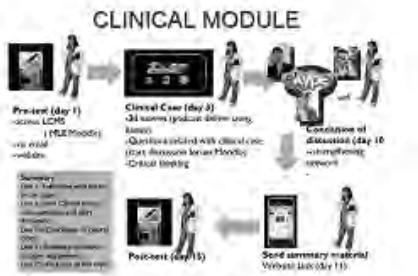


Figure 1. Flow of each CME module

In the conception of this training program we developed a set of learning scenarios (hereinafter called 'clinical module') simulating interactive clinical cases which are adapted to mobile devices and sent to physicians working in different HIV clinical stations in Peru (Figure 1).

Methods

Program description

Out of 24 Peruvian Department Capitals, 20 were involved in the previous years with an IMTAvH in a distance learning project, which started in 2004 having as aim the scaling up access to antiretroviral treatment in Peruvian peripheral regions.

All those facilities, where almost 70% of the total HIV-patients can get free treatment, were involved in this mLearning pilot project, which has taken place during the whole year 2009. The health centers in the Department Capitals are run by medical doctors and staffed by 5-10 health care workers as social workers, counselors, and data clerks.

Individual smartphones (ten Nokia N95 and ten iPhone) equipped with a portable solar charger were used by twenty physicians based in these 20 urban and peripheral Peruvian HIV clinics.

The didactic material consisted in 3D animation on a specific topic, critical reading, module discussion and revision, together with the suggested readings which were distributed along the timeline of the clinical module discussion. Learning outcomes of the acquired knowledge were tested through web-based multiple choice questions issued at beginning and end of each module.

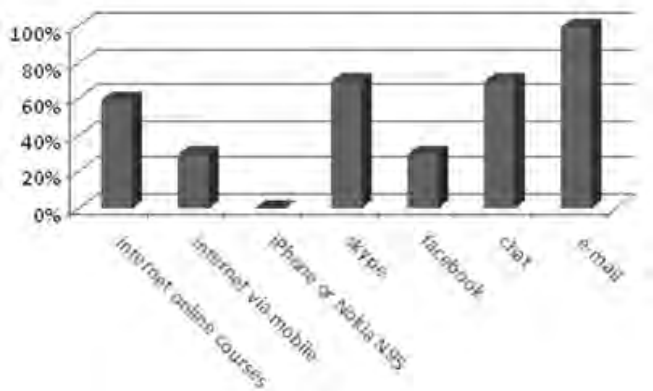


Figure 2 Participants' internet experience

A functional stable platform (MLE Moodle) was offered to support the learning events, tracking students' progresses over time. The platform also functioned as a forum for participants for peer-to-peer learning within a network of experts to assure content quality.

Evaluation

A mid-term evaluation was performed in December 2009 and consisted of users' satisfaction surveys, through a standardized anonymous questionnaire, focus group discussion and informal feedback with the help desk.

The users' satisfaction surveys sought to gain feedback on quality of the tutorials, usefulness of the information, applicability to the daily context of HIV treatment and care; the focus group discussion sought to identify general barriers to the program adherence; and informal feedback from the 2 responsible of the help desk gave information about the technical difficulties encountered in implementing the program.

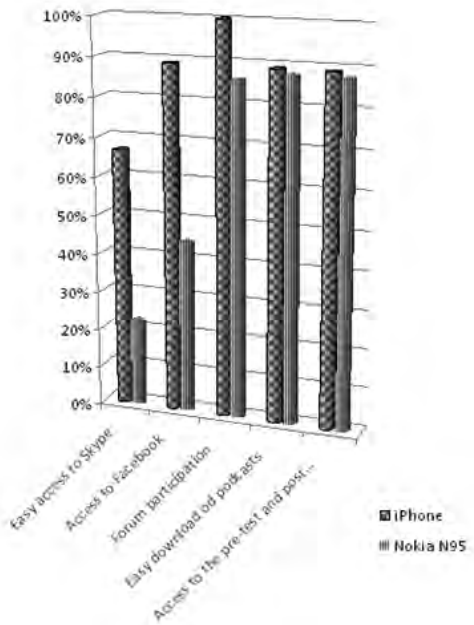


Figure 3. Use of applications according to mobile device

Out of 20 participants, 18 returned the questionnaire; the medium one of age of the participants is of 48,5 years (range, 34 - 55 years), with a median of 6 years experience in treating HIV patients. The previous knowledge of the participants in the use of the different applications is shown in Fugure 2.

Results

The educational strategy of mLearning has been considered overall positively by the participants. The advantages indicated by the participants are many, being the most important portability of the equipment and easy access to the educational content at own space and time. The topics covered by the program have been graded as pertinent to the daily clinical practice and very well thought.

The overall satisfaction of using iPhone or Nokia N95, expressed by the participants was generally greater for iPhone: access to Skype and Facebook has been more complicated for the Nokia N95 users (Figure 3). The main problems indicated by the Nokia N95 users were: screen size of the equipment, the keyboard and the quality of the images.

The most important difficulties emerged during the technical evaluation with the two help desks were the short time frame for the implementation of the project; the lack of participants' basic data at beginning of the project (existing "gmail" accounts, dilemma of multiple passwords, …); the lack of direct communication with the participants; the profile of some of those already busy with their daily schedule; the long time the phones have been kept stored before to be distributed (which could have been used for the participants to familiarize with the tools); the need of a stronger action plan and the difficulty in using some of the software/tool to generate the tutorials.

Conclusions

With mobile devices learning environment is enhanced and ability to share knowledge through online discussion is strengthened through social media or directly on phone line [4-6]. Educational modules available on mobile computing give flexibility to the health care workers who can carry content anywhere [7].

These preliminary results show that the delivery of up-to-date modules on comprehensive treatment and care of people living with HIV/AIDS can be contextualized and customized to different devices, and adapted to small screen size, with production of standardized knowledge, applicable to multiple operating systems.

Acknowledgment

This work is a result of the collaboration between ITMA and IMTAvH eLearning teams, particularly Mr Luis Fucay and Mr Ellar Llacsahuanga. This project is supported by REACH-Tibotec 2008 Educational Grant.

References

[1] Hadley GP, Mars M. Postgraduate medical education in paediatric surgery: videoconferencing--a possible solution for Africa? Pediatr Surg Int. 24:223-6, 2008

[2] Alexander L, Igumbor EU, Sanders D. Building capacity without disrupting health services: public health education for Africa through distance learning. Hum Resour Health.7:28, 2009

[3] Lester R, Karanja S. Mobile phones: exceptional tools for HIV/AIDS, health, and crisis management. Lancet Infect Dis, 8 :738-9, 2008

[4] MacKay B, Harding T. M-Support: keeping in touch on placement in primary health care settings. Nurs Prax N Z. 25:30-40, 2009

[5] Kaplan WA. Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries? Global Health, 2:9, 2006

[6] Ybarra ML, Bull SS. Current trends in Internet- and cell phone-based HIV prevention and intervention programs. Curr HIV/AIDS Rep,4:201-7, 2007

[7] Curioso WH, Kurth AE. Access, use and perceptions regarding Internet, cell phones and PDAs as a means for health promotion for people living with HIV in Peru. BMC Med Inform Decis Mak, 7:24, 2007

Maria Zolfo, M.D., specialist in Infectious Diseases (Catholic University, Rome). She trained in Tropical Diseases at Institute of Tropical Medicine, Antwerp, in 1998 and worked from 1999 until 2003 for an international organization (MMB) and Ministry of Health in Zimbabwe.

Since 2003, she has worked at the Institute of Tropical Medicine, Antwerp, in the HIV/AIDS unit, Overseas subunit, responsible for the Telemedicine project (http://telemedicine.itg.be), which provides remote-based advice on HIV/AIDS care to colleagues working in low resource settings.

She is particularly interested in the topic of AIDS care in resource-limited settings, PMTCT, PEP, HIV-drug resistance and second-line antiretroviral therapy, remote consultations, and distance learning.

New Technologies Applied to Education Maneuver Training Basic Cardiopulmonary Resuscitation for Medical Staff

F. S. Collet e Silva[1-2], R. Pires[1], L. Serpa[1], C. Oliveira[1]
[1]Instituto de ciência e pesquisa do Hospital Alemão Oswaldo Cruz, São Paulo Brazil. Education departament of Hospial Alemão Oswaldo Cruz Sao Paulo Brazil fscollet@haoc.com.br, Rua João Julião 331 SP - Brazil
[2] Emergency Surgical Department of Hospital das Clinicas of University of Sao Paulo – Medical School

Abstract: **Retraining and certificate d medical doctor in basic cardiopulmonary resuscitation was possible using a di stance ed ucation program.**

Introduction

One of the requirements of hospital accreditation programs is the establishment of training programs and maintenance of medical knowledge to the clinical staff. Medical procedures are taught and trained during the medical and residency courses, such as cardiopulmonary resuscitation maneuvers. Because many reasons, depending on the activity of these medical, these procedures are not incorporated into the daily life of several physicians.

Are all doctors able to carry out cardiopulm onary res uscitation maneuvers correctly and quickl y with today's standar d? The answer to this question is no. Despite the learning and training of these maneuvers during medical school and residency, only the doctors working in pre-hospital care, ICU and emergency room perform these procedures frequently. In other medical specialties, the management of these patients can be compromised, since these procedures performed only sporadically.

The medical staff of a private hospital consists of physicians and surgeons who perform elective procedures, these doctors have different time and experience of professional practice and, not least the difficulty to attend training.

Objective was to create a distance course and face-to-face train to remember and update the cardiopulmonary resuscitation maneuver to medical staff of a hospital with 4,500 doctors in different specialties, with different levels of experience and professional practice.

Method

Using the technique of E-learning platform Moodle® reviews the theoretical content of these maneuvers, together with demonstration videos of these procedures. Sure that the students finished the course: test at the end of the course, and enable these students to perform practical training. All students who took the course over the Internet were invited to do the practical skill.

Results

After 50 days of the implantation, 203 doctors performed these course with 100% satisfaction this methodology. After 100 days 282 physicians and after 200 days 409 doctors performed these courses.

Same questions included in the final test reveal: **80%** of the doctor **never assisted a cardiac arrest outside the hospital**. The **59%** of the doctor **know the automatic defibrillation but only 39% know how to use this equipment.**

This course needs advertising campaign to for an appropriate implementation. We note also that this model of course was cheaper than the conventional course.

Conclusions

This model of course has shown flexibility to produce and transmit knowledge. Association and integration of content through images, audio and text - assist in the practical activity. There is no change in the essence of education interactive process between those who teach and learn.

Acknowledgment

Humberto Mazzareto thank for training of the use of Moodle plataform.

References

[1] J. P. Collins, I. D. Civil, M. Sugre, et al "Surgical education training in Australia and New Zealand," World J Surg 32:2138-44, 2008.

[2] I. H. M. Bore-Rinnkes, D. J. Goum, J. F. Hamming, "Surgical training in the Netherlands," World J Surg 32:2172-77, 2008.

[3] M. M. Hammoud, M. L. Barclay, "Development of a web-based question database for student' self-assessment, "Acad Med 77: 925, 2002.

[4] G. Huang, R. Reynolds, C. Candler, "Virtual patients simulation at US and Canadian medical schools," Acad Med 82:446-5, 2007.

[5] F. S Collet e Silva, "Telemedicine and trauma management education" , University of São Paulo - medical school - surgery Department - Trauma service, thesis 90p, 2007 (Portuguese).

Participation of Undergraduate Nursing Students in Online Discussion Forums about Endocrine Physiology

E. M. L. Rangel, I. A. C. Mendes, A. Mazzo, L. M. M. Alves, S. Godoy, M. A. Trevizan
University of Sao Paulo at Ribeirao Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil,
elrangel@eerp.usp.br, iamendes@eerp.usp.br, amazzo@eerp.usp.br, lmarchi@eerp.usp.br, sig@eerp.usp.br, trevizan@eerp.usp.br

Introduction

Discussion forums are non-synchronic tools that permit interaction among participants in an online course without the need for simultaneous connection [1]. This tool is adequate for situations in which the teacher wants students to go deeper into a certain theme. Its advantages are: answers are posted at the most adequate time for the students, more time for study and research on the theme under discussion and availability of the information for the group [2]. The goals of this research were to: characterize the profile of undergraduate students in a Teaching Diploma Nursing program at a Brazilian public university who took an online course module on Endocrine Physiology in the virtual learning environment Teleduc, and verify their participation in the proposed discussion forums.

Methodology

Descriptive research: Sample of 44 students. To organize the discussion forums, seven questions were posted on the Teleduc discussion forum. Data were collected after the students had signed the Free and Informed Consent Term (FICT), filled out a questionnaire with data about sociodemographic characteristics, use of internet and microcomputers and registered for the Teleduc discussion forums.

Results and Discussion

The results evidenced that most students were female 41 (93.2%) and between 19 and 23 years old (75%), according to table 1.

Internet was the most used communication means to stay updated with 23 (59.0%) students and all students 44 (100%) had internet access. Twenty-

Sociodemographic Characteristics	Students	
	f	%
Sex		
Female	41	93,2
Male	3	6,8
Total	44	100,0
Age (years)		
<=19	13	29,5
20-20	12	27,3
21-23	8	18,2
24+	11	25,0
Total	44	100,0

Table 1 – Sociodemographic characteristics of students participating in the module. Ribeirão Preto, 2010

The mean participation in the discussion forums was 30 students. This result differs from findings by Silva [3] who conducted an online course on mood disorders for nursing undergraduates, found small participation in forums and attributed this result to the teacher's absence from the discussions. Because this is a non-synchronic activity, with lesser requirements for students to participate, it becomes easier for them to temporarily give up the online course and dedicate themselves to other activities. Setting dates helps to avoid dispersion, although this demands more time and dedication from the teacher. Other aspects besides the teacher's absence can collaborate for students to assume a negative posture towards discussion forums. According to Oliveira (2005) discussion forums demand: students' preparation by adequate searches in pertinent literature, organization of thoughts to discuss ideas and chance to value solid knowledge. Students' participation is also related with their motivation since, if they want, they can

three students (56.1%) used microcomputers and a majority (58.1%) had learned to operate computers alone.

According to table 2, thirty-one students (70.5%) participated in discussion forum number 1, 29 (65.9%) in 2, 3 and 6, 30 (68.2%) in 4, 33 (75.0%) in 5, 27 (61.4%) in 7 and 34 (77.3%) in 8.

Forum	Students	
	f	%
Forum 1	31	70,5
Total	31	100
Forum 2	29	65,9
Total	29	100
Forum 3	29	65,9
Total	29	100
Forum 4	30	68,2
Total	30	100
Fórum 5	33	75,0
Total	33	100
Forum 6	29	65,9
Total	29	100
Forum 7	27	61,4
Total	27	100
Forum 8	34	77,3
Total	34	100

*Considered only students who participated in discussion forums.

Table 2 – Distribution of the discussion forums 1, 2, 3, 4, 5, 6, 7 e 8. Ribeirão Preto, 2010

participate in different discussions at the same time.

Final considerations

The discussion forum showed to be an effective tool in the Endocrine Physiology course and made students participate actively in the teaching-learning process.

References

[1] C. Depover e cols. Um dospositivo de apresndizagem a distância baseado na partilha de conhecimentos. In: Alavas e cols. **Ciberespaço e fo rmações aber tas:** rumo a novas práticas educacionais? Porto Alegre: Artmed, 2002. p.153-170.

[2] G.P. Oliveira. O fórum em um ambiente digital de aprendizado colaborativo. 2005. Disponível em: < http://www.pucsp.br/tead/n2/pdf/artigo3.pdf >. Acesso em: 15/10/2008.

[3] E.C. Silva. Educação a distância: ambientes digitais para o processo ensino-aprendizagem em enfermagem psiquiátrica. 2007. 181f. Tese (Doutorado) - Escola de Enfermagem de Ribeirão Preto. Universidade de São Paulo, Ribeirão Preto, 2007.

Elaine Maria Leite Rangel is Professor at General and Specialized Nursing Department of University of São Paulo at Ribeirão Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil. President of the Brazilian Society for Nursing Communication - SOBRACEn, since June 2009. Member of Rho Upsilon Chapter, The Honor Society of Nursing Sigma Theta Tau International, since 2006.

Isabel Amélia Costa Mendes is Full Professor and former Dean (1994-1998 and 2002-2006) of the University of São Paulo at Ribeirão Preto College of Nursing, Brazil. Former Chair of the Pan-American Network of WHO Collaborating Centres for Nursing and Midwifery (2003-2005), Nursing Representative at the Brazilian Ministry of Science and Technology (1996-1998 and 2002-2004). Director of the WHO Collaborating Centre for Nursing Research Development since 2002. CNPq researcher 1A (National Council for Scientific and Technological Development, Brazilian Ministry of Science and Technology). Secretary-General of the Global Network of WHO Collaborating Centres for Nursing and Midwifery Development.

Alessandra Mazzo is Professor at General and Specialized Nursing Department of University of São Paulo at Ribeirão Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil. Specialist in Surgical Center, Materials Center and Anesthetic Recovery from Brazilian Society for Surgical Center Nurses (SOBECC) in 1998. Member of the Brazilian Society for Nursing Communication – SOBRACEn. Deputy Member of Research Ethics Committee at University of São Paulo Medical School Hospital das Clínicas.

Leila Maria Marchi Alves is Professor at General and Specialized Nursing Department of University of São Paulo at Ribeirão Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil. Member of Rho Upsilon Chapter, The Honor Society of Nursing Sigma Theta Tau International, Deputy Member of Research Ethics Committee at the University of São Paulo, Ribeirão Preto College of Nursing and member of the Ethics Committee for Animal Use at the University of São Paulo.

Simone de Godoy is Doctoral student, Interunit Doctoral Program, General and Specialized Nursing Department of University of São Paulo at Ribeirão Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil. Laboratory Specialist at Communication & Nursing Center of General and Specialized Nursing Department of University of São Paulo at Ribeirão Preto College of Nursing.

Maria Auxiliadora Trevizan is Full Professor at EERP/USP with an academic career totally focused on Administration Applied to Nursing. She is Leader of the Research Group on the Use of Human Resources in Nursing – GEPURHEn. CNPq researcher 1A. Member of the Rho Upsilon Chapter of the Honor Society of Nursing Sigma Theta Tau International. Member of the Brazilian Nursing Association; the International Center for Ethics and Legal Medicine in Haifa, Israel; the WHO Collaborating Centre for Nursing Research Development and the World Association for Medical Law.

Public Superior Education of Majority with Quality and Excellence

M. H. Petrich; N. Dinsmann, M. Guillaumet, G. Bill, L. Scopetta
Educative Computing Area and Tele-Medicine-College of Medical Sciences, National University of Rosario, República Argentina
petrich_m@yahoo.com

Abstract: **According to our University Rules, Article 1st, in keeping with CRES Car tagena 2008 and UNESCO , Paris-Jul y 2009, where they determined in its article third, the importance of access into a superior education as a hum an being ri ght a nd a go od s ocial p ublic and try to make a pr oper use of inform ation and communication technologi es with educ ative ai ms, pu tting a l ot of ef fort and i mprove th e seri ous inequality that exists among countries.**
The str ategies of this management, that were pl anned, supported strongly from Educative Computing Area and Tele-Medicine-College of Medical Sciences Na tional Univ ersity Ros ario, tr y to put the Information and Comm unication (TI Cs) as the principa l step in its work and a principal c oncept in or der to guarantee equa lity in the access and as efficient administr ation an d dem ocratization of the contents, educative subjects and government actions, this is not for one student or a teacher for learning, this is an opening and this is a tool in order to create a citizenship

Introduction

The strategic plan was made by three steps, it was created with three principal points in a project of technological support, making strong and promoting development in teaching, assistance and research. They are three points:

- The connector
- The equipment (hard and soft)
- The contents to spread.

The connector: we have it from 2007 in the historical building with three floors, CUAS I and II and Centenario Hospital. The access is by cable, WIFI or ISDN. Referring (hard and soft) equipment, this will be ready in 24 months, so the College installed:

- 120 terminals more,
- Center of Contact, 30 terminals of PC and reception of calls,
- Room for Video-Conferences, peripherals for physicians, for making second consults in the distance,

- Rooms for Computing subject, (2) 25 PCs,
- Auditorium Multimedia for 150 persons, PCs, equipment of audio, microphones of room and wireless, cannon of showing and videoconferences.
- The management gave 30 Notebooks and 8 cannons of showing for Coordinators of Area, Heads of Area and Principals of Department. This is the third and perhaps the most important of the steps. From the middle of 2008 this management is looking for own contents, but not canning.

The strategy is like this:

- Laboratory of Virtual Communications and Multi-medial Resources, that give digital instruments and tools for being used in the process of teaching-learning (Web, CDs, Videos, Films, Graphic, etc)
- Virtual Campus: where the different areas develop their materials of Studying, guides of learning.
- Laboratory of Tele-Health: the place where the digital applications are developed, generally in distance and live; A – B - C
  a) General Practitioner: Scene Room, simulations, clinical and inter-consults. Team of experts is developing guides of management and diagnosis of different specialities and prevailing pathologies.
  b) Surgery. Centenario Hospital. Surgeries live at auditoriums and inter- Action live with the expert surgeon.
  c) Pedagogy: Multi-Media, Video-Conference Room, Room of Computing, Dissection lives, simulators. All of them create the interaction in a PC and the process of teaching-learning, supported and supervised by TICs.

In March there will be ready the first welfare applications in distance, as support for medical decisions, by speciality and with different instruments for diagnosis help, Web, Center of Video-Conference

Contact, (IP e ISDN), WAPs applications, for inter-acting with mobile phone and in a near future try to catch signal to satellite in order not to have physical and geographical limitations, this is referring by GIS applications.

This support in the second medical opinion in distance, will be possible, not only technology but also the College has created expert Teams: the guide for management and diagnosis of different specialities and the prevailing pathologies, trying to reach the different treatments.

This is a summary that we can give. There is covered a long way in the subject.

We had good results and mistakes in this work. It is not easy but there is a feeling when we try to help people through these tools. The results can be seen, felt and shared, so it is wonderful.

Our proposal is to share the work, trying to improve by a Web of knowledge Generation in the region, without doubts there will be a new chapter in this subject.

The development of Superior Education represents nowadays a challenge for the societies and governments. It needs resources, time and the right decisions for the investment.

A very important challenge for a lot of Institutions of Superior Education, private entities and governments is the practice of the information system that compiles analyses and provides information about performances of quality standards.

Marcelo H. Petrich, is,

- Manager the Proyect "Telehealth network of the Americas" CCP.I/RES.152 (XIV-09); The Inter-American Committee of Telecommunications, from the Organization of American States
- General Secretary College of Medical Sciences - Universidad Nacional de Rosario
- Director Educative Computing Area and Tele-Medicine-College of Medical Science,
- Profesor TICs y Health
- Director Era Digital Foundation

Natacha Dinsmann, is;

- Director of Visual Communication and Multimedial Resourses Laboratory, College of Medical Science – Universidad Nacional de Rosario
- Profesor TICs y Health
- Artistic Director Era Digital Foundation

Miguel Guillaumet, is,

- Director Area Teacher Training College of Medical Sciences,
- Profesor TICs y Health,
- Profesor Research Methodology, College of Medical Science – Universidad Nacional de Rosario

Simulated Case Based in Decision: An Useful Method to Teach and Evaluation People in Health Care

F. S. Collet e Silva[1], N. D. Mori[1], R. S. Poggetti[1], S. Rasslan[1], C. L. Wen[2]
[1]Emergency Surgical Department of Hospital das Clinicas of University of Sao Paulo – Medical School, Rua Carlos Steinen 32 ap 31 SãoPaulo, Brazil
fscollet@terra.com.br
[2]Department of Telemedicina of the University of Sao Paulo – Medical School, Brazil

Abstract: **These paper pre sents an initia l experience in prepar ation of simulated clinical case for use in te ach and evalu ation studen t in take correctly clinical decision and procedures.**

Introduction

Clinical cases is a great teaching tool, it puts student in front of a real clinical problem and made possibility of join and use all knowledge to make diagnosis developing clinical decision. Studies case can be made through various resources; most common presentation is descriptive.

Allow to the audience had more visibility of the case, decreases misinterpretation, facilitating presentation was possible by the use of still and /or moving image of patient, diagnostic methods and treatment. To created realistic scenarios, we need: 1- the correct way of the diagnosis and the treatment; 2 - the pictures of the wrong diagnosis or exam or procedures as the consequences of these mistakes. For the firsts item, it's possible to use real case, but material for others possibilities to avoid damage to patient and ethical problems, the devolvement these is factitive by use a 3D animation case move.

Using these methods association, real cases and 3D animation were possible the idealization of new teaching tool: a case study based on decisions that is so realistic allows you to choose procedure to perform, view the running and consequences of your decision, correct or wrong. It also allows choosing treatment for complications or going back and restarting evaluation.

This method has the great advantage of allowing the student to clinical decision and treatment before having to make these decisions in a real patient.

Methods

Interactive module for training techniques of airways definitive control was developed. Several clinical situations were studied to teach and check if the student or the health care people do or resolve the clinical difficulties. We develop in 3D-animation the possibilities of the procedures and the corrections. So if the student goes to the wrong way, he had the possibility of diagnosis the mistake and sees the correction.

The interactivity of this was made by multimedia program Flash®. The initial program that we develop was definitive control of airways. Start by real case student chooses material for definitive control of airways, watch through 3D-animation what happened if he did correct or not maneuvers. He observes anatomical changes of these maneuvers and then checks the correct diagnosis and observes maneuvers to fix. This module allows student to perform procedure through Internet.

Results

The case: Figures beneath illustrated the clinical case. The student choose what he needs to put laryngoscope, and allow see the consequences of his

choose (in this case: esophageal intubation) and the treatment (take out the endotracheal tube and the maneuver to fix it.

All students who underwent this module approved it.

Conclusion

Furthermore it has proved interesting for evaluation of learning. Conclusion simulation case based in decision may be important tool to prepare student and workers in health care, and knowledge evaluation.

References

[1] J. P. Collins, I. D. Civil, M. Sugre, et al "Surgical education training in Australia and New Zealand," World J Surg 32:2138-44, 2008.

[2] I. H. M. Bore-Rinnkes, D. J. Goum, J.F. Hamming, "Surgical training in the Netherlands," World J Surg 32:2172-77, 2008.

[3] M. M. Hammoud, M. L. Barclay, "Development of a web-based question database for student' self-assessment,"Acad Med 77: 925, 2002.

[4] G. Huang, R. Reynolds, C. Candler, "Virtual patients simulation at US and Canadian medical schools," Acad Med 82:446-5, 2007.

[5] F. S Collet e Silva, "Telemedicine and trauma management education" , University of São Paulo, Medical School, Surgery Department - Trauma Service, Thesis 90p, 2007 (in Portuguese).

Tele-Health in Americas: Project for Making up a Tele-Health Network in the Region

M. H. Petrich[1,2], N. Dinsmann[2,3], M. Guillaumet[4], G. Bill[5], L. Scopetta[5]
[1]Educative Computing Area and Tele-Medicine-College of Medical Sciences, National University of Rosario, República Argentina
[2]Era Digital Foundation, República Argentina, petrich_m@yahoo.com
[3]Visual Communication and Multimedial Resourses Laboratory, National University of Rosario, República Argentina
[4]Teacher Training College of Medical Sciences, National University of Rosario, República Argentina
[5]Educative Computing Area and Tele-Medicine, National University of Rosario, República Argentina

Abstract: **The projec t of the "Tele-he alth Ne twork i n America" i s a proposal o f integration, the col laborative w ork i n gro ups among Government Institutions, Co llege o f Medical Scienc es, H ospital and ONGs, where each of them gives its e xperiences fr om the c areer, in order t o set up a gr oup of strong work. The experiences will support the needs. The place and situation will not be important.**

Introduction

The necessity is to do emphasis in contents, manual procedure, standards and inter-operational capacity of actions, not because the equipment and options of connector, understanding that the most important of the Network is the node, the academic duty with results referring aims. Not because the budget that is invested in equipment.

In the same way we consider that involving local actors, International Organisms, Government Institutions, College of Medical Sciences, Hospitals and Civil Society, they reassure to think in working and making deeper this kind of projects, where the real actions can be appreciated in a medium and long time.

We observed in the region and countries very important projects that depend from only one institution, but because the politics and economic instability they fail.

The Inter-American Committee of Telecommunications, from the Organization of American States, CITEL-OEA [1], its XIV meeting, in the next past of May in Cusco-Peru determined to support the Creation of the Network of Tele-Health from America. The project was presented by members of Argentina.

Project Aims

The general aim of the project "Tele-Health in Americas" is to build up a Network of Tele-Health in the region [2], where successful experiences are integrated, local initiatives with regional project are harnessed, is allowed to take advantage of appliances and principally to capitalize the contents and professional diagnostic valuations, services of health or hospital of the region which they are arranged to add itself to he Network.

Optimizing the existing equipment, spreading the best practices, learning of the errors, that allow to develop, to implant and to operate an integrated system of Tele-Health, sustained in the Technologies of the information with the purpose to improve and to extend the services provision of the health through National, Regional and International Telematics Networks.

This doubtless will allow that different unprotected populations can get benefits, as much geographic as economically, also strengthening the processes of continuous education, by means of clinical association, diagnostic collaboration between professionals of the health and strategies of remote education that use the TICS among pairs.

Specific Objectives

Identify the best local practices of each one of the countries of the region.

Develop Guides of handling and prevailing diagnosis of the different specialities and its pathologies, trying to establish pre-determined clinical parameters for the boarding of the different treatments.

Develop a technological platform of Second Consultations, Digital Clinical History, HDC and collaborative work between professionals of the health.

Involve and integrate Permanent Professors, Chiefs of Hospital Services and Experts in the different medical specialities trying to make up an own staff of Experts of the Network where can be given answer and containment to the second diagnostic consultations.

Create a Portal that spreads the advances in the subject and where contains the different areas.

Foment and promote the design of sanitary prevention about special programs with Dengue, Chagas, etc.

The important thing of the development of this Regional Network, is that it sets out to work on projects in the area of telemedicine in Latin America, that have a real incidence in their means and adhere to the plans of work, trying the inclusion, cooperative, not to superpose strategies and thus to harness the successes thinking about the medium and long term.

The secret is that these programs are viable, that last in the time which they exceed in the same administrations, since it would be desirable that last beyond the different institutional political changes that happen in our countries.

In this sense, we think that the model of mixed administration is very good resource. Thus also analyse strategies and policies tending the access to the Network of knowledge, different platforms and solutions and thus works for reducing the social breach that without doubt will diminish the digital breach.

References

[1] CCP.I/RES.152 (XIV-09); The Inter-American Committee of Telecommunications, from the Organization of American States, CITEL-OEA, CCP I its XIV meeting, in Cusco-Perú.

[2] Books "Telehealth in the Americas", Edited by CITEL-OEA, ITU-UN, OPS and ACHIET.

Marcelo H. Petrich, is,

- Manager the Proyect "Telehealth network of the Americas" CCP.I/RES.152 (XIV-09); The Inter-American Committee of Telecommunications, from the Organization of American States
- General Secretary College of Medical Sciences - Universidad Nacional de Rosario
- Director Educative Computing Area and Tele-Medicine-College of Medical Science,
- Profesor TICs y Health
- Director Era Digital Foundation

Natacha Dinsmann, is;

- Director of Visual Communication and Multimedial Resourses Laboratory, College of Medical Science – Universidad Nacional de Rosario
- Profesor TICs y Health
- Artistic Director Era Digital Foundation

Miguel Guillaumet, is,

- Director Area Teacher Training College of Medical Sciences,
- Profesor TICs y Health,
- Profesor Research Methodology, College of Medical Science , Universidad Nacional de Rosario

Electronic Health Records

Analysis of Current Technologies and Devices for Mobile Data Capture: A Qualitative Usability Study for Comparison of Data Capture via Keyboard, Tablet PC, Personal Digital Assistant, and Digital Pen and Paper

Ronald Boldt
University of Applied Sciences, Berlin

***Abstract*: Ronald Boldt will present the findings of a study conducted in 2008 at the University of Applied Sciences in Hamburg, comparing the usability of electronic data capture (EDC) methods. The study revealed that Digital Pen and Paper (DP&P) technology is more user-friendly, quicker and more accurate compared with using a keyboard, tablet PC or Personal Digital Assistant (PDA) to capture data.**

The aim of the study, conducted with test candidates from the technology and healthcare areas, was to investigate mobile data entry using different appliances – looking at speed, error rates in captured data and ergonomic support of the input processes.

During the tests, candidates had to solve several identical tasks using different devices. The entry of patient data was chosen to exemplify the findings. Data capture using the digital pen was by far the fastest, with a minimum time of 98 seconds – more than twice as fast as a PDA.

DP&P was particularly popular among the test candidates. While a variety of devices were preferred before the test, by the end the majority of candidates felt the digital pen was the most suitable data input device.

It can be assumed that the study confirms a trend. Every day, doctors, policemen, field staff, managers, technicians and others across a wide range of professions, prepare documents that for an extensive decision-making basis for a large number of people, so it is of primary importance that the data entry is as efficient and accurate as possible.

DP&P technology exploits one of the most fundamental cultural assets inherent to people - namely our own handwriting.

Comparison of Mobile Data Capture Methods Study

The project – "Comparison of mobile data capture methods" at the Usability Lab of the University of Applied Sciences Hamburg – covered mobile data capture via tablet PC, Personal Digital Assistant (PDA), keyboard and Digital Pen and Paper, examining speed of the process, error

rates for captured data and ergonomic support of the devices in the capturing process.

The study, which was carried out with test persons with either a technology or healthcare background, showed the advantage of familiar technologies and methods. Capturing methods like handwriting or typing on a keyboard, which are based on established cultural techniques, have significant advantages in acceptance and usability.

The test scenario simulated the workflow in a hospital, where a person uses a data-capturing device to admit patients. This person needs to capture a lot of data from incoming patients. The test subjects had to capture the data as quickly as possible with as few errors as possible.

The study delivered qualitative findings about the usability of capture methods and technologies. The closed environment and the availability of all test data with simultaneous picture and audio recordings represented and secured the results in a form not possible in other studies.

The findings led to the assumption that there is actually a connection between the cause of errors, the capturing time and the usability of devices. The findings should be corroborated with a quantitative study and a focus on the error rate of the respective method and device.

Objective of the Study

The objective of the study was to examine the most important technologies currently available for mobile data capture, relating to capturing speed, quality and ergonomics. The goal was to come up with findings regarding the correlation between intuitive usability and process performance. With this research, it was intended to determine the usability of technologies and devices for mobile data capture processes.

Approach of the Study

For the study, a test environment was installed at the Usability Lab of the Hochschule für Angewandte Wissenschaften Hamburg. The lab equipment for analyzing usability was used accordingly. In this study, a small group of test persons were going through the test environment to get qualitative results.

The Test

On each of the devices, the data for one patient had to be captured by the test person. The order was: first the PDA, second the tablet PC, followed by the keyboard/PC and finally, the Digital Pen and Paper. For each of the

devices, an individual text was dictated and an individual patient form shown. Each test person received the same patient data on each device.

The test person was put under time pressure – especially during the dictation, i.e. the dictation continued even when the person was still typing or writing. For the test person it was important to capture the data as fast as possible with minimal errors.

If the test person was unable to memorise the information fast enough, he/she could always interrupt and ask for the information he/she had missed. They could also ask for help with the use of the devices, but this added to the time the person needed to capture the information, which created disadvantages for delivering fast and accurate data capture.

Study results

The study and analysis of the results confirmed the reason for doing the study in a Usability Lab. The closed environment and the recording of all of the tests using video and audio sources in parallel, secured the results of the tests, which were not found in other studies. The study provided usable results, which led to qualitative statements.

The goal – to make a statement about the speed and quality of data capture using technically supported capturing methods on the basis of study results – was achieved. The following results can be derived.

The use of Digital Pen and Paper for handwritten data capture leads to the fastest and most accurate results in the scenario analyzed. Familiarity with the use of the device was quick and only disrupted the dialogue slightly. Users' familiarity of writing with pen and paper led to an easy transfer of knowledge when using Digital Pen and Paper.

Data capture via a keyboard came second, with good results in speed and quality. The competence using this method was the same across all test subjects. Among most professions and levels of education, it can be assumed that this technique is widely known.

Using a PDA or tablet PC led to poor results. The strength of these devices lies in their processing power and connectivity. It can be assumed that a PDA or tablet PC is most appropriate for mobile data capture scenarios where communication with other systems is key.

The ergonomics could only be looked at with the analysis of the data capture times and errors. Digital Pen and Paper and the keyboard, were the devices that best supported data capture processes ergonomically.

The results of this study provided a good basis of information for deciding the most appropriate data capturing technology.

Ronald Boldt is a Lecturer in Process-Oriented IT Management at the University of Applied Sciences Berlin. He is also Managing Director of Allpen Gesellschaft für Systementwicklung mbHm, a company which develops Digital Pen & Paper Systems and is a solutions provider for better data capture processes. Mr Boldt was previously the manager marketing and sales BENUS IT-Service AG.

Benefits of a National Electronic Radiological Record

A. Jahnen[1], C. Pruski[1], H. Bouzid[1], N. Jerusalem[2], R. Krippes[2], U. Roth[1], S. Benzschawel[1], C. Back[2]
[1]Centre de Recherche Public Henri Tudor, CR SANTEC, Luxembourg
[2]Ministry of Health Luxembourg, Radioprotection, Luxembourg
andreas.jahnen@tudor.lu

Introduction

In 2005 the Luxembourg Ministry of Health initiated the development of a nationwide electronic radiological record (ERR; Project Title: CARA – Carnet Radiologique [1]). In the first phase, carried out in 2006 and 2007, a feasibly study – including a demonstration prototype at a pilot site – was carried out. In the currently running second phase the promising results [1] lead to the design of an overall concept for the implementation of this application in the framework of the national eHealth program. The concept does not only focus on the different involved IT systems, but also on structuring of the available information. An implementation of the CARA platform with limited functionality is planned to be operational at the end of the year 2010. This paper deals with the benefits of the CARA project for the health professionals and the patients.

Materials and Methods

The implementation of the electronic radiological record cannot be done independent of other related applications in the medical domain. It has to be assured that different applications in the same domain are able to exchange data and provide unified access for the users. For example, the access to laboratory results has similar requirements at technical and organizational level. In Luxembourg, the eHealth program is coordinating and developing different national eHealth activities with the implementation of a common eHealth platform [2]. This platform will provide common services that will be used for several applications. It includes services dealing with data encryption, health professional identification, cross-organizational patient identification, data exchange and a common backup strategy.

As a specific application within this program, the CARA project is providing information about all radiological examinations (figure 1). Access is available to physicians with the consent of the patient. A sophisticated

security system guarantees the data protection. Not only information about type, purpose, acquisition parameters, location, dates and dose, but also significative and illustrative images will be available. Further functionalities like electronic prescription are in preparation but will be implemented during a later phase of the project. The storage and the transfer of images and corresponding data, will base on international standards, like Digital Imaging and Communication in Medicine (DICOM, [3], HealthLevel7 (HL7 [4]) and Integrating the Healthcare Enterprise (IHE, [5]). This is an important aspect to enable interoperability and the implementation of future requirements.

Results

A national radiological record will provide several benefits for the different involved parties: for the patients, for the health professionals, for the hospitals and for the government.

Due to the fact that it is easy to access information about previous examinations, double examinations would be avoided. This reduces dose levels and saves time for the patient while at the same time reduces the costs for the healthcare system.

As it will be possible to access significative and illustrative images in the system, better diagnosis can be made: the treating physician is able to take into account images from the anamnesis of the patient for his diagnosis.

Given the availability of a centralized, pseudonymous database, the Ministry of Health now has the possibility to perform statistical analysis. This can focus on economical or public health topics, but as well patient and population dose related questions can be answered.

Due to the fact that all examinations will be coded with the same nomenclature, research into types of examinations and their related diagnosis is possible as well.

The database will provide fast and secure access to dose related information. At the patient level, this can be used to calculate the overall patient dose, especially important in high-risk groups. At the governmental level, the development of population dose levels over the years can be monitored. Even the control of international and national laws can be verified to detect radiation overexposure.

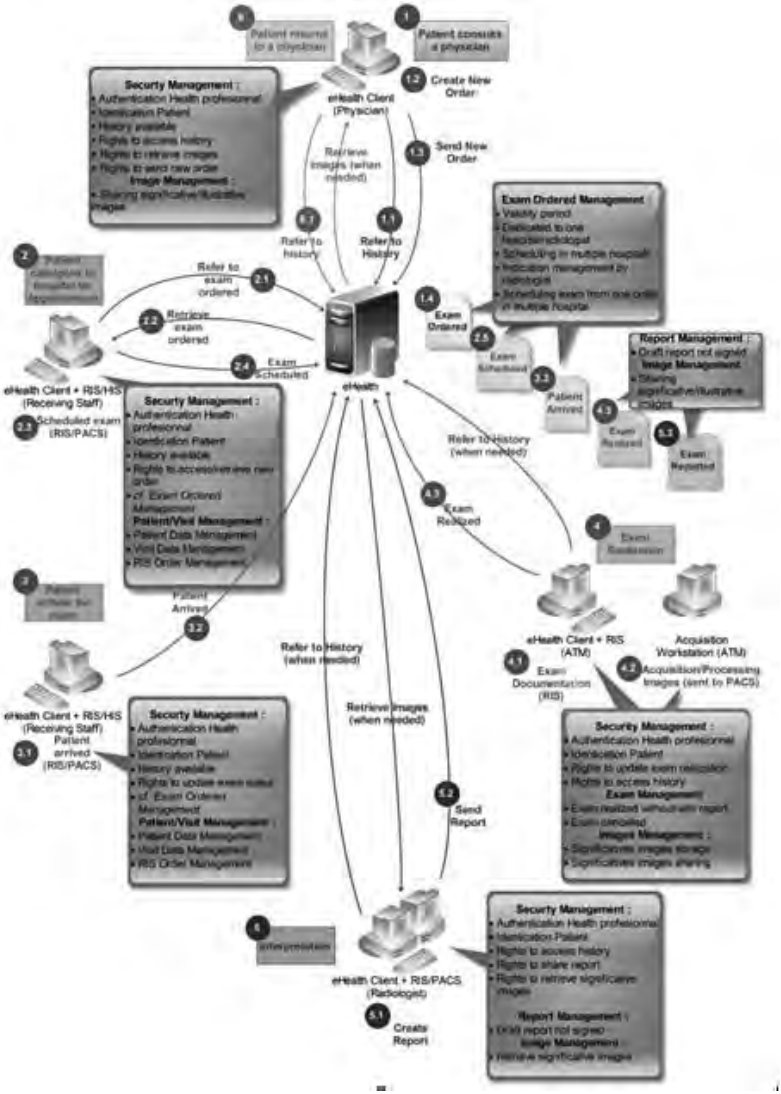


Figure 1: The CARA approach

Conclusion

The system will allow us to give secure access to the image related information to assist health professionals. This allows the physician to use the anamnesis of the patient and to avoid double examinations. It is possible – as the same nomenclature and diagnostic reports are used at national level – to exchange medical reports, create statistics and follow trends in examinations. Dose related information help in the risk analysis for high-risk groups.

Acknowledgment

We would like to thank the hospitals of Luxembourg for their collaboration and input in the work group sessions.

References

[1] F. Shannoun et al. Carnet radiologique fiche projet Phase 1, http://www.sante.public.lu/fr/travailler-sante-social/healthnet/applications-healthnet/cara/carnet-rad_art.pdf
[2] S. Benzschawel et al: IT infrastructure for National Electronic Health Records in Luxembourg – Acceptance occurs when benefits outweigh disadvantages, Med-e-Tel 2010, 14-16.04.2010, Luxembourg
[3] Medical Imaging & Technology Alliance:: DICOM Homepage, http://medical.nema.org
[4] Health Level Seven International: HL7 Homepage, http://www.hl7.org
[5] Integrating the Healthcare Enterprise: IHE Homepage, http://www.ihe.net

Andreas Jahnen has studied Computer Science at the University of Applied Sciences in Trier, Germany. He started in 1999 as a research engineer at the Centre de Recherche Henri Tudor - SANTEC. In 2005 he successfully completed his Master of Science - Frontiers in Medical Science – degree from the Open University / UK. He is coordinating the medical image processing activities at his department. His main research activities include topics related to the evaluation of image quality, the associated radiation dose and transfer and management of medical images. He is as well interested in topics related to free and open source software.

Diakonie-Pflege Verbund Berlin: Digital Pen and Paper Technology Helps Improve Social Care Services for Home Care Provider in German Capital

Ronald Boldt
University of Applied Sciences, Berlin

***Abstract*: At Diakonie-Pflege Verbund Berlin, a home care provider in Germany, carers use Digital Pen and Paper (DP&P) technology to record information during home visits. The technology provides significant time savings, as well as ensuring patient updates are instantly accessible to health agencies and health insurance companies for billing and quality control purposes.**

Diakonie-Pflege Verbund Berlin started to roll out Anoto's DP&P technology in 2008 to the first nursing ward, to help automate the mountains of paperwork that social carers create during their working day. Using the digital pens, staff can now capture patient information instantly, eliminating the need to re-enter handwritten notes electronically. Previously, carers had to manually fill in care forms and deployment records after each home visit, and then enter the data into the patient management system when they returned to the office.

With the digital pens, information is collected at the bedside and stored in the pen's memory. Back at the care station, it is docked and the data is transmitted automatically to the patient management system respectively the Electronic Patient File. Digital versions of the forms can be viewed as PDFs and made available for review and auditing by the respective health insurance providers.

More importantly, doctors and other care staff can work with up-to-date information, which means treatment can be deployed to patients more quickly for improved care quality.

Following a successful pilot with 40 staff at a care station in the east of Berlin, two further locations are being equipped with the digital pens, which will see a total of 166 employees working with the technology.

Better Quality of Outpatient Care with Digital Pen and Paper

Diakonie-Pflege Verbund Berlin decided at the end of 2006 to introduce a data capture system using Digital Pen and Paper, (DP&P) which at the time was not in use in Germany.

DP&P technology, which is now starting to become more popular in the German market, enables the capture of handwritten data automatically into electronic data systems. Notes are taken with pen and paper, which most people are familiar with. The pen, which looks like a normal pen, has a complex technical interior that stores the written data. For all documents related to outpatient care, the result is an innovative model for document management.

Health and Social Care Challenges

Health and social care is faced with many challenges, such as time, cost cutting and large amounts of paperwork. Delivering food to elderly people, taking care of their household and providing nursing or geriatric care are all time-consuming activities.

However, these are often overshadowed by accounting and administrative tasks that have to be done by the care staff in addition to their day-to-day activities. So what should be the main focus for care workers – time spent caring for people – can easily become secondary. In order to help care staff improve their work processes, Berlin's charity healthcare association, Diakonie-Pflege Verbund Berlin, has had to find new ways of supporting its care staff in their everyday work.

In the course of a day, not only do a large number of patients have to be cared for and visited, but also a multitude of data has to be transferred into the patient management system following each patient visit. When it was being done manually, it was time-consuming, prone to errors and often not up-to-date. A solution was needed to automatically capture and process the data.

Making Improvements without Changing the Way They Work

Due to legal requirements, a paper copy of the care documentation has to be given to the patient. This ensures transparency of the care staff's diagnosis for the patient and is also an important factor in the process of establishing a strong relationship between care staff and patients. So any new solution for data capture had to allow for a paper copy to be kept.

Before choosing the Digital Pen and Paper, Diakonie-Pflege Verbund Berlin tested a Personal Digital Assistant (PDA) solution. However, it was

not popular with staff due to its complexity and the need to adapt working procedures to the technology. In addition, battery life, handling and practicality did not meet the minimum requirements of the staff.

The New Solution – How It Works

Diakonie-Pflege Verbund Berlin was introduced to Digital Pen and Paper by Anoto partner Allpen. The solution consists of a digital pen and paper with Anoto's dot pattern, which can be printed out either as a care form or deployment transcript that lists the care staff's activities during the course of the day.

Diakonie's care staff collects data at people's homes with the digital pen. The data is then stored in the pen and transmitted to a PC via a docking station at the end of the shift. The entries can be opened as a PDF file in the Document Management System for further processing, or made available instantly to the Medical Review Board of the Statutory Health Insurance Funds for review.

Benefits with Digital Pen and Paper

Anoto Digital Pen and Paper technology is proving its worth in day-to-day outpatient care. The ease of use for care workers at Diakonie-Pflege Verbund Berlin was instantly noticeable. The solution was easy to implement, as no training was required, and workflow processes did not have to be changed.

As the solution enables fast, almost error-free data capture and a much quicker execution of the accounting process, care workers at Diakonie-Pflege Verbund Berlin can now save a couple of working hours every day. What was a matter of additional hours at the end of a shift is now a matter of minutes.

For Karl-Martin Seeberg, General Manager of Diakonie-Pflege Verbund Berlin gGmbH, the use of digital pens plays an important role in further improving the quality of the organization's outpatient care: "Caring for people means spending time with them. With Anoto Digital Pen and Paper technology, Allpen has given us a solution that allows our care staff to concentrate on looking after patients instead of being tied down with bureaucracy."

Another benefit is that patient records are always up-to-date, since there are no delays in transferring the field data into the document management system. This way, if a doctor or other member of staff looks in the patient records, he/she can see for example if a patient has received their medicine

or experienced any particular symptoms. This leads to improved medical treatment with fewer errors.

The solution also complies fully with legal requirements, as it enables care workers to retain paper forms for verification and record keeping.

At the moment, 166 pens are being used at the Diakonie stations in Berlin, and there are plans for further implementations in the Berlin area.

Ronald Boldt is a Lecturer in Process-Oriented IT Management at the University of Applied Sciences Berlin. He is also Managing Director of Allpen Gesellschaft für Systementwicklung mbHm, a company which develops Digital Pen & Paper Systems and is a solutions provider for better data capture processes. Mr Boldt was previously the manager marketing and sales BENUS IT-Service AG.

Electronic Health Records as a New Dimension of User Profiles in Recommender Systems

Martín López-Nores, Yolanda Blanco-Fernández, José J. Pazos-Arias
Department of Telematics Engineering, University of Vigo
ETSE Telecomunicación, Campus Universitario s/n, 36310 Vigo, Spain

***Abstract: Recommender systems* are tools intended to discover items that are likely to be of interest for the users, as inferred from *profiles* that gather information about their preferences, interests and needs. This paper deals with the introduction of *electronic health records* as a new dimension of the profiles, in a system that brings together TV watching, e-commerce and home-based telemedicine.**

Introduction

Knowing the overwhelming amount of data available through the digital media, the scientific community has been working on *recommender systems* to tailor the information delivered to the users' preferences, interests and needs. These systems rely on *profiles* that store personal data of the users, plus web navigation or TV watching records, learning or consumption histories, etc. We have enhanced this scope to exploit information from *electronic health records* (EHR). This idea enables a number of features that may have a significant impact in the field of interactive services to the home. For example, we make it possible to advertise over-the-counter (i.e. non-prescription) drugs to receptive users who may benefit from them, while avoiding offering groceries or drinks (e.g. coffee) that may interact with any prescriptions they are following. Also, we can use propitious scenes of TV programs to offer relaxation services to users who may be stress-prone (e.g. as inferred from their jobs). Likewise, we provide the foundations to achieve greater targeting for herbal, first-aid or dietetic products, for rehabilitation or assistance services and so on, following factual information about the users' health problems or factual/inferred information about their hobbies. We can avoid offering certain products to users touched by diabetes, celiac disease or allergies, and even think of preparing personalized diet plans following the culinary preferences and the metabolic possibilities of each individual.

In exploring these functionalities, we have solved several flaws of traditional personalization techniques, which failed to reckon the special nature of health-related data.

Refining the Current Personalization Techniques

The first approach devised to automatically select items for a user was *content-based filtering*, looking for items similar to the ones he/she liked in the past. This strategy is easy to adopt, at the expense of *overspecialization*: the recommendations are repetitive for considering that a user will always appreciate the same kind of stuff. This may not pose a problem with users who want to remain informed on specific topics (e.g. people with chronic diseases), but it does so in general. In response to that, researchers came up with *collaborative filtering*, to examine not only the profile of the target user, but also those of users with similar interests. Yet, this approach faces problems like difficulty to find users with similar ratings for the same items when the number of items is high (*sparsity*), or the treatment given to users whose preferences are dissimilar to the majority. It also entails risks for promoting items by their popularity, which is not desirable, e.g., with proanorexia videos. Knowing this, in a first phase of the recommendation logic, our proposal is to use a *hybrid approach*, weighing the estimations of interest computed by content-based and collaborative algorithms.

Regardless of the filtering strategy, many recommenders rely on *syntactic* matching techniques, which relate items by looking for common words in their metadata. These techniques miss a lot of knowledge for being unable to reason about the meaning of the metadata –e.g. they cannot observe a relationship between "*measles*" and "*rubella*", because the two words are dissimilar. In many areas, this limitation may just imply another source of *overspecialization*. When reasoning about health-related data, however, it entails risks that would make a recommender undependable for its little wisdom. To solve this, we resort to techniques from the Semantic Web, that gain insight into the meaning of words –so that, for example, "*measles*" and "*rubella*" can be automatically recognized as two eruptive infectious diseases. The key lies in the use of *ontologies* to describe and interrelate items by means of class hierarchies and attributes. There exist various semantics-enabled recommenders, but they are driven by *cumulative metrics* that merely count the attributes shared between the items available to recommend and the ones recorded in the profiles examined. That way, item features that do not align with a user's profile (e.g. sugar-richness in the case of a diabetic person) dilute as a negative contribution to a summation of many addends, so the items can be recommended if the sum exceeds a given threshold. This inability to prevent recommendations depending on health-related conditions (and, conversely, to boost the value of items that might have a beneficial effect) calls for using reasoning

mechanisms based on *rules*, as we do in the second phase of our proposal. Specifically, we use *semantic rules* to revise the outputs of the content-based and collaborative algorithms, considering three types of corrections: DISCARD for items that are unsuitable for the user, PENALIZE for items that are not a mainstream choice for people with certain conditions, and BOOST for the opposite case. E.g., rule **R1** below ensures that a diabetic user will never be recommended items classified as desserts in the ontology, unless they have been explicitly annotated as "*safe for diabetics*":

R1: USER(?U) AND ITEM(?I) AND HASCONDITION(?U,"*Diabetes*") AND ISA(?I,"*Dessert*") AND NOT HASATTRIBUTE(?I,"*Safe for diabetics*") THEN DISCARD(?I,?U)

PENALIZE and BOOST can be ABSOLUTE or RELATIVE. Using either version is often a question of the items' nature and whether the user's conditions are temporary or chronic. In the first case, we cannot assume that the items will appear in the user's profile, so absolute decreases/increases are needed to modify the 0 values returned by the first-phase algorithms. On the contrary, in case of chronic (or long-lasting) conditions, the items will get non-zero values in the first phase, and relative decreases/increases (expressed as %) make sense in the comparison with other items. For example, rule **R2** causes an absolute increase for the relevance of baby clothes for pregnant women; a relative increase here would have been unwise, because the user may have never found her in the need to purchase such items before:

R2: USER(?U) AND ITEM(?I) AND HASCONDITION(?U,"*Pregnancy*") AND ISA(?I,"*Baby clothes*") THEN ABSOLUTEBOOST(?I,?U,0.3)

Thanks to the semantic formalization of the ontologies, "*Diabetes*" applies to cases of "*Diabetes mellitus type I*", "*Diabetes mellitus type II*" and "*Gestational diabetes mellitus*", among others. Likewise, retrieving the condition of "*Gestational diabetes mellitus*" from the user's EHR would match the HASCONDITION clauses of both **R1** and **R2**.

A Quick Example

Our proposal has been implemented as an extension of the recommender presented in [1], using *openEHR* specifications (http://www.openehr.org) in all aspects related to the management of EHR. Let's consider the case of a TV viewer whose profile indicates that he is diabetic, fond of traveling and a frequent viewer of documentaries. It is Christmas, and the viewer is watching a documentary about polar fauna and flora. Due to the nature-

related topic, the TV provider delivers advertising material about herbal remedies and rural tourism; the snowy settings and the fact that it is Christmas time lead to broadcasting material about nougat bars, too.

Figure 1. Advertising herbal remedies in a nature documentary

In this scenario, the first phase of our personalization strategy yields high relevance values for some rural sites due to the viewer's fondness for traveling, and also for nougat bars provided that these are appealing items for like-minded viewers. By whichever means, we assume that herbal remedies receive positive (though low) relevance values. Having those preliminary estimations, the second phase causes a reordering that fixes nougat bars to the lowest value (by rule **R1**), whereas herbal remedies that claim benefits for diabetics gain increased relevance. Assuming that this suffices to exceed the values computed for the rural sites, we end up advertising a garlic-derived preparation as shown in Fig. 1.

Conclusions

Research in personalization has hitherto failed to deal with health-related data, even though these are undoubtedly a wealthy source of knowledge about the interests, preferences and needs of many users. Our position is that a suitable health-aware recommender can be built by combining a semantics-based hybrid filtering strategy with rule-based refinements.

Acknowledgment

Work supported by the Ministerio de Educación y Ciencia (Gobierno de España) project TSI2007-61599 and the Consellería de Educación e Ordenación Universitaria (Xunta de Galicia) incentives file 2007/000016-0.

References

[1] M. López-Nores, J. J. Pazos-Arias, J. García-Duque, Y. Blanco-Fernández et al.. "MiSPOT: Dynamic product placement for Digital TV through MPEG-4 processing and semantic reasoning," Knowl Inf Syst, vol. 22(1), pp. 101-128, 2010.

Health Data Management with an Archetype Driven EHR System in Low Resource Environments (EHRFlex)

A. Brass[1], D. Moner[2], C. Hildebrand[1], M. Robles[2]
[1] Helmholtz Zentrum München, German Research Center for Environmental Health, Germany
[2] Instituto ITACA, Universidad Politécnica de Valencia, Spain

Abstract: **A semantically interoperable Electronic Health Record (EHR) is one of the most challenging research fields of health informatics. EHR standards that formally describe health data structures are a prerequisite for sharing medical records. CEN EN13606 is one of the most promising approaches to solve this problem since it covers the technical needs for semantic interoperability and, at the same time, incorporates a mechanism (archetype model), which allows clinical domain experts to participate in the definition of the medical content of an EHR system. In this paper we present EHRflex, a generic archetype driven system that provides a flexible EHR solution. The graphical user interface is generated on-the-fly and allows to capture data according to the archetype descriptions of the user. EHRflex shows that the dual model approach of CEN allows the separation of software development and definition of clinical concepts. This affords to satisfy the most diverse and constantly changing data requirements and to save cost-intensive software adjustments at the same time.**

I. Introduction

Even only one disease or health problem results in a lot of documentation. It ranges from the patient's demographic information to the treatment and evolution of the disease. New forms, views and structures to document or interact with health information are cost-intensive and need to be customized for each case.

The international standard CEN EN13606 [1] contains an approach on how to structure medical extracts, which can be used to design complex and generic information in a fast and efficient way. In 2009 the Instituto ITACA developed the idea of creating a native system based on EHR standardized models. This resulted in a working application, which can handle generic standardisation models to capture and manage complex health information, but is independent from pre-defined data structures.

The software includes a complementary model to the EN 13606 that is needed to create a generic user interface for an EHR. This model is used to

generate dynamic widgets, which allow form based interaction with the data out of user defined archetypes and templates.

Methods

CEN EN 13606

The European standard EN 13606 - Health Informatics -- Electronic Health Record Communication was developed by the European Committee for Standardization. It describes an approach to enable an interoperable exchange of health data between electronic health record (EHR) systems. An information architecture is specified that makes use of a reference model in combination with archetypes and takes a so called „dual model approach“ that separates the medical knowledge from the technical concerns.

The Reference Model captures the global characteristics of medical records. It defines generic building blocks for aggregation of health record components and for collecting the context information required to meet ethical and legal requirements.

The generic information model is complemented by a knowledge domain. Archetypes are formal definitions of combinations of the building blocks defined by the Reference Model for particular clinical organizations or settings. They express distinct clinical concepts by specifying a particular hierarchy of record components and define or constrain names and other relevant attribute values, data types and values ranges.

Operational Template Model

EN13606 was designed primarily for EHR communication purposes of existing data. Since the main objective of **EHR***flex* is to enable the user to interact with data, we had to add some formal definitions.

The Operational Template Model defines generic structures and data types, which represent a minimal intersection of several known health informatics data models [2]. An instance contains entered data and its hierarchical composition can be modified during the runtime of the application. The implementation is done in the deployed user interface technology.

System

EN 13606 empowers health professionals to define and describe medical content without any knowledge of the technical background [3]. However, there is still a lack of software that offers a technical platform to manage self defined health information.

Thus **EHR***flex* works on external defined archetypes and allows the user to create and edit standardized medical data. The actual version of the application is a stable and working prototype implementation in Java.

A clear self-explanatory and user friendly graphical interface was an important objective during the development phase. For a high-performance on- and offline software, we choose the "Google Web Toolkit" to implement **EHR***flex* as a rich client application. To reach a direct binding between the widgets and an OTM instance, the model had to be implemented in the used framework.

The OTM is transformed out of an archetype or template (Figure 1). The

Figure 1 "Operational Template Model" dynamical binding

Figure 2 "Operational Template Model" transformation

transformator observes the constraints, structures and the underlying reference model to combine the entities of the OTM model in the right way. The resulting instance is interpreted by a builder to create a flexible interaction mask, which includes two widgets: a navigation tree, which represents the actual data, and a dynamic form, which interprets the OTM (or parts of it), its constraints and data types into structure and field widgets. The user can interact within the archetype defined borders and create concrete data. The documented information is transformed into an instance of the reference model and stored in XML (Figure 2). The native XML database enables direct interoperability with other systems without further mapping or transforming of data.

Conclusion and Future Work

The implementation of widgets that are working on the generic Operational Template Model is, in the beginning, more time-consuming, but the scenarios showed that once accomplished, the user can easily change the data structures without further adjustment of the software. This flexibility enables powerful data management even in low resource environments, since the changes can be done without cost intensive technical expertise.

By using appropriate architecture and development methodologies, technical complexity of the standards can be hidden from the clinical end-user. Clear and visually attractive application forms invite the user to interact with the data giving a good overview on the whole content. Moreover, users can import their self-defined archetypes and immediately see a working application based on them. The benefits of this approach are:

- Knowledge defined by the medical community by archetypes can be used and integrated.
- Information can be received and communicated seamlessly from its source.
- Quality EHR systems can be created by using international standards.

One important characteristic of the implemented application is its openness. The *Helmholtz Zentrum München* and *Instituto ITACA* are working on an open source project that is based on **EHR***flex*. The free availability of software solutions can accelerate the adoption of standards in real use cases.

Future work to be done includes improving the support of archetypes of different reference models, such as OpenEHR [4] and HL7 [5] CDA. **EHR***flex* is built upon a generic architecture which is independent from the EN13606 model. Thus it is feasible to align other models easily.

A second line of work is to evolve the definition of the OTM in order to include more properties needed for correct screen rendering: support of several concurrent archetypes, selection of a default language and even definition of the size and positioning of the visual gadgets.

References

[1] EN 13606 – CEN standard "Electronic health record communication"

[2] T Beale, S Heard, *OpenEHR Templates*, http://www.openehr.org

[3] Gerard Freriks, *Lessons learned: Implementing the EN13606 EHR standard the need for European Semantic Interoperability Infrastructure Framework*, Travel Health Informatic and Telehealth EFMI Special Topic Conference, Antalya, Turkey (2009), 135-141

[4] OpenEHR – http://www.openehr.org

[5] Health Level 7 (HL7) – http://www.hl7.org

IT Infrastructure for National Electronic Health Records in Luxembourg – Acceptance Occurs When Benefits Outweigh Disadvantages

S. Benzschawel, H. Zimmermann, M. Da Silveira, U. Roth, A. Jahnen
Public Research Center Henri Tudor
stefan.benzschawel@tudor.lu; heiko.zimmermann@tudor.lu; marcos.dasilveira@tudor.lu; uwe.roth@tudor.lu; andreas.jahnen@tudor.lu
29, avenue John F. Kennedy, Luxembourg, 1855, LU

***Abstract*: Electronic Health Records (EHR) systems manage the most intimate and private information. The acceptance of EHR systems is proportional to their positive balance of benefits weighted against the risk of insufficient data protection. An objective, better treatment process for patients on the one side and a highly secured system on the other side are the most important preconditions. The aim of this paper is to present the requirements to design architectures to national eHealth platforms and to describe the architecture proposed by SANTEC team.**

Introduction

Compilations of medical records are the basis for treatment decision support systems. They support practitioners to diagnosis diseases and select therapies or medical pathways by taking into account the patient's current symptoms and his complete medical history. With the advances of the Internet, medical data can be more easily shared between healthcare professionals. But this context also has some critical risks and the confidentiality and reliability of medical data need to be assured. The contribution of this work is on the data protection level within national EHR architectures. In this paper, we present an architectural solution to manage 3 kinds of data:

(a) Small and structured documents, where personal data can be separated from medical data. Example: CDA laboratory results.

(b) Small documents where personal and medical data cannot be separated. Example: PDF discharge letters with patient identity.

(c) Large documents where personal and medical data cannot be separated. Example: DICOM images with patient identity.

System Architecture & Security

The proposed system deals with these kinds of data: (a) Laboratory results which are pseudo-anonymized and stored in a central medical data repository. (b) PDF documents are encrypted and stored in a centrally encrypted DMS (Data Management System), (c) X-ray images are stored in encrypted decentralized data repositories (for example on servers in the hospital's DMZ (demilitarized zone)). Also national PACS backup systems are good alternatives and may act in a second role as decentralized repositories.

To avoid attacks from external or from internal users the system splits person-identifying data and medical-result data into different systems, operated by different institutions. One system (called TTP – trusted third party) keeps the person-identifying data and maps it to pseudonyms. A second system (CMReg – central medical registry) keeps pseudonyms together with their corresponding medical data (see Fig. 1).

Dealing with Pseudo-anonymized Data

Primary systems (that produces medical data) are charged to split the information into two messages: one with the person-identifying data; and one with the medical data. The messages are sent to TTP and CMReg, respectively. Both messages have the same link-ID which will be used by CMReg to request to TTP a pseudonym. CMReg will never know the patient's identity and TTP will never know where the medical data is stored.

The medical data document is stored in the CMDRepo (central medical

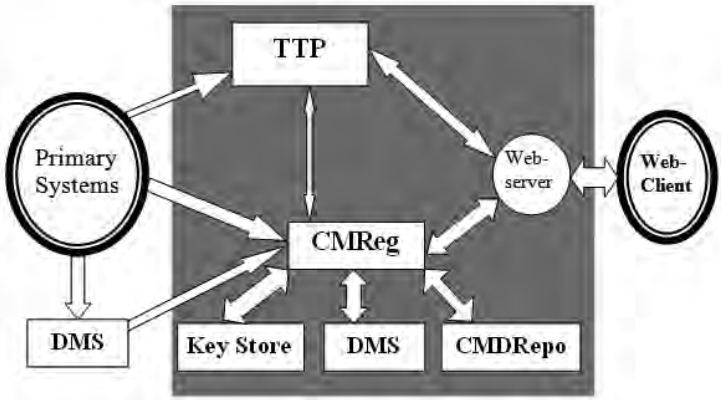


Figure 1: Simplified Architecture representation

data repository) and the CMReg keeps meta-data (location, pseudonym, etc.) about the document.

When a Web-client queries data from the system, the query is splitted into two messages. The TTP receives person-identifying data (of the patient) and a token; the CMReg receives the query and the same token. The CMReg asks to TTP for the pseudonym(s) corresponding to the token. The TTP replies to the CMReg with a list of pseudonyms that match to person-identifying data sent by the Web-server (with the same token). These pseudomyms are used to perform the query in the medical data storages. The query results are encrypted with the public key of the client and sent back.

Dealing with Non-anonymized Data

As long as the system can assure that medical data does not contain person-identifying data, the pseudo-anonymization works well. For documents that pseudo-anonymization cannot be guaranteed, a new procedure must be implemented.

For small documents like patient discharge letters in CDA or their PDF versions this problem can be solved by: (a) charging the primary system to generate a symmetric key; (b) encrypt the medical data with the symmetric key; (c) encrypt the symmetric key asymmetrically with the public-key of the *KeyStore* server; (d) send the encrypted key and the encrypted medical data to CMReg; (e) CMReg sends the medical data to DMS and the encrypted key to KeyStore; (f) CMReg creates meta data (locations, pseudonyms, etc.) about the documents.

For large and unstructured documents like x-Ray images, where a separation of data is impossible, the transmission time can become a bottleneck to the system. In that case, data may reside on the producers' side instead of getting copied to the central encrypted DMS. Therefore we considered to have Encrypted Decentralized Data Repositories. The procedure to register these documents in the EHR system is quite similar to small documents (e.g., PDF files): (a) the documents are symmetrically encrypted (as explained before), the key is sent to the *KeyStore* server and the medical data location is sent to CMReg (to complete the meta data). The only difference is that documents are stored on the producer side.

The retrieving process is the same for small or huge documents. When the document is requested by a client, the symmetric key is decrypted by the *KeyStore* server and re-encrypted asymmetrically with the public key of the client. Both, document and encrypted key, are sent to the client.

Statistic evaluations are possible only on non encrypted medical results which are stored in the CMDRepo. If further statistical research has to be done and personalized data like age and sex are necessary, special exceptional queries must be allowed to query the TTP.

Conclusion

This paper describes the architectural approach of SANTEC to improve confidentiality and reliability of medical data within a national eHealth platform. The proposed architecture was designed to satisfy the following requirements:

- Medical data must be separated from person-identifying data.
- The same organization must not have complete access to both data stores. A TTP is charged to map real identities and pseudonyms while a CMReg is charged to map pseudonyms and medical data.
- Data can be sent as structured or unstructured file formats.
- If possible, medical data must be pseudo-anonymized.
- Non pseudo-anonymized data must be encrypted.
- Data must be accessible via secured connections over the Internet.
- Encrypted data and the encryption key cannot be available to the same person or organization (e.g. server manager).
- The results of a query can only be readable by the requester.
- Users must be identified.
- The access' rights of users must be predefined. The services are available according to the users' rights.
- Pseudonyms of patients are never sent outside of the platform. They are not visible for clients and primary systems.
- Statistic evaluations are possible only with non encrypted medical data.
- The system must foresee a solution to verify patients' consents. Consents are associated to pseudonyms.

Acknowledgements

The authors thank their partners from the Health Ministry of Luxembourg for their very helpful advises and for providing insights into organizational and legal aspects of the eHealth platform.

Stefan Benzschawel received a Diploma in Computer Science at the University of Kaiserslautern, Germany. After his studies he worked 5 years as a member of a research group of IBM Germany and the University of Trier. His software and healthcare industry experience based upon 13 years at SAP, GWI, and AGFA HealthCare, as system analyst, software developer, and R&D manager. Since April 2009 he is working at the CRP Henri Tudor.

Heiko Zimmermann received his Diploma in Computer Sciences at the University of Applied Sciences in Trier, Germany. His experience in the healthcare industry is based on nearly 5 years working as a system analyst and software developer in the healthcare sector. At CRP Henri Tudor he is working as an R&D Engineer on concepts and implementations for secure architectures and the exchange of medical data.

Marcos Da Silveira is currently working as researcher at the CRP Henri Tudor – department SANTEC, Luxembourg. He holds a PhD. in Industrial Informatics from Paul Sabatier University, Toulouse, France. He had worked 5 years as associate professor at Pontifical Catholic University of Parana, Brazil and he has over 10 years of experience in project management. His main research interests are “Service-Oriented Architecture”, “Fault Diagnosis and Recovering”, “Adaptative Care Flow”, and eHealth.

Uwe Roth received his Diploma in Computer Science at the University of Kaiserslautern, Germany. He has worked as a scientific researcher at the Institute of Telematics and at the University in Trier, Germany, where he received his PhD. At the University of Luxembourg he was a senior researcher and head of the Interoperability Laboratory for Security in Ad-Hoc Networks, SECAN-Lab. At CRP Henri Tudor his main focus are concepts for security and data privacy protection in the eHealth sector.

Andreas Jahnen has studied Computer Science at the University of Applied Sciences in Trier, Germany. He started in 1999 as a research engineer at the CRP Henri Tudor – department SANTEC. In 2005 he successfully completed his Master of Science – Frontiers in Medical Science – degree from the Open University, UK. He is coordinating the medical image processing activities at his department. His main research activities include topics related to the evaluation of image quality, the associated radiation dose and transfer and management of medical images. He is as well interested in topics related to free and open source software.

New Paradigms for Patient Record Sharing with Privacy, Ease of Use and Compliance with Emergency Situations: Case of the French Nonprofit System Sanoia.com

A. M. Selamnia, H. Servy
Association pour l'Information Médicale en Situation d'Urgence
Centre Hospitalier de La Ciotat, Bld Lamartine, 13600, La Ciotat, France, mselamnia@sanoia.com

Abstract: **AIMSU, a n on-profit me dical ass ociation gathering emergency physicians and engineers, decided to explor e new tracks for information medica l really a dapted by nature and han dling to the circumstances of the emer gency. S upported earl y on by tw o major public institutio ns, AIMSU ha s demo nstrated the relevance in the context of the emergency practice of a simple and robust solution that is based on three axioms in a untappe d co mbination: (1) focus on the emergency medical informati on; (2) manage the data under the responsibility of the patient; (3) unbound the ci vil and the medica l identity. Our work leaded to the cre ation a website cal led sanoia.c om allowing free and a nonymous online st orage of pers onal heal th d ata essential for medical c are in emerge ncies and accessible to any doctor in Fran ce and abr oad, thr ough a unique and secured number. Several French medi cal institutions, attr acted by the i mmediacy and operational features of sanoia.com have expressed an interest.**

Introduction

More than 20% of the French population suffer from chronic diseases or have a health history. Their medical profile must be well known to any medical doctor to receive the best possible care. According to study from the French National Ministry of Health, an estimate of 405 000 adverse effects in health structures (hospitals, clinics ...) has been calculated of which 155 000 might be avoidable [1]. Yet, according to the General Manager of Marseille Hospitals (400 beds and 80 000 admissions/yr) 85% of emergency patients are not able to accurately express their medical history. The main trends increasing the risks are known and growing [2]:

- Ageing population with a greater source of medication interactions,
- Greater mobility of populations in France and abroad,
- Prevalence of chronic diseases that impact the choice of treatment,

- Advances in medicine and associated technologies, which result in a tendency to hyper-competence, resulting in fragmentation of care.

The public expectations are high in terms of electronic communication of personal health information. Although, 91% have expressed the wish to an increase use of informatics in physician practice, they were more than 78% to consider confidentiality of their health data as a critical issue [3]. We therefore, decided to build a tool accessible at http://www.sanoia.com that will meet these expectations and requirements (fig 1.)

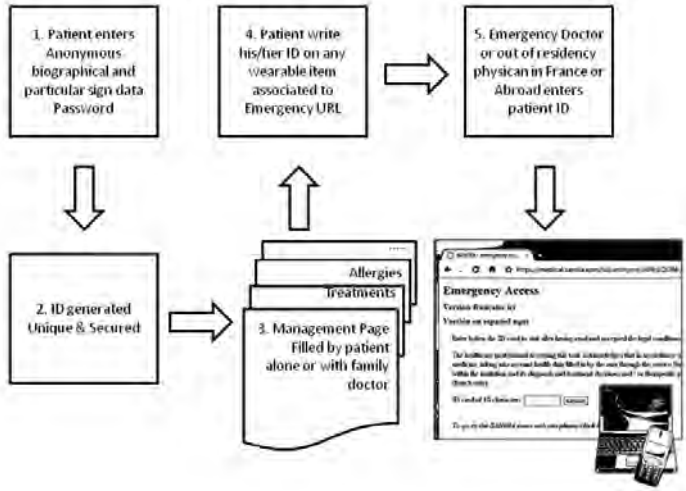


Figure 1: Schematic representation of Sanoia.com

Methodology and Results

Doctor/Emergency Interface

We have gathered a panel of physicians and emergency physicians having them to define and focus on the most common parameters needed in emergency situations. Once the basic and anonymous data entered a secured and unique ID is generated. The ID associated to doctor access URL can be written on any wearable item or displayed on the mobile screen. Associated to user provided password, the patient can enter his personal space and fill the items alone or with the family doctor.

Technical parameters

Sanoia.com, built with php, mysql and javascript tools, is hosted on 2 dedicated servers at a major hosting company providing all services in terms of maintenance and back-ups. It has been successfully tested to allow 500 000 users per day. To help the user enter his treatments, we generated a dynamic link with the French national drug database. We aim to be able to connect all major national drug databases through the International Nonproprietary Name.

Anonymity and Privacy

All possibilities of identification, even by overlap, were discarded. For example, besides the absence of name or email in Sanoia.com, it is assumed that three antecedents with a specific date (date / month / year) and location identifies a person. So we opted to ask only the month and year history.

We have placed the management system of health records behind a proxy that anonymizes traffic. Our two tiered architecture, the first rendering invisible to the second the IP address of applicants, has led to the recognition of anonymity by the expert services of the French National Commission of Informatics and Freedom (CNIL).

Conclusion

SANOIA is beneficial both for care givers and patients on several levels. Since the launching of the first release on February 2009 previously under the name medurg.com, we are facing an accelerating trend of visits reaching today about 2 000 monthly visits and a subscription conversion rate of 40%.

Sanoia.com has proven to generate interest among the different parties.

Interest of Sanoia for key actors of the health chain

- Patients improve their safety in an emergency, anywhere in the world while preserving their privacy.
- Physicians save time and secure their practice.
- The emergency teams make quicker good decisions and improve the quality of the psychological status at the admission.
- The public health actors (State, Regions, Territories ...) offer a new reflex preventive health simply and immediately operational.

Perspectives

Sanoia.com, offering now a practical solution, immediately operational, might represent a complementary or add-on module for emergency and international access, to the future DMP or the European Heath insurance card which contains only reimbursement information [4]. In this regard, contacts were established with local health institution in charge of Digital

Health and the local chapter of the National Order of Medical Doctors to study the terms of integrating services, which will be entrusted to the LSIS Laboratory in Marseille (http://www.lsis.org/).

Acknowledgment

We would like to express our sincerest thanks to the Staff of the Marseille Multimedia Incubator Belle de Mai for their enriching discussion, and the research laboratory LSIS for our collaborative work on anonymity and medical certification.

References

[1] P. Michel et al, Les événements indésirables graves liés aux soins observés dans les établissements de santé : premiers résultats d'une étude nationale, Études et Résultats, DREES , n°398, Mai 2009.

[2] P. Lasbordes La télésanté: un nouvel atout au service de notre bien-être, Congressman Report to French Health & Sport Minister Dr. R. Bachelot-Narquin, Juillet 2009.

[3] Les nouvelles technologies et l'exercice de la médecine TNS Sofres Poll for the National Order of Medical Doctors, Avril 2009.

[4] L. Ulmann E-Health in Europe (French Version), Eds., The European Files, p. 5. 2009.

Adam Mohammed Selamnia holds a Ph.D. in Physiology of Human Nutrition (1997, Univ. Paris 7) and Master in Marketing. After 8 years serving in pharmaceutical and medical marketing, he launched DCIS in 2008 dedicated to innovation in marketing and new health technologies and started a partnership with Hervé SERVY and co-founded the Association for Medical Innovation in Emergency Situations in charge of the technical management of sanoia.com they co-develop.

Hervé Servy holds a Master of Informatics from the University "Méditerranée" in Marseille, ESIL-Computer Engineering Department. After serving as a IBM's key account sales manager. He joined Microsoft in North Africa as Marketing Director. Since 2007, he devotes himself to coaching young innovative companies by providing strategic marketing skills and in 2008 he developed with Dr. Adam SELAMNIA an innovative project in the field of health and founded the AIMSU where he ensures Presidency.

Portable Access to Electronic Medical Data in PCS*CARE

M. Citavy, R. Trzicky
PCS Systems, spol. s r. o., Na Dvorcích 18, 140 00 Praha 4, Czech Republic
mcitavy@pcs.cz; rtrzicky@pcs.cz

Abstract: **A pronounced requirement is audible for quite a while from the medical professionals to access medical data and possibly other Hospital Information System (H.I.S.) features from 'anywhere' within the hospital premises, specifically during the ward round. A deployment of a mini touch screen notebook seems like a technically viable solution. There are suitable models on the market with 10" touch screen displays. The touch screen technology is much more user friendly than the standard keyboard. A high performance and secure WiFi infrastructure is a prerequisite which is, however, often present already. H.I.S. modifications to fit the simplified functionality and limited screen size also need to be done. These modifications require close cooperation with the users in order to fulfil their needs, involve them in the process and motivate them into using it. This technology can be easily complemented with other technological features (possibly already in place): RFID or bar code patient identification thus allowing during the round to propose the M.D. the list of patients currently in the room visited. The benefits are multiple and obvious. The described solution encounters good user acceptance.**

Introduction

Comprehensive clinical hospital information system PCS*CARE® developed and maintained by PCS Systems, spol. s r. o., Prague, Czech Republic, has been in use by many hospitals and other health care providers in several countries (EU, Middle East) since 1994. Its users, both nurses and physicians find it difficult to make daily records during the rounds in an ‘off line’ mode. Such process involves making temporary notes on paper with the need to enter the data at some later time into the H.I.S. This requires extra work with an additional disadvantage of making errors. Thus a pronounced interest has been expressed by the users of PCS*CARE to deliver a solution which would enable them to enter daily records online, during the rounds.

Solution

During discussions with the users the following points and requirements have been identified:

- Should serve both for nurse as well as for physicians
- For nurses, should serve for entering regular measurements (temperature, blood pressuer, etc.) and applied medication
- For physicians it should allow prescription (both new and modifications), ordering tests and examinations.
- Results, preferably in graphic mode (where applicable) should be make available
- Entering to be kept as simple as possible, e.g. ticking a box, or using a touch screen button
- Written input should be kept minimal
- The possibility to enter longer texts needs to remain should the need arise
- Open for future technical and functional extensions and additions

These requirements were taken into account in both the prototyping phase as well as in the pilot testing.

The proposed solution uses, of course, the robust infrastructure of PCS*CARE H.I.S. – its Oracle database, Unix/Linux operating system on the server side and its data structure. For the user interface both .Net or Java could be used. Our choice was Java.

Major Advantages

Introduction of this portable technology increased significantly the rate of daily records entered into the H.I.S. Its affordability and convenience for the users surpassed the expectations. Probability of errors in the entered data decreased. All data can be shared between PCS*CARE and the portable solution which becomes an integral part of the the H.I.S.

Software Functionality

The available functionality started with a limited set of functions. Prototype handled on the nurses' side the possibility to enter regular measurements and the confirmation of the medication delivery. For the physicians viewing of the results was made available (temperature, lab results) in both graphic and tabular forms. Also the results of other findings could be viewed. The most frequently used tests and examinations could be ordered for the selected patient by a 'tick'. Medical prescription can be entered or modified. For all staff entering notes (daily records) was available, though not encouraged.

Technical Requirements

The inevitable preliminary condition is the availability of a secure and fast wireless net. This is usually already in place. A mini notebook or net notebook with a touch screen display is another hardware item required. Operating system can be any supported Windows platform. Windows 7 seems to be a good choice. We have used Gigabyte T1028X with 10.1" display which provides good functionality at a reasonable price, currently around |350,- . It can be reasonably expected that this ratio will surely continue to improve in time. It is also lightweight and small enough to carry around.

Figure 1

RFID chips or bar coded identification of the patients can be used to make the process even more fast, simple and error free. Again, such patient identification can be often found already in place and is useful for a number of other applications. In such a case a suitable reader needs to be added to the notebook.

Summary

Providing the portable technology for daily records and in future for other features as well brings the long awaited ease of use and flexibility. It offers the possibility to view and enter the data when and where needed while sustain the robustness and full functionality of a comprehensive H.I.S.. The increased efficiency more than justifies the modest cost of this solution. The acceptance rate by the staff is high indeed and negative comments rare. The functionality can be gradually extended both by technical means (bar code, RFID) as well as by software enhancements.

Michal Citavy has been Chief Executive Officer of PCS Systems, s.r.o. since its foundation in 1990. Mr. Citavy's experience in medical information systems includes five years as System Engineer for the processing of medical data, database applications and image processing at Charles University. His international experience includes two years with Centrotex a.s., a trading company, where he had direct responsibility for products with an annual turnover of $200 million. He also spent a year in France as a programmer for the Centre Hospitalier Frederic Joliot in Orsay. Mr. Citavy holds an MSc degree from the Czech Technical University, Prague, in Bio cybernetics.

Radovan Trzicky has been working in the IT sector all his professional life. He held the positions of system engineer, database administrator, administered UNIX and Linux servers as well as large computer networks, initially in the Czech Social Security Office. In 1996 he joined PCS Systems, where he remained as system administrator, Oracle DBA, as well as analyst and programmer in C, C++ and Java both for PCS*CARE H.I.S. and for internal applications. His experience includes the development of the "Intelligent SMS messaging into PCS*CARE H.I.S.", participates on behalf of PCS in the NetC@rds project, etc.

Prototype System Supporting Modular, Stack-Oriented Personal Healthcare Services

Thomas Clark[1], Ryszard Krzyminiewski[2]
[1]Patient Measurement and Monitor Corporation, 10490 SW Meier Drive, Tualatin, Oregon 97062 USA, cctualatin@speakeasy.net
[2]Medical Physics, Os.Tysiaclecia 65/9, 61-255 Poznan, Poland
rku@amu.edu.pl

Abstract: **A Prototype System composed of two Desktop Systems connected to a Router to form a subnet has been built using multiple dissimilar Application Stacks (BitNami Stacks). Use of the Stacks enables a modular, reconfigurable system capable of incorporating various advanced local networks, embedded systems and networks plus commodity wireless and telecommunications systems. Beneficiaries of the design will be Participants in Patient-Centric, Personalised Medicine and Legacy Healthcare Services.**

Introduction

Health and Medical Services can be static or dynamic across Populations. For those Populations receptive to and experiencing change in services, delivery models are likely to be moving toward Patient-Centric and/or Personalized Medicine. In both models, continuous, periodic and aperiodic Patient Monitoring provides relevant data upon which local and remote analysis and diagnosis can be based. Integrated with Telemedicine and eHealth the end-products will substantially extend and expand existing and future services.

The Patient is and has been a data source for Practitioners. The acquisition, analysis and usage of Patient-supplied data has been affected by various errors, leading to a dependence upon Practitioner-selected, Laboratory-performed tests. Detection, isolation, analysis and response are common technologies in more disciplines than Healthcare Services. Medical Diagnosis is based upon Medicine and Knowledge-based Decision-making. Continuous reliable, accurate, precise and relevant Patient data is a critical requirement.

Presuming the existence of adequate, accessible, appropriate, current, necessary, sufficient, reliable, repeatable, timely and historical Patient data covering lifelong conditions, events, results, successes, failures, Facilities, Practitioners, Support and environments, it is likely that a secure Patient Knowledge-based System (sPKS) can support: (1) current state

determination, (2) triage of serious medical conditions, (3) risk analysis and proper treatment.

Developing the sPKS is a co-operative task involving Information Technology and Medical Groups. Supplying the sPKS with data inputs is a co-operative task involving Medical Device and Information Technology Groups. The primary focus herein is the development of required data inputs for the sPKS. Data inputs can be composed of raw data from Medical Devices, or similar sources, Patient- and Community-supplied data, (e.g., audio/visual), local pre-processed data (e.g., statistical data generated over time) and reports from local and on-site Practitioners. Local Patient Monitoring activities can be multifunctional; multiple data sources and types is typical. The above indicates a data flow from the Patient to a Practitioner at a remote site, with an attendant concentration of remote data processing and storage, much in line with current practice. This concentration translates into rather large bottlenecks which adversely impact overall efficiency and performance.

With readily available, over-the-counter Medical Devices the Patient has available a range of such devices that should support computer interfaces or software applications that accept Patient-entered data. Local Computer Systems are likely to support the downloading and uploading of applications along with databases and application data.

An alternative to fixed configurations are modular, reliable, reconfigurable, expandable, maintainable architectures that operate under the joint control of the Patient and remote Practitioner. Similar approaches to dynamic configurations have successfully been taken in other Industries over time, e.g., Enterprise Computing, Smart Manufacturing, Chemical Processing and Aerospace.

Platforms

The Computing Platforms and Networks identified herein are Commercial Off-the-Shelf (COTS) items; their Operating Systems are drawn from Microsoft Windows and Linux offerings; Application Software Tools are Open-Source and Commercial products.

Open-Source Development

All software is written with open-source code. The code is protected by a special license that ensures everyone has access to that code. Such access is necessary since developing custom Application Stacks will require code integration for newly designed and legacy software packages.

Application Stacks

A Software Operating System is an example of a Software Stack, i.e., a set of software components and subsystems required to deliver a fully functional solution for a product or service. An Application Stack is a Software Stack that delivers an Application. An Application can include multiple, identifiable Components, e.g., Databases, programming language and control packages. Application Stacks herein support directly or indirectly Healthcare Services.

BitNami Stacks

BitNami Stacks (http://bitnami.org) include an open source application and all of the other software necessary to run it, such as Apache, MySQL, PHP or Ruby. The selected BitNami Stack is installed on the Platform (herein a Windows XP Professional or an UBUNTU Linux Platform). Thereafter it is accessible via a User-defined port number associated with an internal or external Apache Server.

BitNami Stacks were chosen to demonstrate presence, functionality and versatility of currently available Application Stacks. Many new Stacks have been proposed; each will substantially broaden the Stack library. Commercial Custom Application Stack Designers are available. With the combination of BitNami Application Stacks, Custom Application Stacks and proprietary Application Stacks, an advanced Prototype can be built to enable Participants, Facilities and Support Groups to configure and built models for advanced Healthcare Services suitable for Patient-Centric and Personalised Medicine Healthcare Services.

Advanced Prototypes and Models can also be used to integrate medical researchers and specialists plus advanced technologies, e.g., imaging, decision-support, conditions, chronic care and whole-body health. A selection of existing BitNami Application Stacks includes, but is not limited to: DjangoStack (Rapid Application Development), LAMPStack (Linux, Apache, MySQL, PHP), RubyStack (Ruby), Drupal (Content Management), phpBB (Bulletin Board), Liferay (collaborative tools), Spree (eCommerce), Moodle (Documentation), DokuWiki (Wiki).

A selection of proposed BitNami Application Stacks includes, but is not limited to: AIOCP (All in One Control), Epiware (Document Management System), FUDforum (Web Forum), Open-Xchange Server (Collaboration and Integration), SQL-Ledger (double entry account/ERP system), Pandora FMS (Monitoring), Plone (content management system).

Application Stack Caveats

Developers must consider that a Computing System supporting Application Stacks encounters additional inherent overhead, resource limitations, processing tasks and User limitations. Scalability, Capacity Planning and Performance must be closely monitored. Since this development effort has been directed at Patients and Communities of Patients (e.g., multiple systems), related limitations are expected to be less severe. Performance and scalability will remain issues.

Anticipated Additional Architectural Requirements

Overlay Structures: an overlay is when a process replaces itself with the code of another program.

Swap Data Structures: enable the execution of programs that manage data files larger than available memory.

Roll-in and Roll-out: Task Sets, comprising selected tasks to be performed by the Computing System, may not be fixed, i.e., the member tasks in any Set may vary depending upon current and future processing requirements. The number of Task Sets may vary as well. Hence, at any time the number of Task Sets and the number of Tasks in any Set may vary. Furthermore, at any time, individual Tasks may not be required to perform assigned processing. During this dwell time a Task may be 'rolled-out' to a storage facility to await the next time it is required when it would be rolled-in from the storage facility.

Task Sets, comprising selected tasks to be performed by the Computing System, may not be fixed, i.e., the member tasks in any Set may vary depending upon current and future processing requirements. The number of Task Sets may vary as well. Hence, at any time the number of Task Sets and the number of Tasks in any Set may vary. Furthermore, at any time, individual Tasks may not be required to perform assigned processing. During this dwell time a Task may be 'rolled-out' to a storage facility to await the next time it is required when it would be rolled-in from the storage facility.

An example is a test-oriented Task assigned to run during periods of very-low activity. Another example would be a Task designed to support a Sleep Apnea Study. Similarly, an Application Stack that is currently in a dwell processing state could be rolled-out to a storage facility to await the next time it is required when it would be rolled-in from the storage facility. This would be the topic of a future project.

Overlay and Swap in Extended Application Stacks: A reasonably prudent

presumption is that not all Application Stacks are required to be continuously resident, active and performance task sets. This presumption is justified by the reality that a Patient progress through a sequence of activity states within a 24-hour period. The set of currently resident, active and performing Application Stacks must at least properly match the current activity state. Inactive Application Stacks can relinquish resources and/or be rolled-out to a storage facility.

Sensor data can be processed to determine the current activity state and software configuration management can make the proper modifications. When Sensor data is not available, e.g., the Patient is unavailable, a low activity related configuration would be achieved.

Overlay Application Stacks: Application Stacks can be designed to function as Overlay Structures, i.e., a set of Applications can be configured to use a specific Application Stack under a preset set of rules. Multiple such Stacks would support multiple Overlay Structures. For example, a remote Practitioner may request that a set of non-standard tests be performed (e.g., two) and each test is designed to execute on a standard Overlay Stack. Where the local System supports two or more such Overlay Stacks, the tests can be performed in parallel.

Swap Data Application Stacks: These Application Stacks are likely to be under the control of other resident Application Stacks. This may entail access to data on remote storage resources.

Future Testing: Future testing will address expanded testing on each System and on co-operative and peer-peer application testing involving both Systems and external applications.

Future Developments: Bluetooth and Wireless Technologies inject multiple and substantial possibilities into this configuration. These cover a variety of embedded systems and networks, Cellular Systems and mixed-mode configurations, e.g., all of the above plus current infrastructures.

Conclusion

The Prototype integrating BitNami Application Stacks functioned well in preliminary testing. The results obtained indicate that an expanded configuration is appropriate as is the inclusion of embedded systems, wireless networks, e.g., 802.11x, and Bluetooth-enabled devices and networks. The integration of open-source Medical Packages is both feasible and planned, e.g., imaging and diagnostics.

The 'next step' in development is an advanced Prototype that integrates available open-source Medical and Health packages. When a level of

successful completion is accomplished, additional integrations will include Telemedicine, eHealth and more advanced Medical Devices.

Thomas Clark: A BSEE from the University of New Mexico and an MSEE from Wichita State University provided a basis for Electronic and Computer-based Control Systems in the fields of Military Ground and Airborne Radar, Fire Control, Navigational and Guidance Systems. A MSCS and an Engineer Degree from The University of Southern California provided a basis for Enterprise-level, Fault-Tolerant and Highly-Available Computer Systems and Networks. A BSL and a JD degree provided a basis for related fields. Recent activities include Telemedicine, eHealth, Public Health, Medical and Health Informatics, Embedded Systems and Networks, Electronic Record Systems, Reconfigurable and Personal Systems, Medical Devices and related Diagnostics Interests extend to Public Health, Patient-Centric Healthcare and Personalized Medicine.

Using Digital Pen and Paper to Improve Electronic Care Record Keeping, Boosting Productivity, Accountability and Quality of Social Care

Petter Ericson
Anoto AB, Sweden

***Abstract*: In the face of tight resources and growing workloads, social care providers are under constant pressure to deliver 'more for less'. Explosive demand for social services – for instance as a result of a rising elderly population – is not matched by higher staffing levels and a shift in resources.**
Anoto's Petter Ericson, co-inventor of Digital Pen and Paper (DP&P) will discuss how DP&P can help healthcare providers respond to these pressures by simplifying service management and delivery – without jeopardizing well-oiled, existing working routines.
The digital pen records carers' notes in real time, as they fill in care forms and deployment transcripts. The digital pen writes just like an ordinary ballpoint pen, with a tiny infrared camera at its tip tracking its movements relative to a nearly invisible dot pattern printed on the form. The data can then be transferred from the pen to a PC via a USB docking station or a mobile phone, and is immediately available for further processing.

ADAC Uses Digital Pen and Paper for Fast Entry and Analysis of Patient Data

Every year, ADAC-Luftrettung gGmbH, Germany's largest air rescue service, takes thousands of rescue flights. Every ADAC air rescue operation must be documented in detail – with an emphasis on speed, precision and efficiency.

The information is then needed for follow-up treatment in hospital, administration purposes and to settle charges with the various service providers, such as health insurance funds and insurance companies. Previously, everything was done manually, which meant a lot of time and effort was spent on filling out forms and capturing accurate data.

Various electronic data entry devices, including Personal Digital Assistants (PDAs), tablet PCs and a solution based on Anoto Digital Pen and Paper (DP&P) technology, were tested. The DP&P solution from Diagramm Halbach was the most convincing choice due to the ergonomics

and practicality of the technology.

The company developed a digital emergency doctors' log – 'dotforms® rescue' – in collaboration with ADAC-Luftrettung and the German army hospital Bundeswehrkrankenhaus Ulm. Verification software with handwriting recognition was also developed. The solution met one of ADAC's main requirements – the need to graphically illustrate and digitally analyze the correlation between different medical factors during the period of a patient's medical treatment.

The dotforms application now means fast, accurate data entry without any additional effort, as well as the ability to retain paper forms, which accompany the patients to hospital. Data capture with 'dotforms rescue' is now 4-5 times faster than when it was being done manually.

ADAC-Luftrettung has now decided to use the application at all of its 33 centres across Germany.

Bethesda Emergency Associates, Suburban Hospital, Bethesda, Maryland – Verifying Information in the Emergency Department

For doctors in an Emergency Department, getting documentation into the computer system quickly and easily is a major concern in their daily work.

It is important to ensure that documents are verified and contain correct and complete information. At the same time, learning new and complicated software is something busy medical professionals could do without.

A system using Digital Pen and Paper (DP&P) has helped doctors at Bethesda Emergency Associates at Suburban Hospital in Bethesda, Maryland, to simplify documentation. The system is electronic, but physicians can learn how to use it instantly.

Developed by Bartcharts LLC and PSR and incorporating Anoto DP&P functionality, the eBC system means that doctors can record patient information using familiar pen and paper and then transfer it directly into the system in digital format.

The eBC system is simplicity itself from the doctors' perspective. They simply print off the appropriate template from a computer at the beginning of their rounds, and complete the template during the patient examination, documenting items such as medical history, care and diagnosis.

While ease of use and speed is top of mind, the eBC system is also much cheaper than traditional solutions, providing savings that can be passed on to patients. The success at Bethesda has led to further orders for eBC, which is being introduced at two new locations.

Digital ‘Pain Diary’ Brings Relief to Palliative Home Care

In 2003, an academic study in Linköping, Sweden, tested the innovative use of Digital Pen and Paper technology in the care of terminally ill patients in their homes.

The application, developed by Anoto, gave palliative care patients the opportunity to use a networked digital pen to keep a ‘pain diary’ and register facts about their condition several times a day. This information was sent to medical staff via mobile Internet, leading to more precise and timely pain management.

The digital pain assessment method was considered effortless by patients in spite of their state of health. It helped that the digital pen resembles an ordinary pen and is easy to use, even for fragile or elderly patients.

Patients experienced an improvement in the contact with their caregivers and felt that they were participating more in their own care. The technology allowed patients to combine the comfort of being cared for in their own homes with real-time monitoring and control of pain levels.

In the next phase, the monitoring of heart failure patients will be studied.

Petter Ericson studied Engineering Physics at Lund Institute of Technology and joined C Technologies in 1997, where he worked as head of software development. In 1998 the world’s first consumer hand-held image processing device, the C-Pen, was launched. Two years later, Anoto was founded as a spin-off from C Technologies. Mr. Ericson currently works with R&D, and has filed patents for over 40 inventions in the field of image processing and digital pen and paper.

Using Digital Pen and Paper to Improve Provision and Management of Home Care in Sweden

Monica Edenståhl
Solna Municipality, Stockholm, Sweden

***Abstract*: In the Stockholm suburb of Solna (65,000 inhabitants) the local council has deployed Digital Pen and Paper technology to improve the management of its home care services.**
Monica Edenståhl will explain why Solna opted for this specific technology; how it has helped save the council over Euros 1.2m annually; and how Solna's success has led over 40 other Swedish municipalities adopting similar solutions.
In 2002, the delivery of home care in Solna was split between council staff and private home care providers. As there was no central record of carers' work within this new structure, the council could not maintain adequate quality control over its services. It finally found an effective way of addressing this by introducing Digital Pen and Paper (DP&P), which automatically captures handwritten information and converts them into keystrokes. A tiny infrared camera at the tip of the pen tracks its movements relative to a grey dot pattern printed on the form, recording and storing what is being written.
Home carers now use digital pens to record the exact time of their arrival and when they leave, the tasks performed and information about the patient's wellbeing. This has created much greater transparency for everyone involved.
Back at Solna's Home Help Centre, the pens are docked and the stored records are transferred to a central computer system. This means the council has an instant account of the level and quality of care provided and can confirm that care time is accurately recorded and paid for. The handwritten notes are signed and left in the home, where other carers or family members can then refer to them.

Digital Pen and Paper Solution Creates Security for Elderly

Simplicity and Security

Staff taking care of old people in their homes often do not have time to get to grips with complicated IT solutions, but as they are dealing with a group of vulnerable people the need for good documentation is paramount.

In Solna, a suburb of Stockholm, the local council has found that a solution based on Anoto Digital Pen and Paper technology has revolutionized their processes.

The Mobipen Care solution, developed by Swedish company Catrel using Anoto technology, is simplicity itself from a user's perspective. This is

vital in the home help service, where many of the workers are not used to IT and sometimes stay in the job for relatively short periods.

By properly registering every visit and every service provided for the patient in both written and electronic form, patients' families can be reassured about the level of care being provided, and care managers can ensure that procedures are being followed.

The digital pen means that there is an instant, contemporaneous account of the care provided that can be incorporated directly into the home help service's computer records.

Three Components

The solution has three components: digital pens, binders with special forms and docking stations for the pens. When care assistants visit people in their homes, they take the pens with them and note in the binders with special forms how the old person is being cared for. They make a record of when he or she has eaten, showered, and note any other observations, such as whether he or she was feeling unwell.

Staff members also use the pen to make a note on a sheet of paper by the door as to when they arrive and when they leave. Both this and the binder remain in the home to give families exact information about how their relative is being treated.

This can be particularly important in cases where the old person has dementia, and cannot remember whether care assistants have visited them. Families can then be sure of the care their relatives have received.

As the digital pen looks feels and writes like any other pen, this process is straightforward for all of the staff. The fact that the pen also stores everything they write in digital format goes unnoticed by the user.

A Precise Picture

Once the information is saved in the pen, it is taken back to Solna Home Help's office. Here, the pen is placed in the docking station, and the information on it transferred to the council's computer system.

This enables care managers to get a precise picture of how the home help service is working, and makes it easier for elected councillors to ensure that money is being spent effectively.

The solution is now being used in more than 40 Swedish municipalities, for example Sundbyberg, Kristianstad, Lomma and Karlskrona.

In Solna, 330 digital pens are now being used. Altogether, 3,000 digital pens are being used in different Swedish towns.

e-Mental Health: Enhancing Mental Health Services through Information and Communication Technology

Biofeedback, Virtual Reality and Mobile Phones for the Treatment of Generalized Anxiety Disorder

F. Pallavicini, D. Algeri, A. Gorini, C. Repetto, G. Riva
Istituto Auxologico Italiano,Milan, Italy
pallavicini.federica@gmail.com

Abstract: **Generalized Anxiety Disorder (GAD) is a psychiatric disease characterized by long-lasting anxiety that is not focused on a specific object or situation. Physical (relaxation and controlled breathing), behavioural (visualization and controlled exposure) and cognitive control strategies (challenging negative thoughts) represent a key part of the GAD treatment, even if they are hard to be acquired. To overcome this limitation the EU funded INTREPID research project (IST-2002-507464) proposes to improve the treatment of GAD through the use of a biofeedback enhanced virtual reality (VR) system used to provide both relaxation and controlled exposure. The patients are made aware of their reactions through the feedback provided by the VR environment in real time. Using mental exercises the patients learn to control their physiological parameters, while using the feedback provided by the virtual environment they become able to gauge their success. More, this experience is strengthened by the use of a mobile phone that allows patients to perform the virtual experience even in an outpatient setting, enhancing the patients' ability to deal with their symptoms in real life contexts. This approach was tested in a Phase II randomized controlled trial (NCT00602212), including three groups of 4 patients each (for a total of 12 patients): (1) the VR and Mobile group including biofeedback (VRMB); (2) the VR and Mobile group without biofeedback (VRM); (3) the waiting list group (WL).**

Introduction

Generalized anxiety disorder (GAD) is an anxiety disorder that typically has an early age of onset, a chronic course and a high degree of comorbidity with other anxiety and mood disorders [1]. According to the DSM-IV-TR [2] the essential feature of GAD is at least 6 months of "excessive anxiety and worry" about a variety of events and situations. GAD is usually treated with medications and/or psychotherapy. In particular, the two most diffused treatments are cognitive therapy and applied relaxation [3;4]. The EU funded INTREPID research project (IST-2002-507464) proposes to improve the treatment of GAD through the use of a biofeedback enhanced virtual reality (VR) system in order to facilitate the relaxation process. One of the main advantages of VR in association with biofeedback is the

possibility to create specific environments that can be controlled in real time by the physiological modifications occurring in the patient [5;6]. However, a critical issue related to the use of virtual exposure in the treatment of GAD is the lack of a VR system that can be used in the everyday situations: both the cost and the setting of the system limit its use to the health care centre/hospital/therapist's office. To solve this issue we included in the protocol a mobile phone, in order to provide the guided experiences also in outpatient settings.

Instruments and Methods

To test the efficacy of the proposed approach we set up a phase-2 controlled clinical trial. One hundred and five consecutive patients seeking treatment in a public health-care institute in Italy were screened for the admission in the study. Criteria for participation included the following: (1) Diagnosis of GAD, following DSM-IV-TR criteria; (2) Age between 18 and 50 years; (3) No psychotherapy received for GAD; (4) In case of taking pharmacotherapy, the kind and amount of medication had not to be varied during experimental period; (5) No history of neurological diseases, mental retardation, psychosis, alcohol or drug dependence; (6) No migraine, headache, or vestibular abnormalities.

Twelve patients who met the inclusion criteria, 9 female and 3 male, entered the treatment phase and were randomly assigned to one of the following groups: (1) the VR and Mobile group including biofeedback (VRMB); (2) the VR and Mobile group without biofeedback (VRM); (3) the waiting list group (WL). A semi structured interview was used to identify the relevant DSM-IV-TR diagnostic criteria for GAD in the sample. The following psychometric questionnaires were also administered to each patient at pre-treatment and upon completion of the clinical trial: *Generalized Anxiety Disorder -7 questions* (GAD-7), *Penn State Worry Questionnaire* (PSWQ); *Beck Anxiety Inventory* (BAI); *State-Trait Anxiety Inventory Form Y-2* (STAI-Y-2), *Hamilton Anxiety Rating Scale* (HAM-A).

The two experimental conditions that received treatment (VRM and VRMB) were also assessed at the beginning and at the end of each of the 8 protocol sessions using the following questionnaires: *State-Trait Anxiety Inventory Form Y-1* (STAI Y-1) and *Visual Analogue Scale for Anxiety* (VAS-A). At the beginning and at the end of each training session (the Heart Rate (HR) was recorded for 3 minutes. Finally, HR of the patients included in the VRMB group were also assessed during the treatment

sessions, in order to obtain and monitor the variations of their emotional state.

To study the efficacy of the different protocols, a repeated measured between subjects design with three experimental conditions was used. Specifically, the study included the following conditions:

Fig. 1 The control unit: a)a personal computer (Asus G2S;); b)a crosscable; c)a therapist's laptop (EEPC 100H - BK039X); d)A joypad (Xbox Controller); e)a head-mounted display (Vuzix iWear VR920

1. *Virtual Reality + Mobile Phone without Biofeedback Condition (VRM).* In this experimental condition patients received an eight-session VR-based treatment including both relaxation and exposure and techniques supported by HR biofeedback. From sessions 1 to 6, the patient explored a beautiful tropical island in an immersive condition (wearing a head-mounted display and a head-tracker) and following a predefined path leading to different relaxing areas: Campfire, Beach and Waterfall. Each experience was supported by an audio narrative based on progressive muscle relaxation and/or autogenic techniques. To improve the efficacy of the training and to increase the effects of relaxation, patients experienced at home, using a mobile phone, a non-navigable version of the same virtual reality environment experienced during the therapy. The patient was asked to train relaxation abilities at least once a day for the entire duration of the protocol. In session 7 and 8 the patient explored the island reaching a Gazebo in which he was exposed to pre-selected words or images related to his personal stressful events and was asked to use the learned relaxation techniques to cope with them.

2. *Virtual Reality + Mobile Phone with Biofeedback Condition (VRMB*). The patients experienced the same protocol described above, but with the support of biofeedback. Specifically, in the sessions with the therapist, HR personal variations were used to modify specific features of the virtual environment.

3. *Waiting List Condition (WL).* This was a control condition, in which patients not received any kind of relaxation training.

Results and Discussion

The main results of the study are reported in the tables.

The study offered three interesting results. On one side, it confirmed the possibility of using VR in the treatment of GAD. Both experimental groups improved their clinical outcome after the end of the treatment. On the other side, this study provides initial evidence of the better efficacy of the treatment for the VRMB group. Subjects belonging to this group reported higher decrease in the anxiety psychometric questionnaires after the treatment than both the VRM and the WL groups, even if the VRM group too reported some significant improvements at the end of the therapy. This study also supports the clinical use of a mobile phone to re-experience and anchor the contents of the VR sessions at home. When interviewed about the usefulness of the PDA, the majority of patients (91%) answered that they were very satisfied about it because it helped them to consolidate the relaxation training in the absence of the therapist.

In conclusion, this study represents the first experimental evidence that (1) VR can be used for the treatment of GAD; (2) in a VR treatment, patients take advantage of a mobile device that delivers virtual guided experiences in an outpatient setting; (3) the effectiveness of an immersive virtual relaxing environment, that helps patients to master the complex training of relaxation, can be reinforced using the patients' physiological data to modify specific features of the virtual environment in real time. Currently, on the basis of these interesting results, the project is still ongoing and twelve new patients have been selected to participate in the study.

Table 1 Demographic details by study group

	Group				
	VRMB	VRM	WL	F	p
Variables	Mean (SD)				
Age	41.25 (13.24)	48.5 (12.66)	51.25 (9.84)	.746	.502
Years of Education	14.25 (2.5)	11.75 (4.78)	10.25 (3.59)	1.164	.355

Table 2 Mean of HR differences between Pre and Post all sessions training

	Group	Mean	Std. Deviation
Mean of HR differences Pre-Post all sessions training	VRMB	4,67	3,327
	VRM	2,83	1,169

Table 3 Mean of STAI-Y1 and VAS-A differences between Pre and Post all sessions training

	Group	Mean	Std. Deviation
Mean of STAI-Y1 differences Pre-Post all sessions training	VRMB	6,7917	2,71761
	VR	5,2083	3,26886
Mean of VAS-A differences Pre-Post all sessions training	VRMB	7,7083	4,28782
	VR	6,4583	3,82563

References

[1] R. C. Kessler, K. A. McGonagle, S. Zhao et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States.Results from the National Comorbidity Survey. *Archives of General Psychiatry*, *51*, pp. 8-19, 1994.

[2] APA *DSM-IV-TR. Diagnostic and Statistical Manual of Mental Disorder. Text revision Fourth edition*. 2000.

[3] J. Siev, D. L. Chambless. Specificity of treatment effects: cognitive therapy and relaxation for generalized anxiety and panic disorders. *Journal* of *Consulting and Clinical Psychology*, *75*(4), pp. 513-522, 2007.

[4] H.U. Wittchen. Generalized anxiety disorder: prevalence, burden, and cost to society. *Depression and Anxiety*, *16*(4), 162-171, 2002.

[5] G. Riva, A. Gaggioli, D. Villani, A. Preziosa, F. Morganti, L. Strambi, R. Corsi, G. Faletti, L. Vezzadini. NeuroVR: an open source virtual reality platform for clinical psychology and behavioral neurosciences. *Studies in Health Technology and Informatics*, *125*, 394-399, 2007.

[6] J. Freeman et al. Relaxation island: virtual and really relaxing. In 7th *International Workshop on Presence*. Universitat Politecnica de Valencia, Spain, 2004.

Client-centered Design of Technology to Support Mental Health

G. Doherty[1], D. Coyle[1], M. Matthews[1] and J.Sharry[2]
[1]Trinity College Dublin, Gavin.Doherty@tcd.ie
College Green, Dublin 2, Ireland
[2] Mater Misericordiae Hospital, jsharry@mater.ie
CAMHS, James Joyce St., Dublin 1, Ireland

Abstract: **A variety of new technologies to support mental health treatment are emerging. Many of these technologies aim to improve access to treatment and to provide more engaging and relevant treatment to clients. However, technologies which suffer from usability problems or which fail to take into account the real needs of clients and the context in which treatment is provided are unlikely to succeed. There is a need to establish guidelines and processes to support the development of usable and useful technology interventions. Research on Human Computer Interaction (HCI) has yielded both general and domain specific guidelines and development processes, but further work needs to be done to deal with the unique challenges posed by the mental health domain. We outline a client-centered development process, drawing on prior research in HCI and experience gained through development of a number of e-mental health interventions.**

Introduction

Technology to support mental health can potentially address a range of problems, including difficulties encountered accessing services, engaging successfully in treatment and providing affordable treatment. Similarly technology can target a number of different contexts, including systems designed for use in prevention of mental illness, standalone computer-based treatments and self-help systems, and systems intended for use in conjunction with face-to-face psychotherapy. Within these contexts of use, systems may support monitoring of and self-monitoring by clients, communication (such as computer-mediated therapy), delivery of content (e.g. psycho-educational video material), and interaction with content (e.g. interacting with a Virtual Reality environment to support controlled exposure treatment for phobia). To date, a range of disorders such as depression, eating disorders and phobias have been targeted using a number of different technologies, including animated agents, 3D gaming, virtual

reality, and mobile phones. The space of possible technology interventions has been reviewed along with the state of the art in [1].

Addressing usability and human factors issues is recognized as critical for successful technology development projects, and research on HCI has resulted in a philosophy of User-Centered Design, in which end users are consulted early and often during the development process. System designs are generated through activities which involve end-users, and prototype systems are evaluated with real users. While many of these techniques may be difficult to apply in the mental health care setting due to ethical constraints and access problems, the motivation for using them remains. Clinical evaluations of technologies which have major usability problems or which do not match well with the needs, circumstances and interests of the client group are likely to discover little beyond the fact that the technology is unusable or un-engaging. That is, design problems with the technology may mask any positive effect associated with the technology intervention.

A Client-Centered Process

We propose that a client-centered design process be employed for the development of mental health technologies. Our recommendations on such a process represent experience gained through development of a series of therapeutic applications: Personal Investigator – a therapeutic 3D game [2]; PlayWrite – a content authoring tool for therapeutic games (used to produce a series of therapeutic games); the Mobile Mood Diary – a mobile phone based mood diary [3]; My Mobile Story – a mobile-phone and desktop based system for constructing therapeutic stories, and the ongoing development of the Technology Enhanced Therapy (TET) platform for online and mobile delivery and support of stepped care interventions.

The design process begins with a needs-analysis of end-users, both clients and therapists. Given the unique features of the mental health care domain, it is vital to design in collaboration with therapists, and we recommend that therapists be part of the design team. While collaborative design, involving domain experts, is desirable in most design spaces, it has particular importance in mental healthcare [4]. Few therapists currently have the experience and expertise required to design or develop new technologies or to rigorously evaluate them to the standards required for successful introduction to clinical settings. Equally, designers may be unfamiliar with clinical issues, therapeutic models and protocols. Collaboration permits a sharing of knowledge from each expert's domain. The designer needs to appreciate the sensitivity of the situation and be able to characterize

potential clients and to understand a therapist's motivations and typical working practice. User-centred design techniques such as workshops, roleplay, and paper prototyping may be used at the early stages to engage both clients and therapists in the design process. For example, prototyping involves creating physical representations of technological designs in order to provide feedback on design ideas. Prototypes incrementally embed functionality into the artefact through successive iterations. The use of prototypes can help end-users envision the potential for the proposed technology and the resulting changes in work practice.

Choosing a therapeutic model which complements the existing work practices of therapists and their clients is an important step in any design process. There are several ways in which this decision can affect system design. For example a therapeutic model can be incorporated explicitly into a tool, as in the Personal Investigator game which embodies Solution-Focused Therapy. Equally systems can seek to improve upon existing therapeutic tools or activities – the Mobile Mood Diary uses mobile and online technology to try to create a more engaging and convenient mood chart than the traditional paper-chart. Finally, systems can be open-ended and allow therapists to adapt and create their own therapeutic content – PlayWrite, My Mobile Story and TET platform take this approach, allowing therapists to incorporate their existing therapeutic models into the system.

Guidelines

Another aspect of HCI research is the development of domain-specific guidelines for new technologies. Specific guidelines for mental health technologies can include *design for outcomes*, *make the systems adaptable and sustainable* and *provide flexibility in the delivery of support*. Here we briefly expand on the example of designing for outcomes.

In technology development projects it is beneficial to set goals and identify outcomes which a system will seek to achieve. Many outcomes can be targeted which increase the capacity of services and provide larger numbers of people with access to professional support, e.g. computerised cognitive behavioural programmes can supplement face-to-face contact with therapists [5]. A second broad challenge is to improve the outcomes of interventions by improving the effectiveness of treatments and increasing the degree to which clients successfully engage with treatments. Depending on the nature of an intervention (disorder experienced, intervention method) systems can be developed which aim to support, as well as monitor [6], specific therapeutic outcomes (e.g. reductions in anxiety levels,

improvements in moods, improved coping strategies). It is also possible to identify broad objectives which contribute to the success of a wide range of interventions. For example, the quality of the client therapist relationship plays a significant role in the success of many interventions. Other examples of outcomes that might be targeted include improved client self efficacy, encouragement of increased levels of self-reflection by clients or designing to support behavior change.

A phased evaluation approach is important within the mental healthcare area; the framework for design and evaluation of complex health interventions of [7] provides a useful conception of the process ranging from the preclinical theory phase through to long term implementation. An important distinction from a systems development perspective is between *formative evaluation* and *summative evaluation*. Formative evaluation is an integral part of any user-centered process; the evaluation generates knowledge which is used to aid in the design of the application. This might relate to difficulties clients encounter in operating the system or engaging with the treatment and motivates changes to the design. In contrast summative evaluation seeks to quantify the performance of the system, and is typically the goal of a clinical trial. As part of a phased evaluation, peer-user evaluations of non-clinical aspects may be appropriate. For example the mobile-phone mood diary was initially evaluated with peer users not experiencing mental health problems [8]. This allows usability problems to be identified and rectified before proceeding to clinical evaluation.

References

[1] D. Coyle, G. Doherty, J. Sharry and M.Matthews, Computers in Talk-based mental health interventions, Interacting with Computers, 19(4), pp.545-562, 2007, DOI 10.1016/j.intcom.2007.02.001

[2] D.Coyle, G. Doherty, J.Sharry, An evaluation of a solution focussed computer game in adolescent interventions. Clinical Child Psychology and Psychiatry, 14, (3), p345 - 360, 2009, DOI 10.1177/1359104508100884

[3] M. Matthews, G. Doherty and J. Sharry, Mobile Phone Mood Charting for Adolescents, British Journal of Guidance and Conselling, 36(2), pp.113 - 129, 2008. DOI 10.1080/03069880801926400

[4] D. Coyle and G. Doherty, Clinical Evaluations and Collaborative Design: developing new technologies for mental healthcare interventions, Proceedings of CHI 2009, Boston, Mass., ACM, New York, 2009. DOI 10.1145/1518701.1519013

[5] Marks, I. M., Cavanagh, K., & Gega, L. (2007). Hands-on Help: Computer-aided Psychotherapy (1st ed.): Psychology Press Ltd.

[6] Percevic, R., Lambert, M. J., & Kordy, H. (2004). Computer Supported Monitoring of Patient Treatment Response. Journal of Clinical Psychology, 60(3), 285-299.

[7] Campbell, M., Fitzpatrick, R., Haines, A., Kinmonth, A. L., Sandercock, P., & Tyrer, P. (2000). Framework for design and evaluation of complex interventions to improve health. British Medical Journal, 321, 694-696.

[8] M. Matthews and G. Doherty, The invisible user, ACM interactions, XVI(6), pp. 13-19, November/December 2009. DOI 10.1145/1620693.1620697

Gavin Doherty is a Lecturer in the School of Computer Science and Statistics at Trinity College Dublin, and has led a number of projects on Technology in Mental Health. He is Principal Investigator of the Technology Enhanced Therapy project. He specialises in Human Computer Interaction research, and has a particular interest in design methods and designing for healthcare

David Coyle is a post-doctoral Research Fellow at Trinity College Dublin. He currently holds a Marie Curie Mobility Research Fellowship, based jointly with Trinity College Dublin and the University of Cambridge. His research focuses on the application of Human Computer Interaction methods to the design of technologies for the mental healthcare domain.

Mark Matthews designs systems to help engage people in therapeutic activities. He has worked on projects in this area ranging from therapeutic computer games to mobile support systems and online virtual environments. His research interests include mobile design for the self-management of mental health disorders and the use of play to develop relationships.

John Sharry is a Child and Family Psychotherapist at the Mater Hospital Child and Adolescent Mental Health Service and a founder and Director of the Parents Plus Charity. He is co-developer of the award winning *Parents Plus Programmes* (video based parenting courses) and the *Working Things Out* Programme (a multimedia therapeutic resource for young people overcoming mental health problems).

Do Patients with Severe Obesity Overestimate or Underestimate Their Body Size?

G. Aguayo[1], M. Larcelet[1], M. Vaillant[1], C.B. Pull[1,2]
[1]Laboratory of Emotional Disorders, Centre de Recherche Public Santé, Strassen, Grand Duché de Luxembourg
[2]Department of Psychiatry, Centre Hospitalier de Luxembourg, Strassen, Grand Duché de Luxembourg, gloria-.aguayo@crp-sante.lu

Abstract: **Background: Distortion of body image is common in patients with severe obesity as are psychological problems such as depression.**
Aims: **To assess body image perception in patients with severe obesity and to investigate the impact of body size overestimation on depression, anxiety, self esteem, body dissatisfaction, binge eating and quality of life.**
Methods: Body size (BS) perception was assessed in 185 patients (71.4% females, 28.6 % males) with severe obesity (mean BMI 42.1, min-max: 31.2-62.5) applying for gastric by-pass surgery, using "Virtual and Body" (PREVI), a virtual reality program. In addition, all patients were assessed for depression (Beck Depression Inventory-2), anxiety (Beck Anxiety Inventory), self-esteem (Rosenberg Self-Esteem Scale), body dissatisfaction and binge eating and drive for thinness (Eating Disorder Inventory) and quality of life (IWQOL-Lite).
Results: 3.2% of the patients underestimated and 58.4% overestimated their BS by more than 10% in comparison with the perception of an external observer. Patients overestimating their BS had a higher BMI, higher scores of bulimia and reduced quality of life.
Conclusions: Patients with severe obesity tend to overestimate their body size and tend to have special psychological characteristics.

Background

Obesity is nowadays a worldwide public health problem [1]. Severe obesity can have important psychological consequences such as depression, anxiety, low self-esteem, poor quality of life and negative body image [2]. Body image refers to a mental image that a person has of the physical appearance of their body [3]. It has been argued that body image dissatisfaction could be beneficial to motivate people to lose weight. It is more likely however, that this dissatisfaction erects emotional barriers which lead to increased eating and depression [4]. The scientific literature in this area is difficult to summarize, as there are findings supporting different conclusions: obese individuals overestimate, underestimate, or are accurate

regarding body size estimation. These inconsistent findings across the literature may be due to different measurement methods and varying sample sizes 4). Johnstone et al, using a novel digital morphing tool, have observed that obese subjects displayed poorer body perception than their lean counterparts and overestimate their actual body size [5]. Improved body image would be one of the main reasons for post-surgical psychological improvement, better social integration, and enhanced quality of life [6]. Virtual reality can be used as an assessment instrument for body image in obesity. Through the use of immersive virtual reality environments, it is possible to induce a controlled sensory rearrangement that facilitates the correction of biased body image [7].

Aim

The aim of the present study is to assess body image distortion in obese patients seeking a bariatric surgery by a virtual reality program. Furthermore, relations between these results and the degree of obesity, quality of life, depression, anxiety and psychological traits of eating disorders are investigated.

Methods

Subjects

All consecutive patients with severe obesity seeking bariatric surgery from September 2008 to August 2009 were assessed. Patients who were not able to understand or read German or French were excluded. All patients signed an informed consent form before evaluation. The study was approved by the national Luxembourgian ethics commission.

Anthropometry

Weight was measured in kilograms and height in meters to calculate BMI.

Assessments

- Depression: *Beck Depression Inventory 2*
- Anxiety*: Beck Anxiety Inventory*
- Quality of life*: Impact of Weight on Quality of Life-Lite (IWQOL-Lite)*
- Self-esteem*: Rosenberg self-esteem questionnaire*
- Body dissatisfaction and binge eating*: Eating Disorders Inventory (EDI).*
- Assessment of body image using virtual reality:

Body image was assessed in three steps, using a virtual reality program called “Virtual & Body” (PREVI). In the first step, an external observer

draws an "objective" image of the patient's body form. In the second step, the patient "draws" his/her body as he/she sees it. In drawing his image, the patient can change each part of the virtual body. In a third step, his/her image is compared with the image drawn by the external observer.

Statistical analyses

Comparisons were done using the Mann-Whitney test. Correlations were done using Spearman's Rho coefficient. All statistical analyses were done with PASW 18.

Results

185 patients seeking surgical treatment for obesity were assessed, 132 women (71,4%) and 53 men (28,6%), aged between 18 and 67 (mean=40,5 ± 11,1 years), with BMIs ranging from 31,2 to 62,5 (mean BMI= 42,1 ± 6,1). 3.2% of the patients underestimated and 58.4% overestimated their BS by more than 10% in comparison with the assessment of an external observer. BS estimation by patients was 12,8 % ± 12,5 higher than BS estimation by an external observer.

Patients who overestimating their BS most had significant higher BMIs, reduced quality of life, and higher bulimia scores on the EDI (table 1,

Test	Percentile 0-25 (n=46) Mean ± S.D.	Percentile 25-75 (n=93) Mean ± S.D.	Percentile 75-100 (n=46) Mean ± S.D.	P value
BMI	42.9 ± 5.5	40.4 ± 0.5	44.9 ± 7.2	*<0.001
Depression	12.2 ± 8.8	14.5 ± 10.4	17.3 ± 12.3	0.093
Anxiety	12.5 ± 10.5	13.5 ± 11.8	14.5 ± 11.3	0.722
Self-esteem	20.3 ± 5.7	19.0 ± 5.8	18.5 ± 6.2	0.372
Drive for thinness	0.4 ± 0.2	0.4 ± 0.2	0.5 ± 0.2	0.504
Bulimia	0.1 ± 0.2	0.1 ± 0.2	0.2 ± 0.2	*0.011
Body dissatisfaction	0.7 ± 0.3	0.7 ± 0.2	0.7 ± 0.2	0.576
Quality of life	40.8 ± 19.4	42.6 ± 21.1	51.4 ± 22.8	*0.045

Table 1 Differences of mean of psychological variables in three groups of percentile of body overestimation (test Mann-Whitney)

Mann-Whitney test).

Conclusions

Most candidates for bariatric surgery overestimate their weight. Patients who overestimate their weight more than the median of this population, have higher BMIs, decreased quality of life, and more binge eating than patients who do not overestimate their weight. In particular, there are significant correlations and differences between "overestimaters" and "non-overestimaters" with regard to bulimia scores and binge eating. In addition, severity of obesity is positively correlated with body image distortion i.e. severely obese patients tend to overestimate their BS more than those whose obesity is less severe.

All patients tolerated and accepted the virtual reality technique well. Patients can better imagine their body image and can change parts of the body separately. This is an advantage in relationship to traditional methods of body image assessment [8].

References

[1] S. Low, M. Chew Chin, M. Deurenberg-Yap. Review on Epidemic of Obesity. *Annals Academy of Medicine Singapore,* 38:57-65, 2009.

[2] T. A. Wadden, D. B. Sarwer, A. N. Fabricatore, L. Jones, R. Stack, N. S. Williams. Psychosocial and Behavioral Status of Patients Undergoing Bariatric Surgery: What to Expect Before and After Surgery. *Medical Clinics of North America*; 91:451-69, 2007.

[3] D. Garner, P. Garfinkel, H. Stancer, H. Moldofsky. Body Image Disturbances in Anorexia Nervosa and Obesity. *Psychosomatic Medicine,* 38:327-36, 1976.

[4] M. Schwartz, K. Brownell. Obesity and body image. *Body Image*; 1:43-56, 2004.

[5] A. Johnstone, A. Stewart, P. Benson, M. Kalafati, L. Rectenwald, G. Horgan. Assessment of body image in obesity using a digital morphing technique. *Journal of Human Nutrition and Dietetics,* 21:256-267, 2008.

[6] G. van Hout, F. Fortuin, A. Pelle, G. van Heck. Psychosocial Functioning, Personality, and Body Image Following Vertical Banded Gastroplasty. *Obesity Surgery*; 18:115-20, 2008.

[7] G. Riva. From virtual to real body: virtual reality as embodied technology. *Journal of Cybertherapy & Rehabilitation*, 1:7-22, 2008.

[8] A. J. Stunkard, J. M. Albaum. The accuracy of self-reported weights. Am J Clin Nutr, 34:1593–9,. 1981.

Experiences of Telerehabilitation on Articulation Disorders for Children

A. Hosokawa
Prefectural University of Hiroshima, Department of Communication Sciences and Disorders, hosokawa@pu-hiroshima.ac.jp
1-1 Gakuen-machi, Mihara, Hiroshima 723-0053, Japan

Abstract: **We built a videophone -based speech tel etherapy sys tem through the internet and provided rehabilitation services for 2 children with articulation disorders, who lived in a remote area.**

Introduction

Childhood articulation disorders are a type of communication disorder, which affects speech. Children with this disorder mispronounce words by omitting, distorting, substituting, or adding sounds. This is because it has been estimated miss-leaning on motion of pronunciations in development of speech.

Speech therapists (STs) provide rehabilitation services for individuals of all ages who have speech, language, and hearing disorders, including articulation disorders, which affect the ability to communicate with other people. There are more than 14,000 STs in Japan. However, patients in many remote regions do not have easy access to rehabilitation services for speech-language problems.

For treating patients in remote areas, telerehabilitation can be considered as an effective alternative. However, we need to investigate in a case-by-case manner whether telerehabilitation is as effective as face-to-face rehabilitation. Therefore, we administered videophone-based speech teletherapy for children who have articulation disorders. In this report, we discuss our experiences with such cases.

Method

Patients

The patients were 2 children (age, 5 and 6 years) who mispronounced Japanese sounds [s] or long “s” in International Phonetic Alphabet (IPA) (voiceless palato alveolar fricative: in English “[sh]e”) by substituting these sounds with other sounds (e.g., [k], [t], [ts]). These children live in areas that have no rehabilitation services for childhood articulation disorders.

Equipments

We built a videophone-based speech teletherapy system delivered over a broadband internet connection. The system is described below.

Therapist's PC

We set up a desktop personal computer (PC) with broadband connection; the PC was equipped with Windows OS, Skype, Real VNC viewer, and PacketiX VPN 2.0 client software, web camera, and headset microphone.

PC in the remote area

A note-type PC was installed at a nearby community health center with the same features as that of the therapist's PC. In addition, a printer and loudspeaker were installed.

Software

We describe the role of the softwares that were installed in the PC.

Skype: This software establishes the video-phone connection. We can communicate interactively through voice and video. Moreover, we can send some files (text or photo etc.) as an attachment through this connection.

RealVNC: This software enables the operation of the PC in the remote area from the therapist's PC. Therefore, once the patients switch on the PC, they need not further operate the PC.

PacketiX VPN 2.0: This software is used for establishing a virtual private network. We built a local area network virtually on the internet to increase the security in our system and to control the remote-area PC from the therapist's PC.

Goal of the Therapy

The goal of this therapy was to help children pronounce these sounds correctly. At the end of the telerehabilitation sessions, the children were able to pronounce Japanese speech sounds [s] or long "s" correctly in their conversation.

Therapy Methods

Our teletherapy methods are similar to face-to-face therapy. During teletherapy, the children were taught exercises for correct motion of the articulatory organ (lip, tongue, etc); the execution of these actions was the goal of the first stage of the therapy. After the children achieve this goal, they continue to perform these exercises using phoneme, syllable, words, and sentences in their conversations.

We use various cues to correct the articulatory motion. In face-to-face therapy, these cues may be verbal or visual or tactile. However, in teletherapy, we could not use tactile cue. Therefore, first, we visited the patient and performed a face-to-face therapy session for correcting the

articulatory motion by using tactile cues. At the end of the first session, we taught the children's parents and the community health-care nurse in that area to give tactile cues. From the second therapy session onwards, we performed teletherapy once in a week or once in 2 weeks. The frequency of these sessions was the same as that of face-to-face therapy.

Since children must exercise correct articulation repeatedly, the parents are encouraged to practice these exercises with the children at home everyday. We prepared the teaching material in text with photographs for home-exercises on the therapist's PC; this material was then transmitted via Skype to the PC at the community center, where it was printed. All these operations were performed by the therapist from his/her PC.

Result

One child pronounced these sounds clearly after 12 teletherapy sessions, while the other child pronounced these sounds clearly after 21 sessions. The children were seated in front of the web-camera during the teletherapy sessions.

Conclusion

Duration of 2–6 months may be required to achieve the goal of correct pronunciation if the teletherapy session is conducted once in a week or once in 2 weeks. Moreover, we were able to give personal attention to the children during every session of teletherapy. The therapy outcome obtained in these cases suggests that telerehabilitation is as efficient as face-to-face rehabilitation. However, we studied only 2 cases. We will include more patients in our future studies.

Acknowledgment

This work was supported by the Japan Society for the Promotion of Science (JSPS), Grant-in-Aid for Scientific Research (KAKENHI) for Young Scientists (B) 20700436, and France Bed Medical Home Care Research Subsidy Foundation.

The author is a licensed Speech-Language-Healing Therapist since 1997 and teaching therapist training course since 2005. He has 10 years clinical experiences of Speech-Language-Healing Therapist in hospital and care center for children with communication disorders. Four years of the 10 years, he had worked in hospital on remote island in Okinawa Japan. The experiments spurred him to research of tele-speech-language therapy systems.

Internet Addiction and Facebook

Milan Stojakovic
Department of Psychiatry, School of Medicine, University of Banjaluka, Banjaluka, Bosnia Herzegovina; misos@blic.net

Abstract: **Background: The aim of the study was to evaluate the relationship between Facebook users and Internet addiction (IA) by Telepsychiatric service. Facebook is a social utility that connects people with friends and others who work, study and live around them by internet. Method: A total of 100 facebook clients were studied with Free online telepsychiatric services. Internet Addiction Test (IAT) was used, by Telepsychiatric service, to assess state measures of symptom severity. IAT, developed by Dr. Kimberly Young, is a 20-item questionnaire that measures mild, moderate, and severe levels of Internet Addiction. First, we investigated facebook users by internet. Second, we evaluated for their severity of Internet addiction. Third, we investigated correlations between facebook and Internet addiction use by IAT. Results: Score: 16% clients without Internet Addiction;20-49 points (mild IA) had been founded 19 % clients;50-79 points (moderate IA) had been found at 18% clients (frequent problems with the Internet); 80-100 points (severe IA) had been found at 47% clients (significant problems with the Internet). Moderate and severe level off IA had been found at 65 % clients (facebook users). Conclusions: This study reveals a significant association between Internet addiction and facebook users (p<0.01). The data suggest the necessity of the continued examination off facebook users, evaluation and follow-up evolution of IA by Telepsychiatric service.**

Introduction

Addictive use of the Internet is a new phenomenon which many practitioners are unaware of and subsequently unprepared to treat. Some therapists are unfamiliar with the Internet, making its seduction difficult to understand [1].

Internet addiction disorder (**IAD**), or, more broadly, *Internet overuse*, *problematic computer use* or *pathological computer use*, is excessive computer use that interferes with daily life [2-3].

A **social network service** focuses on building and reflecting of social networks or social relations among people, e.g., who share interests and/or activities. A social network service essentially consists of a representation of each user (often a profile), his/her social links, and a variety of additional services [4].

Internet Addiction Test (IAT) developed by Dr. Kimberly Young, is a 20-item questionnaire that measures mild, moderate, and severe levels of Internet Addiction. IAT was used, by Telepsychiatric service. To assess your level of addiction, answer the following questions using this scale: 1=Rarely. 2=Occasionally. 3=Frequently. 4=Often. 5=Always. Questions include items: How often do you find that you stay on-line longer than you intended? How often do you check your e-mail before something else that you need to do? How often do you feel depressed, moody, or nervous when you are off-line, which goes away once you are back on-line, etc [1, 2, 5].

Face book is a social utility that connects people with friends and others who work, study and live around them by Internet.

Aim

The aim of the study was to evaluate the relationship between Facebook users and Internet addiction (IA) by Telepsychiatric service.

Methods

A total of 100 random facebook clients were studied with free online telepsychiatric services and 100 total of no facebook clients (control group). Internet Addiction Test (IAT) was used, by Telepsychiatric service, to assess state measures of symptom severity. Research instrument was IAT, developed by Dr. Kimberly Young, with 20-item questionnaire for measures different levels of Internet Addiction [1-2].

For statistical processing we used programs and methods by SPSS-10 and PASW-18 statistics for computer.

First, we investigated facebook users by internet and no facebook clients.

Second, we evaluated for their severity of Internet addiction.

Third, we investigated statistical correlations between both groups, especially facebook and Internet addiction use by IAT.

Results

Based on the goal front, we get the following results for facebook users:

- Score: 16 % clients without Internet Addiction;
- 20-49 points (mild IA) had been founded 19 % clients;
- 50-79 points (moderate IA) had been found at 18 % clients (frequent problems with the Internet);
- 80-100 points (severe IA) had been found at 47 % clients (significant problems with the Internet).

Based on the results front total moderate and severe level off IA had been found at 65 % clients (facebook users).

Also, we get the following results for no facebook users:

- Score: 65 % clients without Internet Addiction;
- 20-49 points (mild IA) had been founded 13 % clients;
- 50-79 points (moderate IA) had been found at 19 % clients (frequent problems with the Internet);
- 80-100 points (severe IA) had been found at 3 % clients (significant problems with the Internet).

Based on the results front total moderate and severe level off IA had been found at 22 % clients (no facebook users).

Table I and Table II shows statistical results by SPSS-10 and PASW-18 statistic programs ($p < 0.01$)

Table I

Internet Addiction Test(IAT)	Facebook Users		No Facebook Users	
	N	%	N	%
Clients without Internet Addiction	16	16 %	65	65%
20-49 points (mild IA)	19	19 %	13	13%
50-79 points (moderate IA)	18	18 %	19	19%
80-100 points(severe IA)	47	47 %	3	3%
TOTAL	100	100 %	100	100 %

Table II

Descriptives	Facebook Users		No Facebook Users	
Internet Addiction Test(IAT)	Statistic	Std. Err.	Statistic	Std. Err.
Mean	25.0000	7.35980	25.0000	13.73560
95% Confidence Interval for Lower Bound	1.5778		-18.7128	
95% Confidence Interval for Upper Bound	48.4222		68.7128	
5% Trimmed Mean	24.2778		24.0000	
Median	18.5000		16.0000	
Variance	216.667		754.667	
Std. Deviation	14.7196		27.47120	
Minimum	16.00		3.00	
Maximum	47.00		65.00	
Range	31.00		62.00	
Interquartile Range	23.50		48.00	
Skewness	1.957	1.014	1.653	1.014
Kurtosis	3.862	2.619	2.983	2.619

Conclusions

Only 16 % clients without Internet Addiction, 19 % clients with mild IA. Total moderate and severe level off IA had been found at 65 % clients (facebook users). This study reveals a statistically significant association between Internet addiction and facebook users ($P<0.01$).The data suggest the necessity of the continued examination off facebook users, evaluation and follow-up evolution of IA by Telepsychiatric service.

Acknowledgment

The author wish to thank all participants for their time and willingness to take part in this study. The authors report no competing interests.

References

[1] K. S. Young, Caught in the Net: How to Recognize the Signs of Internet Addiction—and a Winning Strategy for Recovery, 2001.
[2] K. S. Young Internet Addiction: Symptoms, Evaluation, And Treatment, Clinical Practice (Volume 17), 1999.
[3] S. Byun et al. Internet Addiction: Metasynthesis of 1996–2006 Quantitative Research. Cyberpsychology & Behavior, 12, 1-5, 2008.
[4] S. Hansen. "Excessive Internet usage or 'Internet Addiction'? The implications of diagnostic categories for student users." Journal of Computer Assisted Learning 18(2) pp. 232-236, 2002.
[5] J. J. Block. "Issues for DSM-V: Internet Addiction". American Journal of Psychiatry. 165:3; March 2008; p. 306-307, 2008.

Milan Stojakovic, MD, PhD is an expert for forensic medicine and psychiatry at the Medical faculty, University of Banja Luka, Bosnia and Herzegovina.

Education: Medical faculty, University of Banja Luka,YUgoslavia, graduate study M.D., 1989. Postgraduate study (M.Sc.) in Social Psychiatry 1993-1996 at Medical faculty, University of Belgrade.

1992-1997 - residency in psychiatry, Institute for mental health, Belgrade University of Belgrade, Yugoslavia. Exchange educational program in Japan 1996.(XI-XII) (Okinawa, Ryukyu University) (Department of Mental Health, Psychiatry, Faculty of Medicine, Department of Clinical Psychology) Medical faculty, University of Belgrade, specialization in forenzic psychiatry.

Affiliations: 1996-1997 Research Assistant UNHCR project:"Program of psychosocial help to refugees and displaced persons in Republic of Srpska", Regional centre Banja Luka , Republic of Srpska; 2000 Project manager for AMDA projects in YUgoslavia Project: Psychosocial help to refugees and displaced persons in former Yugoslavia with mental health problems; 1998 WHO EURO contact -responsible person for National Mental Helth R.Srpska - elect at the discretion of the Ministry of Health Republic of Srpska; 2000 president of AMDA Republic of Srpska chapter (Bosnia).

Introduction to LifeGuide: Open-source Software for Creating Online Interventions for Health Care, Health Promotion and Training

S. Williams[1], L. Yardley[1], M. Weal[2] and G. Wills[2]
[1]Centre for Applications of Health Psychology, School of Psychology, University of Southampton, UK L.Yardley@soton.ac.uk
[2]School of Electronics and Computer Science, University of Southampton, UK

Abstract: **This presentation will introduce 'LifeGuide'; free open-source software that allows people with no programming capabilities to develop, modify and evaluate online interventions. Online interventions are used in healthcare to assist service users to manage or change health behaviours or to provide e-learning modules to train and assess healthcare staff. The presentation will describe the software, provide examples of current LifeGuide interventions and give a brief demonstration of the tool.**

Introduction

The benefits of providing healthcare interventions online are well-known. The low-cost, 24 hour availability and global accessibility make them an important resource for both the intervention user and for policy makers [1]. Furthermore, internet interventions can be made available to large numbers of people therefore researchers can collect longitudinal data on the use and effects of intervention components in large samples.

Traditionally, the development of online interventions has been resource intensive. Each intervention is normally programmed individually by a team of programmers and the initial development of an online intervention can be more expensive than for other formats (e.g. face-to-face or printed). Moreover, once an intervention has been programmed it can be difficult to modify it. In contrast, LifeGuide enables people with no programming capabilities to develop online interventions in a cost-efficient and flexible way. This opens up online intervention development to people who may not normally have the resources to do so (e.g. postgraduates and early career researchers). Moreover, the software is embedded in a virtual research environment (the LifeGuide Community website) which allows researchers to share intervention components and therefore avoid costly duplication of interventions.

The LifeGuide Software

The LifeGuide software consists of an authoring tool (Fig. 1), logic and an intervention manager (Fig. 2).

The Authoring Tool

The authoring tool is used to create the pages of the intervention and has been designed to be easy to use to allow novice researchers to create their own internet interventions. Within the authoring tool users can add: their intervention content; interactive questions to obtain information from intervention users in order to provide tailored advice; buttons to navigate throughout the site; and images, videos and audio files. The look and feel of the website can also be changed using a flexible drag and drop interface to alter background, layout and colour whilst a templates function is also available to allow users to create a standardised design.

The Logic

The logic is a written set of commands that works behind the scenes of an intervention to make it run as expected; it is what makes the intervention work. It is the logic that allows intervention users to move from one page to another ensuring that they are directed to pages that are tailored to their situation. Logic commands can also be used to enable the intervention to: give personal feedback to intervention users; automatically randomise users into groups; automatically score questionnaire items, send automatic e-mails or text messages and lots more. More information about how logic is

Fig 1: The LifeGuide Authoring tool

Fig 1: The Intervention Manager

used in LifeGuide interventions can be found in our LifeGuide Researcher Manual [2].

The Intervention Manager

Completed and tested interventions can be uploaded to our LifeGuide server on the LifeGuide Community website (or on a researcher's own server) to run their intervention trial on the intervention manager. Here, researchers can collect research data and track participant usage of the intervention. All information entered by a user throughout the course of an intervention is securely stored and then can be exported from the intervention manager to Excel for analysis.

Creating Tailored Interventions

Interventions developed using the LifeGuide software can provide intervention users with key features for effective behavioural interventions. Interventions can be individually tailored for the website user and provide essential longitudinal support in the following ways: including diagnostic or assessment questions that can then be scored automatically; providing tailored (personalised) advice based on the intervention user's responses to interactive questions; helping users to plan and self-monitor their activities; and providing communication with peers and therapists through e-mails, forums and message boards.

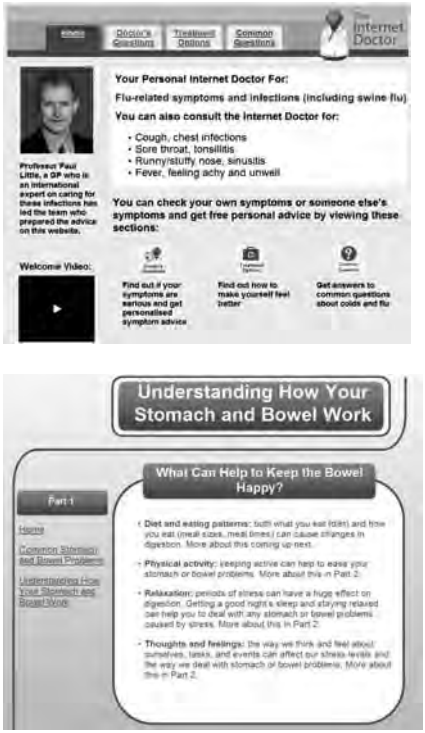


Figure 2: Example Internet Interventions

LifeGuide has already been used successfully to create interventions for: promoting hygiene behaviour to reduce transmission of pandemic flu; delivering tailored advice for self-management of cold and flu symptoms; delivering 8 sessions of cognitive-behavioural therapy for irritable bowel syndrome; and providing e-learning and assessment tools for health

professionals. Projects that are currently in development include interventions that aim to: aid smoking cessation; reduce antibiotic prescribing in GPs across Europe; reduce weight; and manage stomach and bowel problems.

Future planned capabilities of LifeGuide include the ability to link with medical records; connect to monitoring devices (e.g. heart rate monitors); and to deliver interventions through other communication modes (such as mobile phones).

The LifeGuide Community

The LifeGuide software is freely available to download from our LifeGuide Community website (www.lifeguideonline.org) where users can find a detailed user manual and support from others using the tool, share intervention components and find examples of internet-based interventions developed using the software.

Our LifeGuide community also allows networks of researchers to share whole or parts of interventions enabling collaboration, collection of larger datasets and the opportunity to flexibly modify existing interventions (e.g. translating them for use in other languages).

Acknowledgments

The LifeGuide project is funded by the Economic and Social Research Council (ESRC).

References

[1] F. Griffiths A. Lindenmeyer, J. Powell, P. Lowe and M. Thorogood "Why are health care interventions delivered over the internet? A systematic review of the published literature." *J Med Internet Res, 8(2),* e10, 2006.

[2] S. Williams, J. Joseph and L. Yardley "LifeGuide Researcher Help Manual" 2010. Available from http://lifeguideonline.org

Migrating Virtual Worlds to the Internet and Mobile Platforms

Brenda K. Wiederhold[1], Lingjun Kong[2] and Mark D. Wiederhold[2]
[1]Virtual Reality Medical Institute (VRMI)
28/7 Rue de la Loi, 1040 Brussels, Belgium
[2] Virtual Reality Medical Center (VRMC)
6155 Cornerstone Court East, Suite 210, San Diego, California 92121

Abstract: As virtual reali ty tec hnology continue s to mature , wider dissemination is occurring as th e I nternet and m obile platfor ms continue to proliferate worldwide. The rapid pace o f t echnological development is allowing for more creative and widespread development and im plementation of ne w clinical protocols and applicati ons. As healthcare c ontinues to migrate to non-hospital and n on-clinic environments, these pl atforms w ill enco urage both healthcare providers an d patients to innovate and experiment with individualiz ed applications that meet thei r needs. Jus t as the phar maceutical and genomics industries move rapidly toward personaliz ed medicine, the advent of adva nced digital technologies may g ive rise to wha t will be known as "Personalized Digital Medicine."

Introduction

Simulation technology has long been used to train individuals in highly specialized fields. For example, the U.S. Air Force and NASA used simulations to allow pilots and astronauts to practice maneuvers in a safe environment before attempting these complicated tasks in the real world. However, new applications of these technologies are enabling residents to practice surgery without endangering human life, encouraging patients to complete physical therapy without resistance, and allowing individuals to overcome their fears and distorted cognitions in the privacy of their clinician's office.

The applications of simulation technology in health care are numerous. Below is a partial list of the uses that are currently being investigated:

- Treatment of anxiety disorders, including specific phobias, panic disorder, agoraphobia, social phobia, and posttraumatic stress disorder;
- Treatment of eating disorders and obesity;
- Assessment and treatment of schizophrenia;
- Assessment and treatment of attention deficit disorder;

- Skills training in autism;
- Treatment and diagnosis of cognitive deficits;
- Physical rehabilitation;
- Management of chronic pain;
- Distraction from pain associated with medical and dental procedures;
- Quality of life in individuals with chronic illnesses;
- Empathy;
- Stress inoculation training.

For more than fifteen years, VR environments have allowed clinicians to treat patients more effectively and efficiently, without concerns of excessive cost, loss of confidentiality and limited safety that arise with many conventional treatments. The therapeutic benefits of using simulations are becoming increasingly well recognized and fully supported with results from controlled clinical trials. With more than 1,000 papers already indexed in Medline, it is certain that simulation technology is a strong force in health care.

As these methods have reached maturity, many investigators are now beginning to manipulate aspects of the VR environment that will maximize the effectiveness of therapy for individual patients and specific disorders. A challenge still remains, however, in the widespread adoption of this technology which is currently limited by requirements for in-hospital or in-clinic visits. Because of technological advances, many simulations are now able to be delivered over the Internet, as well as on hand-held portable devices. This allows for wider healthcare dissemination and personalization in the areas of prevention, training, education, therapy, and rehabilitation.

Noteworthy advances in mobile and handheld technology with their inherent significantly improved communications and graphical user interface representations are also providing an explosion of new possibilities for remote healthcare and next generation telemedicine applications.

Mobile platforms should not be viewed as replacing the more traditional systems currently in use in major medical centers and hospitals, but rather they should be viewed as providing a type of seamless and 24/7 access to healthcare. The combination of advanced, miniaturized sensors and rapid point-of-care testing will help to integrate the fusion of a new type of patient-centered healthcare delivery system paradigm. Although new, there are some preliminary studies that show advantages in using mobile platforms which primarily demonstrate efficacy in both patient education

and administrative support. It is now time to broaden the horizon and pursue additional clinical applications.

Some examples of virtual environments ported to the Internet and handheld devices include:

- Posttraumatic stress disorder (PTSD) VR treatment environments delivered via the Internet;
- Teen smoking VR treatment environments delivered via the Internet;
- Pain management VR environments delivered via a mobile telephone;
- Physiological monitoring and feedback delivered via a mobile telephone;
- Mental Armor Training delivered via an iPhone.

Posttraumatic Stress Disorder (PTSD)

Posttraumatic stress disorder (PTSD) continues to be a significant problem worldwide for populations affected by accidents, natural disasters, acts of terrorism, and violence. Pioneers in treating PTSD with VR-enhanced, physiologically facilitated prolonged exposure therapy with attentional retraining have shown that this skills based technology enhanced therapy approach can increase treatment effectiveness. For example, in Greece, children with special needs have been taught to cope with earthquakes. In the U.S. and Poland, troops returning from Iraq and Afghanistan have been successfully rehabilitated. And in Ireland, the U.S. and Korea, victims of motor vehicle accidents have been able to successfully drive once more. It has even been proposed that by placing Rwanda genocide survivors in, for example, a virtual field where crops have just been burned, a virtual church where a family is hiding, or in other virtual environments where a trauma has occurred, and then having them slowly experience that situation in a controlled way, the patient may begin to habituate to his or her specific PTSD symptoms and come to reappraise the situation, allowing full emotional processing to occur [1, 2] (Fig. 1).

These same worlds are also now being ported over the Internet to increase the availability and access of this successful regimen to more individuals. The VR worlds and clinical protocols used in the first ever randomized controlled clinical trial conducted by VRMC in collaboration with Balboa Naval Hospital, San Diego, have the capability to effectively treat those military members who have left active duty service and are now located in remote parts of the U.S. Many of these individuals suffer extreme hardship in trying to attend regular treatment sessions at facilities, many of which are located several hours from their home.

Stress Training

To attenuate or prevent PTSD in vulnerable populations, many groups are performing pre-exposure "stress hardening" or "stress inoculation" training. Initial reports indicate that this training can successfully prepare individuals prior to the exposure and may in fact help to reduce rates of trauma post-exposure. The goal of VR training is to teach tactical and/or trauma care skills, allow individuals to practice stress management techniques (e.g., combat breathing), and improve performance during real-life combat situations. Initially training performed in VR, these same treatments are now being ported to handheld devices including the iPhone to take advantage of "anytime, anywhere" booster sessions to decrease skill decrement and provide additional training. One example of this innovation is Mental Armor Training (iMAT) (Fig. 2). The way people think about a particular experience impacts current mood and how they think about future experiences. Created for use by deployed soldiers, iMAT serves to enhance soldiers' abilities to form accurate interpretations of the events they experience during deployment and in every day life [3]. The first study, being done in collaboration with the Arkansas Veterans Health System, the Southeast Louisiana Veterans Healthcare System and VRMC, is part of a study with U.S. Army National Guardsmen to determine physiological and cognitive interventions during overseas deployment. Not intended to replace diagnosis or treatment, this is a perfect example of how new portable technologies can extend healthcare and empower patients to become active participants in their own well-being.

Pain Management

VR worlds for pain management showed initial success in attenuating pain during wound care in burn victims. Funded by the National Institute on Drug Abuse, VR worlds developed to be run on either a laptop or desktop computers were tested during medical and dental procedures, as well as with chronic pain populations (Fig. 3). Results indicated a decrease in both anxiety and pain, subjectively as well as objectively (physiological signals). The challenge to then port these successful therapeutic strategies to handheld devices has been started. Initial human factors testing were completed with a mobile telephone product. Significant efficacy in a study of patients with chronic low back pain was found. Pain focus conditions vs. VR focus conditions indicated patients in the VR condition had a drop in heart rate and skin temperature as well as a reduction in self-report pain intensity ratings. As with the PC-based product, all participants reported a

drop in pain while in the cell phone pain VR environment, with significance ranging from $p < 0.05$ to $p < 0.001$, depending upon which of the three pain rating scales were used. Also, a significant decrease in heart rate ($p < 0.05$) and a significant increase in peripheral skin temperature ($p = 0.007$) while the participant was in the virtual environment substantiates the three self-

Figure 1. Posttraumatic Stress Disorder (PTSD) Virtual Environment

Figure 2. iPhone Application : Stress Training iMAT on iPhone

Figure 3. Virtual Reality Cell Phone Solution for Chronic Pain Management

Figure 4. VR Delivered via Internet and Cell Phone to Curb Teen Smoking

reported pain ratings, indicating a reduction in levels of pain and anxiety and suggesting that VR is an effective method of reducing distress [4].

Teen Smoking

Smoking is an addiction that kills 440,000 Americans each year, yet 2,000 adolescents begin smoking every day [5]. Reaching these smokers while they still have the chance to choose to quit is of utmost importance. In an Internet-based VR program (Fig.4), it is theorized that adolescents will

experience a reduction in urges to smoke and a decrease in the number of cigarettes smoked weekly. After regulatory approvals (IRB) were received, an initial study was performed with adolescents in San Diego, California (n=15). Participants indicated that keeping busy and doing physical activity distracts them from the desire to smoke. To favor mobile-savvy teens, the application is now being transferred to a cell phone platform.

Physiology

A portable medical device known as the Mobile Medical Monitor (M3) was developed and designed to be used in the field to support injury assessment through real-time vital signs monitoring. The multiple FDA-approved sensors were integrated into a portable, ruggedized existing military platform that allowed medical data to be transmitted over existing military bandwidth. As medical sensors continue to be miniaturized and contain wireless communications capabilities, the opportunities for continuous 24/7 non-invasive remote monitoring are today realities. There will be a need for advanced software programs that can manage, interpret, and signal to both the patient and clinician early warning signs and indications of subtle abnormalities. This approach will go a long way towards achieving the next level of preventive healthcare.

Acknowledgment

Research performed by the Virtual Reality Medical Center which is described in this study was funded by the following agencies: CDMRP; National Institutes of Health, National Institute on Drug Abuse; Office of Naval Research; RDECOM; and Telemedicine and Advanced Technology Research Center, U.S. Army.

References

[1] B. K. Wiederhold. Cyberpsychology, Behavior & Social Netoworking Journal. Special Issue on Posttraumatic Stress Disorder, vol. 13(1), 2010.

[2] B. K. Wiederhold and M. D. Wiederhold. « Virtual Reality for Posttraumatic Stress Disorder and Stress Inoculation Training. » Journal of CyberTherapy & Rehabilitation, vol. 1(1), 2008.

[3] Personal communication with Lauren Gay, Southeastern Louisiana Veterans Healthcare System.

[4] M. D. Wiederhold and B. K. Wiederhold. « Virtual Reality and Interactive Simulation for Pain Distraction .» Pain Medicine, vol. 8 (53), 2007.

[5] American Legacy Foundation, 2005.

Brenda K. Wiederhold, Ph.D., MBA, BCIA is President of Virtual Reality Medical Institute (VRMI), an SME incorporated in Brussels, Belgium. She is a licensed clinical psychologist in the U.S., Switzerland, and Belgium and earned a doctorate in Clinical Health Psychology as well as international certification in both biofeedback and neurofeedback. She serves as a Visiting Professor at the Catholic University in Milan, Italy is a Clinical Instructor in the Department of Psychiatry at the University of California, San Diego and as Executive Vice-President of Virtual Reality Medical Center (VRMC) in the U.S. She is also a Clinical Instructor at University of California, San Diego, Department of Psychiatry.

Dr. Wiederhold is recognized as a world leader in the treatment of anxiety, panic, phobias, and posttraumatic stress disorder with VR exposure and cognitive-behavioral therapy, objectively measuring results with physiological monitoring of heart rate, heart rate variability, skin conductance, skin temperature, respiration, and brain activity.

Dr. Wiederhold is the founder of the international CyberTherapy & CyberPsychology Conference series, now in its 15th year, Editor-in-Chief of the MedLine-indexed CyberPsychology & Behavior Journal, and publisher and Editor-in-Chief of the Journal of CyberTherapy & Rehabilitation and CyberTherapy & Rehabilitation Magazine. She is Secretary General of the International Association of CyberPsychology, Training & Rehabilitation (iACToR).

She has given invited lectures on the topic of advanced technologies and healthcare in 24 countries throughout Europe and Asia and has published more than 150 articles and twelve books on the subject.

Tele-rehabilitation of COPD Patients across Sectors

B. Dinesen[1], B. M. Ege[1], C. Nielsen[2], O. Grann[3], E. Toft[1], O. K. Hejelsen[1], S. K. Andersen[1]

[1]Department of Health Science and Technology, Aalborg University, bid@hst.aau.dk, Fredrik Bajers Vej 7 D1, 9220 Aalborg, Denmark
[2]Aalborg Hospital, Århus University Hospital, Denmark
[3]Vejgaard Healthcare Center, Healthcare Center Aalborg, Denmark

Abstract: **The aim of this paper is to explore the development of a tele-rehabilitation program across primary and secondary care, based on user-driven innovation. The paper is based on findings from an ongoing research and innovation project, called "Telehomecare, chronic patients and the integrated healthcare system" (the TELEKAT project). The project utilizes three sets of interventions, aimed at patients, professionals, and the organisation of care. The development of the telerehabilitation program across sectors based on a user-driven approach is shown to be a promising framework for avoiding the fragmentation and discontinuities that characterize so much COPD care.**

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a serious public health problem. COPD is presently the fourth leading cause of death in the world, with 2.75 million deaths worldwide [1]. According to the global strategy for the diagnosis, management and prevention of COPD, stable COPD is managed using a combination of interventions [2]. However, the question remains as to the most effective approach of delivering and coordinating multidisciplinary care according to the disease continuum and across the healthcare system [3]. Reviews of the disease management programs for patients with COPD shows that the programs are heterogeneous in terms of interventions, outcome measures and study design. However, quality of life is improved, and triple intervention programs resulted in lower probability of at least one hospital admission compared to usual care [3-4]. The reviews conclude that there is a need for more research on chronic disease management programs in patients with COPD across primary and secondary care. We have taken this challenge up in an ongoing research and innovation project, called "Telehomecare,

chronic patients and the integrated healthcare system" (the Telekat project). The project uses telehomecare technology to develop a new concept for rehabilitation of COPD patients across primary and secondary care. Telehomecare technology is defined as the care and treatment between the patient's home and health care professionals with the support of communication and information technology [5]. The target group is patients diagnosed with serious and moderate levels of COPD.

The aim of this paper is to describe the development of a telerehabilitation program across primary and secondary care based on user-driven innovation.

The Concept of Telerehabilitation across Sectors

In the Telekat project, three sets of interventions are implemented: those aimed at patients, at healthcare professionals and for the organisation of rehabilitation. A telehealth monitor box is installed in the patient's home. Using wireless technology, the telehealth monitor can collect and transmit data about the patient's blood pressure, pulse, weight, oxygen level, lung function, etc. via the Internet network, transmitting the data to a web-based portal or to the electronic health care record. Healthcare professionals such as district nurses, GP, nurses, doctors and physiotherapists at the health care centre or hospital can assess the patient's data, monitor the patient's disease and training inputs and provide advice to the patient. The patients and relatives can also view the data on the web portal but can decide whom they want to share their data with. The patient has the equipment placed in their home for 4 months. They receive an individual training program by a physiotherapist and may carry out home-based exercises. A telehomecare team consisting of health care professionals from primary and secondary care meet virtually to coordinate and discuss the individual rehabilitation program for the COPD patients.

Theoretical Framework

The organizational perspective is based on inter-organisational theory [6]. Traditional organisational theories tend to overlook the role of networks and rely on a more hierarchical perspective. Inter-organisational theories, in contrast, open the boundaries of the organisation. The patient perspective is based on a theory of everyday life [7].

Methods

Through user-driven innovation [8], the experimental project focuses on developing the rehabilitation offerings so that they can be utilised in the patients' own homes and from a multidisciplinary point of view. The data included ethnographic observations in the homes and qualitative interviews with patients (n=8), relatives (n=6), healthcare professionals (n=21) and representatives from private firms (n=5). The data collection process sought to identify the known and unknown needs and wants for COPD patients, relatives and healthcare professionals. The participants in the project have developed the tele-rehabilitation program using data from the researchers as discussed in workshops, a user panel and a network laboratory. A total of 82 patients with COPD are participating in the experiment, with 41 patients in an interventions group and 41 patients in a control group.

Ethical approval was obtained from the regional Committee on Biomedical Research Ethics and reported to The Danish Data Protection Agency.

Findings

Through the innovation process founded on a user perspective, a tele-rehabilitation program across primary and secondary care has been developed and is presently being tested. So far, the findings [9] indicate that the patients and relatives regard tele-rehabilitation as a useful concept. The patients use the monitored values as a guide for the type and extent of their daily activities. The patients can also use the monitored values as indicators of when a doctor or other health professional ought to be contacted, or when to begin self treatment. There is a striking difference in strategies of self-care, depending on whether or not patients live with a spouse. Patients living with a spouse may rely on that person to carry out strenuous chores, drive the car, carry groceries, and watch over them. Patients living alone have to rely primarily on their own capacity, although they may sometimes draw on their adult children or neighbors. These patients feel safer due to the collaboration with the health care professionals. The health care professionals regard the developed telerehabilitation program as a benefit to the patient because new channels of communication are created, making for enhanced collaboration across primary and secondary care. The benefits of the patients are in the form of more timely contact with the doctor or readmission to the hospital. Data on these issues will be analyzed after the project has been completed.

Conclusion

The development of the tele-rehabilitation program across sectors based on a user-driven approach has been shown to be a promising concept for avoiding the fragmentation and discontinuities of COPD care.

Acknowledgment

The Telecat project is funded by the Program for User-driven Innovation, the Danish Enterprise and Construction Authority, Center for Health Care Technology, Aalborg University, and by various clinical and industrial partners in Denmark (see www.Telekat.eu).

References

[1] I. Annesi–Maesano. "Epidemiology of chronic obstructive pulmonary disease", in Management of Chronic Obstructive Pulmonary Disease, "in *European Respiratory Society Journals*", pp. 41-70, 2006.

[2] R. Rodriguez-Roisin, A. Anzueto, J. Bourbeau, P. Calverley, T.S. de Guia, Y. Fukuchi. Global Strategy for the diagnosis, management and prevention of Chronic Obstructive Pulmonary Disease. Medical Communication Resources, 2009.

[3] A. Niesink, J.C.A. Trappenburg, G.H. de Weert-van Oene, J.W.J. Lammers, T.J.M. Verheij, A.J.P. Schrijvers. "Systematic review of the effects of chronic disease management on quality-of-life in people with chronic obstructive pulmonary disease", Respir Med, vol. 101, pp. 2233-2239, 2007.

[4] K. M. M. Lemmenes, A. P. Niebur, R. Huijsman. "A systematic review of integrated caer use of disease management interventions in asthma and COPD". Respir Med, vol 103, pp. 670-691, 2009.

[5] B. Dinesen. Implementation of telehomecare technology – impact on chronically ill patients, healthcare professionals and the healthcare system. Aalborg University, p. 26, 2007.

[6] C. Alter, J. Hage. Organisations working together, Newbury Park, Califonia, Sage Publications, 1993.

[7] L. L. Mørck, L. Huniche, "Critical psychology in a Danish context", *Annual Review of Critical Psychology*, vol. 5, 2006.

[8] E. von Hippel. Democratizing Innovation, MIT Press Cambridge, 2005.

[9] L. Huniche, B. Dinesen, O. Grann, E. Toft, C. Nielsen. "Empowering patients with COPD using telehomecare technology". Submitted to EFMI Iceland 2010. Unpublished

Birthe Dinesen, assistant professor at the Department of Health Science and Technology, Aalborg University, Denmark, PhD in telehomecare for chronic patients. Her research is centred on telehomecare, innovation and implementation of technology between organisations in the healthcare system.

Bernhard Ege is project engineer, in the Telekat project at the Department of Health Science and Technology, Aalborg University, Denmark

Carl Nielsen is a Consultant at Department of Pulmonary Medicine, Aalborg Hospital, Aarhus University Hospital, Denmark. He is clinical responsible for the Telekat-project.

Ove Grann is a general practitioner and specialist of family medicine. He works at Vejgaard Healthcare Center and Healthcare Center Aalborg, Denmark.

Egon Toft is Professor and specialist in Cardiology and Associate Dean responsible for Health Science at Aalborg University. His interest is in integrative technologies for the health care system and the organisational challenges the implementations of these technologies are met with. Furthermore he develops and implements new educations in the health area at Aalborg University.

Ole Hejlesen is professor at the Department of Health Science and Technology, Aalborg University, Denmark. His main research expertise is in the areas of physiology & modelling, telemedicine, telehomecare, medical decision support systems based on Bayesian networks, integration of decision support into electronic patient records and diabetes technology.

Stig Kjær Andersen, associate professor and deputy head of department at Department for Health Science and Technology, Aalborg University, has a PhD in Physics and is doing research and teaching in the field of Health Informatics. He has currently focused on Electronic Health Records, the information models and terminologies behind and, is in general interested in all aspect of "the right information to the right person on the right form at the right time".

Virtual Psychological Support: User's Personality Characteristics

M. Jordanova[1], R. Bojinova[2], L. Vasileva[2]
[1]Solar-Terrestrial Influences Institute, Bulgarian Academy of Sciences, Bulgaria, mjordan@bas.bg
[2]Institute of Psychology, Bulgarian Academy of Sciences, Bulgaria,

Abstract: **The p aper focuses o n r esults of a s urvey a ddressing the relation between the Big Five an d clients' motives and readiness to use Internet psychological consultations. The study was funded by National Science Fund, Bulgaria, project OHN 1514/2005.**

Introduction

Personality is a dynamic and organized set of characteristics that uniquely influences his or her cognitions, motivations, and behaviors in various situations. Contemporary researchers have agreed that there are five basic dimensions of personality nicknamed the "Big Five". Empirical evidence supporting the Big Five has been growing over the past 50 years, beginning with the research of D. W. Fiske in 1949 and expanded upon by other hundreds of researchers including Goldberg [1], McCrae & Costa [2-3] and other [4-5].

While there is a significant body of literature supporting this five-factor model of personality, researchers don't always agree on the exact labels of each dimension. However, these five categories are usually described as follows:

- Extraversion - Introversion: This trait includes characteristics such as excitability, sociability, talkativeness, assertiveness, and high amounts of emotional expressiveness. This is the least controversial dimension, observed as far back as the ancient Greeks;
- Agreeableness - Antagonism: This personality dimension includes attributes such as trust, altruism, kindness, affection, and other pro-social behaviors;
- Conscientiousness - Undirectedness: Common features of this dimension include high levels of thoughtfulness, with good impulse control and goal-directed behaviors. Those high in conscientiousness tend to be organized and mindful of details;

- Neuroticism - Emotional stability: Individuals high in this trait tend to experience emotional instability, anxiety, moodiness, irritability, and sadness;
- Openness to experience - Not open to experience: This trait features characteristics such as imagination and insight, and those high in this trait also tend to have a broad range of interests.

These dimensions represent broad areas of personality. As personality is a complex and varied, each person may display a combination of behaviors across several of these dimensions.

Material and Method

As a part of project OHN 1514/2005 funded by National Science Fund, Bulgaria and Bulgarian Academy of Sciences a survey, assessing clients' motives to use virtual psychology consultations, started in August 2009. The objective was to follow and/or the clients' attitudes toward Internet psychology consultations in relation to the five factor dimensions of personality (Big Five).

An extensive questionnaire consists of:

- A standard self-report inventory, measuring the Big Five dimensions;

- Questionnaire revealing subjects' motivation to use or not to use virtual psychology consultations.

This paper presents the results of the first group of 129 subjects (aged 18-65 yrs old, 4 age groups). When finalized, the survey has to include 300 subjects.

Results and Discussion

As a first step, we were trying to find out whether potential users are ready to use Internet as a media to receive psychological help and/or advice or prefer face-to-face contact with the expert. The respondents (subjects) were divided in 2 groups:

a) Ready to use e-psychology counseling and

b) Those that will not run the risk of searching virtual psychology consultations. Those that doubted are rejected from further analyses.

Comparing the two groups data revealed:

- A statistically significant difference in the *education level* of these two groups: The group that is ready to rely on telepsychology counseling consist predominantly of people with university education (71.5%), while in the group that will not rely on virtual psychology support only 33.3% had university education (comp. err. 17.8, $p<0.0001$, $z=\pm3.851$).

- The *frequency of Internet practice* does not influence the decision to run to virtual psychology support. In both groups subjects that exploit Internet daily or at least 2-3 times a week is close or exceeds 80% (85.6% from the first group and 79.1% from the second group).

- Results from evaluating the Big Five are presented at Figure 1. . The differences in readiness to use virtual psychological support are revealed more clearly in Neuroticism-Emotional stability, compared to the other dimensions. There is statistically significant difference between the two groups: 40% of subjects that will not use Internet for psychology consultations scored high on Emotional stability, while only 14.3% of subject from the group with high neuroticism had the same scores (comp.

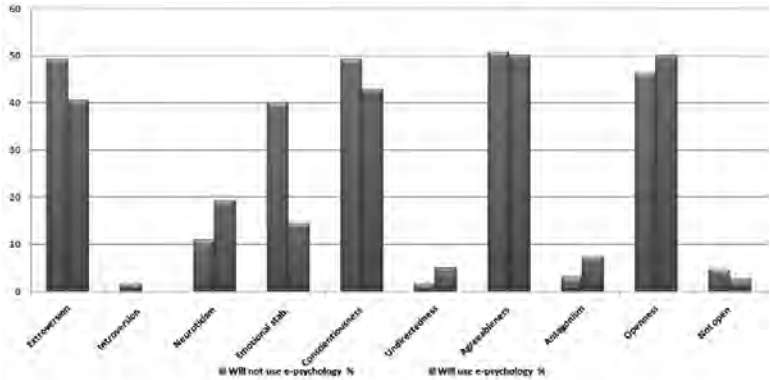


Fig. 1 Distribution in percentage

err. 15.9, $p<0.0046$, $z=\pm 2.835$).

- There are some differences found out between the two groups according to the main motives for using Internet to receive psychological consultations. For subjects with high level of neuroticism the leading motive is the feeling of freedom (I feel free) – no inhabitations, no conventions, while for those with high emotional stability it is "because Internet is my basic communication tool to form relationships with social environment, or to receive various health consultations". This tendency is in accordance with the characteristics of the two types of subjects and explains to a great extent their choices: to use or not to use Internet psychological consultations. Anxiety, uneasiness and psychological problems typical for neurotic subjects are logically in connection with their readiness to use psychological counseling via Internet that gives possibility to avoid face-to-face contacts. On the other hand, emotionally stable individuals do not feel

a systematic need of psychological support, but they would use virtual counseling because it is comfortable.

Despite of the fact that the difference between the two groups does not reach statistical significance, it is interesting to examine further the motives of the second group that will not use virtual psychology support. For this group Internet is a preferable communication tool, which is applied for communications and/ or to receive various health consultations. At the same time these subjects will not exploit Internet to receive psychology support. Is this because these subjects view physical and psychology health as not related?

Conclusion

Telepsychology is an excellent tool, offering psychological help to those who need it, no matter where they are and at what time of the day or night this happens.

The preliminary data of our survey revealed that both education and the Big Five may play significant role shaping clients attitude and readiness to use virtual psychology. They are influencing motivation to use virtual psychology counseling, too and have always to be considered. Further experiments are needed. Knowing more about motivation that drive people towards virtual psychological help will help psychologists in their contacts with clients. It will also prevent misunderstanding and will give a precious tool in the hands of experts to increase motivation in groups of sufferers and stimulate them to care more for their psychological health.

Acknowledgment

The authors would like to thank the NSF, Bulgaria for their funding of the project OHN1514/2005.

References

[1] L. R. Goldberg. Language and individual differences: The search for universals in personality lexicons. In L. Wheeler (Ed.), Review of Personality and Social Psychology, Vol. 2. Beverly Hills, CA: Sage, pp. 141-166, 1981.

[2] R. McCrae, P. Costa. Validation of the five-factor model of personality across instruments and observers. Journal of Personality & Social Psychology, 52, 81-90, 1987.

[3] R. R. McCrae, P. T. Costa. Personality trait structure as a human universal. American Psychologist, 52, pp. 509-516, 1997

[4] S. E. Hampson (Ed.), Advances in Personality Psychology, Vol. 1, : Psychology Press, Taylor and Francis Group, Hove, East Sussex, 2000.

[5] O. P. John, L. P. Naumann, C. J. Soto. Paradigm Shift to the Integrative Big-Five Trait Taxonomy: History, Measurement, and Conceptual Issues. In O. P. John, R. W. Robins, & L. A. Pervin (Eds.), Handbook of personality: Theory and research. New York, NY: Guilford Press, pp. 114-158, 2008.

Home Care and Assisted Living

A Context-aware Tele-homecare System for Senior Citizens

Shahram Nourizadeh[1,2], Y.Q. Song[1], J.P. Thomesse[1], C. Deroussent[2]
[1]Loria research center Lorraine University - INPL, Nancy, France
{shahram.nourizadeh, song, thomesse}@loria.fr
[2] MEDETIC – 18 rue du Nord, Colmar – France
{shahram.nourizadeh, claude.deroussent}@medetic.com

Abstract: **As part of a thesis at the Loria research center of National Polytechnic Institute of Lorraine (INPL) and MEDETIC, a non-for-profit organization, a tele-homecare system is developed. The segment of population, we are targeting is the senior citizens. This system uses home automation sensors and other environmental sensors like bed and chair sensors to monitor the activity level of the elderly. Activity patterns are analyzed by an intelligent application which is based on Fuzzy Logic to find any unusual behavior. The system is designed for the elderly who wish to spend their old age in their own home, because of its potential to increase independence and quality of life. This would not only benefit the elderly who want to live in their own home, but also the national health care system by cutting costs significantly. In a survey done by MEDETIC, a total of 24 elderly dependent people experiencing several types of limitations and leaving in 3 different residential home care units in France and 13 healthcare professionals were interviewed in order to measure user needs and technology acceptance. Results of this study provide us a great support to improve our system.**

Introduction

Telehomecare and home-based eHealth services are being used to maintain safety and independence among elderly. The concept of home-based eHealth that includes both telehomecare and the smart home is introduced in [1]. In this context, smart home refers to discreet illness and trouble prevention and monitoring of residents who may not receive other forms of home care, such as the disabled or elderly [1]. The major targets are improving comfort, dealing with medical rehabilitation, monitoring mobility and physiological parameters, and delivering therapy [2]. Smart homes contribute to the support of the elderly, people with chronic illness and disabled people living alone at home.

This New mode of health assessment can improve the quality and variety of information transmitted to the clinician. Measures of physiological signs and behavioral patterns can be translated into accurate predictors of health risk, even at an early stage, and can be combined with alarm-triggering systems as a technical platform to initiate appropriate action [3]. Home automation sensor and actuators are the main building blocks in smart homes. Home automation systems may be used not only to provide security, entertainment, and energy conservation, but also to make it possible for the elderly and disabled to remain at home, by providing an activity monitoring services.

Activity monitoring for healthcare can range from very simple alerts like the delay in window opening, to a complex intelligent application based system to analyze the activity patterns of the person in a long period, in order to determine any abnormal behavior in his daily life of any health problem and risks.

Challenges

Many telemedicine and e-health systems are being developed and many innovations and ICT-based emerging solutions are close to be operational, nevertheless the expected take-up did not occur yet, since proposed systems and their targeted medical benefits are certainly too segmented and disconnected the ones from the others. In this type of systems, several challenges need to be addressed. The technological challenges regard the generic features of the dynamic database, of the wireless sensor networks, of the different supporting platforms, of the video call center, and web services, to allow a flexible and smooth interaction among those items and to anticipate further additional functionalities, interacting devices, and so on. In addition, as the healthcare industry is turning to information technology to help solve its business issues, specially provide to quality patient care services, it is important to develop QoS (Quality of Service) specification in distributed telehealth systems [4].

Any failure or lack of performance on the system which could not be tackled in a reasonable delay may have some damageable consequences on the solutions' acceptance and development potential: the confidence is a basic and elementary factor of acceptance or reject, such incident could also generate a psychological defiance towards ICT's in general and towards such innovative assistance and monitoring services [5]. The lack of studies related to user needs is also a major barrier to the implementation of health care technology in smart homes. The biggest concern expressed by potential

users of home based health technology is "fear of lack of human responders" [6]. In this respect, the home based health care systems should be seen as a complementary for human care not as a substitute for it.

Proposition

The system has a distrusted architecture, and consists of client side and server side platforms. At the client side, a PC (home gateway), is the responsible to connect the home network with the server platform (database server, web server, application server…) via Internet. The system proposes many different services:

Activity monitoring and Comfort: By using Home automation sensor and actuators, the system uses a more passive method. It senses person's presence in a room by home automation sensors installed throughout the living areas, such as motion and presence detectors, light sensors.

Medical: Blood pressure, Blood sugar and Weight, monitoring. For instance, the system uses Bluetooth medical devices.

Communication: Video conferencing (with family or with a doctor), Internet, emails and instant messaging,

Multimedia: TV, Video and music on demand.

The system proposes also a management and control platform for remote access to the server platform or the home network.

The home gateway communicates via the home network with the home automation sensor and actuator networks and gathers the information. In order to process the information, on the one hand, the daily or weekly, activity patterns are analyzed in the central server for unusual behavior of a discrete illness, by using intelligent method based on Fuzzy Logic [5]. On the other hand, if the gateway detects any inactivity in a specific place, for certain time, it will generate an urgent local alert to a medical call center.

The application installed in the home gateway, has a management part also. This part is the responsible to detect any failure or crash in the sensor and actuators, in order to guaranty the right information about activities of the person and also to reduce the number of negative positive alerts [7].

In this system, a wireless camera network has been used for fall detection. Nowadays, the most used system for elderly fall detection is the alert buttons (a bracelet with a push button around the neck). Unfortunately, if the person forgets to carry the system, it is possible that the help does not arrive early. By using the cameras (a camera installed in every room) and the information provided by home automation sensors (Indoor localization),

the system will be able to follow the person and detect potentially dangerous situations.

Results

A distributed tele-homecare system is developed at the Loria research center, to remotely monitor activity and health state of the elderly by using home automation sensor and actuators and medical devices. The system is designed for the elderly who wish to spend their old age in their own home, because of its potential to increase independence and quality of life. This would not only benefit the elderly who want to live in their own home, but also the national health care system by cutting costs significantly.

Our first study shows that all the healthcare professionals have a positive attitude toward using ICT application. The majority of elderly declare not to know what ICT could do for them (45.83%); 37.5% of them think that they would be favorable to use ICT and 16.67% think that they would be unfavorable to use ICT. Our study shows that the limited knowledge about ICT does not lead to a favorable or unfavorable view [8].

By using this system, MEDeTIC, a non-for-profit organization, offers a new concept of smart homes for the senior citizens, named in French “Maisons Vill’Âge”. The first housing schemes are being built in 2 departments of France.

For further information please see: http://www.loria.fr/~nourizas and www.medetic.com.

References

[1] G. Demiris, Electronic home healthcare: concepts and challenges, Int. J. Electr. Healthcare 1 (1) 4–16, 2004

[2] M. Chan et al. “A review of smart homes—Present state and future challenges” computer methods and programs in biomedicine 9 1 55–81, 2008

[3] Marie Chan et al. “Smart homes — Current features and future perspectives” Maturitas October 2009 - volume 64 issue 2 Pages 90-97

[4] Ray Pradeep, G.Weerakkody, “Quality of service management in health care organizations: a casestudy” Computer-Based Medical Systems, Proceedings 12th IEEE Symposium, 1999

[5] S. Nourizadeh, C. Deroussent, Y.Q. Song, J.P. Thomesse, "A Distributed Elderly Healthcare System", MobiHealth2009, Porto - Portugal, 16 Jan. 2009

[6] P. Cheek, L. Nikpour,”Aging well with smart technology”. Nursing Administration Quarterly, 29 (4), 329-338, 2005

[7] S. Nourizadeh, Y.Q. Song, J.P. Thomesse, “A Distributed Fuzzy-based Failure Management for Wireless Sensor Networks” CTRQ2009, Colmar - France

[8] Boulanger, J. Reerink; Deroussent, C. “Preliminary Based Service Evaluation for Elderly People and Healthcare Professionals in Residential Home Care Units” Digital Society, 2008

Shahram Nourizadeh prepares a PhD in distributed healthcare systems and mobile ad-hoc sensor networks, at INPL (National Polytechnic Institute of Lorraine). He is Telehealth application/solution engineer at MEDeTIC. He holds a master degree in Distributed Systems and Communication Networks from university of Nancy and a computer Engineering diploma from Iran. His research interests include Routing, Mobility management and Fault tolerance in mobile medical and home automation sensor networks; Middleware and Dynamic QoS for sensor networks, Telehomecare and smart homes; Application of Fuzzy Logic in sensor networks and Telehomecare systems.

Ye-Qiong SONG is Professor in Computer Science at ENSEM-INPL, Nancy University, France, and responsible of the Lorraine doctoral training department in computer science (more than 150 PhD students). His research interests include modeling and performance evaluation of networks and real-time distributed systems by using queuing analysis, network calculus and scheduling theory, and the implementation of real-time QoS mechanisms in industrial networks, in-vehicle networks, IP networks, power line communication networks and wireless sensor networks.

Jean-Pierre Thomesse is Professor since 1981 at INPL He obtained his PhD degree in 1974 and « Doctorat d'état » degree in 1980. Member of TRIO research group of LORIA laboratory. He is now DRRT (Délégation Régionale à la Recherche et à la Technologie) of Lorraine. His research intresets are Design, modelling and validation of time-critical protocols and of distributed real-time applications and also telemedecine (time constraints specification, interprocess cooperation modelling).

Claude DEROUSSENT, physician, geriatrician, former doctor at the emergency service of Colmar Hospital, physician at the global emergency service of North Alsace, former elected official (pro-mayor , manager of elderly house building). Currently Liberal doctor. Founder and president of MEDeTIC.

E-technologies for e-Health and Assistance for Loss of Autonomy: The Important Role of University Networks through International Joint Degrees

L. Billonnet[1], E. Desbordes[2], J-M. Dumas[1], B. Lapotre[3]
[1]University of Limoges, Limoges, France, laurent.billonnet@unilim.fr
[2] Jean Favard High School, Guéret, France
[3] "Home automation & Health" Pole, Guéret, France

Abstract: **This article deals with the role that can be played in the Silver Economy by the universities through local territory initiatives. In this frame, international degrees can be considered for international networking in these domains.**

Introduction

To face the socio-economic and medico-social problems of elderly and disabled people, many territories in many countries have started local initiatives to find technical, medical, social and economical issues. In this frame, universities clearly have an increasing important role to play through many aspects:

- Universities can provide new specific trainings with new diplomas relative to assistive technologies including e-health (telecare and telemedecine) and also ICT systems (including home automation).
- Through research and academic exchange programs, university networks can provide new joint diplomas dealing with common territorial problems, for example through Erasmus and Erasmus Mundus programs.

The local initiative context

The department of Creuse today prefigures how large areas of Europe will stand within the next 20 years. The rural population of the department of Creuse is at now one of the oldest in Europe. To take benefit of this demographic reality, the district of Guéret (department of Creuse in France) [1], (19 towns for 29 000 inhabitants) decided, 3 years ago, to create the "Home automation and Health Pole".

The aim is to drive a coherent action plan in terms of comfort, safety, autonomy and communication for the elderly and disabled people. E-

communication techniques and networks technologies together with home automation management constitute the backbone of this rural healthcare initiative. It has to answer and fit the following objectives:

- Improvement of the living conditions of elderly people, in respect to their socio-economic environment, following ethical rules;
- Help for the development of home automation companies and associated services for health and assistance domains;
- Participation of the university and the education system in specific training and research programs.

More recently, different public and private partners have joined in the EnoLL program and as been validated as a "Living-Lab" [2], thus emphasizing the need for coordinating actions in the domain:

- The region (Limousin) and department (Creuse) councils;
- The hospital center of Guéret;
- The Legrand industrial group, world leader in home automation equipments;
- Axione, the regional telecommunications operator;
- The Chamber of Commerce and professional offices;
- A wide range of official organizations, foundations and medical centers which services are dedicated to elderly and disabled people;
- The University of Limoges through academic and research programs.

The context of building new diplomas

In conjunction to the Creuse initiative, the University of Limoges now proposes since september 2008, a BSc degree dedicated to "Home automation for elderly and disabled people" based on the use of e-technologies together with home automation techniques. Many industrial partners are involved in the academic program of the BSC to make sure it fits the job market requirements.

To emphasize as much as possible the benefit of its diplomas, the University of Limoges is also resolutely committed to expanding its international cooperation, at different levels:

- Through students and faculty mobility (through Erasmus and Leonardo programs);
- Through educational programs with the development of innovative joint diplomas.

The objective is to build new educational and research cooperative networks to share experiments and competences in technical and social domains.

At the first level, the “Home automation for elderly and disabled people” BSC has set up agreements (mostly through Erasmus) with partner universities to provide work placements abroad :

- VIA college university in Horsens, Denmark [3],
- DOMUS laboratory at the University of Sherbrooke, Québec, Canada [4],
- TUSUR Tomsk State University of Control Systems and Radioelectronics in Tomsk, Russia [5],
- Bogazici University (University of Bosphorus [6]) in Istanbul, Turkey.

Six of the 24 BSc students will do their internships in these partner universities in 2010.

Toward an international joint master degree

At the second level, the next step is now to build a new international joint Master diploma in the field of “Intelligent decisional systems for people in loss of autonomy”. Nowadays, the technology enables the first step of what is improperly called “intelligent housing”. In fact, for the people in loss of autonomy, technologies now just provide technical solutions in terms of home automation equipment, communication networks and connectivity. These technological means also enable to collect data and data from different sources (environment, user context, alarm and security parameters, telecare and telemedicine, equipment auto-diagnostic and maintenance). What is not yet provided is a way of interpreting such a multi-format information flow to extract prioritary decisional data. The objective is then to think new technical solutions from new e-technologies and advanced computer programming to intelligently extract the right information from a multi-agent context.

This project has started initially within the frame of the Franco-Norwegian Åsgard program [7]. This program is intended to:

- stimulate exchanges between France and Norway in terms of the expertise and scientific competences,
- emphasize the initiatives of cooperation in research & development,
- enable French and Norwegian researchers to extend their own international networks.

In this Master diploma project, several partner universities (from France, Belgium, Denmark and/or Norway) are now in the process of building together a complete master academic program for a new diploma opening in September 2012.

The objective is to establish, through the “e-technologies and ICT for elderly and disabled people”, an international diploma with which the students would take benefit of all the partner universities competencies. The students would perform a semester in each partner university to pass a single joint diploma.

The background of this diploma is also linked to two other mains objectives that are:

- stimulate exchanges from territory to territory between France and the other partners from a political point of view in order to develop common policies in a regions network,
- develop common research projects and participate jointly in European programs in the domain of “e-technologies and ICT” for the silver economy.

References

[1] http://www.cc-gueret.fr/ - Community of Communes of Guéret Saint-Vaury

[2] European Network Of Living Labs - http://www.openlivinglabs.eu/

[3] VIA University College in Horsens, Denmark - www.viauc.com

[4] DOMUS laboratory in Sherbrooke, University of Sherbrooke, Québec - Canada http://domus.usherbrooke.ca/?locale=en

[5] TUSUR Tomsk State University of Control Systems and Radioelectronics, University of Tomsk, Russia - www.tusur.ru/en/

[6] Bagazici University – University of Bosphorus in Istanbul, Turkey http://www.boun.edu.tr/index_eng.html

[7] Åsgard franco-norwegian program - http://www.france.no/pages/sciences/asgard_fr.html

Laurent Billonnet received the Ph-D degree in 1993 from the University of Limoges, and the Doctorat d’Etat degree from the University of Limoges in 2001. Currently, he is a Professor at the Ecole Nationale Supérieure d'Ingénieurs de Limoges (ENSIL), University of Limoges. Teaching topics are from automatics, internet protocols, electronics and computer engineering. His research topics are focuses on home automation and ICT for people in loss of autonomy. He is the Director of the BSc diploma “Home automation for elderly and disabled people”.

High Signal Resolution Pulsoximeter in Home Care Telemonitoring

R. Krzyminiewski
Medical Physics Division, Faculty of Physics, Adam Mickiewicz University, rku@amu.edu.pl
Umultowska 85, 61-615 Poznan, Poland

Abstract: **The study developed a computer analysis of digital pulse wave recording by linear transformation HSR to enhance resolution of pulse wave signal. The pulse waves were recorded using a standard electronic pulsoximeter working in a range of 660 and 940 nm. Thanks to resolution enhancement analysis appeared the details in pulse wave changes, invisible in standard record. New parameters were determined characteristic for particular peaks visible in a high resolution record.**

Introduction

A typical data record from pulsoximeter put on patient's finger gives information how well the arterial blood is oxygenated and pulse rate. The parameters of pulse wave, eventual pulse disturbances etc. are usually not analysed.

The study developed a computer analysis of digital pulse wave recording by linear transformation method [1] to enhance resolution of pulse wave signal (high signal resolution HSR).

Results

The pulse waves were recorded using a standard electronic pulsoximeter working in a range of 660 and 940 nm. The pulse wave signals were subjected to computer processing using linear transformation method enhancing their signal resolution [2,3]. Thanks to resolution enhancement analysis appeared the details in pulse wave changes, invisible in standard record. The results of such analysis are on Fig.1and 2.

a)

b)

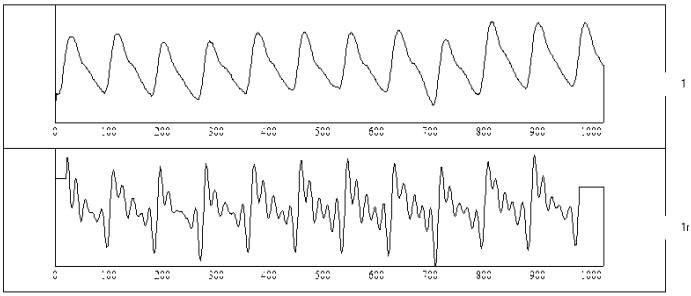


Fig.1. Pulse wave before a) and after high signal resolution processing b).

a)

b)

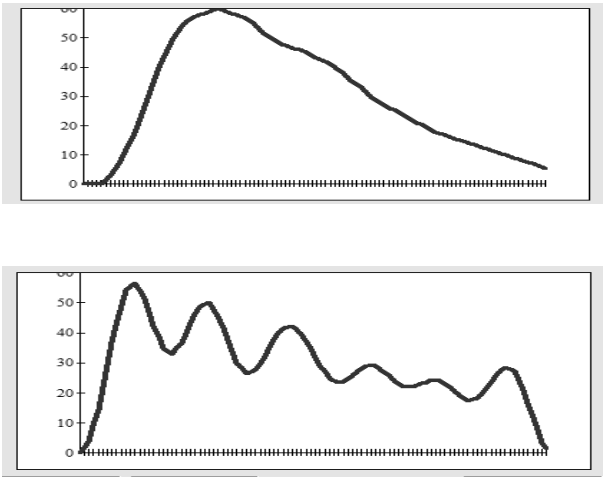


Fig.2. Original pulse wave of the one heart evolution before a) and after high signal resolution processing b).

To interpret the obtained results, the ultrasound signals received from brachial artery using Doppler method were compared to pulse wave HSR of the same patients, obtaining very good signal structure correlations Fig.3.

a)

b)

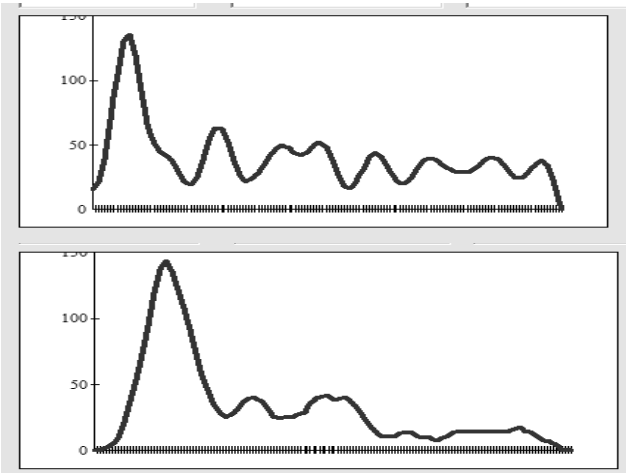


Fig.3. Pulse wave of the one heart evolution after high signal resolution processing a) and brachial artery Doppler signal of the same patient.

New parameters characteristic for particular peaks visible in a high signal resolution pulse wave records were determined. Typical presentation of the calculated results is shown on Fig.4. It was possible to determine the parameters of pulse wave HSR and to connect them with some parameters of cardiovascular system for example: vascular resistance, artery elasticity etc. To determine the standard values of above parameters the group of 55 people in age range 20-30 years was tested. It was stated that some parameters in pulse wave HSR record can be used as sensitive indexes of deviation from the norm in a case of people with cardiovascular diseases, hypertension and arrhythmia etc.

The telemedical network called MONTE (www.monte.net.pl) was established to connections between individual patients and a leading doctor or a doctor presently on duty or an expert centre in order to monitor the patient's health status using inexpensive pulsoximeter and Internet

techniques. Applied software has created this opportunity to extend the so-called, home care monitoring of the new method: pulse wave analysis HSR. Developed client-server software that permits the automatic transfer of pulse wave data to an analysing server and automatic results collection of that analysis by a patient in on-line mode. The results of an analysis were immediately send back to physician office or medical centre.
In this aim a server of Poznan Science-Technological Park of UAM Foundation was used. The time of such analysis was a few seconds.

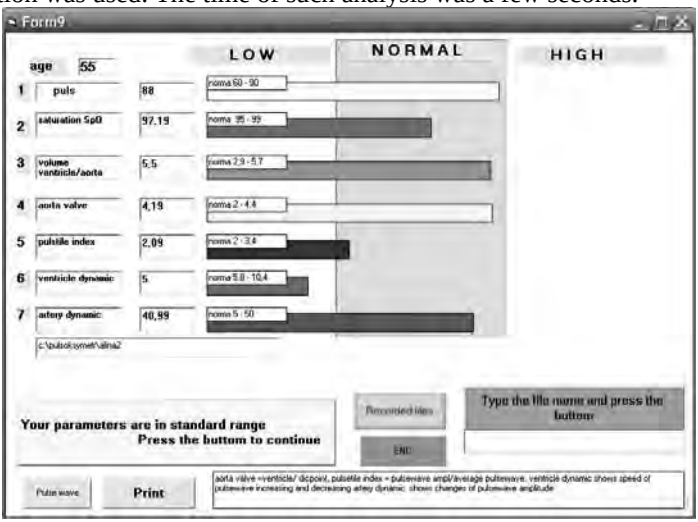


Fig. 4. Results of high signal resolution processing of the pulse wave

Currently being tested by patients practical functioning of the telemonitoring system using pulsoksymetry HSR within the broader system of medical telemonitoring MONTE is now tested by patients.

Because of its ease of use typical pulsoximeter and its automation, the services may be able to benefit virtually all of its own, including the elderly, bedridden sick. The process of pulsoximeter monitoring HSR can be planned in any sequence, for example in an hour and of course automatically signalises serious deviations from a norm in chosen calculated parameters.

Results of the tests of the MONTE telemonitoring system and high-signal resolution electrocardiography (NURSE-ECG) method show that the system allows more comprehensive analysis of the data from diagnostic apparatus by the use Internet and special or unique methods of signal

analysis. The system allows fast, inexpensive and non-invasive detection of changes either testifying to the threat of cardiac arrhythmia or muscle infarct in people whose standard e.g. ECG do not reveal any changes. The system includes better care for patients discharged from the hospital, improved control of patients staying at home.

References

[1] R.Krzyminiewski,"Computer enhancement of complex spectroscopic spectra resolution", Mol.Phys.Reports, 6,174-80, 1994.

[2] R.Krzyminiewski, "Telemonitoring System "MONTE" in Diagnosis of Heart Disease", Abstracts of 33rd International Congress on Electrocardiology and 47th International Symposium on Vectorcardiography, June 28th - July 1st, 2006, Cologne, Germany, PS7, 2006.

[3] R.Krzyminiewski,G.Panek and R.Stepień, "High resolution vectorcardiogram", Journal of Medical Physics, 24,181-185, 1999.

[4] G.M. London, J.Blacher, B.Pannier, A.P.Guerin, S.J.Marchais, M.E.Safar, "Arterial wave reflections and survival in end-stage renal failure", Hypertension 38, 344-348, 2001.

R. Krzyminiewski is a head of Medical Physics Division, Faculty of Physics, Adam Mickiewicz University Poznan, Poland at professor position. The one of main field of research is the application of spectroscopic methods EPR and ENDOR to investigate electronic structure of free radicals in biologically active compounds. The second field of scientific activity is numerical analysis of complex signals e.g. electrocardiography, pulse wave etc. I am the author of an original computer method for enhancement of spectral resolution of ECG and pulse wave records. He is author of telemedical monitoring network MONTE establish in Poznan in cooperation with Poznan Technology Park. This network MONTE is used to connection patient-physician, transmission and advanced computer analysis of patient medical data.

Home Automation for the Service to the Person: An Economic Stake in the Local and National Craft Market

S. Cherat[1], J. Chignac[1], E. Desbordes[2], M. Denis-Gay[3],
L. Billonnet[1], J-M. Dumas[1],
[1]University of Limoges, Limoges, France, laurent.billonnet@unilim.fr
[2] Jean Favard High School, Guéret, France
[3] CNISAM, National Center for Innovation in Health, Autonomy and Trades, Limoges, France

Abstract: **The dem ographic problem c onnected to the ageing of the population in the European countries comes along with a new spectrum of questionings in terms of care coverage and services, but also in terms of aging at h ome an d its conseq uences on economy and loc al cr aft market. In this context, the Limous in region, the oldest re gion in France and Europe, seems to be a pri vileged gr ound of experim ent especially in the field of home automation devices.**

Introduction

The increasing importance of aging at home opens new perspectives to technicians who are able to propose and implement adapted technical solutions which compensate the handicaps and delay the loss of autonomy. These technicians come from new university diplomas and fulfill the local craft sector's needs of new technical skills in particular in the frame of the law of February 11th, 2005 for the accessibility and the autonomy of the persons.

In this regional background, the Limousin's Chamber of Craft Trades has created the Innovation Pole for health, autonomy and trades in small enterprises (CNISAM) [1]. The CNISAM is an Innovation Pole (a label granted by the French ministry of SME's, Trade, Craft industries, Services and Professions and the ISM (The Institut Supérieur des Métiers). It aims to be a resource centre capable of identifying solutions adapted to the needs of small enterprises, and of coaching them in their development process through technologies and innovation.

The CNISAM leans on the existing French craftsmen's assets: variety, nearness and adaptability, to transform this one into a major actor of aging at home and adapting home for disabled persons.

To achieve this goal, the CNISAM helps the craftsmen to integrate sanitary, social and statutory environmental aspects and new technical skills in their professional practices, especially in the design of housing environnement and installation of home automation equipments. It is a centre of resources for the national network of the professional associations and the crafts sector. The CNISAM, with its partner's network, proposes tools and devices in the domains of housing design for the old and\or disabled persons, the accessibility of small shops, the conception of adaptable furniture, the application of healthy materials in the building, the innovation of the services linked to the aging of the population. It publishes, besides its news bulletins, data sheets on these subjects.

Reference “home automation” data sheets for the craft market

The University of Limoges [2], through its Bachelor's degree "Home automation and Autonomy of the Persons ", collaborates with the CNISAM in the conception of reference data sheets on home automation devices.

Intended to craftsmen, the challenges of this data sheets are:

- consciousness of the contribution of this device to aging at home or adapting housing environment for disabled persons,
- integration of the ethical aspects of using home automation device (respect for private life, dignity, limits of use..),
- capability to present all the possibilities offered by home automation devices in term of comfort, convenience of usage, safety and reliability,
- capability to elaborate a customized solution in adequacy with the life’s project of the person.

These data sheets consist of a description and an identification of:

- the handicaps,
- the corresponding technological solutions,
- the specifications for installation and use.

To realise handicap data sheets as precise as, we have consulted dedicated web sites but also met persons in loss of autonomy. The data sheets first list what should be known about each type of handicap and the underlying consequences, the method to be adopted face to the disabled person and also the main technological solutions to be proposed to the handicapped persons in respect to their project of life.

The handicaps are listed in five big categories.

The first one concerns all the visual deficiencies for which are specified five levels of deficiency, from the average deficiency to the absolute blindness. As mentioned above, the behaviour to have in face to this category of disabled person is also specified, in conjunction to the behaviour to the guide dog if there is one, and also a standard list of useful technological needs that can be of help for this kind of deficiency. These needs are sometimes very simple and basic to arrange or install. A light switch in contrast with the colour of the room, an adapted lighting of the rooms, a centralised command system for several house functionalities, the automatic closure of the motorised curtains with crepuscular sensors.

The hearing handicap is described according to the same approach. As the visual deficiency, the levels of deafness are described according to the hearing loss level. The distinction and the cause of the deafness (deficiency of transmission or of perception), the mixed deafness, and the nervous deafness (deep and total) are also described. For such deaf persons, the technical solutions will be directed clearly focused on compensation through a visual augmentation such as videophones or light signals.

The motor disability includes several aetiologies among which only the most important are presented. The deficiencies are classified according to the way the handicap arose (congenital, traumatism, ageing, disease, evolutionary, hereditary). A list of the technologies has been defined according to the demands and needs (automated doors, and windows, automated and/or programmable window shutters, centralised command system …)

The mental handicap turns out to be the most difficult handicap to evaluate because referring to a large field of pathologies. In fact, in this case, this handicap clearly has to be handled by medical specialists. The adequate solution can only be driven by these specialists in conjunction with the advices of engineers from the technological domains. A convergence must then be found including the medical and technical aspects to define personalised solutions.

The last category concerns the elderly people in loss of autonomy. As anyone knows, this category of the population is increasing and the “Silver Economy” is really a challenge for the next 20 years for all countries in the world. The data sheet states of economic and social parameters that have to be taken into account in the next years for the problem of the dependence of the aging people. The indoor and outdoor lighting of the houses, the global electric installation, the services to the persons through home automation

(light roads, sick call, fall detection …) and the telecare/telemedicine aspects are for example described.

In addition to the data sheets, we also provide a catalogue of about 30 home automation solutions that can be proposed to the handicapped person. Each technological solution is described in a dedicated data sheet. It covers all the aspects in the domains of lighting, heating, automated window shutters, safety, security, communication systems.

References

[1] CNISAM – http://www.cnisam.fr

[2] University of Limoges – www.unilim.fr/?lang=en

Jean-Michel Dumas received the Diplôme d'Ingénieur degree from the Institut National des Sciences Appliquées, Toulouse, in 1973 and the Doctorat d'Etat degree from the University of Limoges in 1985. Member of the technical staff of France Telecom research centre till 1994. Then, Professor at the Ecole Nationale Supérieure d'Ingénieurs de Limoges (ENSIL), University of Limoges. Teaching and research topics on high bit rate communication systems and IT for people in loss of autonomy.

Home Healthcare – Target Group Specific Access to Telemedical Services

A. Mertens[1], J. H. Dornberg[2], D. Dünnebacke[2]
[1] Chair and Institute of Industrial Engineering and Ergonomics of RWTH Aachen University
[2] Research Institute for Operations Management (FIR) at RWTH Aachen University

Abstract: **Due to demographic changes and increasing healthcare requirements on the one hand and stagnation of the financing basis on the other hand, the healthcare system in most industrial countries suffers from cost pressure. The system is forced to enhance their efficiency. To encounter these challenges, hospitals have reduced e.g. the exposure time of their patients. Hence homely rehabilitation is becoming increasingly more important. To ensure a reliable convalescence it is crucial to continuously control the recovery of the patients, but regular home visits by the physician are hardly possible or cost-intensive. Therefore innovative medical monitoring services have to be invented to ensure the patient's state of health at home. MeDiNa is a project with the objective to address this necessary access to telemedical services in order to meet home healthcare requirements within the interface between the physician and the patient considering the needs especially of elderly target groups.**

Introduction

The prospect of a longer life may appear charming to the individual, but current health care systems may face their biggest task so far in tackling this enormous challenge. Trapped in the dilemma of constantly increasing costs and the ever present expectations of high value medical health care, new solutions in providing the necessary services are needed imminently.

These trends are constraining the health care system to react. The system has already noticed the need of improving process efficiency and effectiveness. The result of the enormous cost pressure can be seen in a 25% shortened duration of hospital stay within the last 15 years [1].

Subsequent to the stay in hospital numerous medical procedures require patient care in a rehabilitation clinic (rehab clinic) in order to re-establish a state of health that enables independent coping with daily life. The rehab clinics seem to be overstrained with that increasingly early dismissal into

the stationary follow up treatment.The MeDiNa project [2] has identified these problems and works on the provision of technical as well as procedural solutions. A short cycle monitoring system at home is a key target for MeDiNa and will help to establish an early warning mechanism which identifies relapses in its earliest stadiums and also invokes necessary countermeasures.

State of Research and Medical Application

For the implementation of an integrative solution for the support of the rehab process by an innovative constellation of technical and organizational methods and systems some different fields of technology must be considered. Recent development and current conditions will shortly be introduced in the following.

With the establishment of the first networks of the integrated health care in 2004 a demand for systems emerged for IT systems providers, to support the cooperation of different medical service providers. Although at present the majority of providers of hospital information systems develop products for the support of these frameworks, the heterogeneity of more than 100 different information systems of hospitals and surgeries on the German market represents a substantial limit for larger benefits. By input of the legislator and supported by the activities of the project "bIT4health" (better IT for better health), a framework architecture for telemetric in the health service is currently developed. Thereby a standard is created, which will permit the exchange of clinical information between heterogeneous IT systems of different service providers.

With a multiplicity of diseases and injuries a two stage medical support is indicated by patients: After medical acute supply in the form of operations or other therapeutic interventions in the hospital, the patient is supplied for subsequent welfare treatment in a rehabilitation hospital, in order to re-establish the physical functions. Main indications for rehab therapy are cardiac infarcts, polytraumata, spinal column injuries as well as certain psychiatric illnesses. Due to positive correlation of the mentioned illnesses with the age and with consideration of the current demographic development it is to be forecasted that the incidences of these illnesses continues to rise [3].

Due to these circumstances a medical monitoring of the patient’s state of health has to be ensured at home as well. A critical state of the patient’s health must be promptly recognized and impending complications should be observed [4]. The support of the patient by the family doctor is insufficient. Regular home visits by the physician are hardly possible for temporal or monetary reasons for the physician or the clinic he worked for. Currently

there is no medical application that could provide such a homely rehab with a coherent flow of information on vital parameters between the doctor and the patient.

Approach

Based on rehab treatment trends new systems that not only cover the need for clinical information are necessary. These systems do have to enable technical and economical spanning, patient centered treatment processes and value adding services for the improvement in the quality of life.

To solve these requirements stated above a holistic approach is presented. It integrates innovative information and microsystem technology. Accordingly new healthcare services and business models must be developed to support therapy for elderly persons in the domestic environment. One of its core objectives is the integration of various devices for the capturing of vital signs and linking them to a central database via the internet, e.g. in a rehab clinic. Therefore, organizational and technical partial solutions are introduced and combined to an overall concept based on the developed platform.

Microsystem technology already includes many innovative devices and programs that can determine different vital signs. An integration of the components and the specific implementation in rehab pre and post care has not yet been realized. Because of a strong practical orientation of the mentioned challenges an interaction of case studies and action research affects this methodical approach (see figure 1).

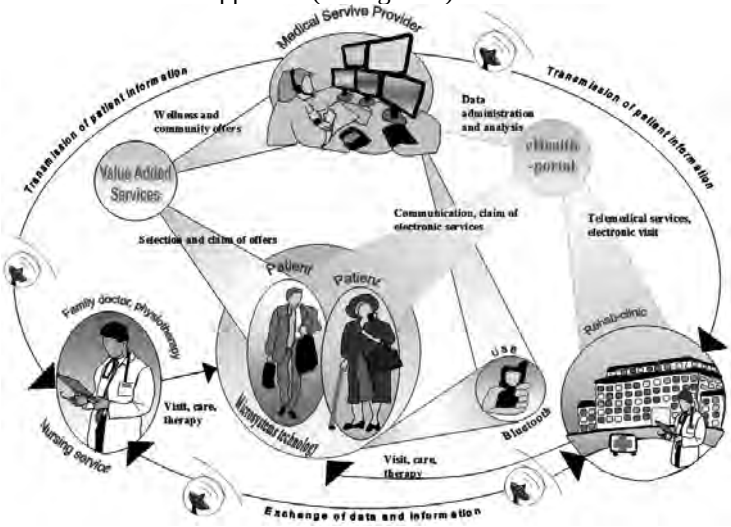


Fig. 1: Holistic solution for a scenario of microsystem supported services in medical aftercare

Design Patterns for interaction techniques for the elderly

The broad user interaction options made available through modern microsystems technology give the user (patient) access to numerous applications and services. However, the primary target group for MeDiNa are elderly people who must be considered rather untrained regarding computer literacy. The results are very individual user profiles that are hard to generalize. Due to the large field of action MeDiNa could possibly face once commercialized, a case oriented design of most systems appears to be unavoidable but would guarantee the covering of most patients in the overall target group.

This paper may only present one exemplarily design pattern. The used framework for formulizing the concepts consists of several segments that help structuring the content and the distribution as lingua franca. Within the scope of this paper only a simplified version of the pattern is applied as the focus is on application oriented solutions and not on creating a pattern language [5].

TRABING – Tremor swabbing away

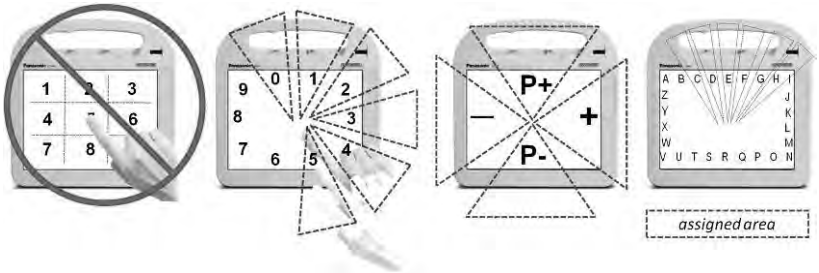
CONTEXT: To prompt your desires to a telemedical system when you have a strong tremor or suffer from restriction can be very unsatisfactory, as you cannot indicate special position with a sufficient accuracy.

PROBLEM: The size of buttons, check boxes, text fields or scrollbars of a graphical user interface (GUI) should be adapted to the user needs. For that reason modern devices that are handled by elderly people mostly offer barrier free GUIs where font size and contrast can be aligned or even image information can be read to the user. This process becomes problematically if the size of a region cannot be extended to a degree, that action tremor can be compensated and the number of relevant elements still fit on the screen.

SOLUTION: For integrating the mentioned user groups in eHealth scenarios, the implementation of an inconvenient method of interaction that compensates even strongest tremor is necessary. This is realized by not stopping the user’s input-movement at the screen border but letting him swab beyond. The detection is solely on the touch screen-surface but because of the sustained movement, the relevant information, namely the orientation, can be calculated. The action of two dimensional tangency is tracked and several parameters like starting point, orientation and acceleration are detected that can be used to estimate the desired choice. With help of an aligned algorithm the aberration of the tremor can be

compensated and the error rate for inputs can be downsized. An additional increase in precision is given through the continuous contact of the finger with the screen, as the friction coefficient serves as a damping effect on the symptoms of a tremor.

ILLUSTRATION:



Conclusion

In summary, this paper reports on two contributions:

1. Requirement Analysis in relevant scenarios for a telemedical approach of homely aftercare, which currently are not provided with sufficient solutions. For this, the economic influences coming with demographic change is given special regard with a new access to supply potentials.

2. Specification and functionality of the implementation of TRABING. Identification of relevant parameters for an efficient use among the target group. A first evaluation showed high acceptance from the subjects, a very fast learning curve and a significant decrease of the error rate for inputs.

References

[1] Klauber, J.: Krankenhaus-Report 2010. Schwerpunkt: Krankenhausversorgung in der Krise?, Schattauer 2010.

[2] Mertens, A.; Dünnebacke, D.; Kausch, B.; Laing, P., Schlick, C. M.: Innovation of homely rehab with help of telemedical services. In: *IFMBE Proceedings of World Congress on Medical Physics and Biomedical Engineering*, Dössel, Schlegel (Eds.), Munich. Springer, 2009.

[3] Behrens, J.; Schulz, M.; Schmidt-Ohlemann, M.: Hospital at home, ambulante Rehabilitation, Überleitungspflege und die ICF: Die Mobile Rehabilitation im Spiegel von Barhel-Index und Reha-Aktivitäten-Profil. 2003.

[4] Leidl, R.; Schweikert, B.: Kosten-Effektivität stationäre versus ambulante Rehabilitation bei Patienten nach akutem koronarem Herzereignis (SARAH-Studie): Endbericht; Rehabilitationswirtschaftlicher Forschungsverbund Ulm: „Bausteine der Reha“; Projekt 2;Teilprojekt:Gesundheitsökonomische Analysen, Ulm Hannover, Onlineressource, 2006.

[5] Mertens, A.; Przybysz, P.; Kausch, B.; Dünnebacke, D.; Schlick, C.: Adequate assistance for elderly people in Homely Rehab. In: Proceedings of intelligent interactive assistance

and mobile multimedia computing conference 2009, Communication in Computer and information science (CCIS), Springer, 2009.

Alexander Mertens.
October 2001 - December 2008 Academic studies in computer science at RWTH Aachen University, Human-Computer Interaction (HCI), Project Management & Object-Oriented Software Construction, Neurophysiology. January 2009 - today Research Assistant at the Chair and Institute of Industrial Engineering and Ergonomics of RWTH Aachen, Department: Human-Machine-Systems and Ergonomics, Requirements Analysis, Design of age-based user interfaces and assistance, Development of an design pattern language for the Ambient Assisted Living (AAL) domain process optimization

Jan Henrik Dornberg.
October 2003 - November 2009 Academic studies in Industrial Engineering and Management, Electrical and Information Engineering at Christian-Albrechts-University Kiel, Production and Operations Management, Business Management and Entrepreneurship. December 2009 – today research Assistant at the Institute for Operations Management of RWTH Aachen, Department: Information Management, Lean Information Management, Process-oriented Knowledge Management

Daniel Dünnebacke.
April 2001 – January 2008 Academic studies in computer science at RWTH Aachen University, Databases, Data communication, Functional programming. October 2002 - February 2009 - Academic studies in economics at RWTH Aachen University, Controlling, Macro economics, International business.
February 2008 - today Research Assistant at the Institute for Operations Management of RWTH Aachen, Department: Information Management, RFID & Auto-ID, Business process management, Evaluation of IT & eHealth.

Identifying New Market Opportunities in Telecare and Telehealth

Katy Lethbridge
E-Health Development Manager, South East Health Technologies Alliance
Suite 3, Leatherhead Enterprise Centre, Randalls Road, Leatherhead,
Surrey, KT22 7RY, United Kingdom

Abstract: **Market opportunities for telecare and telehealth companies have historically been limited by the procurement processes and organizational structures of traditional health and social care providers. But, with Governments and individuals requiring more effective and efficient care, technology-based care products and services are being viewed as a potential solution to the increasing pressure on care services. This will generate new market opportunities in telecare and telehealth.**

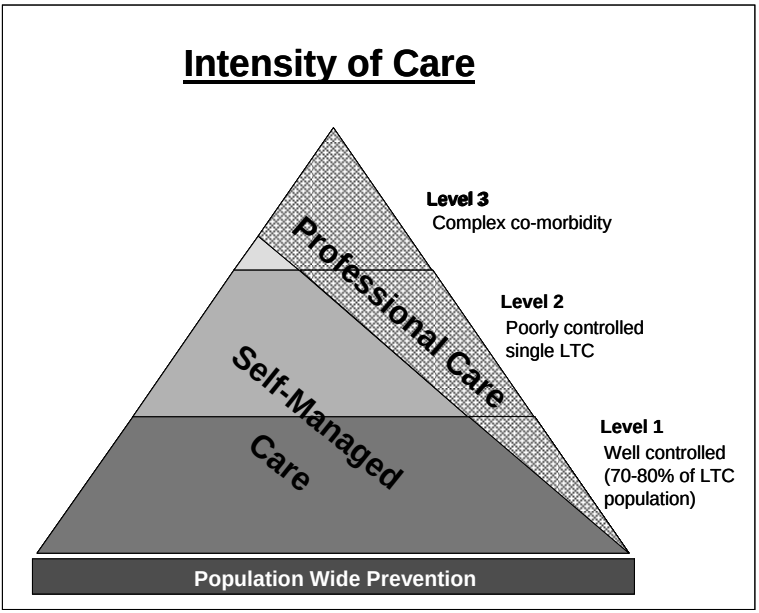
Currently, companies wishing to enter the telecare and telehealth market may encounter obstacles to building a sustainable business. Accessing statutory and traditional telecare and telehealth markets is often a difficult task for companies, especially SMEs, frequently requiring a level of sales effort disproportionate to the order quantities won. At the same time, only a small proportion of people who could benefit from the use of technology to support their care actually have access to it. Technology is mostly prescribed to support those with existing complex and/or severe long-term conditions (LTCs) and is infrequently used preventatively, limiting the market opportunities for companies.

However, several factors are driving the requirement for greater use of technology in health and social care. Population demographics show that the number of elderly people is increasing; in Europe, the number of people aged from 65 to 80 will rise by nearly 40% between 2010 and 2030. The ageing population and poor lifestyles will lead to more people suffering from LTCs. In England, LTCs already consume 69% of the primary and acute care budget. At the same time, the proportion of the population available to deliver professional and informal care is diminishing. Current methods of delivering health and social care will become unsustainable.

Pilot studies have shown that investment in technology improves the effectiveness and delivery of residential and domiciliary care. Evidence supports the value of remote monitoring for people with chronic diseases, which results in reduced risk of hospitalization, a reduction in the length of

hospital admissions and also in fewer doctors' appointments. Technologically-supported health and care services can help reduce demands on carers and provide better, more effective solutions for health and care. Governments are beginning to acknowledge the role that technology may play and are also professing a preventative agenda, to which technology could contribute.

Other factors are also driving market change. The figure below shows that the majority of the population self-manages their care. The advent of 'the professional patient', taking personal responsibility for their own health, will push towards the availability of 'elective telecare'. The technology-savvy generations will want sensor, information and communication technologies that they can purchase and access on demand.



The International Centre of Excellence in Telecare (ICE-T) was established at the end of 2009, by the South East Health Technologies Alliance (SEHTA) and the South East England Development Agency (SEEDA), to support and facilitate the establishment of sustainable businesses in telecare. In ICE-T, we define telecare as 'the use of information, communication and sensor technologies to deliver health and

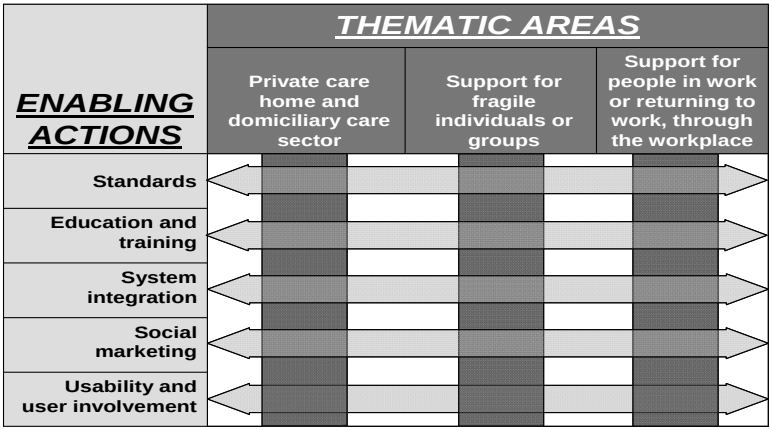
social support to people to help them live as independently as possible in the lowest intensity care setting consistent with their needs and wishes'.

ICE-T aims to identify and develop new market opportunities in telecare, whilst also addressing the inherent challenges of implementing technology-based care services. By focusing on user need and demand, rather than on technology push, ICE-T identifies specific areas where a care provider's or user's problems may be solved using technology. Activity is concentrating on potential new preventative and 'elective' markets. Opportunities have been identified in three thematic areas:

1. Residential care homes generally employ very little in the way of technology to support the delivery and accountability of their care, or the ability of the resident to communicate with external carers and family. It is a large and relatively untouched potential market for technology companies. In South East England alone the private care sector is a £10 billion industry.
2. Supporting fragile groups and individuals is another possible market for telecare companies. These are people who fall into the area of 'self-managed care' in the previous figure, mostly controlling their LTCs well, but vulnerable to life's stresses which may cause them to need acute care. These individuals may elect to use telecare preventatively, to monitor and help manage their conditions to reduce acute episodes. The individual themselves may choose to buy the telecare product or service, or their family may do so, in order to have reassurance about the safety and wellbeing of their loved one.
3. Supporting people with LTCs who are in work, or are returning to work after illness, is another area of opportunity. The annual economic costs of sickness absence and worklessness associated with working-age ill-health are estimated to be over £100 billion to the UK economy. This could be reduced by support delivered through the workplace. Companies could provide telecare support themselves or sub-contract the service to a specialist provider. Either way, the company would benefit from a workforce which was less prone to taking time off work due to illness or to attending doctor and hospital appointments. The company may even benefit from reduced private insurance premiums, if its workforce were supported by telecare.

Promoting these potential markets in 'elective telecare' should reduce the burden on statutory services, allowing them to concentrate on 'prescribed telecare' for those in most need, at the top of the 'Intensity of Care' triangle.

ICE-T also recognizes that there are many challenges to successfully implementing telecare services in any market, new or traditional - challenges such as: improving standards, both in the telecare technologies and in the delivery of telecare services; training of formal and informal carers and also users; integration of telecare systems; improving uptake and compliance through social marketing and user involvement. In the matrix below these challenges are defined as enabling actions which will open up the potential markets.



ICE-T is a means of addressing opportunities and overcoming challenges by providing the necessary infrastructure, facilitating the correct collaborations and seed-funding innovative projects which develop telecare products and services that meet the established needs of care users and providers.

Katy Lethbridge joined SEHTA in November 2008 as Project Development Manager. SEHTA had several large projects developing in the area of telecare and e-Health and created the new position of e-Health Development Manager. She started working life as an analytical chemist in the QA laboratories of Upjohn Pharmaceuticals. Since then she has worked in various sales and marketing roles including, immediately prior to joining SEHTA, as a business development professional for M-Scan Ltd, a contract analytical laboratory serving the bio/pharmaceutical industry.

Information System Architecture for Home-Care Workflow Management

R. Bastide[1], S. Zefouni[1,2], E. Lamine[2], H. Pingaud[2]
[1] IRIT, CUFR J.F. Champollion, ISIS, (szefouni, remi.bastide)@univ-jfc.fr
Avenue George Pompidou, 81104 Castres, France
[2] EMAC, Centre de Génie Industriel, (lamine, pingaud)@enstimac.fr
Campus Jarlard, Route de Teillet, 81013 Albi Cedex 09, France

Abstract: **In this paper, we present an Information System that improves the management of the workflows involved in the homecare activity. Homecare workflows are modeled using the BPMN (Business Process Modeling Notation). An electronic version of the liaison logbook serves as the user interface of the workflow system. The alarms and information that are relevant to the carer's activity (nurse, doctor...) are readily available when she logs into the system at her arrival. The tasks to be performed are indicated, and the carer has the opportunity to indicate whether and how these tasks have been performed. Each of the carers also has the opportunity to transmit relevant information to the other carers. The transmission of information from the home to the homecare association and back is also handled by the system. Finally, the instantiation of new workflows is made easier by the definition of patients' profiles that define typical workflows that might be useful for a specific type of patients.**

Introduction

The demographic statistics on the aging of the population in France and Europe are eloquent. France now counts 14 million people over age 60, so 21% of the population. According to estimates [1], their number will almost double in the next ten years. Increased life expectancy leads to a more than proportional increase of the 'fragile' persons. Direct consequence of this finding is the increased cost of care and hospitalization.

The transfer of some hospital care to home is one of the most explored tracks for the future. So many projects are seeking new organizations and infrastructure able to provide care at home for people with diminished autonomy [2], [3]. However, referring to the main conclusions of the specific CNRS action 2HM (Hospital out the walls) [3], today, there is not really, to our knowledge, works addressing the definition of a generic system architecture for keeping patients at home.

The research project PASPORD aims to develop the homecare of semi-dependent people in loss of autonomy, through a collaborative platform. This project proposes to combine an intelligent system for detecting dangerous situations at home with a support system to coordinate the various activities involved in the assistance mission.

The remaining of this paper is structured in two parts. The first one is focused in a description of the homecare and the system architecture that we propose to improve it. In the second part, we present a case study on the use of the proposed system. This case study concerns the detection and monitoring of malnutrition in the elderly.

Current Organization of Homecare

The various actors involved in homecare are either professional (nurse, doctor, etc.) or specialized organizations with their own structure and operating rules. Generally, an association that specializes in this area of homecare (SHN: Service Home Nursing) intervenes in the management of each case and it is responsible for coordinating the actors. It establishes and maintains the *'liaison logbook'* (presented in the next section).

The *'liaison logbook'* is generally an unstructured, physical notebook that is kept at the elderly's home. It is used for communication between the family and the various stakeholders. Each stakeholder notes the date of the visit, comments, recommendations or any other form of comments on this logbook. This liaison logbook contains very useful data, underused in the homecare process. Indeed, it stores information of different types: logistical information which helps for the coordination of activities, medical information, general information on the patient, any information which may help improve the quality of the homecare and possibly the detection of the patient health change via an intelligent monitoring system. It plays a central role in the various processes of homecare. Seen that is the primary means of communication between different stakeholders. This mode of communication has several limits. In particular, a communication that is not always clear and reliable and there is lack of privacy and security.

Our goal is to provide a collaborative system that helps improving the homecare process. Improving homecare implies better detection and prevention of incidents or of degradation of the elderly's health, as well as improved means of communication and coordination of stakeholders (to overcome the limitations of the liaison logbook). Thus, the proposed architecture aims to achieve these objectives. The architecture is shown in Fig 1. It represents the various tools used in homecare association, by

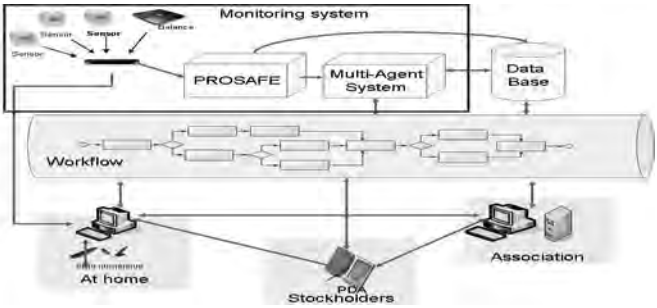


Fig. 1 Overall Architecture Project PASPORD

stakeholders and at the elderly's home. The idea of this architecture is to have a surveillance system to detect dangerous situations. This is performed by PROSAFE [5] a system developed at LAAS, combined with a multi-agent system (MAS) to interpret sensor data [6]. Information from sensors is interpreted, and combined with information in the liaison logbook before being stored in a database. A workflow engine [7] coordinates the work involved by transmitting the necessary information and tasks, with different stakeholders, depending on the condition of the patient's treatment plan and the role of the interveners.

Case study

We propose a case study on the detection and monitoring of malnutrition for the elderly. Malnutrition among the elderly has dramatic consequences. When the elderly suffers from malnutrition, the risk of death is two to four times higher. The best way to fight against malnutrition is to detect it as early as possible. Especially, there are simple ways to detect malnutrition. Most studies [8] agree on screening for malnutrition based on some criteria like weight loss over time. According to the causes of under nutrition, the treatment plan is different.

We propose a system that helps detecting malnutrition as soon as possible. In some cases, this do by preventing measures can be taken, by informing family members of a potential risk of malnutrition, and by displaying the evolution of weight for e.g. to nurses visiting the patient. In other cases, through automatic monitoring of weight, an alert will be triggered whenever there would be an indication of malnutrition. This warning will trigger the appropriate process to the origins of the problem and how to treat it. The process of screening and treatment of malnutrition in the elderly is shown in Fig. 2.

A first step consists to detecting malnutrition: trigger an alarm if malnutrition is suspected. A second step is to preventing medical staff and family: alert stakeholders of the malnutrition problem. Then diagnose the cause of weight loss: diagnosis begins with a questionnaire that helps fill nursing. After the intervention of doctor and discussion between the family and the nurse coordinator, a new treatment plan will be implemented to allow the resumption of weight lost.

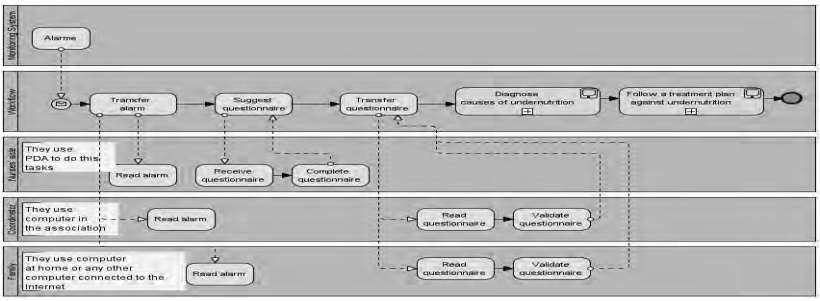


Fig. 2 Overall process management of malnutrition

Conclusion

In this paper, we present an overall architecture of a collaborative system to improve homecare. This architecture is a coupling system of monitoring and coordination system. This helps ensuring the safety of elderly and facilitates coordination among stakeholders. The innovative idea is the use of human actors as sensors that transmit information on the status of the elderly. This information feeds the progress of the workflow and helps prevent some deterioration in the elderly's condition. The next step in our work is the implementation of an inter-organizational workflow flexible and adaptive and we will define connections between business process of homecare and this workflow.

References

[1] http://www.insee.fr/fr/default.asp

[2] Provost, H. "ViSaDom : des enseignements pour la mise en oeuvre de services de téléassistance à domicile en HAD". TeleMedMeeting'09, http://telemedmeeting.org/

[3] Bonomo E., Traineau P., Réseau de compétences en télésanté CATEL, "Hospitalisation à domicile/Maintien à domicile et nouvelles technologies", rapport publique pour le compte de l'ARH Basse-Normandie, 17 décembre 2007.

[4] Guinet A., Ladet P., Marcon E., "2HM : Hospitalisation Hors les Murs", Journées STP d'Aix en Provence 2007, CNRS.

[5] Bonhomme S., Campo E., Esteve D., GUENNEC J. “PROSAFE-extended, a telemedicine platform to contribute to medical diagnosis” Journal of Telemedicine and Telecare Vol. 14 (3) (May 2007)
[6] Rammal A., Trouilhet S., Singer N., Pecatte J-M. “An Adaptive System for Home Monitoring Using a Multiagent Classification of Patterns”. International Journal of Telemedicine and Applications, Hindawi Publishing Corporation, Vol. 2008.
[7] Hollingsworth D., “TheWorkflow Reference Model”, Technical report wfmctc- 1003, 1995, Workflow Management Coalition.
[8] Pirlich M. Lochs H. “Nutrition in the elderly” Best Practice & Research Clinical Gastroenterology, pages 868-884, 2001

Rémi Bastide is professor and head of research at ISIS, engineering school in Health Information Systems. He is a researcher in the IHCS team (Interacting Human and Computer Systems) at IRIT. His current research focuses on Information Systems for home healthcare, especially on the modelling and coordination of activities of homecare stakeholders. He also contributes to the field of Software Engineering and Human-Computer Interaction, and he is former president of the French Association of Human-Computer Interaction (AFIHM). He is a member of the scientific committee for Health in InterOp GSO.

Sabrina Zefouni is a PhD student jointly supervised by ISIS and CGI-EMAC. She is a member in the IHCS team (Interacting Human and Computer Systems) at IRIT. Her current research focuses on the modeling of collaborative business process and the agility of inter-organizational systems. The targeted application domain is home healthcare.

Elyes Lamine is assistant professor at ISIS. He is also associate researcher at CGI-EMAC. His research is focused on the engineering and agile management of collaborative business processes for inter-organizational systems run in dynamic and uncertain environments. The targeted application domain is mainly within the health sector: Drugs circuit, Home healthcare, etc.

Technical Solutions for the Accessibility of Web Sites: A Current Preoccupation for the Disabled Persons

F. Coëffic[1], G. Terrier[1], M. Lanique[1], L. Billonnet[1], E. Desbordes[2], J-M. Dumas[1],
[1]University of Limoges, Limoges, France, laurent.billonnet@unilim.fr
[2] Jean Favard High School, Guéret, France

Abstract: **In this article, we draw up a list of handicap problems met by a disabled person and try to associate it material and software technical solutions to compensate for these problems.**

Introduction

The accessibility of buildings to everyone is a fundamental right today. For already 15 years, the access to establishments or collective houses is regulated as shows the French decree 94.86 of January 26th, 1994 defining which types of statutory arrangements must be applied. It is a precursor decree to the law of February, 2005, which law imposes the stake in conformity of all the public access buildings.

But buildings are not the only place where the disabled person is confronted with the problem of the accessibility. The internet, which has become today a fundamental communication tool for the access to the information and the freedom of expression, is still inaccessible under many points to the disabled persons.

With the aim of remedying these lacks in accessibility, our work consists in drawing up a list of the handicap problems met by a disabled person and trying to associate it material and software technical solutions to compensate for these problems.

Facing the handicap: What are the technical solutions?

Face to navigation on a website, the problems stressing the handicap of the person (and sometimes creating new ones) are many.

The most typical example is a website which contains too much information on the same page, in a non-hierarchical basis or too bushy way. It does not allow a visual deficient person to navigate serenely and effectively. A solution can then consist in acting on the shape of the

navigation within the site itself and in simplifying the searches for keywords and the access to the various links.

To evaluate these problems, our approach has been to be put in the situation of the disabled person to better evaluate the engendered trouble or lack and look for the most adequate solutions. We leaned for that on the current legislation and on the latest available material and software technologies of information and communication.

We have handled the various technical solutions according to the type of handicap.

Motor disability:

One first technical solution deals with the “mouse without strength” or DIM Device of Interpretation of Movement. This is a project from students of the ESIEA engineering school (College of Computing, Electronic, automatic) [1]. It concerns the accessibility of computer technology tools. The principle consists in putting 2 small metallic surfaces at the end of the index and the thumb and with an infrared system. The respective position or movement of one piece to the other drives the movement of the cursor on the screen. The first system and prototype uses Wii-mote (Remote control of the WII game station set). The fingers of the person serve as referents points on a 2D plan. The Wii-mote is the used as an interface to make the adequate projection of the fingers movement on the screen.

The Eyegaze system [2] is developed by LC technologies. It is a system of driving based on the eye movements. He allows simultaneously to communicate, to pilot your computer (for example to access the installed software) and control the system functionalities. It has been designed for the persons affected by important physical diseases with the only capability of only eye movements. To “click”, the disabled person just has to stare during an adjustable duration the area corresponding to the desired active function. The duration needed to activate and “capture” a command is adjustable depending on the disability level of the person and can be optimized just by training the person and adapt the parameters.

Another solution can be provided by the HEADMOUSE Extreme system [3]. The system is based upon the use of a video camera positioned above the monitor screen of a computer or a laptop. It is driven directly by the movements of the head of the user. It is intended to replace a classical mouse for the persons having, either total or partial motor disability who want to recover the use of computers and other devices for communication capabilities. Basically, the global system uses an infrared beam which follows a small target mask placed on the forehead or on the user glasses.

An integrated electronic sensor evaluates the slope and position of the head and adapts itself to the most unusual situations. In combination with a mouse driver software, such as the Dragger, mouse click and selection can be also simulated on the screen. The mouse click can be also realised by means of a contactor driven by the breath of the user or by making use of voice recognition.

Another assistive system for the same handicap category is the system of word prediction called “Skippy” [4]. Skippy helps the persons capable of using a standard or virtual keyboard. Just by analysing the first letters entered on the keyboard the system is able to guess the entire word or at least, to propose several possibilities. This predictive system can save up to 50 % of the keyboard typing. It can be used under Microsoft Windows environment with any application program. When typing the beginning of a word, the user is suggested a list of words beginning with the already typed letters.

Hearing handicap:

The hearing handicap can basically be handled thanks to the speech synthesis which can be made through the use of several different existing software. Among all these software, Dragon Naturally Speaking [5] is of particular interest since is it the most used in the world. The speech synthesis is a computer technique of sound synthesis which allows to artificially create words and sentences from any text file.

To do this, it leans at the same time on linguistic processing techniques, in particular to transform the spelling text into a phonetic version that can be pronounced without ambiguity, and on digital signal processing techniques this phonetic version into a reconstructed sound that can be hear on loudspeakers. On the contrary way of use, it can also work as a voice command for all the application programs and it then also suitable for motor disability.

Visual handicap:

Several technical solutions exist to compensate for the visual handicap. One solution is proposed through the keyboard INTELLIKEYS [6] which is a programmable keyboard making use of working sheets. It appears as a tactile keyboard on which is arranged a sheet where symbolical keys are drawn. These keys can contain a letter, a sentence, an image or a pictogram. The size and contrast of symbols can then provide a real visual benefit for the persons with visual impairment. The system can also be coupled with software of word prediction to optimize the system. Plexiglass grids used as finger-guides can emphasize the efficiency of the keyboard. : They can be mounted on the keyboard to avoid the simultaneous and inconvenient

activation of undesired press of keys. Furthermore, this solution is also adequate for any person with a motor disability, or with a cognitive trouble having no capability in using a classic keyboard or a mouse.

Another proposed project of the students of the ESIEA is called the "digital magnifying lens" [1]. This lens is a tool to help persons with a visual handicap. It consists of a mini high-resolution camera coupled to classical glasses equipped with virtual reality capabilities through digital image processing. There are various functionalities offered, such as the modification of colours, contrast, focus (zoom adjustment allowing the magnifying glass to be used as a digital camera). In this case, a digital movement stabilizer can be added to limit the shivers which are quickly perceptible at high zoom levels. The system can also be used to capture shot pictures or continuous sequences and restore them (a list of events, a map of public transportation network, a procedure to perform a complete task).

After the establishment of a catalogue of technical equipments which role is intended to assist the internet website navigation, the objective is the creation of a test website implementing some of the chosen solutions. The evaluation will be made by persons suffering of all possible handicaps.

References

[1] ESIEA Ecole Supérieure d'Informatique, Electronique, Automatique, www.**esiea**.fr
[2] EYEGAZE, www.Tobii.com
[3] EXTREME HEADMOUSE, www.**orin.com**/access/headmouse/
[4] SKIPPY, www.**ti**.com/ww/fr/
[5] Dragon Naturally Speaking, www.Nuance.fr
[6] Clavier INTELLIKEYS, www.intellitools.com

Laurent Billonnet received the Ph-D degree in 1993 from the University of Limoges, and the Doctorat d'Etat degree from the University of Limoges in 2001. Currently, he is a Professor at the Ecole Nationale Supérieure d'Ingénieurs de Limoges (ENSIL), University of Limoges. Teaching topics are from automatics, internet protocols, electronics and computer engineering. His research topics are focuses on home automation and ICT for people in loss of autonomy. He is the Director of the BSc diploma "Home automation for elderly and disabled people".

Tele-emergency, Teleconsultation and Telehomecare in Belo Horizonte: The Experience of a Brazilian City with Important Incorporation of Telehealth Resources

Marcelo Gouvea Teixeira, Sibele Maria Gonçalves Ferreira, Neuslene Rievers de Queiroz, Eliete Miriam Neves de Pinho e Medeiros, Renata Trad Campos, Alaneir de Fátima dos Santos
City of Belo Horizonte Health Department, Belo Horizonte, Brazil

Objective

The goal of this paper is to describe the process of building a telehealth project in the city of Belo Horizonte, Brazil, identifying the different phases and driving factors of its development.

Methodology

This piece of work will explain the different components of the main telehealth projects carried out in the the city of Belo Horizonte, using the following primary sources: official documents submitted to the financing bodies, reports of activities and internal documents of the Belo Horizonte City Health Department related to the development of the projects. Then the projects were categorized into phases by the team that carried out the telehealth project in Belo Horizonte, identifying the main guiding factors of each phase. The results found were described.

Results

Telehealth resources were used at Belo Horizonte Health Department in Brazil as technologies that favor the structuring of assistance and formative processes. The incorporation of these resources came from significant interactions that took place on the one hand between the Federal University of Minas Gerais and the Ministry of Health, and on the other hand, through a continued interaction with international projects starting in 2003 within the context of the @LIS Project of the European Community.

The incorporation of telehealth resources in the city of Belo Horizonte started in 2003 with a significant participation of the European Community countries such as Italy, Finland and Denmark within the @LIS Project. The idea of this project was to work together in order to set up a telehealth

model applicable to the Brazilian public network with features concentrated on low cost primary care and that could be implemented later on in the whole country, the *Projeto BHTelessaúde* (BHTelehealth Project). This project was created in order to support the family health program teams both in terms of assistance support and continuing education. Its main goal is to strengthen the central role of primary care in managing patient care.

The model developed used a 64 kbps network that connects the healthcare units to the Federal University of Minas Gerais, with only one computer, a webcam and a multimedia kit at the healthcare basic units. This model enabled teleconsultations and videoconferences every fortnight in the areas of medicine, dentistry and nursing. Health professionals of the family health teams could have access and interact with professors of more than 21 medical specialties, in addition to the areas of nursing and dentistry. This Project served as a model for the larger national telehealth project which nowadays is implemented in 900 Brazilian municipalities. Also healthcare basic units have a digital electrocardiogram.

In this initial phase of building telehealth projects in the public sector in the country, the participation of countries with concrete experiences in this area was an essential factor for the feasibility of the project, especially through the international cooperation that took place within the @lis Project. Besides training technical groups, another important factor of this international cooperation was its contribution to the exchanging of experiences in the area involving city health officials and mayors on the importance of this subject. The model developed with the significant participation of the main public university of the State of Minas Gerais was also very important because it introduced a high quality added value in structuring the public network.

In the second phase, the health department of Belo Horizonte created the structure to incorporate the latest development in the educational area involving organic modeling and animations in distance learning courses focused on family health program and the urgency and emergency network. This process was done in close partnership with the School of Medicine of the Federal University of Minas Gerais, which was responsible for developing two courses fostering the use of telehealth/telemedicine resources through teaching-learning objects with different technological resources.

The Health Technology Center of the School of Medicine with its updating of distance teaching platforms with videos, animation processes and 3D organic modeling, enables courses with a very high added value. The use of 3D modeling of organic structures makes possible the building of virtual objects of learning able to simulate at one single moment,

physiological, pathological and anatomic events in a dynamic way. This is possible due to a perfect coordination between the organic objects and the use of animation, sound and imaging resources. Distance courses on ECG interpretation and emergency are at e final stage of application.

The general goal of the project is to incorporate telemedicine resources into the mobile emergency care service (SAMU) in Belo Horizonte in order to speed up and qualify the process provided to the patients of this service. The aim of the project is also to enable a better assistance interaction between emergency units and the pre-hospital system.

This experience shows solutions that include video broadcasting of patients, medical images and different assistance parameters, allowing the regulating physician of SAMU to be virtually present at the remote location and to take part in the pre-hospital care given to the patient. The results of the experience are quite promising with regard to the quality of pre-hospital care and the speeding up of the process in the same place.

During the second phase of incorporating telehealth resources, several committees of telehealth management were created on the area of medicine, nursing, dentistry and emergency, involving technical groups of the Health Department and the Federal University of Minas Gerais. This process reflects an institutionalization of actions within the health department making possible an interface with assistance and educational processes integrated with telehealth projects.

Currently the process of implementing projects on monitoring diabetic/high blood pressure patients is in progress through the establishment of a diabetic retinopathy network at the city level. This network is able to capture images of diabetic patients' retina and to issue retinography reports at the School of Medicine of the Federal University of Minas Gerais. Also a telemonitoring system has been set up to control the glycemic and blood pressure levels of patients at their own homes with a monitoring center at healthcare basic units.

The Belo Horizonte Health Department and the Federal University of Minas Gerais are also the home of the Latin America and Europe Laboratory of Excellency and Innovation in Telehealth, involving 20 countries and exchanging experiences at the public network, publishing important experiences on telehealth through the Latin America Journal of Telehealth and driving the development of telehealth actions in different countries. The Laboratory is increasingly consolidating itself as a model to incorporate telehealth resources into the public area.

In the current phase, the incorporation of telehealth resources is gradually starting to be included into the planning of the assistance activities of the city health department, reflecting the degree of awareness acquired on the

subject in a highly shared way. The continuity of prospecting actions at the international level done by the different committees had enabled new and daring projects on the area.

The close relationship with the Federal University of Minas Gerais and with groups that work together preparing and implementing projects, speeds up the feasibility of prospects and experiments on the area with research and access to equipments making possible the execution of projects in a faster way. This process shows the strength that the public network has in including it effectively as a quality healthcare model provided to citizens.

Despite some difficulties, the experience of Belo Horizonte in telehealth is an example to follow in the country. The incorporation of telehealth resources has gradually contributed to a better quality healthcare for the population, placing Belo Horizonte in the national and international scene regarding advances in management as a result of technological innovations.

References

[1] L. Giovanella, Mendonça, Maria Helena Magalhães de; Almeida, Patty Fidelis de ; Escorel, Sarah ; Senna, Mônica de Castro Maia ; Fausto, MCR ; Delgado, Mônica ; Andrade, C. L. T. ; Cunha, M. S. ; PACHECO, Carina . Family health: limits and possibilities for an integral primary health care approach in Brazil. Ciência & Saúde Coletiva, v. 14, p. 783-794, 2009

[2] M. F. Cabrera; Arrendondo M.T.;Quiroga J. Integration of Telemedicine into emergency medical services. Journal of Telemedicine and Telecare; 8 Suppl. 2:12-4, 2002

[3] C. Gentilini. **Health Care Network**. Rotaltype Mezzocorona, Evaluación cualitativa da teleconsultoria do sistema BH-Telesalud desde la perspectiva del médicoItaly, dezembro de 2006.

[4] B. Frohmann. Taking information policybeyond information science applying the actor network theory. 1995. Availabe at: http://www.ualberta.ca/dept/slis/cais/frohmann.htm. Accessed: 07 fev. 2006.

Alaneir de Fátima dos Santos isVice – coordinator of Telehealth Nucleus of the Federal University of Minas Gerais - School of Medicine, Brazil. Coordinator of the Laboratory of Excellence and Innovation in Telehealth - Latin America and Europe. Editor Chief of Latin American Journal of Telehealth. Member of the National Telehealth Brazil and the Brazilian Council of Telemedicine / Telehealth.

Marcelo Gouvêa Teixeira is Municipal Secretary of Belo Horizonte City Department of Health in Minas Gerais State. Graduated and Master Graduated on Administration.

Telehealth for Hospice and Palliative Care in the Home ©

D. A. Randall
The Law Office of Deborah Randall, drandall.solutions@comcast.net,
4825EssexAvenue, Chevy Chase, MD 20815 USA

The care of persons in their homes at the end of life, and when they are in need of palliative care rather than curative care, has been the focus of many hospice, home health care companies and palliative care health professionals. With the advance of remote monitoring, telehealth and telecare, and video-transmission including with mobile technology, there have been many programs now piloted to care for those with chronic illnesses who still receive curative services. What then are the prospects of using these same techniques for a different population at home---those at the end of life, with medical, emotional and spiritual needs for a reduction in suffering and family dysfunction?

Trends in the United States

The medical insurance payment for remote monitoring and telehealth services provided for care in the home is still nearly non-existent in the United States. Most telehealth care for chronic disease management is provided through grant funding, managed care pilot demonstrations, academic medical center innovative delivery models, and inconsistent state-based tele-homecare funded by Medicaid programs for the indigent. The federal laws establishing payment for the aged under Medicare home health care specifically declare that a 'visit' must be provided in person and a telehealth visit may not be an equivalent or a substitute for a medically needed nursing, therapy, social work or physician service. The private residential home is not among the locations considered to be an 'originating site' for physician consultation visits; that is, Medicare does not yet pay a physician or nurse practitioner for consulting remotely to the patient in her home, even if the technology used is the same as that used in other locations, where it is compensated. This uncompensated care includes palliative care consultations; psychiatric, psychologist or social work services in telemental health; and the remotely monitored care an attending physician or nurse practitioner might otherwise provide his or her terminally ill patient. In addition, the services of nurse triage, nurse case management specialists or off-site disease management clinical services or software

programs to trend and interpret remotely transmitted data are also not independently compensated by Medicare. Some private insurance companies do pay for remotely managed health services but these are arranged for in a case by case manner.

Despite this very slow growth of compensation for telehealth in the American home, there is a robust and growing landscape of research underway to demonstrate and replicate studies showing significant clinical, quality of care and cost efficiency improvement using remote monitoring, sensors and medical devices. These studies are intensely focused on chronic disease management in the areas of congestive heart failure [CHF], diabetes, chronic obstructive pulmonary disease [COPD], asthma and the rehabilitation of stroke and cardiac disease patients. The largest reported study to date is that of the Veterans' Health Administration [1] which has documented very significant reductions in resources such as hospitalizations and emergency room visits across all major chronic illnesses, including behavioral health, for patients utilizing remote monitoring devices that interpret and provide practice guidance for patient care. The communication of data from the home-based patient in the VHA study cost approximately $ 1,600 per patient, annually and resource use reduction for those with multiple chronic diseases averaged in excess of 26 per cent. The American Telemedicine Association [ATA] tracks much of the accumulated research and reports outcomes in journal articles and presentations to its research conferences.[2]

Telehealth use in the field of hospice and palliative care is even less developed in the United States, although there have been significant research efforts undertaken within the last five years. The ATA established in 2009 a Workgroup to explore the prevalence and professional interest in telehospice and palliative care. The very early findings of an informal survey are, not surprisingly, that telehospice is developing first in care settings where there is already an established home health agency working with telehealth technology. In some individual cases, the patient's course of illness reaches a terminal phase and she continues with the supportive use of telehealth for the chronic illness which has now worsened. In other situations, free-standing hospices are undertaking to place remote monitoring and video-communication units with patients for discrete reasons associated with quality of care. These are to increase the ability of skilled hospice clinicians to: access the home rapidly, particularly in remote rural settins; make an assessment during an onset of symptoms or anxiety on the patient and/or family's parts; provide re-enforcement of teaching

around symptom management; provide counseling; engage the patient and family 'live' in care planning done by the hospice team which is located at the hospice's offices; and generally to support the patient and family together---as this is the care unit in the United States hospice model.

Regulatory Changes Could Encourage Telehealth

During 2009, hospices that are billing for care of Medicare and Medicaid patients in the United States implemented changes required by regulatory 'Conditions of Participation'. These regulations are found in the U.S.Code of Federal Regulations Vol. 42 Sections 418.2 through 418.116. Among numerous requirements, hospices must demonstrate measurable quality assurance and program improvement [QAPI] of defined goals in patient care. They also must engage in an intensive, every 15 days reassessment process of palliation and patient care needs, using skilled interdisciplinary teams [IDTs]. Some of the interesting telehealth research being conducted focuses on the capability of video communication to engage the IDT with the patient and family members.[3] This research suggests positive outcomes, although the researchers have also found stronger acceptance of telehealth techniques among some IDT members [nurses] than others, particularly social workers in the hospice field.

Organizational Readiness for Change Could Impede Telehealth

Research conducted on the growth of and impediments to telehospice has been limited, but early suggestions are that it is not the patients who would be reluctant to use the technology [4]. Informal survey by the ATA Telehospice and Palliative Care Workgroup in 2009 showed that hospices found patients and families were accepting about telehealth, and it was hospice staff who were more reluctant to embrace the new approaches. Hospices also indicated that hospice patients were not reluctant to use videocameras; anecdotal research suggest that home care patients are most willing to use audio and remote monitoring devices that do not use camera features. The VHA has research from its Advanced Illness Palliative Care program showing involved clinicians can work with cutting edge telehealth tools to advance patients interests as they move towards end of life.[4] Future suitable hospice research topics are: whether staff reluctance is due to a lack of general industry discussion of telehospice among the professional trade associations' peer groups; whether it is an ingrained belief that 'High Tech' eliminates or degrades 'High Touch'; or whether staff may fear of loss of professional employment or validation.

Given the vast need of resources in the social work and behavioral health areas in the United States, the challenges of great distances between rurally located patients and professionals and the growing positive research in the general field of tele-mental health, change to telehealth may be a near term necessity if patient care needs are to be met. The ATA published Standards for Telemental Health services in 2009, but these do not cover the circumstances of delivering supportive counseling services to a home-centered terminally ill individual and her family and informal caregivers.

Political Reluctance to Expand Remote Monitoring

A final area affecting the implementation of telehospice and palliative care is the current governmental reluctance to expand remote monitoring, generally, in the United States. Largely this is expressed by members of the U.S. Department of Health and Human Services's skepticism about the research outcomes of disease management and chronic care models utilizing telehealth components, even in the face of overwhelming evidence that there are clinical improvements and care efficiencies with remote monitoring. There is also a growing concern about fraudulent activities of some care providers in the medical device and home medical equipment industries, which have resulted in millions of dollars of judgments against the persons accused of these abuses. No doubt the Congress of the United States will have questions about how broadly remote monitoring may be deployed, what the restrictions about medical necessity and utilization may be and what safeguards can be put in place to ensure home monitoring devices do not become the new version of the power wheelchair scandals of the last decade. Given those restraints, it is likely that there will be bundled telehospice services to the per episode payment structure already in existence. It is unlikely there will be a separate reimbursed service for monitoring equipment for medication compliance, vital signs registration or nurse case management. Private resources and private insurance are likely to be required to fully finance the future home telehospice field. Palliative care outside of care of the terminally ill will also likely be a bundled US service, but the interest in eHealth and remote consultations will likely permit an expansion of the definition of care, so long as palliative care physicians, nurse practitioners and specialist pharmacists develop supportive research projects that can support this expansion.

References

[1] A.Darkins, M.D., et al., "The Systematic Implementation of Health Informatics, Home Telehealth, and Disease Management to Support the Care of Veteran Patients witChronic Conditions," Telemedicine and eHealth, vol 14, no. 10, December 2008, 1120-1126.

[2] The ATA website is www.americantelemed.org.

[3] K.T.Washington, G.Demeris, D.P.Oliver,and M.Day, “Telehospice acceptance among providers: a multidisciplinary approach ", Am.J.Hospice and Palliative Care, vol. 25 [6], 452-7, December 2008-January 2009. See also, the website for this collaborative research, http://www.telehospice-project.org/.

[4] J.Maudlin, J.Keene,and R.Kobb, "A Road Map for the Last Journey: Home Telehealth for Holistic End-of-life Care", AmJ Hospice and Palliative Medicine, vol.23[5], 1-5,November 2006.

[5] P.S.Whitten et al, "Telehospice in Michigan – use and patient acceptance", Am.J.Hospice and Palliative Care, Vol. 21[3],191-5, 2004 May-June.

Deborah Randall is a highly regarded expert in American health systems, hospice and palliative care, and homecare. Her Juris Doctor [JD] degree is from Columbia University, and her A.B. from Harvard. She is the author of 12 book chapters and 34 articles on legal issues in the delivery of community-based care. She is a frequent speaker on innovative approaches to telehealth care and chairs the Workgroup on Telehospice and Palliative Care of the American Telehealth Association. She was invited to the EU 2008 Portoroz "eHealth without Frontiers" conference and French International Alzheimer’s conference.

International Telemedicine and eHealth Initiatives and Developments

Application of the Delphi Method for Consensus Building on Factors of Success and Failure in the Brazilian National Telehealth Project – Minas Gerais Cluster

Alaneir de Fátima dos Santos, C. Souza, Simone Ferreira Santos, Marcela Nascimento, Manuel Schutze, Humberto José Alves
Federal University of Minas Gerais-UFMG, Belo Horizonte, Brazil

Introduction

Evaluation of telehealth and telemedicine programs is very complex. Conflicts arise in the definition and delimitation of functions, making the results of studies, particularly economic ones, difficult to extrapolate to other situations or to replicate; there is no measurement standards or evidence of acceptability, it has been difficult to measure the efficiency of projects with regard to the consequences of the introduction of a telemedicine system, which was not clearly circumscribe the structure and process of care and especially when the system on which to formulate hypotheses is complex, such as social systems, the application of quantitative or experimental tools may not be appropriate. This is due to the interdependence of factors [1].

An ethnographic study of evaluation projects of telemedicine systems in England observed a preference of the researchers to controlled trials, noting the need for flexibility in approach between the two types of knowledge, an experimental knowledge about quantitative results and the qualitative knowledge. The second type has particularly useful for evaluating the system in practice, guiding its development. This brought greater recognition of the practical value of research methods that produce knowledge about processes rather than health outcomes [2].

The Brazilian National Telehealth Project is implemented in 900 municipalities The project's central focus is to incorporate telehealth resources in primary health care, mainly using formative second opinion and the realization of web conferencing fortnightly in the areas of nursing, dentistry and medicine as well as distance learning courses.

The Brazilian experience in the construction of the National Telehealth Project required understanding the factors involved in the implementation of the project analyzed in terms of participating municipalities. This study

seeks to contribute to the understanding of this aspect and so help to redirect project activities to expand the process of utilization of telehealth.

Objective

This study aimed to identify factors of success or failure in project implementation as perceived by the municipal health secretaries and directors of health care in 50 municipalities of the state of Minas Gerais, coordinated by the Federal University of Minas Gerais (UFMG) School of Medicine.

Methods and Results

Qualitative research has been used in studies of telemedicine primarily to measure the acceptability of systems by users, degree of application integration within the structures of the health system; studies on the causes that determine the results or specific processes and design assessment training process. We chose a qualitative study using the Delphi method, suitable for a process of consensus between groups. The method involves: 1) sending questionnaires with the most relevant results obtained from the studies reviewed, expressed in the form of statements, 2) the experts are asked to indicate a score to each of the statements, 3) after processing them, the statements are sent back to the experts with the average of the group and his/her own, to ensure that it could consider changing it, to approach the mean, or if he/she wants to keep the score. This interactive process leads to consensus, contributing to solid results of the investigation.

Initially, we reviewed the literature regarding the factors that should be evaluated in telehealth projects, addressing aspects of quality (effectiveness, reliability, ease of use, impact on the clinical process, impact on the organization process, impact on health and well-being, impact on users' and patients' opinions), access (to the diagnosis, treatment and patient follow up, training of health personnel and health information), acceptability (by patients, health staff, management and health authorities) and economic analysis (involving analysis of cost, cost minimization, cost-effectiveness, cost-benefit and marginal analysis). Other studies address the evaluation of telehealth projects based on patient health impacts, patient access to health care, economic and acceptability of the system.

We opted for a structure of the questionnaire focused on approaching the phenomenon of adoption of technological innovations that considered the evaluation focused on three main dimensions: individual, organizational and technological [3].

The **individual dimension** considers individual aspects relating to telehealth system users. These aspects represent the informational behavior, skills, values and beliefs and how those considerations interfere positively or negatively to the adoption of telehealth. The main issues and factors considered were: a) Psychosocial factors associated with the conduct of individuals involved in the process of telehealth in organizations, b) policies and personal opinions that oppose or support the use of telehealth as a tool. It has to do with the use of technology and familiarity with the tools or, in extreme cases, fear (computer phobic) and/or the fact that they do not have any experience with computers, c) Individual inserted values and beliefs about the work of the health professional, or cultural aspects of health professionals, d) Other professional factors related to professional health teams and administrative posts performed by its members in hospitals and care centers. Some authors believe that the team has an influence on the decision of physicians to adopt telehealth and that this influence may manifest itself in the (in) compatibility of technology with the current practice of physician work [4-7].

As for this single dimension, it is relevant to stress the importance of socio-technical approach, characterized by user participation in at least one of the stages of development, proposal and/or system implementation. The lack of such involvement might compromise the professional involvement with the proposed innovation. The positioning encourages users to assimilate the changes necessary for growth of the organization and reduces the resistance, helping in the implementation process, since, in general, most people do not accept or take some time to assimilate the changes that affect their habits and routines.

The **organizational di mension** considered the organizational factors involved in telehealth programs, encompassing aspects of culture and organizational environment, knowledge management and regulation and institutionalization of practices in telehealth. The analysis of innovation adoption in public organizations presented the following issues in the organizational dimension. Specialization and managerial attitude favorable to change are considered as positive influences, while the centralization and formalization are considered negative.

The use of computational resources is considered important factors for successful implementation of standardized practices and training of health professionals. The training of professionals involved in telehealth is especially important in organizations where the technologies applied to professional practices are poor, which can lighten the impact of its changes

Infoethics - privacy, confidentiality, principled legitimate purposes, consent, transparency, participation and education - also ensures the legitimacy of telehealth systems with their users, health professionals and patients [9].

The **technological dimensi on** includes issues of structure, accessibility and usability of telehealth systems and interaction with technology. Compatibility is considered as one of the factors impacting the adoption of telemedicine. Applied to physicians, results that the characteristics of telemedicine technologies should be compatible with their values and experiences and, for that, we must think of appropriate equipment and training. When telemedicine technology is quite different from daily physicians routine it can undermine commitment and create barriers [9].

We used the Delphi method, with the application of 72 questionnaires, using Likert scale. The questionnaires were completed and, after accessing the average score of the group, they were returned for reconsideration by the person who filled it out, then the results were analyzed. The research universe comprised 50 municipal health departments and/or care coordinators in the municipalities of the Brazilian National Telehealth Project that are supervised by UFMG School of Medicine.

The questionnaire responses showed that the factor that most affected the successful implementation of the project was the organizational dimension. On average, the factors that are crucial to the success of the project are: encouragement by directors has a degree of importance of 90% for the success of the project, as well as the participation of the family health team program coordinator, the institutionalized release for training time and systematic monitoring by directors as to levels of utilization of telehealth resources.

When faced with regard to the reality of his/her municipality, an average 60% of respondents estimate that their city does not systematically monitor and in 50% of cases not formally release its employees to participate in telehealth activities. Factors such as personality, in which more communicative professionals can use more the resources, are valued as important for 70% of the participants. Ninety percent agree that technical aspects such as quality of image and sound are important to the success of the project but that they are not essential factors for non-use of the resources.

It was possible to conclude that the main determinants of successful implementation of telehealth projects in primary care relates to the level of engagement of manager, materialized by means of continuous monitoring and articulation with institutional policies. Another important factor is the

formalization of the activity, with guaranteed scheduled training time and formal release of the professionals to pursue the activity. The other dimensions occupied a secondary role. The results showed also a very significant difference in the use of telehealth resources available by different municipalities that make up the project.

References

[1] A. Martínez, R. Rodrigues, A. Infante Bases Metodológicas para Evaluar la Viabilidad y el Impacto de Proyectos de Telemedicina. Washington, D.C.: PAHO, 138, 2000.

[2] T. Finch, C. May; F. Mair; M. Mort, L. Gas Integrating service development with evaluation in telehealthcare: an ethnographic study, BMJ 327; 1205-1209, 2003.

[3] P. J. Hu, P. Y. K. Chau, O. L. Sheng, Investigation of factors affecting healthcare organization‘s adoption of telemedicine technology. 33rd Hawaii International Conference on System Sciences, Maui: IEEE Computer Society, 1-10, 2000, Disponível em: <http://csdl2.computer.org/comp/proceedings/ ecas/2000/0493/05/04935020. pdf

[4] M. L. B. Carvalho, R. B. Costa, Tecnologias da Informação para a Telessaúde IN: Santos et al. Telessaúde: um instrumento de suporte assistencial e educação permanente. Belo Horizonte: Editora UFMG, 2006.

[5] M. P. Gagnon, L. Lamothe, J. P. Fortin, A. Cloutier. The impact of organizational characteristics on telehealth adoption by hospitals. Proceedings of the 37th Hawaii International Conference on System Sciences, 6, 6, pp. 1-10, 2004, Disponível em: <http://ieeexplore.ieee.org/iel5/8934/28293/ 01265365. pdf

[6] T. Ashihara, I. Nakajima, Y. Sawada, Problems and Our Solutions for Implementing Telemedicine Systems. Journal of Medical Systems, 23, 6**,** December 1999, p. 425 – 435. www.springerlink.com/media/N9GHTMWUMP87D1RYDAD3/Contributions/K/2/R/Q/K2RQ202546532814.pdf

[7] N. F. Güler, E. D. Übeyli, Theory and Application of Telemedicine. Journal of Medical Systems, 26, 3, June 2002, p. 199–220, http://www.springerlink.com/content/30t0w7hm3tcj/?p=c56e0923cba34e99a6ebc6efb08f9bbc&pi=33. Acesso em 02/01/2007.

[8] A. Damanpour, M. P. Gagnon, L. Lamothe, J. P. Fortin, A. Cloutier, The impact of organizational characteristics on telehealth adoption by hospitals. Proceedings of the 37th Hawaii International Conference on System Sciences, 6, 6, pp. 1-10, 2004, ieeexplore.ieee.org/iel5/8934/28293/ 01265365. pdf

[9] B. Stanberry, Telemedicine: barriers and opportunities in the 21st century. Journal of Internal Medicine 2000, 615-628, http://www.blackwell-synergy.com/links/doi/10.1046/j.1365-2796.2000.00699.x/full/.

[10] N. Menachemi, D. E. Burke, D. J. Ayers, Factors Affecting the Adoption of Telemedicine: a multiple adopter perspective, Journal of Medical Systems, 28, 6, December 2004, pp. 617–632. http://www.springerlink.com/content/j0t0124167571266/?p=66e6830b8a6b4c5e8b4ca537d96f76da&pi=10 Acesso em: 02 jan.2008.

Alaneir de Fátima dos Santos

Vice – coordinator of Telehealth Nucleus of the Federal University of Minas Gerais - School of Medicine, Brazil.

Coordinator of the Laboratory of Excellence and Innovation in Telehealth - Latin America and Europe.

Editor Chief of Latin American Journal of Telehealth.

Member of the National Telehealth Brazil and the Brazilian Council of Telemedicine / Telehealth.

Claudio de Souza
Coordinator of Telehealth Nucleus of the Federal University of Minas Gerais - School of Medicine.
Coordinator of Brazilian National Telehealth Program in Minas Gerais State
Vice-chairman of the National Telehealth Brazil.
Professor of Surgery Department at Federal University of Minas Gerais - School of Medicine.

Marcelo Gouvêa Teixeira:
Municipal Secretary of Belo Horizonte City Department of Health in Minas Gerais State. Graduated and Master Graduated on Administration.

Conceptual Framework for a Comprehensive eHealth Evaluation Tool

S. Khoja[1], H. Durrani[1], U. Piryani[1], R. E. Scott [2]
[1]Department of Community Health Science, The Aga Khan University, Karachi, Pakistan, shariq.khoja@aku.edu; hammad.durrani@aku.edu
[2]Department of Community Health Sciences, University of Calgary, Canada

Abstract: **As eHealth spreads worldwide various technical problems have been effectively addressed and mitigated along with the impact; the question of whether health-care providers should or should not invest in eHealth becomes more important and have made the Evaluation necessary for assessing and judging the worth of any Health care activity. A wide variety of approaches and methodologies have been applied by different researchers in assessing the impact of eHealth Services in health care, ranging from controlled clinical trials to use of questionnaires and interviews with users. This paper presents a conceptual framework for eHealth evaluation tool to examine and measure the different factors that play a definite role in diffusion and penetration of eHealth services. These factors were identified through literature search on different theories of evaluation, identified and explained by various researchers. These theories define the role of eHealth services highlighting both its facilitators and barriers. The literature search strategy included the clinical and health informatics literature for articles, abstracts and conference proceedings, encompassing all aspects of eHealth, Telehealth, health informatics and telemedicine evaluation. We reviewed the different theories and tried to assess the impact and their outcome in eHealth. The paper provides the general idea of different stages of e Health, and then applying evaluation theories on each of these stages for tool development**

Introduction

Evaluation is defined as "attributing value to an intervention by gathering reliable and valid information about it in a systematic way, and by making comparisons, for the purposes of making more informed decisions or understanding causal mechanisms or general principles" [1]. Evaluation is necessary for assessing and judging the worth of any Health activity. In today's cost-conscious environment there is a demand for value for money and effective outcomes in the allocation of health-care resources. Without evaluation it is hard, if not impossible to know how a product or service works. The introduction of *eHealth* to our health systems represents the promise of information and communication technologies to improve health

and the health care system [2]. The World Health Organization defines eHealth as " the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research" [3].

As eHealth is spreading worldwide various technical problems are overcome along with the impact; the question of whether health-care providers should or should not invest in eHealth becomes more important. It is therefore essential for health care system to evaluate eHealth in relation to different factors that affect its usage either as a benefit or as a barrier. To do proper evaluation, we need to look for different factors that play an important role in eHealth development, implementation and operational use. For the purpose of premium understanding we are taking these important factors as theories and will try to analyze how these theories will work for eHealth evaluation. eHealth. Evaluation is a discrete activity that comes to an end when the “value” of the eHealth intervention has been demonstrated and “value” is the realm of evaluation [4].

Evaluation is the act of measuring or exploring properties of an eHealth project or a program (in planning, development, implementation, or operation), (see figure 1) the result of which informs a decision to be made concerning that system in a specific context. The interconnections of these different stages of eHealth services require proper understanding which can be done by evaluating these stages and indentify the factors which affect its performance.

Objective

The objective of the wider study is to develop an eHealth evaluation tool based on a conceptual framework that includes all the relevant theories for evaluation of eHealth programs. The current paper presents the framework that was developed after studying these theories, which could be translated later into an eHealth evaluation tool.

Methodology

The methodology for this paper is comprehensive literature review. The literature search strategy included the clinical and health informatics literature for articles, abstracts and conference proceedings encompassing all aspects of eHealth i.e. telehealth, health informatics and elearning evaluation. We reviewed the different theories and tried to find out the impact and their outcome in eHealth [4]. From the initial search of over 500

abstracts and conference proceedings, 60 papers were selected as primary references for review. A hardcopy/soft copy of each paper identified was obtained, and each reference was reviewed and summarized by the project research associate. From this original list of primary references, 40 articles were selected and forwarded to a three-member panel for final selection of key references. After the detailed review and summary of the primary references, the evaluation framework document has developed. This framework represents a comprehensive discussion of eHealth evaluation on the basis of different theories of evaluation. Following literature review and analysis, the next step was to discuss the theories with the group of experts in eHealth. Each theory was examined based on its relevance to eHealth, and to the part of the life cycle of eHealth where it may influence the most.

Results

This evaluation framework was developed on the concept of different evaluation theories which affect the eHealth services from there development to sustained operation (figure 1).

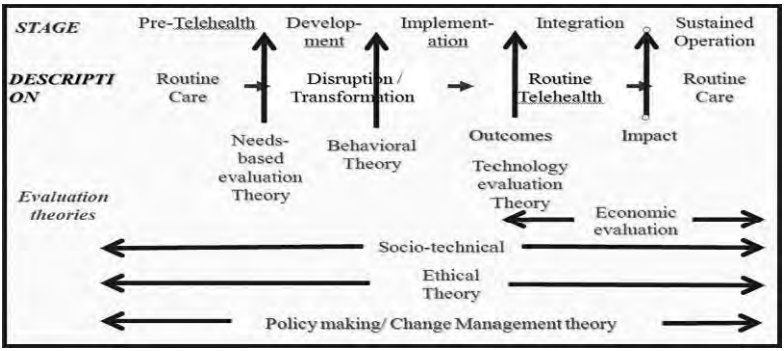


Figure 1. Conceptual framework

We divided the eHealth framework in 2 dimensions, i.e. horizontal and vertical axis, see figure 2.

The horizontal axis divides eHealth in different stages of application and planning such as: 1) Development, 2) Implementation, 3) Integration, 4) Sustained operation.

The vertical access identifies different themes and areas of consideration for eHealth evaluation such as: 1) Health Services Outcomes, 2) Technology Outcome, 3) Economic Outcomes, 4) Socio-technical Outcomes, and 5) Ethical Considerations.

Themes of Evaluation	DEVELOP-MENT	IMPLEMENT-ATION	INTEGRATION	SUSTAINED OPERATION
Health Services Outcomes	Needs-based Assessment of health status	Immediate effects of technology on Health	Outcomes Social and Behavioral impact	Impact MMR, IMR etc
Technology Outcome				
Economic Outcomes				
Socio-technical Outcomes				
Ethical Considerations				
Policy / Change Analysis				

Figure 2. Evaluation Framework

Conclusion

The framework identifies and defines different stages of eHealth, and then applying evaluation theories on each of these stages for the tool development. These theories define the role of eHealth services highlighting both its facilitators and barriers. This paper presents a conceptual framework for developing eHealth evaluation tool to examine and measure different factors that play a definite role in diffusion and penetration of eHealth services.

References

[1] J. Ovretveit, Medical managers can make research-based management decisions, *Management in Medicine*, 2, 6, 391–397, 1998.

[2] R. C. Alvarez, The promise of e-Health - a Canadian perspective. eHealth Int., Sep 17;1(1):4, 2002.

[3] The Fifty-eighth World Health Assembly, Ninth plenary meeting, 25 May 2005, Committee A, 7th Report, apps.who.int/gb/ebwha/pdf_files/WHA58/WHA58_28-en.pdf

[4] R. Bashshur, G. Shannon, H. Sapci, Telemedicine Evaluation, Telemed & e-HEALTH Volume 11, Number 3, 2005.

Shariq Khoja works as Assistant Professor and Coordinator eHealth Programs at the Aga Khan University (AKU), Karachi, Pakistan. He is a physician, with PhD in eHealth from Global eHealth Research and Training Program, University of Calgary. Dr. Khoja has extensive background and interest in using eHealth technologies to facilitate healthcare services and education. His research interests focus on creating evidence and policies to guide the implementation of eHealth in developing countries. Dr. Khoja is leading the 'PAN Asian Collaboration for evidence-based e-Health Adoption and Application (PANACeA)', which supports researchers in 17 Asian countries to create evidence for e-health implementation. Dr. Khoja leads eHealth initiatives for Aga Khan Development Network globally. Dr. Khoja has contributed extensively to literature, especially through the development and validation of eHealth Readiness assessment tools for healthcare institutions. Dr. Khoja holds Adjunct faculty position at the University of Calgary.

Being a strong advocate of integrating eHealth with routine health care, Dr. Hammad Durrani is working as a Manager Research in the Department of Community Health Sciences at the Aga Khan University Karachi Pakistan. In this capacity, he is mentoring two eHealth Projects, being carried out in Philippines, Indonesia, Bangladesh, India and Pakistan which are part of PANACeA project (PAN Asian Collaboration for Evidence-based eHealth Adoption and Application). He is also involved in eHealth Research, conducting systematic reviews on different eHealth modalities (Telehealth and Health Informatics). He is also a member of the eHealth Team for the Aga Khan Development Network (AKDN), with responsibilities of planning and strategizing eHealth applications and its concepts in different countries of Asia and Africa where the Network holds its presence. On a personal note, he is a medical doctor with Masters in Health Policy and Health Management.

Developing eMedical Records for Telemedicine: The Experience of Mongolia

Kh. Mungun-Ulzii[1], D. Mungunchimeg[1], D. Patte[1], E. Sevin[2], S. Becquerel[2]
[1]Cardiovascular Diagnostic Centre Project, cardio_center@telemedicine.mn
Bayangol district, Shastin Central Hospital, Ulaanbaatar, Mongolia
[2]Epiconcept, e.sevin@epiconcept.fr 47 rue Charenton, 75012 Paris, France

Abstract: **The paper discusses the development of an electronic medical record system through a telemedicine network, and how it modified the behavior of the distant physicians. We observed that it was mostly used to communicate from province to province, which proved to be a way to fulfill the project objective to improve the quality of the local case management.**

Introduction

Mongolia is a landlocked country located between China and Russia. Specific problems are: harsh climate, sparse population, huge distances with limited communication means, and obsolete health infrastructure with limited equipments in the provinces. The low income of the rural population combined with a semi-nomadic way of life is a limiting factor to access medical services.

Under these conditions, telemedicine appeared to be the appropriate approach to improve the quality of the local case management. Given the high prevalence of cardiovascular diseases in the country, the first fully developed medical network was the Cardiovascular Diagnostic Center Project started in 2001 with the financial support of the Government of the Great Duchy of Luxembourg.

Since, the project further extended its activity to safe motherhood, and adding more medical specialties is envisioned in the near future.

Structure and Functioning of the Network

Eight provinces out of 21, potentially covering nearly 50% of the population, are enrolled in the project. The “Center” is based at the Department of Cardiology of the Shastin central hospital in Ulaanbaatar. Communication between the center and the provinces began through regular telephone lines and 56 Kb modems. They are now replaced by ADSL connections. Each province is equipped with a computer, an ECG and a simple echocardiograph. These elements are linked together as a LAN which is connected to the Internet. At the central level the scheme is similar

with much more sophisticated ultrasound system. Through this network physicians can exchange messages, images, graphs, and data.

The functioning relies on two components: 1) an information loop between each of the eight project provinces and the center, allowing sending questions directly, and obtaining feedback; 2) a specialized website which offers several services, the most important of them being the educational section, and the forum. Both are in a professional, restricted, area.

The educational material contains a series of algorithms on selected diseases for which a standard case management scheme is proposed. On key points of the algorithm, the physicians may obtain relevant information and references. The forum is used to post questions with attached documents, and to open a thread of peer to peer discussion. Interacting through an electronic network was therefore nothing new to the provinces doctors when electronic medical records were introduced in 2009.

eMedical Record for Telemedicine

The patients' personal medical electronic files are based on an open source software (Voozanoo) developed by Epiconcept, a French specialized firm. This product is a toolbox that permits to design questionnaires of any kind, structured or open, and to include elements from other softwares such as graphs. It includes a statistical module.

It is web-based, which makes maintenance and upgrade easy for distant sites, and facilitates the sharing of data from any place in the network.

Each eMedical record contains three sections:

- The background sheet collects information on personal data and on past medical history.
- The follow-up section collects information on clinical examination and laboratory tests. It may be filled on each visit, and thus accumulates medical facts. It contains questions to be answered by clicks in tick boxes defaulted to "No", which open a dialog box if turned to "Yes". The diagnosis is encoded using the ICD10. It is searchable by key words and/or by code.
- The third section allows the physician to select particular data from the whole medical file, and to attach documents and files of various formats including DICOM, JPEG, AVI, and PDF. This selection can be uploaded, along with comments and questions, to a billboard accessible to other members of the network. It remains open for discussion until its author considers he/she obtained a satisfactory answer and decides to close it. There is no other moderation.

Utilization

The first functional version of the cardiology e-medical record was finalized during the first weeks of February 2009. All physicians had been previously trained, and assistance remained available through the network. However it is not before the beginning of May 2009 that the system was functional and fully deployed in every province.

A total of 17 cardiologists from 8 provinces can use the software to create individual medical files for their patients, and to post questions or comments. This first attempt to introduce electronic files was considered as a test period meant to observe the appropriation of the product. No criteria were imposed either to open a file, or to post a bill.

Over a period of six months, 254 files were created. This is a relatively small number compared to the hundreds of patients seen every week in the provinces. Out of those, 171 (67%) presented a problem to the physician who posted a question on the forum. These 171 questions generated 711 responses. That is an average of 4.16 responses /topic (range 1-14). More than 80% of them, originated from another province.

Discussion

From the very first days of the project existence, the key principles were to keep the operations managed by physicians for physicians; to meet the needs of the distant doctors without imposing centrally oriented constraints; and to introduce behavioral changes by facilitating the daily work of understaffed provincial teams.

Although the individual levels of “computer literacy” remain variable among the cardiologists, using a computer is common practice for all of them after nearly 6-7 years of effective participation to the project. In fact, the principle and the deployment of an electronic patient medical file had been long expected, and were warmly welcomed.

The small number of medical records created routinely, and the comparatively high number of responses and comments that any posted question generates, indicate that the proposed format meets partially the needs which, concerning electronic medical files, are of two kinds:

- One is to dispose of tools allowing easy follow-up of repeated cases.
- Second is the possibility to exchange information and to document a case to support a question.

The reasons given for not systematically filling a file for every patient are time-related. The two most frequently mentioned are a slow connection and the time that typing requires. However, both are dismissed when a physician

feels necessary to post a question or a comment. In that case, the e-medical record becomes a daily working tool for some. Interestingly, except for particularly specialized cases, exchanges are established for their most part from province to province, with limited input from the Centre.

Although only province to centre communications were then possible, a similar behavior was observed at the beginning of the project when transmissions relied on slow and painfully unstable connections made through 56Kb modems: seeking advice surpassed all time constraints.

A tool initially designed to follow-up the patients locally, turns to be primarily used for peer to peer distant communications. This resulted anyhow in better local case management with a measurable decline of undue referrals, which is the major objective of the project.

These findings comfort our view that telemedicine networks are meant to listen to the distant physicians; that they should facilitate their daily work; and that they should not be a means to decentralize problems or to impose a central view point. These are conditions that induce real behavioral changes.

eHealth – Realities and Perspectives

E. T. Kldiashvili
Georgian Telemedicine Union (Association), ekldiashvili@yahoo.com
75 Kostava str., 0171 Tbilisi, Georgia

Abstract: **eHealth and its applications are working out by the developed countries, but countries with middle and low income can use them in the most effective degree. Each application is rapidly developed and the tendency of optimization and development of eHealth solutions in accordance with concrete country's claims could be observed. As a result medical service in the developing world could be turned into a communitarian and safe practice. Virtual health care units and even systems become more and more realistic. They offer new perspectives for medical service and it is envisaged that health care professionals, scientists and researchers will use this facility to form a global network. Georgia is a small country, its health care system faces various problems in the provision of medical service, including expertise, resources, shortage of doctors and other health care professionals. It is obvious that computer and communication technologies, which became the integral part of everyday practice, can provide a solution to some problems. eHealth could allow universal health care access. More important that eHealth offers solutions for remote consultations, infections control, biosafety, administration and logistics, supervision and quality assurance, education and training for health care professionals, researchers and providers. Therefore, eHealth has the potential to improve quality and the accessibility of medical service in the country. But this modern field of medicine should be implemented carefully and managed well because of its obvious and significant impact upon healthcare. When implemented well eHealth may allow developing countries leap frog over their developed neighbors in successful health care delivery. The ideal of health care in the information age must be to create a situation where health care professionals spend more time creating knowledge from medical information than they spend time managing medical information. The application of easy available and adaptable technology together with the improvement of the infrastructure conditions is the essential basis for eHealth applications. The usage of medical information system holds the potential to realize eHealth in the effective and comprehensive mode.**

Introduction

eHealth is the practice of medical service at a distance, based on the transmission through telecommunication means of medical data for their corresponding interpretation and diagnosis. Rapid developments in

information and communication technologies have enabled eHealth to broaden its scope. eHealth applications are cutting across the wide spectrum of communication technologies. This wide distribution permits application of eHealth technologies suitable for all across the digital divide. Collaboration of technologists, researchers, engineers, developers, scientists, clinicians, and practitioners is perpetually working to forge new and greater applications of eHealth.

eHealth is now a well-understood concept. Although in simple terms eHealth refers to the delivery of medical health services at a distance, there is no single or uniform eHealth application. To some extent this observation underpins the reason behind numerous definitions of eHealth, and it also highlights the issue of portraying all the perspectives of eHealth within one definition. In general, the uses of eHealth are for 1) primary diagnosis, 2) second opinion, 3) education / QA (quality assurance). eHealth has left its childhood. Its technical development is mature, and its use for primary and secondary diagnosis has been expanded to a great amount.

Overview

The probability of an incorrect handling of a relevant medical data, still dangerously high, mainly is due to: environmental factors, instinctive factors, emotional factors. As a consequence the probability of a serious error occurrence could be high and the probability of its recognition and correction very low. This frequently causes a repetition of exams in the same time or in different medical units and it slows down the diagnostic process (resources waste) and the proper treatment. So, proper actions for improving the working procedures have to be taken. The health care systems, and the education of health care personnel, have to be reorganized to systems that function in a cross-border fashion. Prerequisites for this development shall be a specific emphasis on equity of access, interoperability and standardization of systems and protocols, security and legal aspects. There are technical, legal, organizational, and financial problems to be solved.

Acceptance of eHealth presents a particular challenge. It is important to promote the use of automated tailoring of information access and summaries to accommodate variations in culture, language, literacy, and health-related goals, as well as integrated decision-support systems that can proactively foster best practices. Unfortunately, collection and delivery of the necessary epidemiological and patient data on which such systems must be built are problematic. From this point of view, the most important and

perspective application of eHealth is the medical information system (MIS) and electronic medical record. There is a very clear need for expanded application of information technology (IT) in health care. Clinical workflow still depends largely on manual, paper-based medical record systems in an activity that is economically inefficient and produces significant variances in medical outcomes. Medical information technology is at the heart of information technology implementation policies in health care systems around the world. Most of these policies are based on beliefs about the positive value of MIS rather than on the available empirical evidence, and as a result, policy documents tend to the full of aspiration statements rather than detailed and realistic expectations.

It is obvious and well-known, that the field of health care informatics is extremely evolving. The new models and protocols of MIS are developed, which are based on implementation of HL7, DICOM and etc. profiles. Despite of obvious advantages and benefits, practical application of MIS in everyday practice is slow. Research and development projects are ongoing in several countries around the world to develop MIS: examples include Canada, Australia, England, the United States and Finland. MIS is used primarily for purposes of setting objectives and planning patient care, documenting the delivery of care and assessing the outcomes of care. It includes information regarding patient needs during episodes of care provided by different health care professionals. The amount and quality of information available to health care professionals in patient care has an impact both on the outcomes of patient care and the continuity of care. The information included in MIS has several different functions in the decision-making process in patient care, and it also supports decision-making in management and in health policy.

Perspectives

Health, health care and wellness support are data intensive activities. For several decades electronic tools of many types have been introduced, from hospital information system (HIS) and related subsystems (e.g. laboratory information system – LIS), to newer tools such as decision support systems (DSS). As well, many countries are pursuing initiatives to implement electronic health record (EHR), electronic medical record (EMR), personal health record (PHR), or similar programs. It is well known, that a hospital information system, which is variously also called clinical information system, is a comprehensive, integrated information system designed to manage the administrative, financial and clinical aspects of a clinic. This

encompasses paper-based information processing as well as data processing hardware. The HIS can be composed of one or a few software components with specialty-specific extensions as well as of a large variety of sub-systems in medical specialties (e.g. laboratory information system – LIS, radiology information system – RIS). CISs are sometimes separated from HISs in that the former concentrate on patient-related and clinical-state-related data (electronic health record – EHR) whereas the latter keeps track of administrative issues. The distinction is not always clear and there is contradictory evidence against a consistent use of both terms. It shall be emphasized, that in an area of medical informatics the aim of HIS is to achieve the best possible support of patient care and administration by electronic data processing. The medical information system aims patient management in health care organizations as well as facilitation of electronic data capture in clinic. This is a class of software that receives, processes, stores and reports information generated by clinic processes.

References

[1] G. Heidenreich, B. Blobel, IT standards for applications in telemedicine. Towards efficient data interchange in medicine. Bundesgesundheitsblatt Gesundheitsforschung Gesundheitsschutz, 52(3): 316-23, 2009.

[2] G. Blackwell, The future of IT in healthcare. Informatics for Health & Social Care; 33(4): 211-326, 2008.

[3] K. Hayrinen, K. Saranto, P. Nykanen, Definition, structure, content, use and impacts of electronic health records: A review of the research literature. International Journal of Medical Informatics; 77, 291-304, 2008.

[4] Harnett B. Telemedicine systems and telecommunications. J Telemed Telecare 2006; 12(1): 4-15.

[5] J. P. Harrison, A. Lee A. The role of e-Health in the changing health care environment. Nurs. Econ, 24(6): 283-8, 2006;

Ekaterina Kldiashvili holds a MSc in Biology (1995) and Ph.D. in Histology, Cytology and Embryology (2003) from the Tbilisi State University. Ekaterina works as Executive Director in Georgian Telemedicine Union (Association), Head of Lab and Telemedicine Group in Medical Center “Neoclinic”, managing NATO Networking Infrastructure Project (2005-2006, 2007-2009), BSEC tender (2005-2006), telemedicine pilot actions, whole activity of GTU and also creation of eHealth network in Georgia. Prior to joining GTU Ekaterina worked at department of Pathology of Central Clinic of Tbilisi State Medical University, establishing and leading the electron microscopy laboratory. She was trained in cytological diagnosis of malignant tumors at department of Oncology of the Tbilisi State Medical Academy. Ekaterina also acted as Clinical Cytologist at department of pathology of Central Clinic of Tbilisi State Medical University and Virologist at Republic Center of AIDS and Clinical Immunology. She participated as researcher in Neuroscience project funded by Soros foundation. Ekaterina Kldiashvili represented GTU’s activity and pilot actions at Med-e-Tel (2004, 2005, 2006, 2008).

Establishment of a Multicentre Telecardiology Project in State of Rio Grande do Sul, Brazil: A Report about Academic Participation

R. Timm, B. Lacerda, T. Almeida, R. Kalil, V. Portal, A. Sparenberg
e-Health Centre of the Instituto de Cardiologia of RS, Brazil
robert.timm@hotmail.com

Abstract: A multicentre project of telecardiology started in 2008, in the state of Rio Grande do Sul (RS), under the coordination of the e-Health Centre of the Instituto de Cardiologia of RS (IC-FUC RS), in a partnership with the State Secretariat of Health. A multidisciplinary team, including IC-FUC professionals and students, was in charge of organizing and delivering - during 6 months - a training program for both 2 cardiological centres and 11 remote health care institutions.

Introduction

Worldwide establishment of new telemedicine and e-health applications brings the potential of overcoming traditional barriers in health care delivery, with a potential impact when implemented in developing countries. Telecardiology is one of the most important areas of telemedicine, as heart diseases [1], mainly coronary heart disease, are the most common cause of death in many countries [2]. It has been strongly highlighted that the education of a new generation of professionals will play a crucial role in the adoption and wide implementation of e-Health services. It can, in fact, guarantee the sustainability of new technological initiatives, allowing to estimate a successful delivery of better health care services in the near future [3].

The State of Rio Grande do Sul/Brazil (RS) has 496 cities. Most of them are small and have a lack of health care professionals, being critically underserved in medical specialties. In RS, a multicentre project of telecardiology started in 2008, under the coordination of the e-Health Centre of the Instituto de Cardiologia of RS (IC-FUC) in a partnership with the State Secretariat of Health and including the participation of 11 small and remote towns/villages and 1 regional hospital. For the implementation of this project, a 6 month training program was prepared by the e-Health Centre, which included the participation of IC-FUC professionals and both undergraduate and postgraduate students.

Objectives

The project's aims are: 1. To work as a pilot project for the establishment of a large network for acute cardiovascular assistance throughout the RS State, Brazil; 2. To offer, for the students, a practical experience with the standards of health care practice in both small hospitals and outpatient care units of remote cities; 3. To allow undergraduate and postgraduate students to get skills in the field of telemedicine and e-health applications.

Methods

The health care infrastructure of the project includes:

1. Two cardiological referral centres :

- Instituto de Cardiologia of Rio Grande do Sul, located in Porto Alegre (capital), as a reference for the cities of the north-western region;
- Hospital de Cardiologia of Rio Grande, located in the city of Rio Grande, responsible for the south-eastern region.

2. Eleven health care institutions (hospitals and outpatient units):

- 6 located in the north-western and 5 in the south-eastern regions.

The medical assistance of severe cases that need advanced cardiac care will be performed in the Hospital de Cardiologia of Rio Grande for patients from the south-eastern region. Patients from the north-western region will be removed to the Hospital SãoVicente de Paulo, in the city of Passo Fundo.

Figure 1. Map of RS State and Telecardiology related regions/cities

The project offers: 1. Immediate digital ECG signal acquisition, Internet teletransmission from remote areas and specialized ECG diagnosis from 2 referral centres; 2. Internet based live second cardiological opinion; 3. Thrombolytic therapy for ST-elevation Myocardial Infarction, to be infused at the remote point of care and; 4. Ambulance transport of critically ill patients, via public health system.

Training team selection: the coordinators of the e-Health Centre were in charge of organizing a training program. The first step was the establishment of a multidiscipline training team, which included a selection of 3 students, from both undergraduate and postgraduate programs.

Results

The Project was implemented during the second semester of 2008. The first steps were the implementation of a high speed Internet network (512 Kbps-1 Megabit/s) and the installation and tests of the equipments. Also, during 2 months, a training program for the students was organized, aiming to prepare them for the training task. In this period, the team organized guidelines and teaching material to be used in the field.

Training in the field: the training program for the professionals took place during 4 months, on every 15 days and consisted of:

- Two joint regional meetings - in north-western and south-eastern regions -, aiming to transmit both telemedicine and e-Health concepts and an overview about the Multicentre Telecardiology Project of RS. Figure 2 illustrates a session at the auditorium of the Health Regional Office, in the city of Santa Rosa.
- During 4 months a series of technical training sessions were delivered for the professionals of both the remote teams and the referral centres. It included 6 team trips to each remote region. A total of 121 professionals were trained in all institutions: 67 in the north-western and 54 in the south-eastern region. Figure 3 shows an example of a training session in a remote institution in the north-western region of RS.

Fig. 2. Regional Meeting in Santa Rosa

Fig. 3. Training Session in S. J. Inhacorá

Conclusions

The Multicentre Telecardiology Project in RS/Brazil, is under establishment as a part of a joint public e-health program, with the participation of 2 public cardiological centres, 11 remote health care institutions, 1 regional hospital and the State Secretariat of Health. Recent studies have demonstrated that planning public health assistance and transport strategies can reduce the time spent to offer proper care for

cardiovascular urgencies and emergencies [4-5]. This project can play a key role in health care delivery, improving cardiac assistance in underserved areas of the state.

The participation of undergraduate and postgraduate students in the training process resulted in an opportunity to visit and to see, during 6 months, the reality of medical practice in small and remote communities of Brazil. Assuming an educational task during the training period was a very innovative experience for the students, allowing them to get experiences in the fields of acute cardiac diseases, public health services, IT infrastructure and implementation of e-health services for emergency cardiac care throughout the state. The results of these efforts, to be documented during the operational phase of the project, are expected to match the objectives.

Acknowledgments

The authors greatly acknowledge to both the eHealth Centre of IC/FUC, the State Secretariat of Health of RS and the ISfTeH Students' Working Group for supporting students' participation in eHealth initiatives.

References

[1] Sans S, Kesteloot H, Kromhout D. The burden of cardiovascular mortality in Europe. Task Force of the European Society of Cardiology on Cardiovascular Mortality and Morbidity Statistics in Europe. Eur Heart J; 18: 1231–48, 1997.

[2] The European Health Report 2002: The burden of ill health. WHO, http://www.euro.who.int/document/ehr/e76907h.pdf

[3] V. Androuchko, et al. The Role of Education for the Introduction of eHealth Services in Developing Countries. Presented at Med-e-Tel, 2008, www.medetel.lu/download/2008/parallel_sessions/presentation/day1/the_role_of_education.pdf

[4] K. Kalla, G. Christ et al. The Viennese Registry on Reperfusion Strategies in ST-Elevation Myocardial Infarction (Vienna STEMI Registry). *Circulation*; 113: 2398-2405, 2006.

[5] H. H. Ting et al. Factors associated with longer time from symptom onset to hospital presentation for patients with ST-elevation myocardial infarction. Arch Intern Med, May 12;168(9):959-68, 2008.

This paper is based on the winning presentation, Med-e-Tel 2009 Virtual Students' Contest.

mHealth Solution in Bulgaria

P. Mihova, I. Pendjurov, J. Vinarova
New Bulgarian University, Sofia, Bulgaria
pmihova@nbu.bg; penjurov@nbu.bg, jvinarova@nbu.bg

Abstract: **mHealth by definition is health care, realized through mobile devices for specialized procedures, information exchange, expertises and effects on patients and healthy way of life. As a technologically assisted action, it ensures dynamic unique interactions and contacts - temporary and permanent, on topics and problems of healthcare, as well as providing medical services to individuals and large contingents in unforeseeable circumstances and conditions.**
The paper presents project of a network for provision of continuity of care with telemedical and telehealth services between Greece and Bulgaria which will: be based on the Internet and 3rd/4th generation GSM services; handle the medical records of citizens of both countries, allow the patients themselves or those responsible for their care to enter data or to utilize for this purpose electronic devices that can do the task automatically (e.g., glucose measuring devices, portable ECG machines, spirometry devices etc); permit the treating physician to continuously monitor his patient's progress from a distance; permit the diffusion and dissemination (to specific target groups) of health related information; use smart card technology to for tify the security of data contained in the patients' records and provide tele-education for the medical and paramedical personnel involved in the project.
mHealth applications ensure collection of health and clinical data, delivering health information and real-time monioring of vital signs, and direct provision of information in different stages of its acquisition and processing. Small and convenient size, low power consumption, they can be integrated almost everywhere: furniture, automobiles and even clothes. Mobile phones or personal digital assistants (PDA) with wireless networking capabilities, can serve as inputs to the processes of storage and transfer of recorded and measured parameters to clinicians, selected by their subsequent applications.
Patients, involved in the current project, using their mobile phones will be able to send and receive short text messages. They can initiate telephone calls related to health information and education, study therapeutic schemes for meetings and consultations, transport to health experts, even just for support and courage.

Introduction

Success of this tele-health approach critically depends on providing easy and affordable access to patients' health records [1]. In this respect Internet

together with 3rd or 4th generation GSM services enable telemedical and telehealth solutions that are both far-reaching and affordable [7]. It is now possible to implement a web-platform which allows affordable access to medical services within the regions of Smolyan in Bulgaria and Central/Eastern Macedonia in Greece. The presented here platform will contain records of the citizens using services, safely and easily accessible by their physician.

Material and Method

"Continuity of Care" is a main prerequisite for the free and movement of people across borders within the EU. However, it is seriously compromised especially in the less developed regions of the EU. It is further compromised when it comes to the Greek - Bulgarian transborder infrastructures devoted to the prevention and control of communicable diseases or the use of controlled substances. In this connection it should be stressed that 16% of the population of both countries is hospitalized for one reason or another each year; more than 25% of the population visited doctor, at least once, during the last year; border mobility for employment accelerates the spread of diseases among the border populations.

During 2008, the border crossing station at Promachonas/Kulata processed more than 950000 vehicles and a total of more than 3500000 passengers in both directions. Today, however, the combination of mobile telephony with the Internet affords great opportunities in preventing the spread and protecting from disseminating infectious diseases (e.g., H1N1 virus) or following up the treatment for such diseases), in caring for patients with chronic diseases (e.g., Alzheimer's Disease, Arthritis, Asthma, Chronic Obstructive Pulmonary Disease, Collagen Related Diseases, Diabetes, Epilepsy, Heart Disease, Hypertension, Minimal Cognitive Impairment etc.) and in long term care and rehabilitation following stroke, surgical operations and chemotherapy or radiotherapy interventions in cancer.

The web-platform will accomodate medical multimedia content and will be geared towards both telehealth monitoring and tele-education regarding public health concerns and it is the choice of the public bodies involved to serve as their tool for introducing high quality continuity of care concepts and services in their respective regions.

Project’s main idea is to develop a network for provision of continuity of care telemedical and telehealth services between Greece and Bulgaria which will be based on Internet and 3rd/4th generation GSM services. It would handle medical records of citizens of both countries, allowing patients

themselves or those responsible for their care, to enter data or to utilize for this purpose electronic devices that can do this task automatically (e.g., glucose measuring devices, portable ECG machines, spirometry devices etc). This solution would permit treating physician to continuously monitor his patient's progress from a distance and least but not last - provide tele-education for the medical and paramedical personnel involved in the project.

According to our calculations, the project would aspire to serve at least 15000 persons, among them workers, tourists, businessmen, soccer clubs and their accompanying personnel and fans and, finally, elderly citizens.

Fig.1. Doctors`view on iPhone

Fig.2. Doctors` view in web site

On Fig.1 and Fig.2 are presented screens from the web platform – loaded on iPhone and web site, view point of the doctor. The model is created purposefully with simplified design, because it should allow fast and smooth loading at the mobile phone. The Patient profile consists of detailed information about Medical history, status and paraclinical data. The doctors` view is enriched with the following data – patients number, initials, sex, age, day, month, year, hour and minute. By selecting a record and clicking the button “Show Data”, the Doctor can review selected patients’ details.

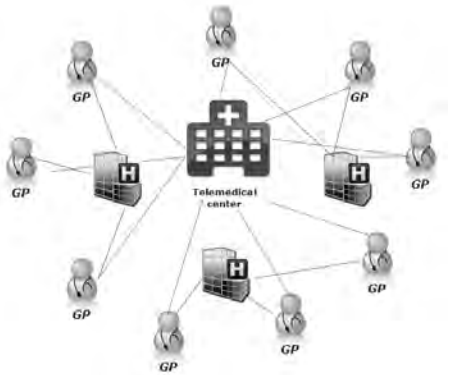


Fig.3. Concept of Telemedical center in connection with GPs

Specialists are entered preliminary in the database, but the patients possess for

each new record individual automatically generated username and password. The reason for this is that according to the Bulgarian law, the system cannot store patients data, except the initials, age and sex, which are not unique data. Using these generated pass and username patients can access the records from any point with Internet through any device – PC, iPhone, PDA.

Our basic concept is to combine and connect each GP in a concrete region by providing telemedical desktop solution – another realized and implemented authors project [4] and presented here mHealth software, in order to achieve complete valuable patient service.

Some of the strategic objectives are:

- Improvement of the access to emergency and general health services
- Improvement of the efficiency of health service delivery
- Improvement of the clinical practice for enhanced health outcomes

Conclusion

Presented here project is an extension of authors development of Telemedical Information System, which combines telemedical functions with modern technologies – PDAs, mobile phones. Formal Internet interventions exist in a broad context of diverse online health resources and services, which share elements in common like information, advice and peer support. However, most online health resources are not created by healthcare professionals. Internet interventions need to be designed to "compete" in that wider context. The democratization of production and distribution is central to the transformative effect of the Internet on society, yet potentially conflicts with healthcare's need for an evidence base and safe practice. This is a core challenge for our project realization.

References

[1.] M. Maheu, A. Allen, E-Health & Telehealth Glossary, www.telehealth.net/glossary.html, [visited 01.10.2009]

[2.] Med-e-Tel 2009 Proceedings, ISSN: 1818-9334

[3.] MIE 2005 The XIX International Congress of the European Federation for Medical Informatics, Vol I No 1, 2005; ISSN 1861-3179

[4.] P. Mihova, J. Vinarova, I. Pendzhurov, Teleconsult – one telemedical solution in Bulgaria, Med-e-Tel 2009 Proceedings, ISSN: 1818-9334

[5.] S. Robert, H. Istepanian, Constantinos S. Pattichis, M-health: emerging mobile health systems, ISBN: 978-0-387-26558-2

[6.] J. Vinarova, P. Mihova Medical informatics, ISBN 978-954-535-515-8, NBU, Sofia, 2009

[7.] J. Vinarova, P. Mihova, S. Tonev, A. Petkov, "eHealth", ISBN 978-954-516-910-6, NBU, Sofia, 2009

[8.]http://www.mhealthbenefits.org/, [visited 02.01.2010]

[9.] http://www.jmir.org/2006/3/e23/, [visited 03.01.2010]

Model of Electronic Health Record for Gynecology Practice in Bulgaria

P. Mihova[1], I. Pendjurov[1], J. Vinarova[1], D. Asenova[2]
[1]New Bulgarian University, Sofia, Bulgaria
pmihova@nbu.bg, penjurov@nbu.bg, jvinarova@nbu.bg,
[2]Governement University Hospital "Lozenec", Sofia, Bulgaria,
dorina_mbg@abv.bg

Abstract: **The Health Information Management Systems Society's (HIMSS) definition of EHRs is: "a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data, and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter, as well as supporting other care-related activities directly or indirectly via interface—including evidence-based decision support, quality management, and outcomes reporting."**
It is important to note that an EHR is generated and maintained within an institution, such as a hospital, integrated delivery network, clinic, or physician office. An EHR is not a longitudinal record of all care provided to the patient in all venues over time.
This paper presents a functional software development, specialized for obstetrics and gynecology practice in Bulgarian medical environment. The record design is subordinated to the Bulgarian and international medical laws for tracing the pregnancy period. It consists of three separated modules – medical history of the patient, administrative data, tracing the pregnancy in 3 trimesters with various tests and medical analyzes, different for each trimester. It allows multimedia history archive, heart rate records, 3D/4D video records, fetal morphology history, biochemical screening record, weekly echograph records and full laboratory history at simple screen. It performs telemedical functions through the possibility to connect from every point with Internet and to be accessible both – for patient and doctor. The EHR is unique for Bulgarian gynecology medical practice. It combines the validate paper version of pregnant patient record with separate medical exams that are performed from different specialists and genetic laboratories.

Introduction

The definition of medical information is a set of data, facts and information (retrospective and prospective) for perceived phenomena,

processes, objects, ideas and theories related to medicine – as practice, specialized work and science.

It should be presented in a form suitable for use by doctor or PC. Health information is presented orally or recorded in due form, in various medium and it is related to past, present or future physical or mental health or condition of the individual. It is created or received by a health officer, public health authorities, health insurers and all specialized healthcare organizations to collect, classify and use such information.

Medical (health) record is a standardized presentation of specialized medical and health information and the physical form of this information. It includes all historical and modern technological forms of presentation of information: correspondence, memoranda, books, plans, maps, images, charts, graphs, photographs, films, microforms, sound recordings, videotapes, machine records and all documented materials, regardless the physical media and performance.

Methods

In the practice of providing health care to women of exceptional degree of importance is to have accurate and timely information for managing the dynamic and complex health needs of their patients. Increasingly, developers of software solutions aim to create technology that can help and meet the challenge of caring for women, based on analysis of complex issues, follow-up preventive measures and prenatal risk management.

In the field of gynecology practice there are number of software solutions, specialized and only for specific needs, or as a part of a common electronic file of patient, respectively of the newborn. Obstetric practice is definitely unique. Patients are monitored for various reasons and often for several reasons at once.

The EHR, presented here, is a set of considerations required by BG regulation studies, which are: adapted from the paper equivalent, required data and additional performance information, generated by long experience and practice in the monitoring of the pregnancy.

The record consists of 5 main screens, namely - Administrative and passport data of patients, Medical history, First, Second and Third trimester.

Administrative data are presented with standard parameters for patient information - name, ID number, phone, age, address, doctor and facility, and specialized information - previous births, marital status, insurance status and employer.

After introducing administrative and passport data, the doctor continues to the medical history screen, where are entered: first day of last menstrual period, and based on the date which is generated automatically, the system calculates the term of birth and gestational week. There is also specific information, consisting of menstrual history, parents history, past and present illness, intake of medications, allergies and harmful habits.

Figure1. Third trimester

Once stored, this information is available at any time to track a patient's pregnancy. After finishing the basic documentation, the doctor starts to enter information for the first trimester, where personal data patient and hospital, are generated automatically.

The medical record includes all required data such as: sexual life, whether the patient is traveling and using a belt, ultrasound images of the examinations and the possible presence of the optional survey data "biochemical screening."

The entrance to the menu software can make references and various reports on specific parameters preset and required by the authors team.

Demand is realized through choice of a function from the following drop-down menus - "Personal data", "Visits" and "References", where each of them offers the possibility to search with the patient ID number.

During the first visit of the first trimester it is obligate to make any regulations and necessary laboratory tests, and whatever exam the doctor finds as an appropriate. A full gynecologycal status and review can be described in a free text entry field - a gynecological status.

In each trimester (Fig.1.), there can be entered various number of visits, each with its own unique ID, generated automatically by the system when staritng "New visit" from the menu Visits. Here are added urine tests, and urine ketones, urobilinogen, a recording of fetal heart tone data and images from fetal morphology.

The software is compared to 5 international solutions and 1 paper version of the EHRs for OG practice. The comparison is developed on the base of 35 parameters, in 4 points scale. The total maximum points from the parameters is 4 x 35 = 140, where with the largest sum is Acrendo's OB /

GYN EMR file with 112 points, with minimum, no doubt - Paper Bulgarian file with total of 60 points, followed by Basic Baby solution - 65 points.

All solutions offer a well-organized introduction and storage of administrative-passport data and print mode for displaying paper equivalent of the file. All records, except paper, offer automated removal of data from the system. Laboratory results are well organized except the Bulgarian version of EHR with 1 point less, because the authors believe that foreign records offer more opportunities. Only in Bulgarian EHR is offered the opportunity to transfer to Excel and Word, and one extremely important parameter - archiving and storage of information.

It is necessary to mention, that the presented solution was introduced in Government university hospital "Lozenec", used by three different specialists and evaluated as an excellent model for innovative work, according to the world tendencies – electronic healthcare and services.

Conclusion

The software solution is composed and approbated by medical practitioners in Bulgarian healthcare system model, which provides better informed treatment methods, where the patient`s history plays a fundamental an central role in monitoring fetal development and last but not least – the patients health.

Medical and health informatics is an evolving process and prosperous health service - an important characteristic feature for the provision of good healthcare. Received and stored in electronic form information ensures patient with greater degree of security and awareness, constant access to the actual information at any time.

References

[1] Electronic Health Records Overview, NIH research center, April 2006

[2] J. Vinarova, P. Mihova, S. Tonev, A. Petkov, "eHealth", ISBN 13: 978-954-516-910-6, Letera, Sofia, 2009

[3] http://www.jmir.org/2006/2/e9

[4] http://www.jmir.org/2005/1/e1

[5] http://www.jmir.org/2004/3/e22

[6] http://www.himss.org/ASP/index.asp

Optimized Representations of X-ray Images

V. Gueorguiev, I. Evgeniev
Technical University Sofia, veg@tu-sofia.bg; iei@tu-sofia.bg
blvd. „Kliment Ohridski" 8, Sofia, Bulgaria

***Abstract*: The aim of this paper is to present approaches in the project DAPSEpro "Medical data acquisition, processing and collection for e-health solutions". The presented in the paper research is oriented to X-ray images processing for their perception improvement.**

Introduction

The aim of this paper is to present some results of the project DAPSEpro "Medical data acquisition, processing and collection for e-health solutions" for optimized visualization of X-ray images. The presented in the paper research is oriented to X-ray images processing for their perception improvement. The second target is pre-design of low-cost high-effective and user-friendly environment for image processing for hospital applications [1].

Hardware Basis

Image processing is based on digitized pictures. The project group has the following sources of images:

- DICOM and JPG formatted images, obtained directly from X-Ray machine
- DICOM formatted images, obtained directly from ultrasonic and Doppler machines
- Scanned X-Ray pictures.

The X-Ray pictures are material and have to be digitized. Digitalization is done by different devices. The experimental test-bed includes two different devices: A3 scanner for semi-transparent pictures and high-resolution digital camera carried by X-Y plotter.

The optical resolution of the scanner is 600/2400 dpi. The optical resolution of the camera is 7.1. Megapixels.

The light source of the X-Y system has number of filters to control light intensity. Movement resolution is 0.2 mm.

Primary Analyses and Observations

Images received directly from X-ray machines, ultrasound and Doppler scanners are accepted “as is” and have their native resolution.

Digitalization by scanner for transparent images has the following disadvantages [2-3]:

- Scanning is slow. High quality scan needs unacceptably long processing time. Pre-view and real scan are two different phases and each one is extremely long.
- If the picture is bigger than A3 format in any dimensions it has to be scanned in sections. This needs to adjust the picture to the axes of the scanner each time for the needs of stitch process. In practice this is not fully possible and at least needs time, skills and experience. In this case stitching is mandatory. Because scan process is not automated stitching cannot be automated too.
- In case when the top optical plane of the scanner is under the top end of the scanner’s case processing images bigger than A3 is impossible because they have to be bent to follow the top surface form.
- Only few scanners include light intensity control function.
- Selected target zone of the picture cannot be zoomed optically.

Digitalization by digital camera moved in X-Y space is an alternative for some of the disadvantages of flat-bed scanner digitalization. It has two variants [2-3]:

- The camera can observe the whole picture at once. It can be positioned on a selected position and target area can be zoomed and digitized. Digitized piece of the picture is ready for processing. Stitching is not available.
- The camera travels and takes pictures covering the full area as a check board. Camera settings are constant for the whole process. After that automated stitching is applied. The digitized image is ready for processing.

The first approach was implemented 10 years ago for X-Ray processing for orthopedic clinic of Medical University Sofia by team from Sofia University and Technical University of Sofia. The system is still operational. Its price is relatively low and image quality is good even after 10 years. The weaknesses are degradation of image quality as a function of the size of target area and low resolution of the camera (for now-a-day criteria).

Under DAPSEpro project was decided to implement the second approach – carried digital camera with remote computer control. Movement, zoom,

capturing and stitching are automated. The main resolution of the camera guarantees resolution better than scanner with optical 2500x2500 dpi.

Image Processing Results

Here are presented the following image improvements:

1. Improvement of low quality X-Ray image. The image is scanned and stitched from the original picture – Figs. 1a, 1b.
2. Improvement of X-Ray digital image received from X-Ray machine directly – Fig. 2.
3. Improvement of ultrasound image from received digitized from ultrasound machine. Improvements in liver's volumetric perception are

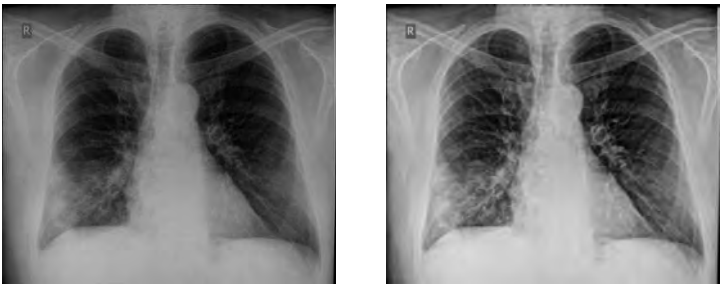


Figure 1: a) Original image b) Processed image

Figure 2: a) Original image; b and c) Processed images

seen. Kidney's structure image is improved, too – Figs. 3a, 3b.

4. Processing 2D image to present 3D view - depth generation (2.5D) is basis for 3D re-creation – Fig. 4.

Conclusion

Preparation of the images for this paper resulted to diagnosis confirmation. Additionally was obtained confirmation that personnel with lower qualification can better interpret images. Finally was confirmed that

Figure 3: a) Original image

b) Processed image

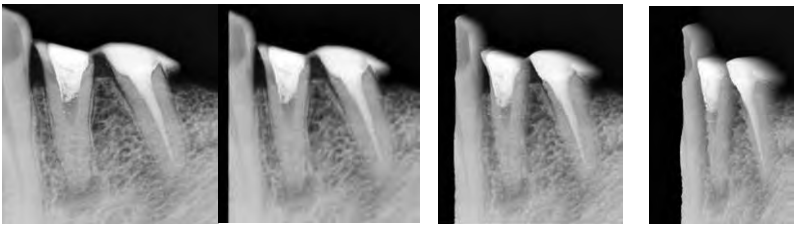


Figure 4: a) Original; b) Rotation 10°; c) Rotation 30°; d) Rotation

images with very low quality can be processed and interpreted. This results to reduced need for new pictures and to reduced dose exposition for the patients [4].

Acknowledgment

This work is funded by Bulgarian NSF under D002/113-2008 project.

References

[1] W. J. Dallas, A digital prescription for X-ray overload, IEEE Spectrum, 1990.

[2] B. Preim, D. Bartz, Visualization in medicine, Morgan Kaufmann, ISBN 978-0123705969, 2007.

[3] Richard S. Gallagher. Solomon Press, Computer Visualization: Graphics Techniques for Engineering and Scientific Analysis, CRC Press LLC, ISBN 849390508.

[4] R. V. Stavitskii at al., An approach to decreasing dose load in prophylactic X-ray examination, Biomedical Engineering, Volume 40, Number 4 / July, pp. 191-193, 2006.

Vesselin Evgueniev Gueorguiev received master degree in Computer Systems and Automation form Technical University of Sofia in 1990 and postmaster degree of Artificial Intelligence and Expert Systems in 1992. He is assistant professor in the Department of Computer Systems and Control, Faculty of Computer Systems and Control, Technical University of Sofia.

He is member of Bulgarian Union of Automatics and Informatics and IEEE. He has led a number of projects oriented to real-time computer graphics, program code analysis and distributed systems. His current scientific interests are oriented to 3D visualizations, image processing and medical data mining.

Ivan Evgeniev Ivanov received his master degree in Automatics and Telemechanics form Technical University of Sofia in 1984 and doctoral degree in 2006. He is assistant professor in the Department of Systems and Control, Faculty of Automatics and Head of Advanced Control Systems Laboratory in Technical University of Sofia. He is also a member of Bulgarian Union of Automatics and Informatics and IEEE. He has led a number of Bulgarian and EU projects oriented to real-time computer applications, program code analysis and distributed control systems. His current scientific interests are oriented to real-time applications, formal analysis and program generation.

Polish Telemedicine Society Heading 2010

W.M. Glinkowski[1,2,3], M. Pilch-Kowalczyk[1,5,6], M. Widanka[1,4], P. Wójcik[1,4], S. Piórek[1,4], R. Mężyk[1,4], R. Sitnik[1,8], M. Nejman[1,6], Z. Kotwica[1,7a], J. Pietryka[1,7], A. Wojciechowski[1,9]
[1]Polish Telemedicine Society, Warsaw, Poland
[2]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", w.glinkowski@teleorto.pl
Medical University of Warsaw, 02-005 Lindleya 4, Warsaw, Poland
[3]Department of Descriptive and Clinical Anatomy, Center of Biostructure Research, Medical University of Warsaw, Warsaw, Poland
[4]Holycross Cancer Centre, Kielce, Poland
[5]Voxel S.A., Kraków, Poland
[6]Alteris Ltd., Katowice, Poland
[7a]Department of Neurosurgery, [7]Westpomorian Regional Hospital, Gryfice, Poland
[8]Institute of Micromechanics and Photonics, OGX, Warsaw University of Technology, Warsaw, Poland
[9] I[st] Department of Clinical Radiology, Medical University of Warsaw, Warsaw, Poland

Abstract: **Polish Telemedicine Society members are entering 2010 with novel applications and continuation of previous implementations of ideas and practical telemedicine and eHealth solutions in clinical practice, research, and new developments. eHealth and Telemedicine activities focus on teleradiology, teleorthopaedics and telerehabilitation. North West, Southern, South East and Central Regions of Poland are presented as focal areas of telemedicine applications development and implementations. Presented examples show systematic and continuous development of Polish Telemedicine Society that may accentuate some specific features of telemedicine and eHealth development.**

Introduction

Polish Telemedicine Society members are entering 2010 with novel applications and continuation of previous implementations of ideas and practical telemedicine and eHealth solutions in clinical practice and research [1-4]. The aim of this review is to present selected Polish Telemedicine Society activities represented by society members across the country.

South Eastern Initiatives and Implementations

Great advancement is noted in many non central and non academic hospitals. Videoconferencing progress is observed in hospitals. An excellent example is the Holycross Cancer Centre Hospital in Kielce that turned into new way of telemedicine due to System X installation in September 2009. The system is designed to didactic purposes and electronic surgical procedures archiving and videoconferencing as well. That prompts regional telemedicine in oncology. Successful IT medical system implementation at the Holycross Cancer Centre is the best example of Telemedicine and eHealth leadership in Holycross Region that follows “e-Health Strategy for Poland 2009 – 2015”.

Southern Poland Telemedicine and eHealth initiatives

Despite legal problems and unclarity, huge and increasing market demand for teleradiology services resulted in impressing growth of teleradiology in Poland [5].

Lower Silesia eHealth Initiative

Lower Silesia was the first region of Poland that has successfully completed EU sponsored eHealth initiative connecting 11 public and private diagnostic imaging centers with a leading hospital (Voivodship Specialistic Hospital in Wroclaw) as a provider of teleradiology services. The system utilizes AGFA Healthcare PACS and RIS/Teleradiology by Alteris. The project serves approximately 10,000 exams a year.

North West Poland enters the “Game”

In Westpomorian Region of Poland in 2009 the telemedicine program “Telenet” **** has started in cooperation with German regions of Brandenburg and Meklemburg. The “Telenet” is designed to link 35 medical institutes and 11 hospitals in Poland and 21 in Germany (Greifswald University Hospital, Szczecin University Hospital and regional hospitals in Gryfice, Szczecin, Gorzów, and Kołobrzeg). The aim of cooperation is an improvement of medical care in wide areas – diagnosis, treatment and prophylactic measures in oncology, cardiology, neurology, neurosurgery and polytrauma. Project supports also organizing International Scientific Symposia with telemedicine included into scientific program.

Teleradiology Network

The institutional member of Polish Telemedicine Society - “Voxel” is a private held company, focused on teleradiology in both internal and external

models. Voxel services currently support teleradiology development and practice. Almost 30,000 imaging exams from 30 submitters a year reported via teleradiology show significant input. The positive response to remote services warrants irreversibility of teleradiology development in Poland.

Postural Telediagnostics

Postural telediagnostics clinically utilized by "TeleOrto" has turned into automatization development phase to improve diagnostic effectiveness [6-8]. Telediagnostic screening system of postural deformities based on structural light optical 3D shape measurement and automated data analysis project is focused on clinical implementation of telemedical system along with a method for three-dimensional measurement of human body surface.

Examples of International Cooperation

Members of Polish Telemedicine Society are involved in European project CLEAR - Clinical Leading Environment for the Assessment and Validation of Rehabilitation Protocols in Home Care that is setting up an innovative e-Health service based on the development of protocols for rehabilitation and chronic disease management therapies provided under control of medical staff, coordinated by Italian company – Signo Motus. The clinical team in Poland is implementing telerehabilitation protocols for musculoskeletal chronic disorders based on individually tailored clinical exercises and remote patient supervision and self-care management. Clinical protocols are elaborated together with well known Clinical centers across the Europe [Stichting Revalidatiecentrum Het Roessingh, (Netherlands), Fundació Privada Institut de Neurorehabilitació Guttmann (Spain), Azienda Unità Sanitaria Locale 11 Empoli (Italy) and Center of Excellence "TeleOrto", Medical University of Warsaw (Poland)].

International Online Service for Orthopedic Surgeons

Web based Online service Fracture healing monitoring (Orthopaedic Intelligence**) has been effectively launched and turned into practice for fracture union assessment, analysis and monitoring. Described system was developed and implemented as Web application that utilizes single server and Web Browser for Internet communication [9-11]. This project was nominated to IT@NETWORKING AWARDS 2009.

Conclusions

The new generation of telemedicine enthusiasts is emerging and supports the society. They enter into telenursing, teleeducation [12] and many more

telemedicine specific activities. Some areas of the telemedicine were not yet explored in Poland. Presented examples show systematic and continuous of development of Polish Telemedicine Society that may accentuate some specific features of the own way of telemedicine and eHealth.

Acknowledgments

Authors acknowledge the support received form: Center of Excellence „TeleOrto", Medical University of Warsaw; Warsaw University of Technology; Alteris Ltd.; Holycross Cancer Centre, Kielce; Voxel S.A. The support of research grants is acknowledged: *NR13-0020-04/2008; **N403 001 31/0024; ***CLEAR (ICT-PSP-224985) Clinical Leading Environment for the Assessment and validation of Rehabilitation Protocols for home care; **** "POMERANIA" telemedicine project.

References

[1] W. Glinkowski, M. Kornacki. Telemedicine -- a new concept for health care (pol.) Acta Biooptica et Informatica Medica, 2, 3-4, 155-156, 1996.

[2] W. Glinkowski, Telemedicine and eHealth, Proceedings of XI International Conference Medical Informatics & Technology Ed.:Piętka E, Łęski J, Franiel S. MIT I – 23–29, 2006.

[3] W. Glinkowski et al. Current Polish Telemedicme Society Activities, Eds.: Jordanova M, Lievens F, Electronic Proceedings Med-e-Tel 2008, The Intern. Educational and Networking Forum for eHealth, Telemedicine and Health ICT ISSN 1818-9334, 240-243, 2008.

[4] W. Glinkowski (Ed.) Advances in International Telemedicine and eHealth Vol.1 Medipage 2006.

[5] W. Glinkowski, M. Kornacki Technological standards of teleradiology function in orthopedics and trauma care.(pol.) Ortop Traumatol Rehabil.; 30;4(6):725-30, 2002.

[6] W. Glinkowski et al. A. Telescreening of the posture and spinal deformations followed by telerehabilitation project: current status Eds. M. Jordanowa, F. Lievens Proceedings of International Conference Med-e-Tel 2007, 58-64.

[7] A. Vladzymyrskyy, T. V. Popova, O.I. Ryaskova, R. Sitnik, W. Glinkowski, Method of Telemedicine Screening of Orthopedic Pathology in Children and Adolescent Groups, Современная педиатрия, 2009, ISSN 1992-5913, 4(26)2009,92-95

[8] W. Glinkowski, R. Sitnik, P. Bolewicki et al. Automated Human Body 3D Measurement System Supporting Screening For Posture And Body Shape Evaluation, Poster Session: 27th International EuroPACS Meeting, Int J CARS 4 (Suppl 1):S332–S333, 2009.

[9] W. Glinkowski, J. Żyłkowski, A. Wojciechowski, K. M. Chui. Remote Decision Support for Fracture Healing Progress Journal of eHealth Technology and Application, 5, 3, 246-252, 2007.

[10] W. Glinkowski. Development of Telediagnostic Tools for Decission Support for web based orthopaedic trauma evaluation w eHealth: CeHR Conference Proceedings 2007, Eds: Blobel B, Pharow P, Zvarova J, Lopez D. AKA, IOS Press, 213-219, 2008.

[11] W. Glinkowski, P. Orłowski, A. Karpowicz. Web-Based Fracture Healing Assessment And Monitoring System, Poster Session: 27th International EuroPACS Meeting, Int J CARS 4 (Suppl 1):S304–S305, 2009.

[12] W. Glinkowski, B. Ciszek. WWW-based e-teaching of normal anatomy as an introduction to telemedicine and e-health. Telemed J E Health.;13(5):535-44, 2007.

Progress in Preparations for Launching Telemedicine and eHealth Initiatives in Armenia: A Report on Recent Activities by the Armenian Association of Telemedicine (AATM)

G. V. Chaltikyan[1], A .E. Avoyan[1], D. L. Gasparyan[1], R. H. Hovhannissyan[1], T. E. Hakobyan[2], K. Vardanyan[3]
[1]Armenian Association of Telemedicine (AATM), info@armtelemed.org
5/19 Mashtots Ave., Yerevan 0015, Armenia
[2]Ministry of Health of Republic of Armenia, thakobyan@moh.am
Government Building No. 3, Yerevan, 0010, Armenia
[3]Union of Information Technology Enterprises (UITE), info@uite.org
1/3 Byuzand St., 4th Floor, Yerevan 0010, Armenia

Abstract: **Armenian Association of Telemedicine (AAT M) is a non-governmental, non-pr ofit organization founded in De cember 2008 in Yerevan, Armenia. The mission of AATM is to promote development of Telemedicine and eHe alth field in Armenia, via cooperation with central and local governmental struc tures, assis tance in Telemedicine and eHealth initiatives, cooperation with major local and international institutions, organiz ations and companies, and devel opment of educational activities. Sinc e 2009 AATM is a national mem ber from Armenia to the Intern ational Society for Telemedici ne and e Health (ISfTeH). In the past one year since its creation AATM established partnership with many local and int ernational stakeholders in the field of Telemedici ne and eHe alth; performed extensive e valuation of the field and c onsultations need ed to in itiate relevant ac tivities; presen ted its vi sion and stra tegy t o resp onsible go vernmental bodi es, a nd obtained t heir supp ort f or proposed ac tivities; participated i n a ser ies of local and international scientific and working meetings; and outlined concepts of s everal s trategic long -term projects, to be developed i n detail, prepar ed, implemented, and monitored during a time period of five years. These include:**
<u>Elaboration of Strate gic Pl an of Long-T erm De velopment of eHe alth Applications and Services in Armenia (eHealth Master Plan).</u> The focus on eHealth development is driven by major challenges that health care systems ar ound the gl obe are fa cing. WHO has re commended all member state s "to consider drawing up a long-term strategic plan for developing and implementi ng e Health services in the various areas of health sector ". To address the issue AATM establ ished a wor king group (eHealth Tas k F orce) with participation of government authorities, NGOs, academic and rese arch centers, ICT representatives, and leading experts in the field, to de velop and present

to the government a strategic plan for eHealth (eHealth Master Plan). The Task Force has performed initial consultations with local and international experts, and started pre-assessment of the field, as well as adopted a working plan and schedule. In the forthcoming months the work will be continued to define necessary standards and requirements for implementing eHealth applications, and develop a template for the Plan.

Establishment, Development & Maintenance of National Telemedicine Network in Armenia. Telemedicine in Armenia has potential to improve performance and cost-effectiveness of health care system, considering severe concentration of health care resources in the metropolitan areas and decreased availability of specialized care in the rural regions, as well as financial limitations. AATM proclaimed long-term goal to establish, develop, operate and maintain a comprehensive nation-wide telemedicine network connecting together all country's health care facilities, as well as providing them with access to leading international health care institutions. As initial step in implementation of the above, AATM is launching a pilot telemedicine connection between a community primary care facility and consult site in Yerevan, to serve as a model for future telemedicine network.

Two other strategic programs (Promotion of Home Telecare Services, and Development of Mobile eHealth Applications in Armenia) are currently at preliminary stage of establishing cooperation with interested stakeholders, designing methodology, and collecting necessary data.

Introduction

Use of Information and Communication Technologies (ICT) in medical practice, education and research have resulted in emergence and maturation of specific area at the crossroads of technology and health care known today under a bunch of terms such as **Telemedicine (TM), Telehealth, eHealth (eH), and Health Telematics**. The area is evolving dynamically in line with current tendencies towards globalization, universal access to critical services (including health care and education), and increasing overall electronic literacy, as well as a need to contain health care associated costs. Benefits of TM and eH for the society and health professionals include improved access to health care and invaluable learning opportunities, correspondingly, while overall economic advantages lie in reduced health care costs through better resource management, shared staffing, reduced travel and shorter hospital stays. The resultant effects ultimately translate into further progress towards democratic and information society. All mentioned above has recently led major international agencies, such as International Telecommunication Union, World Health Organization, and

European Commission, among others, to adopt special documents prioritizing development and wider application of TM and eH services. In that view recently established **Armenian Association of Telemedicine (AATM)** has proclaimed its determination to support wider adoption of ICT in health sector in Armenia. In the past one year since its foundation the Association has established contacts with major local and international government structures, organizations and companies related to the field, and is currently working on several long-term projects aimed to facilitate deployment of TM and eH services in Armenia.

Ongoing and Prospective Projects by AATM

Elaboration of Strategic Plan of Long-Term Development of eHealth Applications and Services in Armenia (eHealth Master Plan)

eHealth covers interaction between patients and health care providers, institution-to-institution data transmission, or peer-to-peer communication between patients or health professionals. It includes wide range of digital health-related data management services, telemedicine services, and multiple medical information delivery services for both health care professionals and community.

Armenia had “inherited” from the Soviet era rather developed health care system, which has been exposed to severe social and economic derangements, experienced significant breakdown, and is currently moving through the period of transition towards health systems of the developed world. Despite recent major advances in ICT field in the country, penetration of ICT applications in health sector remains remarkably low, which reflects absence of national strategy and sustained policy in eHealth.

To address the issue AATM has established multidisciplinary working group (eHealth Task Force) with participation of government authorities, NGOs, academic and research centers, ICT representatives, and leading experts in the field, to develop and present to the government a strategic plan for eHealth (eHealth Master Plan). This will include among others the following sections: detailed analysis of the current state of healthcare sector in the country, international experience in eHealth development, country specific health policies and expected impact of eHealth on existing medical practice, education and research in Armenia; organs responsible and authorized for deployment of eHealth infrastructure and components; cost analysis of implementing eHealth and budget for each stage of development; national eHealth priorities and roadmaps for coming 10 years; structure of Hospital Information System (HIS) and national telemedicine

network; national standards of interoperability, security and privacy; proposed legislative and administrative measures.

The Task Force has performed initial consultations with local and international experts, started pre-assessment of the field, and adopted a working plan and schedule. In the forthcoming months the work will be continued to define necessary standards and requirements for implementing eHealth applications, and develop a template for the Master Plan.

Establishment, Development & Maintenance of National Telemedicine Network in Armenia

Telemedicine in Armenia has potential to improve performance and cost-effectiveness of health care system. Health care resources in the country are mostly concentrated in Yerevan metropolitan area, while other communities commonly experience decreased availability of specialized care. Physicians working outside major tertiary care institutions in Yerevan typically have much less opportunities for continuing medical education and professional development. Besides ability to tackle these inequities between various parts of the country, telemedicine gives unique prospects in international collaboration in the areas of medical practice, education and research.

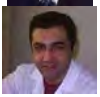
One of the priority strategic goals of AATM is deployment and subsequent expansion of comprehensive nation-wide telemedicine network connecting together all country's health care facilities, as well as providing them with access to leading international health care institutions. As initial step towards implementation of the national telemedicine network, AATM is currently working on a pilot telemedicine connection between a primary care clinic in remote rural community and central facility in Yerevan, to serve as a model for future telemedicine network.

Promotion of Home Telecare Services, and Development of Mobile eHealth Applications in Armenia

Among AATM's plans for strategic development of health ICT in Armenia special place is devoted to remote patients' monitoring and mobile (wireless) eHealth technologies. Importance of home telehealth lies in better management of chronic conditions and maintenance of health status in target groups of patients. Mobile telehealth (mHealth) emerges as one of the most promising areas of development in health ICT. Both programs are currently in initial phase of performing field assessment, defining requirements and calculating investments, establishing cooperation with interested stakeholders, designing concept and methodology, and developing time-table of immediate activities.

Georgi V. Chaltikyan, President of AATM
Associate Professor of Surgery, Department of Surgery #2, Yerevan State Medical University , Republican Medical Center “Armenia”.

Armen E. Avoyan, Vice-President of AATM
Associate Professor of Urology, Department of Urology YSMU, Clinic of Urology, Republican Medical Center “Armenia”.



Davit L. Gasparyan, General Secretary / Treasurer
Associate Professor of Obstetrics/Gynecology, Head of Gynecology Department, Medical Center “Kanaker-Zeytun”, Yerevan, Armenia

Ruben H. Hovhannisyan,
Associate Professor of Urology, Department of Urology YSMU, Head of the Adult Urology Service, Arabkir Joint Medical Center, Yerevan, Armenia

State-of-the-Art in Telemedicine-Telehealth in Slovenia

D. Rudel [1,2] , M. J. Fisk [3]
[1] MKS Electronic Systems Ltd., Ljubljana, Slovenia
[2] SIMIA-The Slovenian Medical Informatics Association
drago.rudel@mks.si
[3]Insight Social Research Ltd., United Kingdom
malcolm.fisk@dsl.pipex.com

Abstract: **The paper aims to report on the state of the art in telemedicine-telehealth services in Slovenia. Such services are at their initial phase. Some applications are presented, and ways to overcome the obstacles and boost the development of services are discussed.**

Introduction

In the field of telemedicine-telehealth Slovenia is among European countries where such services have only started to appear. That which the European Commission says in its declaration on telemedicine [1], namely that "*most telemedicine initiatives are no more than one-off, small-scale projects that are not integrated into healthcare systems*" is highly valid for Slovenia. This was confirmed at the first national conference in Slovenia on telemedicine – telehealth in January 2010 [2]. There are several reasons for this. Among these, the strongest reason is that, as a young country, Slovenia has gone through a series of tremendous changes that have directed efforts away from the social and the healthcare systems into other areas.

R &D Activities in Telemedicine – Telehealth

Several industrial R&D and academic groups are now seeking opportunities to develop their technological solutions in the area of telemedicine – telehealth. But not many are trying to develop services based on ICT supported solutions. Some limited funds are available each year within tenders for e-Contents or supporting schemes for innovative enterprises. Many of groups, furthermore, participate more or less successfully in international consortia, in, for instance, FP5-FP7 programmes and other funded schemes. Among them the most successful has been a specialized hospital for people with pulmonary diseases [3].

Telemedicine among Health Professional

Two services that exist in Slovenia belong to telemedicine and operate among health professionals (B2B - business to business model):

1. Tele-consultations in urgent transfusion medicine [4] represent a mature service offered by the National Institute for Transfusion Medicine, Ljubljana. It supports regional transfusion institutions (hospitals) where no transfusion medicine specialist is permanently present; but where there are trained staff to source the necessary quantities and types of blood, and obtain confirmation for the same, before it is given to a patient.

   The system consists of a safe and coded network, equipment for the capturing and processing multimedia data, a videoconferencing system, and broadband links to individual professional environments. The application is original in its hardware solution - an apparatus (Gelscope) that captures and processes digitized images of laboratory mixtures of gel and blood. By the semi-automatic analysis of the picture the selection of blood is confirmed or rejected.

   The service ensures a uniform quality of blood transfusion services throughout the country. As it reduces the need for a permanent presence of specialised medical staff in smaller hospital environments, resources are saved.
2. Tele-radiological application - external radiologists support three hospitals remotely on request by analyzing tele-radiological pictures. The pilot is planned in 2010 within the national eHealth programme involving additional specialised hospitals.

Home Telemedicine – Telehealth Services

Below there are some examples of initiatives in the area of home telemedicine – telehealth. All of them are in their developmental phase.

1. Home telecare service called Lifeline – “red button” [5] was introduced in 1991. It aims at providing mainly social support. Although the system enables also support for better health such as fall detection, incontinence detection, medication reminders, etc. these solutions have been introduced in only a very limited way within services at home available to elderly population.
2. For more than five years a nation wide network supporting young diabetic patients at home has been used on regularly basis. The system that collects data on blood sugar levels uses a phone-line. It is technically simple but effective.
3. eDepression [6] is an emerging internet-based care management and patient empowerment system introduced in 2008. Patients with depression staying at home periodically fill-in a web based questionnaire, informing professionals on their mental condition.

4. A communication platform called iHub was developed to enable distance support to pulmonary patients with COPD at home. The project went through its feasibility phase but the service itself is not yet available.
5. The Ljubljana Rehab Institute has been developing a tele-rehabilitation service for patients with motor disabilities [7]. The system integrates a body supporting instrumented frame, virtual reality environment and video conferencing between a patient and a physician.

An educative example for all service developers was a trans-telephonic EKG service called Mobilink that was offered to cardiovascular patients some years ago. Although based on a mature technical solution, the service failed to secure prompt responses from cardiologists to the received record.

Actors in the field of telemedicine - telehealth have also considered a possibility of implementing services trans-nationally from other EU countries (where those services have been developed). But marketing activities from other countries have shown that healthcare stakeholders in Slovenia are reluctant to accept telemedicine services that have monitoring centers outside the country.

Obstacles To and Ways of Boosting the Development of Telemedicine-Telehealth Services in Slovenia

Years long efforts to introduce telemedicine-telehealth services have uncovered some significant obstacles to successful development. The obstacles exist on the national, regional and local levels:

- Telemedicine-telehealth is not on a priority list of the eHealth programme and the national development plans for 2008-2013
- Absence of a national strategy on telemedicine - telehealth
- Lack of financial resources for larger pilot projects
- No legal background for new telecare services
- Exclusion from health insurance schemes
- No inter-regional cooperation
- Lack of interest among health professionals, health insurance companies and other stakeholders

Ways of boosting the development of telemedicine-telehealth services in Slovenia could be:

- The Slovenian Medical Informatics Association (SIMIA) has become active in the field. In 2009 it became an ISfTeH member. SIMIA organised the first national symposium on telemedicine-telehealth in January 2010 aiming at getting an overview on

activities and resources for development of telemedicine – telehealth in Slovenia.

- Within the eHealth program of the Ministry of Health five pilot applications are planned to 2015 (only one identified so far).
- A law on long-term care is in preparation that will introduce compulsory insurance for long-term care. New and more effective services will be needed, so costs for providing telemedicine-telehealth services could be refunded.

Conclusion

Committing itself to telemedicine, the European Commission will define in 2010-2011 a set of actions to be taken by the Member States. Additionally, by the end of 2011, Member States should have assessed and adapted their national regulations enabling wider access to telemedicine services. Slovenia too will have to accumulate more political will in the future to fulfil its commitments towards its citizens and the EU.

References

[1]. EC Communication on telemedicine COM(2008) 689 final, Nov.2008. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0689:FIN:EN:PDF

[2]. SIMIA - The Slovenian Medical Informatics Association. MI'2010 National Conference on Telemedicine – Telehealth, Ptuj, Jan.28th -29th, 2010.

[3]. ALIAS – Alpine Hospitals Networking for Improved Access to Telemedicine Services. European Territorial Cooperation - Alpine Space Programme 2007-2013.

[4]. M. Breskvar, I. Bricl, P. Rožman, M. Meža, J. Tasič. Introduction of teleconsultations in the blood transfusion service. Zdrav Vestn 77 I:177-82, 2008:

[5]. D. Rudel, M. Fisk. Exploring the potential of new telecommunication technologies to underpin healthcare service frameworks - Understanding the Slovene experience through a case study of the 'Lifeline' 'telecare service. AIM; 13(2):75-9, 2005.

[6]. A. Marusic, M. Meglic, D. Kozel, M. Kuzmanic, A. Tancic, S. Temnik, M. Mirjanic: eDepression: a new approach to treat patients with depression using internet-based care management and patient empowerment system. Ljubljana Patient 2008 International Conference, 28-29. 3. 2008, Ljubljana, Slovenia.

[7]. I. Cikajlo, M. Rudolf, N. Goljar, Z. Matjačić. Virtual reality task for telerehabilitation dynamic balance training in stroke subjects. In: International conference Virtual rehabilitation; 2009 Jun 29-Jul 2; Haifa. New York: IEEE, 121-5, 2009.

Drago Rudel has 20 years of experiences bringing innovative solutions to people with disabilities particularly elderly people living at home His activities include aspects such as establishing telecare networks to provide telecare services, system integration and implementation of new technological solutions. Dr, Rudel is The Slovenian Medical Informatics Association (SIMIA) board member since 2000.

Malcolm Fisk is Chair the Telecare Services Association (TSA) that represents over 350 telecare and telehealth service provider and supply sector organisations. He is on the Editorial Board of the Journal of Assistive Technologies and is widely published in this and related areas. He leads the Coventry University team in the TeleSCoPE project that will develop a European code of practice for telehealth services. As Managing Director of Insight Social Research Ltd. Malcolm is currently engaged in contracts concerned with domiciliary care, telehealth, visual impairments, support services for children and families, and developments at the interface of health and social care.

Systematic Review of the Use of Telehealth in Asian Countries: Analysis of Outcomes

H. Durrani[1], S. Khoja[1], S. Ansari[2], R. E. Scott[3]
[1]Department of Community Health Science, The Aga Khan University, Karachi, Pakistan
[2]Department of Community Health Sciences, University of Calgary Calgary, Canada
[3]Global e-Health Research and Training Program, HiiTeC, University of Calgary, Canada

Abstract: **Evaluating telehealth outcome indicators is one way of assessing performance of telehealth applications. The goal for this paper is to synthesize the scientific evidence on outcomes of telehealth (clinical and non-clinical) reported in the different studies reported in Asia. The present work explores the outcomes of telehealth use in Asia utilizing modified version of the Canadian National Telehealth Outcome Indicators Project (NTOIP) for Global eHealth settings i.e. i.e. Gloal eHealth Outcome Development Framework (GeHOD Framework). Telehealth outcomes were structured into hierarchy domains concepts to help in their identification and report. The domains include outcome themes, outcome categories, outcome indicators, outcome measures and outcome tools. There was also no consistent pattern noted in stating and evaluating outcomes indicators, measures or tools. Out of the total of 109 studies, quality was measured in 64 articles (59%), quality and access in 23 articles (21%), quality and cost in 11(10%). The study raises some important questions on how outcomes should be used, reported and defined. Studies should use homogenous outcomes so that studies can be compared to other studies in similar settings.**

Introduction

Telehealth feasibility is well demonstrated in many projects, reviews and commentaries around the world. Reviews have described telehealth as a special way of health care delivery with enormous opportunity for clinical care, education, research and administration in the field of health [1]. Amid increasing trends in Telehealth use in both the developing and developed world, there remains concern about 'how the evidence supports effectiveness of Telehealth in improving quality, access and cost-effectiveness' [2]. A systematic review on research methodologies concludes that it will be difficult to draw firm conclusions from review

studies until the telemedicine field adheres to standards of reporting technical details [3]. Other than the quality of studies evaluating telehealth, there is also lack of agreement on the outcomes of these studies, which makes it difficult to compare different initiatives [4]. While limited studies report information about telehealth outcomes in developed countries, no such study exists for developing countries. This calls for reviewing the publications on telehealth projects in the developing world, focusing on the desired outcomes of these studies. This calls for reviewing the publications on telehealth projects in the developing world, synthesizing the outcomes used in these studies.

Methodology

In a previously reported systematic review of telehealth studies in Asia [, a total of 1503 abstracts were retrieved yielding 109 articles for final review. These articles were used in this study. To permit a standardized approach to examining the outcomes used by the studies, the paper aims to apply an established framework in a new (Asian) setting. The authors adopted the Telehealth Outcomes Development framework designed by the Canadian, National Telehealth Indicators Project (NTOIP) [4] as revised for adoption within the Global eHealth setting i.e. Gloal eHealth Outcome Development Framework (GeHOD Framework) [5]. Telehealth outcomes were assigned to different domains representing relationships of outcome concepts to help in their identification and synthesis. The domains included outcome themes, outcome categories, outcome indicators, outcome measures and outcome tools.

Results

The telehealth outcomes were measured in all the three areas of outcome themes, i.e. Quality, Access and Cost. In depth analysis of the articles delineated overlapping definitions and scope of the outcome themes. Many articles assessed more than one theme with the quality being major focus of attention. A total of 109 articles were reviewed from different Asian countries. Outcome themes contained the triad of eHealth outcomes i.e. quality, access and cost, see figure 2. Outcome categories in the quality theme assessed technology performance (25%), satisfaction (25%), treatment and diagnosis of disease (22%) among others. Outcome categories grouped under the access theme included utilization of telehealth service (33%), time in obtaining consult (27%) and time in management of a case (20%). Outcome categories weighed under the cost theme were cost-

minimization analysis (53%), cost-benefit analysis (21%), cost-effectiveness analysis (16%) and cost analysis (10%).

Discussion

The aim of this study was to obtain an overview of the outcomes used in telehealth studies performed in Asia.. The review has identified outcomes themes, categories, indicators, measures and their tools in a consistent and standardized manner using an established framework [4-5].

This review confirms findings from earlier reports (9, 11) that it is often difficult to assign outcome indicators into the defined categories of the published framework. Outcomes had overlapping definitions and scope and were defined in an inconsistent manner and at times were only implicitly reported and defined. Analysis of the outcomes triad (quality, access and cost) revealed that the theme 'quality' related to telehealth programs was found to be the main focus of most of the studies (93%).

Despite a growing body of literature available on telehealth use in Asia, there is no consistent pattern in defining and reporting telehealth outcomes. This complicates systematic assessment of telehealth interventions and hampers accumulation of definitive evidence of the value of telehealth interventions. Adoption and routine application of a uniform framework to identify and define telehealth outcomes, such as the TOD or GeHOD frameworks would assist. These frameworks were used in this review, and highlight the value of categorizing according to hierarchal domains (categories, themes, indicators, measures and tools).

The review shows a lack of consistency in what is considered an 'outcome'. Most articles focused on addressing the theme 'quality' – whether measured alone or in combination with other themes – followed by access and cost. Outcome indicators and measures in the theme 'quality' were the most diverse, with technology performance, satisfaction, diagnosis and treatment being the most recurring indicators. The quality theme was associated with the greatest use of validated tools, followed by access.

The study raises important questions on how outcomes should be identified, defined, used, and reported. Many studies do not give focus and importance to identifying outcome indicators, measures, and tools. Identification of a small number of indicators, measures, and tools within each theme, and consistent use of these in future evaluations would allow the evidence-base for the application of telehealth in Asia to be built rapidly and efficiently. Adopting the GeHOD framework would provide guidance in this process.

Conclusion

We recommend that a standardized framework and a discrete set of indicators, measures, and tools be developed so that we can homogenously report outcomes to assess telehealth initiatives. Use of validated tools will also increase the credibility of studies.

Acknowledgment

We thank the International Development and Research Centre, Canada (PANACeA Project) for funding the review.

References

[1] D. M. Hilty, J. S. Luo, C. Morache, D. A. Marcelo. Nesbitt TS. Telepsychiatry: an overview for psychiatrists. CNS Drugs. 16(8):527-48, 2002.

[2] W. R. Hersh, D. H. Hickam, S. M. Severance, T. L. Dana, K. Krages Pyle, M. Helfand. Diagnosis, access and outcomes: Update of a systematic review of telemedicine services. J Telemed Telecare. 12 Suppl 2:S3-31, Review, 2006.

[3] P. Whitten, L. K. Johannessen, T. Soerensen, D. Gammon, M. Mackert, A systematic review of research methodology in telemedicine studies. J Telemed Telecare. 13(5):230-5, 2007.

[4] R. E. Scott, G. F. McCarthy, P. A. Jennett et al. Telehealth outcomes: a synthesis of the literature and recommendations for outcome indicators. J Telemed Telecare. 13 (Suppl 2):1-38, 2007.

[5] R. E. Scott, A. Saeed. Global eHealth – Measuring Outcomes: Why, What, and How. A Report Commissioned by the World Health Organization's Global Observatory for eHealth. Making the eHealth Connection: Global Partnerships, Local Solutions. July 2008. (http://www.ehealth-connection.org/files/conf-materials/Global%20eHealth%20-%20Measuring%20Outcomes_0.pdf).

Shariq Khoja works as Assistant Professor and Coordinator eHealth Programs at the Aga Khan University (AKU), Karachi, Pakistan. He is a physician, with PhD in eHealth from Global eHealth Research and Training Program, University of Calgary. Dr. Khoja has extensive background and interest in using eHealth technologies to facilitate healthcare services and education. His research interests focus on creating evidence and policies to guide the implementation of eHealth in developing countries. Dr. Khoja is leading the 'PAN Asian Collaboration for evidence-based e-Health Adoption and Application (PANACeA)', which supports researchers in 17 Asian countries to create evidence for e-health implementation. Dr. Khoja leads eHealth initiatives for Aga Khan Development Network globally. Dr. Khoja has contributed extensively to literature, especially through the development and validation of eHealth Readiness assessment tools for healthcare institutions. Dr. Khoja holds Adjunct faculty position at the University of Calgary.

Being a strong advocate of integrating eHealth with routine health care, Dr. Hammad Durrani is working as a Manager Research in the Department of Community Health Sciences at the Aga Khan University Karachi Pakistan. In this capacity, he is mentoring two eHealth Projects, being carried out in Philippines, Indonesia, Bangladesh, India and Pakistan which are part of PANACeA project (PAN Asian Collaboration for Evidence-based eHealth Adoption and Application). He is also involved in eHealth Research, conducting systematic reviews on different eHealth modalities (Telehealth and Health Informatics). He is also a member of the eHealth Team for the Aga Khan Development Network (AKDN), with responsibilities of planning and strategizing eHealth applications and its concepts in different countries of Asia and Africa where the Network holds its presence. On a personal note, he is a medical doctor with Masters in Health Policy and Health Management.

Telemedical Aspects of Long-Term Eco-Medical Researches

O. I. Orlov, E. Y.Bersenev, A. P.Berseneva, A. G. Chernikova, R. M .Baevsky
Institute of biomedical problems RAS, Moscow, Russia
rmb1928@mail.ru , 76A Chroshevskoye sh. 123007 Moscow Russia

Introduction

From year to year, the telemedical systems gain the substance in clinical diagnostics, communication of anamnestic, clinical and laboratory data, remote consultations, and statistics gathering. Yet, telemedicine has not infiltrated so far into the areas of disease prevention and evaluation of the risk of disease development in normal people. Moreover, there is no experience whatsoever in telemedicine-based researches of the human organism interaction with environment, i.e. the processes of human adaptation to stressful factors.

The report describes some of the very early efforts in the domain of eco-telemedicine with the goal to study the body functionality under various ecological conditions. The new discipline has to resolve a multitude of problems; however, we shall enlarge on remote evaluation of health and deviations caused by climatic, industrial, social and other eco-factors. As a matter of fact, eco-telemedicine has arose from piloted astronautics that called for designing technologies of remote measuring the human body parameters and also environmental conditions such as temperature, pressure, humidity and make-up of air in spacecraft cabin. Now, when the eco-telemedical system is part and parcel of the International space station, it is time to address the issue of broadening the implementation of telemedical technologies (TMTs) in rating health of different categories of the population.

The paper deals with research and development of, and hands-on experience with TMT proposed for a projected exploration mission to Mars. The Institute of Biomedical Problems of the Russian Academy of Sciences is making final preparations for the 520-day experiment in the full-size mockup of a space exploration vehicle with the idea to imitate life and work of the crew all through the period [1]. In experiments of the kind, it is crucial to have ways for dynamic crew health evaluation, particularly their

mental performance, mood and general physiological adaptability. State-of-the-art methods have been successfully integrated into the TM system of eco-medical monitoring applied to investigate the "Martian" crew and, in parallel, groups of comparable volunteers in different regions of the world. Thus, the space medicine achievements (TMTs) will be used in the unique human ecology research that will be undertaken in conjunction with the upcoming exploration mission simulation with participation of the “mission” participants and, simultaneously, volunteers residing in different climatic-geographical zones. In effect, the research will endeavor to apply globally the methods of TM ecology.

Methods and Materials

The research methods first developed for the needs of space medicine embody the prenozological approach that is revealing of functional states - precursors of disease (nozological forms of pathology). Prenozological diagnostics has the aim to check it if the functional status of human organism nears the boundary between health and disease and to tap a decline of adaptability while there is still no sign of a disease. Valid health evaluation criteria for normal people were established during concurrent eco-medical investigations of male test-subjects in a 105-day chamber experiment and control groups of male volunteers (25-50 y.o.) in different regions of the world. The 105-day experiment was performed in the exploration vehicle mockup as a rehearsal of the main 520-day experiment (the Mars-500 project). In the chamber and in the world regions the same type of equipment was used to record parameters of the cardiovascular, respiration and vegetative nervous systems. The equipment was identical to that employed in the investigations conducted within the Program of Biomedical Researches on the Russian segment of the International space station. One of the basic methods was heart rate variability (HRV) analysis that reflects the engagement of vegetative components of the physiological functions regulation. The control groups were selected in Germany, Czechia, Canada and five cities in Russia (Moscow, Voronezh, Ekaterinburg, Syktyvkar, Magadan). Files with primary data of the investigations and secondary tables and diagrams were e-mailed to Moscow monthly.

Results

Figure 1 shows the month-by-month dynamics of averaged values of heart rate (HR) and stress index (SI) in the groups of volunteers in Moscow,

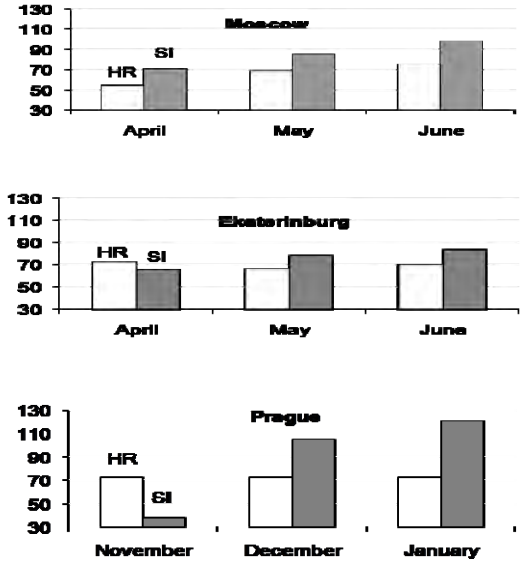


Figure 1. Monthly dynamics of HR and SI in the control groups in Moscow, Ekaterinburg and Prague

Ekaterinburg and Prague. We notice that no matter the region, changes in SI correlate well with the vegetative balance shifting as summer changes spring. In Prague, the correlation has been established during the transition from autumn to winter.

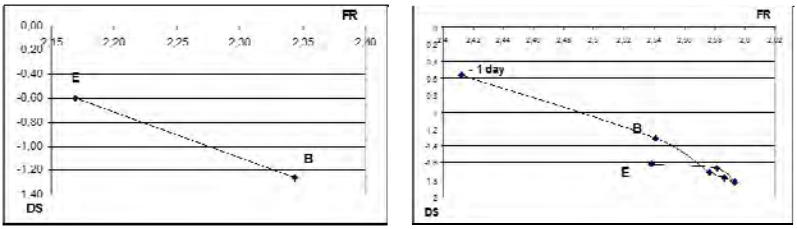


Figure 2. Values of DS and FR calculated from the mathematical model: Control group (left) and the group of chambered volunteers (right) at the beginning (B) and end (E) of the 105-day experiment

Test-subjects in the 105-day chamber experiment served as a group in the eco-stable conditions. Data from the groups of volunteers located in different eco-conditions were compared to the results of monitoring the chambered group. Figure 2 presents the results of comparing the functional status dynamics in the chambered group and Moscow volunteers. The functional status was calculated using the mathematical model [2] of the degree of regulation systems strain (DS) and functional reserve (FR) visualized as a trajectory on the phase plane.

In the period from April till July of 2009, DS values in the control group increased, whereas FR values decreased, that is body adaptability tended downward. In comparison with the functional status of the control group, the volunteers for the experiment increased DS and slightly increased FR on the eve of entry. However, already after one day in the chamber their functional status looked much better, the regulatory systems were less strained and the functional reserve grew. These positive changes were associated with the relief from the hectic life in the “pre-launch day” and the quietude of initial days of the experiment. Similar changes are quite often in cosmonauts on the days close to launch. This is the reason why baseline data collection is scheduled 2-3 months prior to flight.

Conclusion

Eco-medical investigations with participation of essentially healthy people in various regions of the world using TMTs have been initiated recently. These investigations lay the ground for telemedical ecology, a new area of applied researches. The eco-medical investigations included into the scientific program of the upcoming 520-day simulation of an exploration mission to Mars will be done with involvement as participants in the Mars-500 project, so groups of volunteers in various regions of the world.

References

[1] *http://mars500.imbp.ru* .

[2] R. M. Baevsky, A. G. Chernikova. A problem of physiological norm. Mathematical model of functional states on the basis of heart rate variability analysis. Aerospace and ecological medicine, 6, pp. 11-17, 2002, (in Russian).

Oleg. I. Orlov, MD
Correspondent-member of Russian Academy of Sciences
First deputy of director of Institute of Biomedical Problems

Roman M. Baevsky, MD
Head of laboratory for Autonomic Regulation of Cardiorespiratory System
Professor of Institute of Biomedical Problems

Evgeny Y. Bersenev PhD
Head of department for cardiorecpnratory system investigation of Institute of Biomedical Problems

Azaliya P. Berseneva MD
Main scientific researcher of Institute of Biomedical Problems

Anna G. Chernikiva
Main scientific researcher of Institute of Biomedical Problems

The Evidence for Telemedicine: Recent Trends and Expectations

Ronald C Merrell
Department of Surgery, Virginia Commonwealth University
Gateway Building, Room B-217, Richmond Virginia 23298-0480

Abstract: **Despite enormous enthusiasm, advocacy and application telemedicine still suffers from a lack of strong evidence to fully integrate its practice into evidence based medicine. Standards solutions are available from analogous struggles in medical innovation.**

Introduction

Common wisdom declares that telemedicine can offer greater access to health care with significant improvements in outcome and lesser cost. The conviction that this is true is almost a part of our belief system. Whenever reports are contrary to the mantra we tend to discount or become defensive. Two recent papers have challenged the telemedicine belief and are causing some consternation. While both studies can be refuted with some warmth perhaps there is reason to reflect and analyze a little on the arguments that make telemedicine such an obvious benefit to world health. Are they truly sound? Indeed, there is scant reference to telemedicine in the Cochrane Database where trials of robust experimental design and statistical strength are combined to give us references that truly adhere to the expectations for evidence based practice. There is actually only one with 7 trials on face to face versus telemedicine encounters and there was little evidence for clinical benefit from telemedicine. Why is there so little in the gold standard references to uphold our confidence in telemedicine? Currently we are in very short supply of hard evidence and faced with an awful lot of doubters. This paper considers analogous situations in clinical medicine where opinion was the driver and information lagged. The recent data so critical of telemedicine follows with a discussion and the report concludes with some possible solutions.

Analogies

Fifty years ago the treatment of breast cancer in the world was an area of common agreement and the more radical the better. Contrarians argued with passion that lesser procedures should be just as effective and much less ravaging to the patient. Passions were high and data were scant. Into this

fray rode an entity in the US called the National Surgical Adjuvant Breast and Bowel Project (1) Data from collaborative national and international trials began to accumulate. Involvement of multiple centers allowed recruitment of hundreds and even thousands of patients such that the power of the statistic for outcomes was satisfied in years instead of only coming from the presumed wisdom of a life of practice by a single surgeon. The impact of extent of surgery, radiation, chemotherapy and pharmocogenetics was readily apparent on outcomes and evidence for compassionate and competent care followed. Today there is a consensus of relative stability and it is not a matter of passion but of science. Now in the treatment of prostate cancer there is no such organization and the arguments among radiation therapists, surgeons, insurers, patient groups etc is unseemly and very much frustrated by lack of clear evidence. Coronary Artery Bypass was introduced in 1968 and its advantages were so self evident that no studies were every really done and the operation passed into glory with little question until coronary stinting became available. Then stints were obvious the thing. Most recently the advantages of surgery over stints have again been suggested and this time the evidence is in Cochrane (2). When laparoscopic cholecystectomy was introduced in 1987 it rapidly replaced open surgery with never a study of comparative safety or efficacy. In that instance however, the public immediately grasped the difference in pain and disability favoring laparoscopy. A randomized control trial would have been impossibility. The striking lack of collaborative comparative studies is really a failure of medicine to objectively assess new therapy and make comparison to the old. Cancer care is really the exception.

Challenges:

In the Journal of the American Medical Association in December 2009 (3) there actually was a very fine trial reported on ICU telemedicine. The study involved thousands of patient encounters in a study sponsored by the National Institutes of Health in the US. The study found that ICU telemedicine did not improve outcomes and was not readily embraced by potential users in a large health system. The study had a hypothesis that the telemedicine community might not use in the assertion that telemedicine would be better than a full staff of intensivists on site. Equivalence might be seen as a triumph and indeed that is what the study showed. This was not a randomized controlled trial but the power of the statistic was more than convincing. The article certainly got the attention of the US press. Yoo and Dudley in an accompanying editorial in JAMA pointed out some of the

strengths for ICU telemedicine that were always intended to improve access to the equivalence of on site staffs of intensivists (4). In a review by Saperstein in March 2009 the development of ICU telemedicine was reviewed and best practices identified based upon evidence (5). Sadly in all that fine review there is a consistent lack of randomized controlled trials and too few observations to satisfy statistical power. However, in areas of limited specialist ICU telemedicine is a clinical reality that is not likely to go away. The value of electronic records was severely challenged is a very thoughtful article by Hammerstein in recent months. Yet the importance of electronic records is considered axiomatic to digital medicine and thus telemedicine. In the study a survey of 4000 US hospitals computing seemed only to modestly improve quality but at increased administrative costs. (6) One might wonder if too much money had been spent on implementation with too little thought and money being spent on system interface with the medical community and training. Some systems of electronic medicine seem to go well but this survey of real impact on so many hospitals suggests that a good idea may be poorly applied on a huge scale. Such outcomes hardly bode well for transition to digital medicine and the electronic continuum promised by telemedicine.

Solutions

There is an urgent need for multicenter studies that will test the validity of telemedicine applications based upon meaningful clinical outcomes and cost. These studies would probably be best organized by national or international telemedicine organizations with government sponsorship for the inevitable costs. Panels from those organizations should design protocols and guidelines for recruitment of data along with clear outcome measures. The difference in the outcomes due to the intervention of some telemedicine approach or another applied in a randomized control trial should be determined in order to assign a confidence interval and study size needed for a specified end point. The time for feasibility studies is done. The time for case reports is past. The time for national anecdotal reports is closing. New technology always will interest our community but as we look to the integration of evidence based telemedicine into the regular fabric of health care there can be no substitute for respectable evidence. There are examples. Huge data from the US Veteran's Administration for home health, disease management, remote management and electronic records are published (7). By discipline there are excellent data for standards and practices in dermatology, pathology and radiology. But the impact on actual

practice is not known and the answer may not be reassuring to telemedicine advocates. The large scale studies of impact should ask the right questions in an impartial way. Such an approach is the only path to influence the decisions to be made by government and business in the crucial several years ahead. Failure to provide that information and to properly inform the decision makers would be a terrible failure.

Conclusions

Whenever science slowly morphs into a belief system there is danger. Great energy may be applied to support that belief and the objectivity of science can be terribly damaged. The data for climate change are probably irrefutable and the need for early correction has been amply emphasized by international conferences and statements of government intent. However, the detractors of climate change data are articulate in the extreme and they did not believe the data. Believe is not the word to apply to the ephemeral nature of data. Data should always be questioned and hypotheses should never be chosen because the investigator knows the outcome of the experiment and that result will support a presupposition. Recent scandals concerning the climate change data have done considerable harm to the objectivity and purity of a measured approach to climate impact of CO2. (8) If ever the decision makers or the general public get a hint that an advocate for some position or another is sculpting the data for best fit to a recommendation the cause is terribly damaged. It is essential that in telemedicine we rapidly get the evidence for the impact on large scale health parameters by full inclusion of telemedicine. Intuition says telemedicine will help. Anecdote says it is inevitable. The data are lacking.

References

[1] www.NSABP.org - Last accessed 1/26/10.
[2] http://www.cochrane.org/reviews/en/ab004588.html - Llast accessed 1/26/10.
[3] E. J. Thomas.. Journal of the American Medical Association. 302:2671–2678, 2009.
[4] E. J. Yoo, R. A. Dudley. Journal of the American Medical Association. 302:2705–2706, 2009.
[5] Saperstein. Best Practice and Research Clinical Anesthesiology, 23:115–126, 2009.
[6] D. U. Himmelstein, A. Wright, S. Woolhandler. Am J Med. Nov 16, 2009.
[7] S. Dang, S. Dimmick, G. Kelkar. Telemedicine and e-Health. 15:783-796, 2009.
[8] www.nytimes.com/2009/11/21/science/earth/21climate.html

Merrell is Professor of Surgery at Virginia Commonwealth University where he was Stuart McGuire Professor and Chairman of VCU's Department of Surgery from 1999 to 2003. Dr. Merrell was also the Clinical Director of VCU Health Systems Telemedicine Program. Previously he was the Lampman Professor and Chairman of Surgery at

Yale University School of Medicine. He obtained B.S. and M.D. degrees from the University of Alabama, which is his home state. Dr. Merrell has had a long relationship with NASA as advisor in aerospace medicine and researcher in telemedicine. He is also a frequent advisor to the Department of Defense regarding telemedicine and servers on the Board of Directors of the American Telemedicine Association. He has established successful programs in industry and government in the field of informatics research. His innovative work in telemedicine includes early use of Internet telemedicine, sensor applications, international applications and program design. He has over 300 publications and serves on the editorial boards of several major surgical journals. He is an editor-in-chief of Telemedicine and E-Health, the official journal of the American Telemedicine Association.

Toward the Implementation of Integrated eHealth Solution: The Luxembourgish Experience

M. Da Silveira, F. Wisniewski, C. Pruski
Public Research Centre Henri Tudor, marcos.dasilveira@tudor.lu; francois.wisniewski@tudor.lu; cedric.pruski@tudor.lu
29, avenue John F. Kennedy, Luxembourg, 1855, Luxembourg

Abstract: ***e*****Health is a neology commonly employed to state the utilization of Information and Communication Technologies (ICT) to improve exchanges of medical information. Luxembourg is currently working on the definition and implementation of a national eHealth platform in order to improve the connectivity between different health actors (caregivers, administrators and patients) and to facilitate the access to medical information in a standardized and safe way. The adopted strategy is composed of three phases: a national survey to determine the current use and needs of ICT; the elaboration of technical concepts that satisfy those needs; and the implementation. This paper reports the main results of the first phase.**

Introduction

Since 2008, Luxembourg has inquiring different categories of healthcare professionals and patients. The survey consists on a questionnaire sent to all doctors' practices and pharmacies, and several meetings with representatives of caregivers, hospitals' administrators, health insurance and patients. These exchanges are essential to determine what has been used, why, what is necessary to improve/create and how important are these needs. This paper reports the main outcomes from the questionnaires' analysis. The questionnaire was prepared to clarify the current situation of the following topics:

- General information;
- Informatics tools;
- Internet;
- Security;
- Main used software facilities;
- Utilization of electronic health records;
- Medicament reference database and knowledge database;
- Needs and priorities for sharing/exchange medical information.

The questionnaire was sent to all doctors and pharmacies (one questionnaire by pharmacy) registered in Luxembourg. In order to improve

the pertinence of the questions and highlight the importance of the work, the questionnaires were prepared by a group of experts in technology for health from the Public Research Center Henri Tudor (department SANTEC) and validate by the national representatives of doctors (AMMD – Association des Médecins et Médecins-Dentistes) and of pharmacists (SDP – Syndicat des Pharmaciens). Each questionnaire was submitted by post attached to a letter from the Health Ministry explained the objectives of the survey. The letters were also signed the respective representatives of each professionals. An electronic version of the questionnaire was also available in Internet were users could fill up the answers in a webpage. 32% of doctors and 55% of pharmacies sent the answers.

As result of the analysis, we could observe that in Luxembourg the majority of doctors are between 44 and 59 years and they are 86% to use an Informatics tools to manage their practices. A deep analysis shows that the age, the demographic situation (work in cities, work in rural areas) and the Informatics knowledge do not influence the choice of using ICT solutions. Another characteristic of Luxembourg is the diversity of solutions adopted. More than 50 solutions were identified; some of them were designed to be used in other countries and are not adapted to Luxembourgish market. However, 3 software's producers dominate 50% of the market.

An Internet connection is available in 81% of practices and it is mainly used to search medical information. Luxembourg has also HealthNet, a secure network implemented to the healthcare sector, for medical data exchanges. However is only used by 5% of doctors and the most used service is the reception of electronic versions of laboratory results.. The main barriers to the development of this network seems to be the registration costs, the (few) quantity of services offered via HealthNet, and some restrictions imposed to guarantee the security level. .

The security aspect of this study shows an important paradox between what healthcare professionals have been done to protect their data and what they want from ICT solutions. Healthcare professionals request ICT solutions that guarantee that collected data are validated by experts and that they are not modified during the transmission and storage process. They want to be sure that the data presented in the screen is the one validated by the expert. It is normal when we known that medical data are very critical and need to be protected from any illegal utilization. But each side of this interaction needs to proceed carefully to do not break the security chain. For example, the analysis of the survey shows that doctors and pharmacies

(50% and 37%, respectively) do not apply what we had defined as minimal security procedures:

- Access to the software by a login and password;
- Make regularly backups of important data;
- Use an update antivirus ;
- Use a firewall;
- Have a maintenance contract for Hardware and Software problems.

However, they are 85% and 100%, respectively, having patient data stored in an electronic media and manage them everyday (this is the most used Software facility).

When inquired about a national eHealth platform and how it can improve their work, doctors give priority to receive (or access) data through (in) the platform. Send data was classified as a low priority task. Fig. 1 presents the 8th most priority services to be implemented in the eHealth platform according to doctors (General Practitioners, Specialists and Dentists) and pharmacists. This opinion could be confirmed within the interviews. The precise reason of it could not be determined, but they consider themselves as beginners or intermediary users of Informatics resources and they want to use the ICT solutions to facilitate their work. Fill up forms, validate and send data, and correct errors (in the Software) will increase they workload.

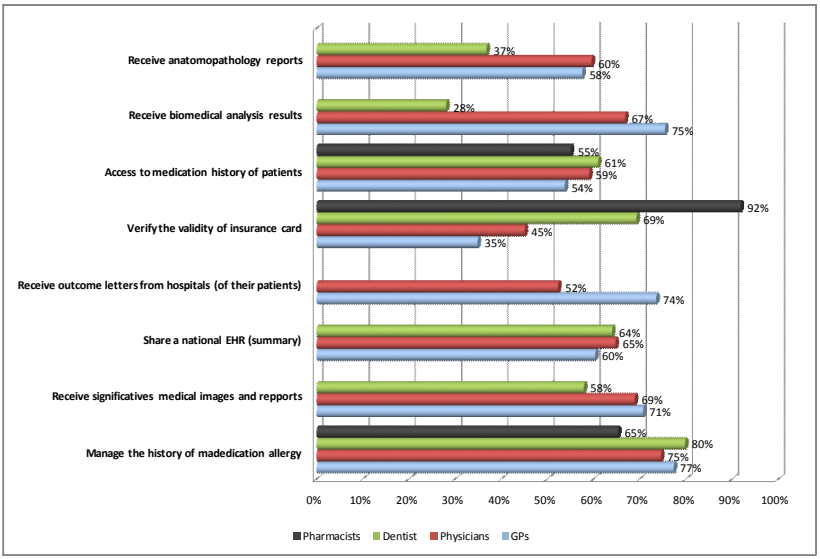


Figure 1: Synthesis of healthcare professionals needs

The main challenge of the platform concerns the technical and semantic interoperability of systems. Many renamed organizations have proposing standards to improve the interoperability of systems, but there still have some critical problems to solve: Intersections of standards, uncovered data, incompatibilities between standards, etc.

In Luxembourg, the used ICT solutions were not designed to be interoperable. Even if two doctors use the same ICT solution, they are often unable to exchange data. The multi-linguistic context of Luxembourg makes semantic interoperability more complex. Several workgroups has been created to deal with this problem, but a new solution will take time to be implemented by the Software producers and used by doctors.

Conclusions

This paper presents the profile of doctors and pharmacists working in private practices/pharmacies with respect to the utilization of ICT solution to manage medical data. The outcomes will be used to define a set of services to be implemented in the eHealth platform and some actions to motivate professionals to use standard solutions.

In order to prepare those professionals to use new technologies, it is necessary to offer them some basic supports. Practical activities with different scenarios must be defined and used in training programs. It is important to make them participate also in the designing phase of the project, explaining them what is planned, how it can be used, what is expected from them, and take note of their feedback to improve the pre-concept. In this sense, the eSanté project creates workgroups with users, technical stuff, administrators and patients. They will participate to the definition of a test environment which will be used to get experience and prepare mature concepts for the final platform, in one side. Training users, inform Software producers, simplify administrative procedures, redefine documents, and evaluate user’s satisfaction, in the other side. Behind this process, there is a methodology to implement step-by-step new services and with the agreement of all parts in order to avoid misevaluations of the consequences (learned from other countries experiences) and loose the confidence from the users.

Marcos Da Silveira is currently working as researcher at Public Research Center Henri Tudor – department SANTEC, Luxembourg. He holds a Ph.D. in Industrial Informatics from Paul Sabatier University, Toulouse/France. He had worked 5 years as associate professor at Pontifical Catholic University of Parana, Brazil and he has over 10 years of experience in project management. His main research interests are "Service-Oriented Architecture", "Fault Diagnosis and Recovering", "Adaptative Care Flow", and eHealth.

Cedric Pruski is a researcher at the Public Research Centre Henri Tudor in Luxembourg in CR SANTEC department. He holds a PhD in computer science from Paris-Sud XI University and from University of Luxembourg, and a MSc from University of Nancy I. His main research interest focuses on semantic interoperability in Health system and Semantic Web technologies.

François Wisniewski holds a BS in Physic Measurement from University of Metz, France, and Master in Biomedical Engineering from University of Medecine of Nancy, France. He is currently working as R&D Engineer at Centre de Recherche Public Henri Tudor - department SANTEC. His main interests are ePrescription and EHR concepts. He is one of the representatives of Luxembourg at CALLIOPE and EHR-QTN projects.

Medical Informatics

A Horizon Scanning System for Identifying New Telehealth Innovations

S. J. Blackburn, P. A. Cudd, M. S. Hawley
School of Health & Related Research, University of Sheffield,
Sheffield, United Kingdom, S1 4DP
s.blackburn@sheffield.ac.uk

Abstract: The paper presents the development of a new horizon scanning tool to identify recent innovations in telehealth technologies; specifically, those that are relevant to the care and management of long-term conditions (LTCs). It also discusses the issues regarding matching appropriate technologies with relevant applications.

Introduction

The telehealth technologies sector has recently begun to develop at a great pace. Several multi-national companies have entered the sector, including some not traditionally associated with healthcare. This is a reflection of ever greater demands on health and care services to support the increasing older population, particularly those with LTCs. The technologies employed are continually changing. This is set to continue with a greater role for Information and Communication Technologies in reformed healthcare delivery [1].

To ensure deployment of innovative but effective telehealth services requires that the technologies are evaluated. In a large project [2] the authors are seeking to separately evaluate both post-proof of concept and newly marketed technologies.

Horizon Scanning is an approach to identify and prioritise new innovations to inform decision makers about their likely impact [3]. It provides a ready and systematic searching method. This paper presents the development of a new horizon scanning tool to identify recent innovations in telehealth technologies and discusses the issues regarding identifying appropriate technologies with relevant applications.

Method

The new telehealth horizon scanning system (THSS) being developed at the University of Sheffield uses established information-gathering protocols from general health technology innovation tracking [4]. That is, the THSS (Fig. 1) uses a systematic process of automated searching and filtering of

conventional telehealth-related, web-based information sources. These include bibliographic databases, technology news sites, industry press releases, and conference proceedings. More broadly it will also search, using keywords relating to technologies and/or health, for new innovations in other industry sectors, such as electronic medical devices, computing and communications. Automated searching of information sources will occur every 3 months using *Copernic Agent* meta-search engine. Additionally, Really Simple Syndication (RSS) feeds from identified websites will provide weekly updates. Key stakeholders (clinicians, practitioners, academics) and selected telehealth companies will be also be consulted to identify new products.

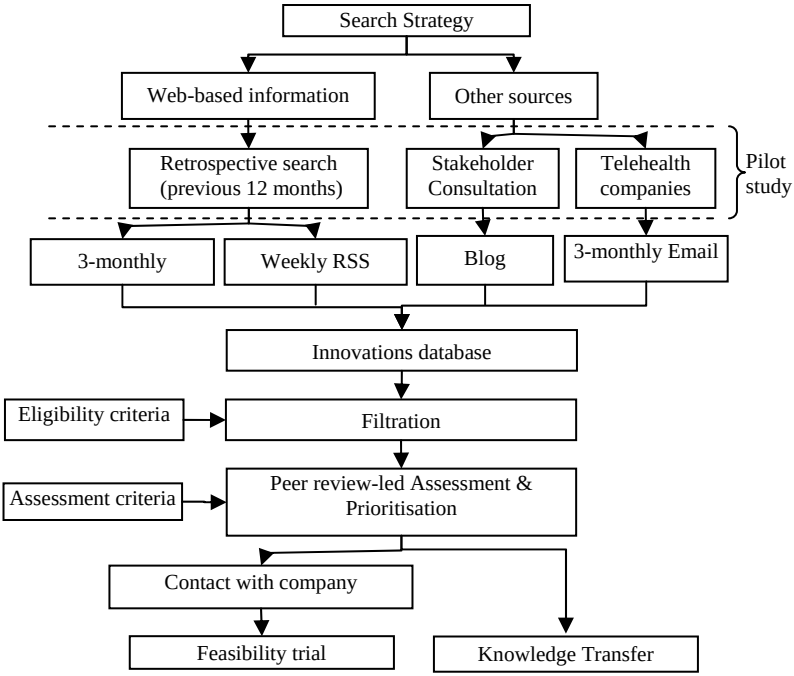


Figure 1. Schematic of telehealth horizon scanning system

References for retrieved technologies will be stored in a database. The reference history of the identified technology will be cross-checked to ascertain its development and to establish eligibility.

Inclusion criteria will be used to filter relevant technologies, as follows: 1) *Technology type*: any device, sensor or whole system which is electronic, home/community-based and allows the remote transfer of information; 2)

Development stage: new or emerging technologies which have yet to be trialled; 3) *Deployment level*: very limited or no deployment in a healthcare setting. Other filtration criteria will include the applicability to LTC care, innovativeness, and the anticipated clinical and economic impacts. The intention is to automate filtering as much as possible but some will always require a panel of experts.

A peer-review process will assess and prioritise the potential impact of the technology on the care and management of specific LTC patients, and on the healthcare system. When a suitable technology is identified, its potential for the care of people with long term conditions will be explored through small scale trials. Allied health and social care practitioners will be kept up-to-date regarding new technological opportunities through knowledge transfer conduits.

As part of a pilot trial, technology-related keywords were used to search for articles published in the *Journal of Telemedicine and Telecare* (JTT) and the health technology website ehealthnews.eu in the previous 12 months. Articles were reviewed to identify the number of new or emerging technologies with application for LTCs.

Results and Discussion

Pilot Study

Table 1 shows the results from the initial pilot study. Out of 484 articles, 41 were selected for further review. From these, 16 products were identified as new or emerging, innovative technologies with defined or clear applications for LTC.

Table 1. New technologies identified in the previous 12 months

			LTC application for new product			
Source	Search hits	New products	Stroke	Diabetes	Dementia	Other/Not defined
JTT	77	5	2	2	0	1
ehealthnews.eu	407	11	1	2	1	7
Total	**484**	**16**	**3**	**4**	**1**	**8**

The other 25 excluded articles described technologies that have been established on the market for several years and therefore regarded as not novel. The 16 new technologies identified were classified as: vital-signs/physiological monitoring (4); movement sensors (2); GPS-enabled location device (2); web-based decision assistants (1); exercise/gaming systems (1); hand-held text reader (1); multi device, integrated telecare/telehealth systems (5).

From the small pilot trial using only two information sources, it is evident that a number of new technologies with potential LTC applications have been developed (or at least publicised) in the previous 12 months. These could be identified by an automated THSS.

A certain level of automation is required to ensure that the THSS is human resource efficient. However, this may cause several risks to the quality of the system's output. Firstly, the accuracy of the initial search results will be governed by the search terms and sources of information used. Secondly, there is likely to be duplication from multiple information sources. Thirdly, the innovativeness of the technology may not be readily established. Automated tracking of the product's reference history may identify if it is already commercially established. Further work is required to establish what elements of the system can be automated and what control measures are required.

A key part of the THSS is the role of peer-reviewers to assess and prioritise the identified products. However, different types of reviewers (e.g. academics, clinicians, health economists) may prioritise technologies differently. There also may be issues regarding how to secure agreements with technology manufactures to trial products (e.g. intellectual property rights, non-disclosure agreements, etc.)

It is too early to draw conclusions on the effectiveness or the level of automation possible. In the end the value of the THSS will be determined on how the information can be translated into potential trials of the technology and later deployed in healthcare settings. However the process and outputs also have wider value in identifying telehealth technology development patterns, and in generally informing workers in the field of innovations.

Acknowledgements

This project is supported and finance by the NIHR CLAHRC for South Yorkshire.

References

[1] European Commission Information Society and Media. "ICT for Health and i2010: Transforming the European healthcare landscape towards a strategy for ICT for Health." Luxembourg: Office for Official Publications of the European Communities, 2006

[2] SY CLAHRC. "NIHR CLAHRC for South Yorkshire". http://clahrc-sy.nihr.ac.uk/

[3] Packer, P. "The National Horizon Scanning Centre (NHSC): Early warning for new and emerging health technologies in England." Evidence-Based Healthcare & Public Health, vol. 9, pp. 410-413

[4] Simpson,S., Hiller, J., Gutierrez-Ibarluza, I. et al. "A toolkit for the identification and assessment of new and emerging health technologies." EuroScan. Birmigham, 2009

Steven Blackburn.
Steven has worked in a variety of research and development fields, including bioengineering, health technology evaluation, and user requirements, for the past ten years. More recently, he has been involved in telecare/telehealth research. His main research interests includes the understanding of holistic user needs and how a specific technology meet those needs. He also conducts community-based evaluations of telecare and telehealth technologies and their impact on users' well-being.

Peter Cudd.
Peter Cudd has been active in medical technology related research for more than 20 years. He is the UK national contact for the Association for Advancement of Assistive Technology in Europe (AAATE). His research interests include user centered design and evaluation, e-inclusion, technology transfer, telehealth and advanced care technologies.

Mark Hawley.
Mark Hawley currently works as Professor of Health Services Research at the University of Sheffield, where he is also Director of Innovation and Knowledge Transfer for the School of Health and Related Research. Mark has led and been involved in many research projects concerned with the development and evaluation of Assistive Technology, Telecare and Telehealth technology.

An Integral Solution for Hospital Information System

I. Evgeniev, V. Trifonov, V. Gueorguiev
Technical University Sofia, iei@tu-sofia.bg
blvd. „Kliment Ohridski" 8, Sofia, Bulgaria

***Abstract*: The aim of this paper is to present approaches in the project DAPSEpro "Medical data acquisition, processing and collection for e-health solutions". The presented in the paper work oriented to investigation about current status of hospital information systems on the territory of the Medical University Sofia and implementation of a pilot version of integrated solution. Elimination of the usual paper-based information exchange to e-health and IT based one is one of the major topics.**

Introduction

The aim of this paper is to present results obtained in the context of the project DAPSEpro "Medical data acquisition, processing and collection for e-health solutions" for preliminary investigations, design, organisation and future expansion of a hospital information system [1].

This part of the DAPSEpro covers deep investigation about current status of hospital information systems on the territory of the Medical University Sofia and implementation of pilot version of integrated solution. Elimination of the usual paper-based information exchange to e-health and IT based one is one of the major topics.

Medical University Sofia is very huge hospital complex distributed on a large territory and has tens different clinics, laboratories and buildings. Currently MU Sofia has not integral intra-university information system. Part of the clinics is connected via optical backbone line. Every clinic has its own unique information system.

The DAPSEpro covers now two clinics – clinics of nephrology and pulmonology. All activities are oriented to conform requirements for supporting Electronic Health Record. Standards HL7 (Health Level 7) [2], CDA (Clinical Document Architecture) as a part of HL7, CEN EN 13606 EHRcom and OpenEHR initiative [3] documents were investigated and re-thought trough Bulgarian requirements for health records. Additional work and observations are presented in [4][5][6].

General structure

The Intelligent Medical Information System's (IMIS) structure and subsystems are shown on Fig.1. It offers the following features:

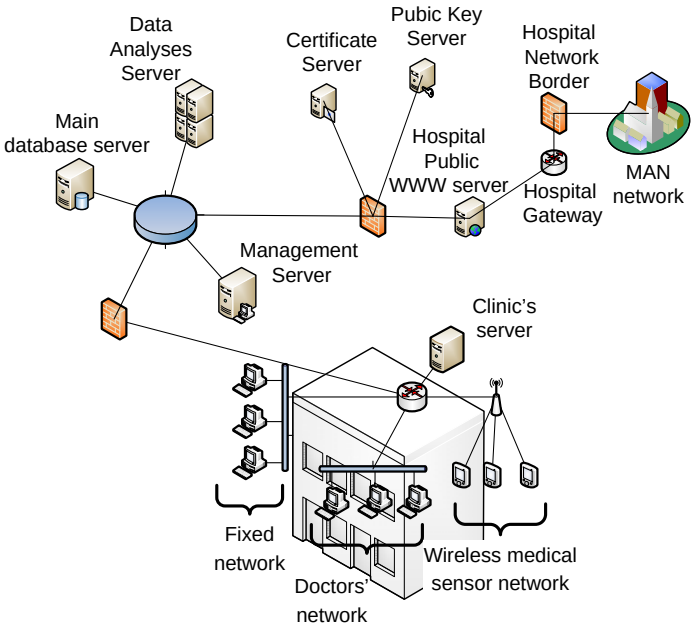


Fig. 1. General structure of IMIS

- Unified environment for data exchange between installed apparatus and systems in the hospital;
- To offer for the personnel access to the information resources via heterogeneous communication environment (mesh).
- Tracking the full process of hospitalization of every single patient.
- Data collection and storage for every medication and procedures.
- To offer a background for expert medical systems for analysis and control of health status for every single patient.
- Offers Remote Medical WWW Services for out-of-hospital health tracking and care.
- Management of all procedures and medications.
- Administrative tracking of all patients.

- Remote messaging of medical personnel about health status of selected patients based on remote vital data acquisition and control.

The future target of this work is to establish environment for transformation of the treatment data to knowledge system which will improve the following elements:

- To increase the quality of the health care and services.
- To offer structured information for increasing diagnosis quality.
- In- and out-of hospital life-long patients' tracking.

Doctors' network

This network has to provide access for the doctors to huge data sources (e.g. pictures, video films, etc.) in the hospital. Different medical machines generate data in different amounts – laboratories, X-ray machines, X-ray- , ultrasound and Doppler scanners, etc. For data bigger than 50MB it is useful to be accessed via fixed network resources. Now bandwidth of 1GB is possible and this guarantees on-line diagnostics and data exchange between sources, doctors' terminals and storage servers.

Clinic's server

It controls access over the local network, data base consistency and tracks patients at home care.

Fixed clinical network

Fixed clinical network has to provide connectivity for all machines and apparatus in the hospital from one side and servers and personnel terminals from the other side. Additionally it guarantees better redundancy and offers possibility to control internal clinical networks loading.

Wireless medical sensor network

This network enables access for the medical personnel to data servers. It offers possibility to sensors and apparatus generating small amount of data to be mobile on the clinic's territory. This guarantees unbreakable control when patients can carry their vital data acquisition sensors or simply to move patients over the clinic without lose of connectivity.

Management Server

It controls all administrative processes, hosts all records about manipulations (total and associated to every patient), personnel and patients archive, etc. Based on this doctors can do different analyzes and increase quality of medication.

Main database server

This is SAN network offering: on-line information for all patients; fast access to disease history and hospital archive.

Data Analyses Server

This is the core for future advances. Data mining services will be positioned there. A hospital grid by specialized servers will be built there.

Specialized subsystems

Special focus for infrastructure upgrade is organization of subsystem in Microbiology laboratory. It has smooth process for cultures analyses and results report based on paper control and tracking. Antimicrobial resistance check is based on the WHONET v.5.5 [7]. To integrate microbiology laboratory to the hospital network now is designed and under implementation a local network having two-level structure. On the first level are connected all analyses machines having outputs to computer. All results from analyses needing human interactions (like microscope analyses) will be recorded manually using unified fill-in-the-blanks forms.

On the upper level are positioned WHONET server, local data-base server and administrative terminals. Network server is positioned over this level and connects laboratory micro-network to the hospital network.

Acknowledgment

This work is funded by Bulgarian NSF under D002/113-2008 project.

References

[1] Ivan E. Ivanov, Vesselin E. Gueorguiev, Medical data acquisition, processing and collection for e-health solutions – DAPSEpro, The International eHealth, Telemedicine and Health ICT Forum'2008, Luxemburg, April, 2008

[2] www.hl7.org

[3] www.OpenEHR.org

[4] Ivan. E. Ivanov, V. Gueorguiev, V. Bodurski, E. Markov, Electronic Health Record: The State of The Art, Computer Science'2009, 05 - 06 November 2009, Sofia, Bulgaria

[5] Ivan. E. Ivanov, V. Gueorguiev, N. Balgzhiev, B. Kehayov, Software Architechture For Medical Information Systems, Computer Science'2009, 05 - 06 November 2009, Sofia, Bulgaria

[6] Nakov O, V. Gueorguiev, I.E.Ivanov, V. Trifonov. Methadata organization in Electronic Health Record (in Bulgarian), Computer Engineering, 2, 2009

[7] www.whonet.org

Vesselin Gueorguiev received master degree in Computer Systems and Automation from Technical University of Sofia in 1990 and postmaster degree of Artificial Intelligence and Expert Systems in 1992. He is assistant professor in the Department of Computer Systems and Control, Faculty of Computer Systems and Control, Technical University of Sofia. He is member of Bulgarian Union of Automatics and Informatics and IEEE. He has led a number of projects oriented to real-time computer graphics, program code analysis and distributed systems. His current scientific interests are oriented to 3D visualizations, image processing and medical data mining.

Vencislav Trifonov received his master degree in security and interlocking systems from High School of Transport in Sofia in 1991. He is assistant professor in the Department of Communication Networks, Faculty of Telecommunications, Technical University of Sofia. He is member of Bulgarian Union of Automatics and Informatics and Union of Electronics and Electrotechnics. His scientific interests are in networks security & intrusion detection and data mining.

Ivan Evgeniev Ivanov received master degree in Automatics and Telemechanics form Technical University of Sofia in 1984 and doctoral degree in 2006. He is assistant professor in the Department of Systems and Control, Faculty of Automatics and Head of Advanced Control Systems Laboratory in Technical University of Sofia. He is member of Bulgarian Union of Automatics and Informatics and IEEE. He has led a number of Bulgarian and EU projects oriented to real-time computer applications, program code analysis and distributed control systems. His current scientific interests are oriented to real-time applications, formal analysis and program generation.

Artificial Intelligence Techniques in the Diagnosis of Breast Cancer: A Case Study

M. Caramihai[1], I. Severin[1], W. I. D. Rae[2], A. Blidaru[1], H. Balan[1], V. Balanica[1]
[1]University "Politehnica" Bucharest, m.caramihai@ieee.org
Spl. Independentei, 313, sector VI, Bucharest, Romania
[2] University of Freestate, CO 9300, raewid.md@ufs.ac.za
Bloemfontain, South Africa

Abstract: **Accurate and verified diagnosis of breast cancer is the first, most important, essential requirement before deciding the best treatment regime to follow. Even though many experienced doctors, and high quality imaging devices are available for mammographic imaging, objective methods and criteria to diagnose and quantify the detected lesion characteristics, in order to define the breast cancer development stage and to decide on a final most probable diagnosis are still imprecisely defined for most of clinical applications. The present paper introduces a set of fuzzy rules to process the relevant breast cancer patient information in order to give a breast cancer risk prognostic factor that is qualitatively comparable to that given by an experienced mammogram reader.**

Introduction

Breast cancer represents a major health problem worldwide and is one of the major causes of death in women. Image based detection and assessment of breast cancer lesion characteristics is currently possible [1, 2]. Automatic software applications specially designed to analyse images and extract, quantify and store the numerical assessment of the relevant characteristics in a reliable database are being developed. Due to the fact that medical, oncological or radiological experts make the diagnostic decisions for breast cancer cases based on past professional experience and knowledge, artificial intelligence techniques are only able to emulate the expert's assessment. Due to their good stability in the presence of noise and uncertainty these techniques can sometimes obtain better results than classical analysis methods. The aim of this paper is to describe an intelligent risk evaluation procedure suitable for breast cancer diagnosis that requires definition of judiciously chosen fuzzy rules derived from relevant personal patient data and malignant mass classification.

Methods

Investigators recognize the following seven broad categories of risk factors that predispose women to development of breast cancer: age, family history of breast cancer (mother or sister), hormonal factors (early onset of menstruation or late menopause), proliferative (reproductive) breast disease (for women who had no children – had not breastfed -, or had children after age 30), irradiation of the breast region at early ages, personal history of malignancy and lifestyle factors. These factors and their complex interactions cannot be determined in more than 70% of breast cancer cases [3], but studies show amongst other things that high-fat diets, obesity, or use of alcohol also contribute to a woman's risk profile. Additionally, according to epidemiologic studies, there is an increase in breast cancer incidence in women with a higher level of education or higher socio-economic status, possibly related to delayed child-bearing and lower parity [4].

Results

The fuzzy logic that evaluates the breast cancer risk (seen as permanent system output) takes into account the possible input variables from Table 1. These input variables, together with their relevance factor (in what matters the decisional process of the breast cancer risk), were selected based on the experience of medical staff.

Table 1: Possible fuzzy logic input variables

Input variable	Relevance factor
Age	6%
Age of first menstruation	6%
Number of invaded axillary nodes	9%
BI-RADS score	24%

The numeric variation interval for each of the input variables can be seen in Table 2. In breast cancer cases, invaded axillary nodes are a measure of the cancer infiltration in adjacent tissues.

Table 2: Numerical range for input variables

Input variable	Min value	Max value
Age	10	70
Age of first menstruation	10	15

Number of invaded axilary nodes	0	15
BI-RADS score	0	5
Output variable		
Breast cancer risk	0%	50%

The breast cancer risk factor is the output of all considered fuzzy systems. The variation interval for the output variable can also be seen in Table 2, 0% corresponding to zero breast cancer risk, while 50% corresponds to a high breast cancer risk.

Fuzzy Systems

The means and technique of developing fuzzy systems was described in the METHODS section and works similarly in all of cases. This paper presents the results of only one of the three researched fuzzy systems that have as inputs and outputs the variables contained in Table 3.

Table 3. Researched fuzzy systems

Fuzzy systems	Input variables (I)	Output variables (O)
FZ1	**I1**: Age **I2**: BI-RADS score	**O1**: Breast cancer risk
FZ2	**I1**: Age of first menstruation **I2**: BI-RADS score	**O1**: Breast cancer risk
FZ3	**I1**: Number of invaded axilary nodes **I2**: BI-RADS score	**O1**: Breast cancer risk

The researched fuzzy system works on a fuzzy logic specified also according to the medical experience. The definition of the fuzzy inference rules for FZ1 is shown in Fig. 1 as a matrix.

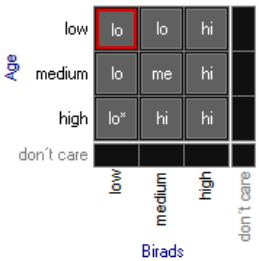


Fig. 1 Fuzzy inference rules for FZ1 (matrix representation)

Fig. 2 presents the simulation results of the researched FZ1 fuzzy logic. Hence, a breast cancer case characterized by age 22 and evaluation BI-RADS result 1 the assessed potential risk for developing breast cancer (in the next five years) is 5%.

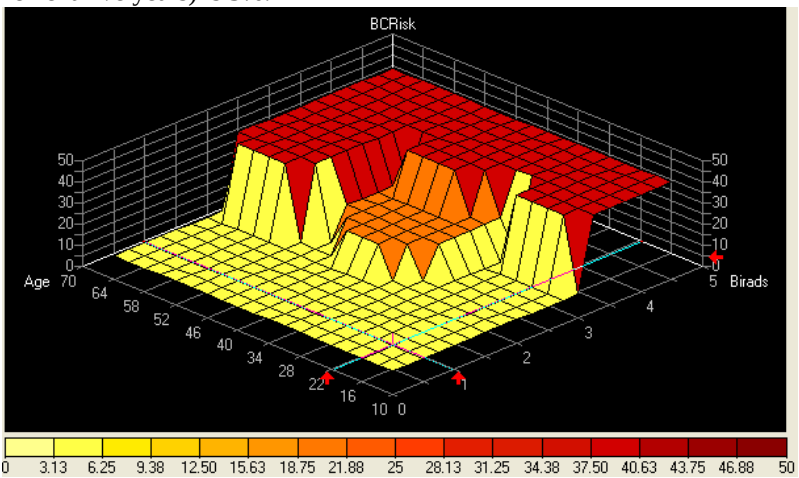


Fig. 8 FZ1 Simulation result (Age 22, Birads 1, BCRisk 5)

Conclusion

The defined fuzzy system makes possible the correlation between stored and evaluated information (like number of invaded axillary nodes, BI-RADS score, age and other case related data) to the prognostic risk of developing breast cancer. Thus this procedure can be easily and successfully integrated and used in screening programs to automatically assign breast cancer risk factors to patients in order to highlight the one that requires prompt attention and care.

Acknowledgments

This material is based on a work supported by the SA National Research Foundation (NRF) under Grant Number UID 67953 and by the National Research Agency under Project Number 101/2008 and also by INTELCAN Project Number 41/060/2007. Any opinion, findings and conclusions or recommendations expressed in this material are those of the authors and therefore NRF and RNRA do not accept any liability in regard thereto. Ethical approval for this study has been given by the Harmonised Ethics Committee of the University of the Free State and is carried out as study:

Mammography Computer Aided Diagnosis Development and Implementation ETOVS NR 72/07A and Sub-study: Mammary Malignancy Modelling using Artificial Intelligence ETOVS NR 72/07B.

References

[1] BI-RADS, "What is BIRADS?" Accessed at http://www.birads.at/info.html on 24/08/2009.

[2] L. Tabár, T. Tot, P.B. Dean, "Breast Cancer The Art and Science of Early Detection with Mammography" Thieme, Stuttgart, 2005, Ch. 1.

[3] A.P. Ekeh, R.S. Alleyne, O.A.Duncan, "Role of Mammography in diagnosis of breast cancer in inner-city hospital", Journal of the National Medical Association, 92:372-374, 2000

[4] fuzzyTECH Software, Accessed at http://www.fuzzytech.com/ on 15/01/2010.

CeRC Story-Game Engine: An Open Source Technology to Power Story Based Investigation Games

David Farrell, Patty Kostkova, Lisa Lazareck, Dasun Weerasinghe
City eHealth Research Centre, City University London, London, UK

Abstract: **Playing computer games is widely popular among children and teenagers as an entertainment activity; however computer games can also be easily transformed into tools for education. City University London's City eHealth Research Centre (CeRC) - has developed such educational computer games to improve young people's understanding of the importance of hand and respiratory hygiene and responsible antibiotic use; and to teach school syllabus concepts such as microbes, the spread and prevention of infection, antibiotic use and antibiotic resistance. We have developed a game platform as an open-source framework to promote game development for education and entertainment. The platform enables the efficient development of new games with new learning objectives along with the ability to support translation into any language. For example, the current CeRC games have been translated into 11 European languages (English, Belgian-French, Flemish, Czech, Danish, French, Greek, Italian, Polish, Portuguese, and Spanish). The existing CeRC games are targeted towards school children; however, we investigate the usability of utilizing such games for adult education as well as examining the effectiveness of these games to convey messages to particular academic, industrial (or otherwise) communities.**

Introduction

The entertainment value of videogames is long established and videogames are a popular past time activity amongst young people in the developed world [1]. Consequently, there is an interest in using games in an educational environment for this demographic [2]; however there is a lack of successful games based learning (GBL) products available [3]. One of the difficulties facing a GBL designer is the lack of established, cost effective platforms upon which to build and expand their game. As part of the EC-funded e-Bug Project, the City eHealth Research Centre (CeRC) at the City University London (London, UK) developed an open source platform, or Story-Game Engine, which provides a suitable middleware framework from which new games can be developed. This paper describes the "e-Bug Detective Game" that was developed using the Story-Game

Engine, the technology behind the Story-Game Engine, and details of how the framework can be used to develop multilingual games with new learning outcomes.

The e-Bug Detective Game

The e-Bug Detective Game is a story-based adventure in which the player is charged with solving microbial mysteries by visiting locations, speaking to non-player characters (NPCs) and by searching for clues and evidence. The game-play was designed following focus groups with 15 boys and girls between the ages of 13-15 years (target demographic). The game uses a Problem Based Learning (PBL) approach "in which the problem drives the learning. That is, before students learn some knowledge they are given a problem" [4]. PBL is a pedagogy that is largely used in medical training, and has been considered by Annetta *et al.* as a suitable pedagogy for GBL products [5]. Also, PBL has been shown to be an effective approach to GBL, whereby Chen *et al.* found a statistically significant superiority for medical interns educated (using PBL) in such areas as professional knowledge and clinical techniques [6].

PBL is implemented through game-play via a story scenario that is presented to the player. The scenario assumes that the player does not yet have knowledge of the target Learning Outcome (LO). In the story scenario, there is a problem which is established, but not fully understood or explained by the NPCs. The player must speak to these NPCs to get the appropriate clues in order to find the desired evidence to advance within the story puzzle. For example, to learn about the importance of post-toilet hand hygiene, the designer may first introduce the player to bacteria discovered on a NPC's plate of food whereby said NPC is sick in the toilet, having already visited several locations (such as a barbeque, kitchen, etc.) The player can seek potential sources of contamination, and through a process of elimination, discover that the microbes on the food plate match those microbes found in the ill NPC's bathroom and on the hand of another NPC. By building a mental model of the problem scenario, the player identifies how the gathered evidence can be used to solve the puzzle and, in the process, learns about the desired LOs.

The e-Bug Detective Game has four scenarios or missions, and includes such LOs as "*microbes are found in our food and can transfer to humans*," and "*if your doctor prescribes you antibiotics, it is important to finish the course of medicine*." The e-Bug Detective Game is currently online (http://www.e-bug.eu).

The Technology behind the Story-Game Engine

In order to ensure that the e-Bug Detective Game is accessible to as wide an audience as possible, the game was developed using Flash ActionScript CS2 targeting the Flash 8 web browser plug-in, which has a wide penetration (95% of internet enabled machines [7]) and, as such, does not typically require the target user to have administrative rights to install new software to their machine.

The Story-Game Engine is built such that it can power any story without having to make changes to the underlying technology; i.e., the story-game is data driven. This means that when the story-game is accessed, it loads text files which define the characters, rooms, objects, graphics (or art assets), and lines of dialogue used in the playing scenario. All of the puzzle logic is also loaded from these text files; i.e., if a change is required to the story-game logic, it is not necessary to edit the coded software, only the contents of the text files (and a subsequent re-compilation of the story-game).

The text files are created via an Excel spreadsheet (.xls). This spreadsheet has a format that guides the designer - including several tabs (or new spreadsheet pages) for each element of the design. For example, if the designer wants to write a new NPC, s/he accesses the 'Character' tab and fills out the fields in a new row. Similarly, if the designer wants to edit or add dialogue, s/he accesses the 'Conversations' tab, etc. Finally, each spreadsheet is saved as its own Comma Separated Value (.csv) file for the story-game to load during compilation. Lastly, the web page that embeds the story-game can pass variables to the game to define which scenario is loaded. In this way, the same code can be used in multiple web pages and can show a different scenario each time.

Facilitating Multilingual Games and New Learning Outcomes

Because the story-game is data driven, it is possible to replace the text files with their translated equivalents that will be accessed by the story-game during compilation. To facilitate this process for the e-Bug Detective Game, at first, the English language version of each scenario was written and tested. Next, the finalised spreadsheet was sent to each partner country for translation. The puzzle logic remains as originally designed; therefore, although the text changes language, it is trivial to switch language files (.xls) based on user preference. For example, the e-Bug Detective Game is implemented in 11 European languages (English, Belgian-French, Flemish, Czech, Danish, French, Greek, Italian, Polish, Portuguese, and Spanish) - with the European Centre of Disease Prevention and Control (ECDC)

already in agreement to fund further translations into the other remaining major European languages.

In order to deliver a new Game LO (in medical or other contexts – such as teaching about gender issues, STDs, sustainability development and agriculture, infection control for hospital staff, etc.), a designer must create a story-based scenario which has a flaw or problem to solve, whilst simultaneously considering the clues, evidence, misinformation (or red herrings), and hints provided. Similarly to the example provided for the e-Bug Detective Game (harmful microbes on the food plate), any LO is possible to implement within the story-game as long as a logic puzzle can be formulated accordingly. For instance, several LOs about providing fair trade principles to propose a sustainable development solution for a small town can be incorporated into a story-game investigating the impact of under-priced supermarket products on local farming communities.

Conclusion

There is great interest in using Games Based Learning (GBL) products in the classroom but one of the difficulties facing GBL practitioners is the cost of developing bespoke software solutions according to each new subject or project. City eHealth Research Centre (CeRC) has developed a low-cost and re-usable framework for building story-based educational games. The resulting Story-Game Engine is open-sourced and provides an appropriate technological platform on which to design new games with ease in English or in any other language.

References

[1] Bengoechea, J I I. "Videogames and Education: a First Empirical Research in the Basqu Country," Proceedings of the 3rd European Conference on Games Based Learning, pp 195 – 201, 2009.

[2] Williamsin, B. "Computer games, schools, and young people: A report for educators on using games for learning," Futurelab. 2009, in press.

[3] Kirriemuir, J. McFarlane, A. "Literature Review in Games and Learning," Futurelab. 2009, in press.

[4] "McMaster Problem Based Learning Program". Website accessed in January 2010, http://chemeng.mcmaster.ca/pbl/PBL.HTM

[5] Annetta, L A. Cook, M, Schultz, M. "Video Games: A Vehicle for Problem Based Learning." Technology-Enhanced Education Part II. Springer. Netherlands. 2009.

[6] Chen, Y-C. Fang, J-T. Lin, J-D. Cherng, W-J. "Evaluation of Problem-Based Learning Education after Clerkship at the Chang Gung University School of Medicine," Chang Gung Medical Journal, Vol. 25 No. 11. 2007.

[7] 2007 Millward Brown survey carried out for Adobe.com. Website accessed in Jan 2010, http://www.adobe.com/products/player_census/flashplayer/version_penetration.html.

Dasun Weerasinghe is a researcher at the City eHealth Research Centre, Lonodn. His main research interests are in Web 2.0, security, privacy and trust, and in particular, identification and authentication. Dasun has worked with a number of international research groups and served as a member of technical committees and organizing committees for a number of international conferences. He has extensive commercial and industrial experience in Software Engineering and also he works as a visiting lecturer at the City University London.

David Farrell is a PhD student at Glasgow Caleonian University where he also teaches game design. At his previous position as Research Assistant at City University in London, he designed and developed games to teach young people about hygiene, microbes and antibiotics. His research interests include the process of designing game mechanics to teach and the role of affect in the games based learning experience.

Lisa Lazareck has recently been awarded her Doctorate of Philosophy (D.Phil) in electrical engineering from the University of Oxford. Lisa is an 11-year member of the Institute of Electrical and Electronics Engineers (IEEE) and has been an elected and appointed volunteer for the Engineering in Medicine and Biology Society (EMBS) since 2003. Lisa currently works as a Research Assistant in the City eHealth Research Centre (CeRC), School of Community and Health Sciences (SC&HS) at the City University London – where she is developing educational web games (science/hygiene) for children.

Patty Kostkova is a Senior Research Fellow and the head of City eHealth Research Centre (CeRC) at City University, London, UK. She has built CeRC into a thriving multidisciplinary research centre collaborating with partners including EC, ECDC and WHO. Recently, she has been appointed a consultant at WHO, ECDC and Foundation Merieux; the Scientific and General Chair of the eHealth 2009 congress, Scientific Co-Chair of ehealth 2010 and a Advisory Board member on the ECDC Knowledge Management Working Group. Patty published over 70 technical papers, book chapter and is the Co-Editor-in-Chief of recently established journal “ICST Transaction on ehealth”.

Martin Szomszor is a Research Fellow at the City eHealth Research Centre with expertise in the Semantic Web, Web 2.0, and Data Mining. He has a BSc and PhD in Computer Science from the University of Southampton where he developed provenance aware service oriented architectures and XML data integration middleware for Web Service Workflow composition. Previously, Martin worked on the TAGora project, investigating Semiotic Dynamics in Online Social Communities, and the EnAKTing project.

Gawesh Jawaheer is a Research Fellow at CeRC. Previously, he was a Research Fellow at Imperial College London where he worked on 'Adaptive systems' based projects such as BOP!, ANS and Patia. His research interests are in personalization on the WWW, user profiling, web analytics and web traffic characterization.

Cloud Computing in Healthcare: An Authorization Perspective

V. Koufi, F. Malamateniou, G. Vassilacopoulos
University of Piraeus, {vassok, flora, gvass}@unipi.gr
80, Karaoli & Dimitriou St., Piraeus 18534, Greece

Abstract: **This paper is concerned with the development of a context-aware, role-based authorization and access control framework that can be used to ensure authorized access to cloud healthcare services. The resultant security system has been incorporated into a prototype PHR system to enable authorized access to integrated patient information when and where needed.**

Introduction

Healthcare providers are increasingly considering migrating to cloud computing in order to exploit its economic, technical, architectural and ecological benefits [1,2]. Cloud computing is an on-demand service model for IT provision, often based on virtualization and distributed computing technologies, that may be divided into [1,2]:

- Software as a service (SaaS), which allows software offered by a third party provider to be available on demand, usually via the Internet.
- Platform as a service (PaaS), which allows customers to develop new applications using APIs deployed and configurable remotely.
- Infrastructure as service (IaaS), which provides virtual machines and other abstracted hardware and operating systems which may be controlled through a service API.

Clouds may also be divided into:

- Public, which are available publicly (i.e. any organization may subscribe).
- Private, which are services built according to cloud computing principles, but accessible only within a private network
- Partner, which are cloud services offered by a provider to a limited and well-defined number of parties.

Given the cloud computing benefits, a personal healthcare record (PHR) architecture based on a combination of the above categories may be used to allow authorized access to integrated patient information at the point of care, anytime. However, security is a priority for many cloud customers (i.e. healthcare organizations) – customers will make buying choices on the basis of the reputation for confidentiality [3,4].

This paper focuses on a context-aware access control mechanism incorporated into a prototype application, named NefeliPortal, which enables access to a cloud PHR. The proposed access control mechanism incorporates the advantages of role-based access control (RBAC) and yet provides the flexibility for adjusting role permissions on individual objects according to context. Thus, at run time contextual information is collected to adapt user permissions to the minimum required for completing a job. Relevant access control policies are enforced at both web service and BPEL task levels.

Motivating Scenario

To illustrate the main principles of the security architecture incorporated into the NefeliPortal, consider a healthcare process concerned with radiological requests issued by physicians. On performing the radiological procedure requested, radiologists access the relevant PHR data and issue radiological reports which are send to requesting physicians.

Given a cloud computing PHR architecture, where patient data are accessed via web services deployed through BPEL, this healthcare process surfaces several authorizations requirements with regard to web service invocations and associated task executions. These requirements include the following:

- *Restricted web service invocation:* Web services for patient data accesses can only be invoked (executed) by a dynamically determined set of role holders subject to contextual constraints (e.g. location and time of attempted access).
- *Restricted task execution:* Given an authorization for invoking a web service, role holders can execute a dynamically determined set of web service tasks subject to contextual constraints (e.g. location and time of attempted access).

Access Control Architecture

Figure 1 shows a high-level view of the security architecture implemented into NefeliPortal. The access control mechanism uses collected contextual information to mediate between subjects (healthcare professionals) and objects (web services and associated tasks) to decide whether execution of an object by a given subject should be permitted or denied. The access control mechanism is certificate-based as it relies on Community Authorization Service (CAS) certificates issued to healthcare professionals by a CAS server. These certificates specify user-to-role

assignments in the form of security assertions, expressed in Security Assertion Markup Language (SAML) [5]. The role-to-permission (role-to-web service invocation and role-to-task execution) mapping is performed by means of access control policies expressed by using the RBAC profile of eXtensible Access Control Markup Language (XACML) [6].

For example, upon submitting a request for invoking a web service, the roles contained in the CAS certificate accompanying the request are extracted and their permissions regarding web service invocations are specified using a file where XACML policies have been stored. Then, during web service execution, a request for executing one of the associated tasks is issued which is accompanied by the same CAS certificate. The roles extracted from this certificate are used in order to specify the permissions regarding BPEL task executions using XACML policies which are stored at each client node (i.e. healthcare organization). Permissions on both web services and associated BPEL tasks are dynamically adapted by the constraints imposed by the current context.

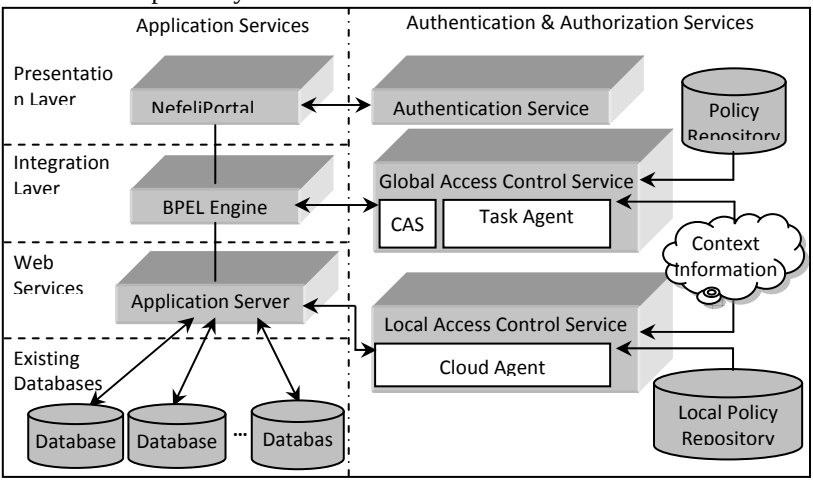


Figure 1. Security architecture in NefeliPortal

In the NefeliPortal prototype, the contextual information is determined by a pre-defined set of attributes related to the user (e.g. user certificate, user/patient relationship), to the environment (e.g. location and time of attempted access) and to the client or healthcare organization (e.g. local security policy). Contextual information is collected by a Context Manager which consists of two kinds of agents developed in JADE [7]:

– *Cloud Agent:* Hosted on a cloud server and manages user permissions on web services.
– *Task Agent:* Hosted on a participating healthcare organization server and manages user permissions on BPEL tasks.

Each agent uses context collection services to monitor context and interacts with a state machine that maintains the permission subset of each role. The state machine consists of variables that encode state (permissions assigned to each role) and events that transform its state. Upon an attempted access (either to a web service or to an associated task), the relevant agent generates an event to trigger a transition of the state machine. Changes in user and environmental context are sensed by both agents, whereas changes in client context are sensed and dealt with by the cloud agent of each client node.

Conclusions

Development of cloud computing applications that provide readily access to integrated healthcare information at the point of care introduces security risks especially with regard to authorization and access control. To this end, the proposed security mechanism, embedded into a cloud portal application, ensures authorized invocation of web services and execution of associated BPEL tasks subject to the constraints imposed by the execution context.

References

[1] O. Shimrat, "Cloud Computing and Healthcare", San Diego Physician.org, April 2009.

[2] van der Burg S and E. Dolstra, "Software Development in a Dynamic Cloud: From Device to Service Orientation in a Hospital. Environment", In Proceedings of the 2009 ICSE Workshop on Software Engineering Challenges of Cloud Computing, May 23, 2009, Vancouver, Canada.

[3] P. Bruening and Treacy B, "Cloud Computing: Privacy, Security Challenges", The Bureau of National Affairs, 2009.

[4] S. Pearson, "Taking Account of Privacy when Designing Cloud Computing Services", In Proceedings of the 2009 ICSE Workshop on Software Engineering Challenges of Cloud Computing May 23, 2009, Vancouver, Canada.

[5] L. Pearlman , V. Welch, I. Foster, C. Kesselman and S. Tuecke , "A Community Authorization Service for Group Collaboration", In Proceedings of the 3rd IEEE International Workshop on Policies for Distributed Systems and Networks, 2002.

[6] OASIS Standards, http://www.oasis-open.org/

[7] Java Agent Development Framework, http://jade.tilab.com/

Vassiliki Koufi received a B.Sc. in Informatics from the University of Piraeus and a M.Sc. in Data Communication Systems from Brunel University, UK. Currently, she is a Ph.D candidate in the Department of Digital Systems at the University of Piraeus while she is a teaching fellow (under the provision of 407/80 Presidential decree) at the Department of Digital Systems of the same university. Her research interests include pervasive, process-oriented health information systems, healthcare systems security and cloud-based personal health record systems.

F. Malamateniou received her M.Sc and the Ph.D degree in Health Informatics from the University of Athens, Greece. She has been actively involved in many national and EU-funded R&TD projects. Currently, she is an Assistant Professor at the Department of Digital Systems of the University of Piraeus. Her current research interests include process-oriented, web-based healthcare information systems, pervasive healthcare, virtual healthcare records, information security and workflow systems.

George Vassilacopoulos is a Professor at the Department of Digital Systems of the University of Piraeus. His research interests include health information systems, workflow systems, health systems security and electronic medical records. He has authored numerous publications in these areas in international journals and refereed conferences.

Enabling Collaborative eHealth Research Using Web 2.0 Tools

Martin Szomszor, Dasun Weerasinghe, Patty Kostkova, Gawesh Jawaheer
City eHealth Research Centre,
City University, London, UK, firstname.lastname@city.ac.uk

Abstract: **In this paper, we describe two Web 2.0 based systems designed to facilitate and enhance collaborative eHealth research activities. Using a combination of Forums, Wikis and connectivity to 3rd party social networking systems, we have designed systems to support collaborative document creation (including editing, reviewing and publication), dissemination of material to relevant communities, discussion of ideas, and sharing of opinions. The ECDC Field Epidemiology Manual Wiki and Medicine Support Unit Online Forums are presented herein, including an overview to the system architectures, and user interaction models. We present our planned methods of evaluation, focusing on the ability to measure successful and sustainable community involvement.**

Introduction

In recent years, the Web has evolved from a static, publish and consume oriented platform to a dynamic and interactive shared space where users can easily publish material, view and comment on other people's contributions, and connect easily with others via social networking. This new generation of the Web, or Web 2.0 as it is commonly known, supports a wide range of services that enable lightweight publishing (Blogs), collaborative knowledge creation (Wikis), and sharing of ideas and opinions (Forums). Much interest is developing [1,3] into how these tools can be used to support better eHealth related activities, including teaching and research. Wikis have been successfully used as platform for the creation, dissemination, and management of teaching materials [4,5], and Forums have been utilised to enable question and answer type discussions between both citizens and healthcare professionals [2]. In the following Sections, we describe two systems developed to support eHealth research activities: the ECDC Field Epidemiology Manual Wiki (FEM Wiki) – a system for epidemiologists to collaboratively build, review, edit, and publish a training manual using a community of proffesionals and students; and the Medicine Support Unit (MSU) Online Forums – a discussion site for Optometrists.

MSU Forums (www.med-support.org.uk)

An Online Forum is a web application that hosts discussions and postings from online users, much like a bulletin board. Posts are organized by threads (or subjects), where a history of all comments on a particular topic is kept. This kind of interaction model is particular suited to question and answer situations: a user with an inquiry starts a new thread with their question or comment as the subject. Others may respond, giving their ideas or opinions on the matter, creating a conversation between all contributors.

Medicines Support Unit (MSU) for Optometrists website brings together resources for optometrists in the UK. It is dedicated to providing a web resource that supports optometrist's in the safe and effective use of drugs. This project is funded by the Central LOC Fund and the College of Optometrists. The Online Forum is the latest phase in the development of the MSU website. Its function is to act as a discussion board on topics relating to prescribing and therapeutics. It also has the potential to create networking opportunities and develop a community of optometrist prescribers. Forum users can create topics related to the filed optometric and reply to the existing topics and posts in the site. Meanwhile, the user can choose to receive an email alert when a reply is received to a posting and administrator can make decision on approval and un-approval of posts in the Forum.

FEM Wiki (www.femwiki.com)

The current ECDC Web Portal http://ecdc.europa.eu serves as a principle access point for information relating to disease control, including news, upcoming events, recent publications, and press releases. As part of this Web Portal, ECDC will host a Wiki platform to enable the sharing of information between experts and professional networks in the EU. Central to this effort is the Field Epidemiology Manual (FEM), a set of essential training materials reflecting the core competencies required by intervention epidemiologists. The European Program for Intervention Epidemiology (EPIET) has developed 18 draft chapters of ‘lecture notes’ from the core scientific lectures in this training program.

The aims of the FEM Wiki are twofold: (i) To provide a platform on which the Field Epidemiology Manual can be created, edited, reviewed and updated easily by a number of contributors. Using state-of-the-art Web2.0 technology, the FEM Wiki enables collaborative document creation and supplements coordination between contributors through the use of online Forums. The FEM Wiki will automatically maintain two versions of the Field Epidemiology Manual: a private, editable version (visible only to authors, editors, and reviewers), and a public, non-editable version (visible

to anyone that visits the site). Once material in the private version has been edited, properly formatted, reviewed, and deemed suitable for public dissemination, it can be published to the public version where it will remain static and officially approved by ECDC. This separation will allow ECDC to maintain control over the content and ensure that only quality-assured material is made public. (ii) To create a social network for individuals interested in field epidemiology, such as EPIET fellows, EPIET Alumni, ECDC staff, academics, researchers, professionals, teachers, and students. This network will enable people to advertise their affiliations and expertise, link-up with others sharing similar research interests, provide help and advice to others, disseminate new ideas and opinions, create a share useful material, and to generally foster a community centered on epidemiology research. Users of the FEM Wiki are given the opportunity to create profile pages that lists their interests, areas of expertise, professional affiliations, and links to other online profiles (such as Facebook and Twitter).

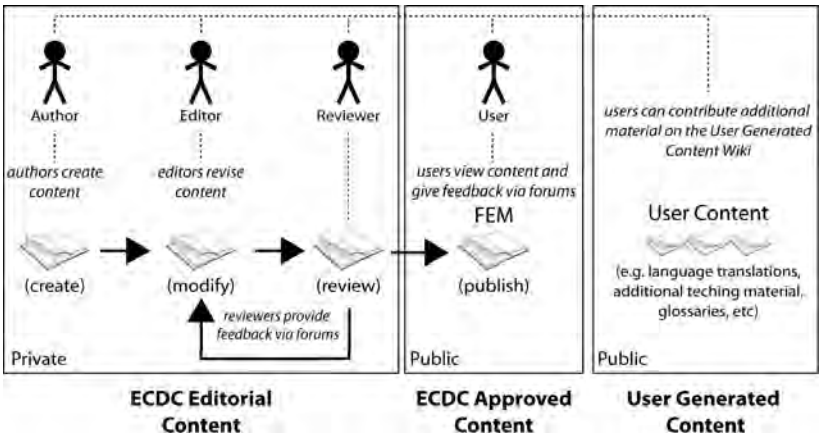


Figure 1 - The Fem Wiki Workflow

The FEM Wiki has been implemented using the Telligent Community platform (www.telligent.com). Figure 1, shows a high level overview of the reviewing, editing, and publishing workflow: Users of the system are assigned one of four roles: 1) User, 2) Author, 3) Editor, and 4) Reviewer. Once authors, editors, and reviewers have finished creating the FEM content, pages are published to the ECDC Approved Content Wiki where anyone can view it. Users may comment on the articles and discuss the content using the Online Forums but they may not edit them directly. Users

may also generate their own content, such as language translations of the FEM, additional teaching materials, glossaries of terms, etc. using the User Generated Content Wiki.

Planed Evaluation

Standard logging of both the FEM Wiki and MSU Forums will be undertaken, recording the number of visitors to pages, the number of Wiki edits made, the number of Forum posts made, visitor geo-location, etc. Such a log will enable us to perform a number of interesting evaluations:

- How does the community grow over time? Little is understood about the dynamics of online communities. Our intention is to gain better knowledge of how new communities evolve over time, in terms of the number of users, how active they are, the amount of interaction between users, the amount of new material contributed. One important point is to investigate how links with Social Networking Sites effect the growth of communities.
- What is the relationship between feedback and contribution? With the FEM Wiki, we will have detailed logs of the comments made by reviewers (and users once the page is made public) and an edits that are made as a result of them. Such logs will enable us to measure the improvements made to articles over time, and assess how feedback and commenting affects the quality of pages.
- How does the behaviour of users differ? Using information gathered about site users from other sources, such as academic publications, their activities on other Social Networking Sites (e.g. Twitter, Delicious.com, Facebook), their professional affiliations, we will identify correlations between user behaviour and their identity. We also attempt to profile users, i.e. classify them by activity and connectedness, and identify whether these traits are universal.

References

[1] Giustini, Dean. *How Web 2.0 is changing medicine.* 333, 2006, British Medical Journal, pp. 1283-1284.

[2] Mankuta, D, et a. *The use of a perinatal internet consulation forum in Israel*.**.** 114, 2007, BJOG: An International Journal of Obstetrics & Gynaecology, pp. 108-110.

[3] Hawn, Carleen. *Take Two Aspirin And Tweet Me In The Morning: How Twitter, Facebook, And Other Social Media Are Reshaping Health Care.* 2, 2009, Health Affairs, Vol. 28, pp. 361-368.

[4] Kardong-Edgren, Suzan E., et al. *Using a Wiki in Nursing Education and.* 1, 2009, International Journal of Nursing, Vol. 6.

[5] Barsky, Eugene and Giustini, Dean. *Introducing Web 2.0: wikis for health librarians.* 28, 2007, Journal of the Canadian Health Libraries Association, pp. 147-150.

Dasun Weerasinghe is a researcher at the City eHealth Research Centre, Lonodn. His main research interests are in Web 2.0, security, privacy and trust, and in particular, identification and authentication. Dasun has worked with a number of international research groups and served as a member of technical committees and organizing committees for a number of international conferences. He has extensive commercial and industrial experience in Software Engineering and also he works as a visiting lecturer at the City University London.

Patty Kostkova is a Senior Research Fellow and the head of City eHealth Research Centre (CeRC) at City University, London, UK. She has built CeRC into a thriving multidisciplinary research centre collaborating with partners including EC, ECDC and WHO. Recently, she has been appointed a consultant at WHO, ECDC and Foundation Merieux; the Scientific and General Chair of the eHealth 2009 congress, Scientific Co-Chair of ehealth 2010 and a Advisory Board member on the ECDC Knowledge Management Working Group. Patty published over 70 technical papers, book chapter and is the Co-Editor-in-Chief of recently established journal “ICST Transaction on ehealth”.

Martin Szomszor is a Research Fellow at the City eHealth Research Centre with expertise in the Semantic Web, Web 2.0, and Data Mining. He has a BSc and PhD in Computer Science from the University of Southampton where he developed provenance aware service oriented architectures and XML data integration middleware for Web Service Workflow composition. Previously, Martin worked on the TAGora project, investigating Semiotic Dynamics in Online Social Communities, and the EnAKTing project.

Gawesh Jawaheer is a Research Fellow at CeRC. Previously, he was a Research Fellow at Imperial College London where he worked on 'Adaptive systems' based projects such as BOP!, ANS and Patia. His research interests are in personalization on the WWW, user profiling, web analytics and web traffic characterization.

Generating Structured Patient Data via Automatic Analysis of Free Medical Text

Dimitar Tcharaktchiev[1], Svetla Boytcheva[2], Ivelina Nikolova[3], Elena Paskaleva[3], Galia Angelova[3], Nadya Dimitrova[4]

[1] University Specialized Hospital for Active Treatment of Endocrinology, Medical University, Sofia, Bulgaria, dimitardt@gmail.com
[2] State University of Library Studies and Information Technologies, Sofia, Bulgaria, svetla.boytcheva@gmail.com
[3] Institute for Parallel Processing, Bulgarian Academy of Sciences, Sofia, Bulgaria, {iva, hellen, galia}@lml.bas.bg
[4] National Oncological Hospital, Sofia, Bulgaria, dimitrova.nadia@gmail.com

Abstract: **Many essential findings are traditionally stored as free text descriptions. Automatic text analysis is viewed as information technology of vital importance, because it enables automatic generation of databases with structured patient data, using internationally accepted, standardized classifications. Exchanged before or during the teleconsultation sessions this data can help the prompt understanding of patients' diagnoses, treatments, manipulations etc. The coded data can be automatically presented in the language of consulting specialist.**

Introduction

Patient-related descriptions in Patient Records (PRs) are often summarized as free text. Hospital PRs in Bulgaria, which discuss one hospital episode, contain the most important facts and conclusions in the form of unstructured textual statements. In this way important patient-related information cannot be processed by Hospital Information Systems. Automatic text mining and Information Extraction (IE) are advanced but difficult information technologies since free text is hard to process with high accuracy. Despite the numerous problems, there are projects, research prototypes and industrial systems in many natural languages which aim at the automatic extraction of patient features from free text (see for example [1] and [2]). Here we briefly present an approach for processing hospital PRs in Bulgarian and discuss its relevance to the field of telemedicine.

Automatic Information Extraction from Hospital PRs in Bulgarian

Currently we process PRs in order to extract important patient characteristics, thus turning the free text description into a structured

internal representation. The length of PRs texts in Bulgarian hospitals is usually 2-3 pages. These documents contain the following standard sections: *(i)* personal details; *(ii)* diagnoses of the leading and accompanying diseases; *(iii)* anamnesis (personal medical history), including current complains, past diseases, family medical history, allergies, risk factors; *(iv)* patient status, including results from physical examination; *(v)* laboratory and other tests findings; *(vi)* medical examiners comments; *(vii)* discussion; *(viii)* treatment; *(ix)* recommendations.

IE systems need preliminary-prepared language resources, since they map the strings occurring in the PR texts to the lexicons thus recognizing the terms, the attributes of patient status etc. We use a terminological bank of medical terms, derived from ICD-10 in Bulgarian language (10970 terms). The Bulgarian version of ICD-10 has no clinical extension, i.e. some medical terms need to be extracted from additional resources like a partial taxonomy of body parts, a list of medicines etc. A lexicon of 30000 general-purpose Bulgarian lexemes provides words recognition and morphological analysis of Bulgarian medical text. We use also ICD–9 CM for procedures and ATC classification for medications.

Our present experimental corpus consists of 1197 anonymized PRs of patients, diagnosed with different types of diabetes, with about 700000 wordforms of 6400 different words, among them 2000 terms. PR texts contain a specific mixture of terminology in Latin, Cyrillic and Latin terms transcribed with Cyrillic letters. The terms occur with a variety of wordforms which is typical for the highly-inflectional Bulgarian language. The major part of the text consists of short declarative sentences and sentence phrases without agreement, often without proper punctuation marks. There are various kinds of typos in the original text which we avoid at present since the we deal with a research prototype (but they have to be addressed in a real system).

In addition to the lexical resources, our prototype uses the following linguistic and conceptual resources which support the partial IE analysis**:** semi-automatically prepared regular expressions which enable recognition of particular language constructions; rules for negation treatment [3]; sets of possible and default values for each attribute for each anatomic organ as well as observations about attribute correlations for each anatomic organ.

Our present IE prototype has the following functionality: *(i)* search and update in the termbank; *(ii)* segmentation of the PRs text into zones; *(iii)* recognition and structuring of diagnoses and status features (*age*, *sex*, *skin*

and *limbs* status); *(iv)* PRs retrieval by given features; *(v)* export of structured patient descriptions.

Current assessment results show that there are serious obstacles to automatic analysis: e.g. merged PR zones; individual expression styles; missing descriptions since medical experts consider them insignificant etc. The automatic PR segmentation is done with an average accuracy of 95,96%. The patient *age* is automatically recognized with 89,44% accuracy, the *sex* – with 61,54% accuracy, the diagnose - with 97,47%, the phrasal descriptions of diabetes duration – with 89,22%; the status of patient skin - with 81,33% and the status of patient limbs – with 89,01% accuracy. Some improvements can be achieved by more complicated analysis algorithms.

Conclusion

Despite the difficulties, our experiments show that certain facts can be extracted relatively easy. These promising results support the claim that the Information Extraction approach is helpful for the obtaining of specific medical statements which are described in the PR texts. Developing further our prototype, we are moving towards the automatic construction of database with structured patient descriptions. In the future the recognized terms, medications, treatments will be mapped to the international medical nomenclatures and linked to the international subject codes. This structuring leads to automatic replacements of words by codes in the PRs which facilitates the data exchange. The coded data can be sent before or during the teleconsultation and can be presented in the language of the consultant.

Acknowledgment

The research work presented here is partly supported by grant DO 02-292/ Dec-08, funded by the Bulgarian National Science Fund in 2009-2011.

References

[1] Clef Clinical E-Science Framework, 2008. See http://nlp.shef.ac.uk/clef, University of Sheffield, UK

[2] Savova, G. K., K. Kipper-Schuler, J. D. Buntrock, and Ch. G. Chute. 2008. *UIMA-based Clinical Information Extraction System*, LREC 2008 Workshop W16: Towards enhanced, interoperability for large HLT systems: UIMA for NLP. May 2008.

[3] Boytcheva, S., A. Strupchanska, E. Paskaleva, and D. Tcharaktchiev. *Some Aspects of Negation Processing in Electronic Health Records*. In Proc. of the Int. Workshop "Language and Speech Infrastructure for Information Access in the Balkan Countries", held in conjunction with RANLP-05. Borovets, Bulgaria, September 2005, pp. 1-8.

Dimitar Tcharaktchiev is Associate Professor in Medical University – Sofia, and has a Ph.D. in Medical Informatics and acknowledged medical specialties in Internal diseases, Public Health and Health Management, specializations in Geriatrics and Endocrinology. He is a Head of Department of Medical Informatics of the University Hospital of Endocrinology, a Member of Bulgarian Institute of Standardization (BDS), Bulgarian representative in the European Federation of Medical Informatics (EFMI) and a Chairman of Association PROREC Bulgaria, Member of EUROREC Institute.

How to make eProtocol?

László Daragó[1], András Jávor[2]
[1]Semmelweis University, darago@inf.sote.hu
1082 Budapest, Üllői út 78/B, Hungary
[2]Semmelweis University, javor@inf.sote.hu
1082 Budapest, Üllői út 78/B, Hungary

Abstract: **The claims for the growing quantity and quality of health services are present; therefore the more efficient use of resources became necessary. The collection, processing and transmission of the data describing the state of the patient, and the medical decision making during the treatment not in any case require the direct physical physician-patient contact and do not always require the full therapeutic use of the curing infrastructure. The use of telemedicine, the appearance of new medical procedures is investment-intensive, but the invested money returns in other resources saving an individual or social level pay. The obstacle of spread of telemedicine and its fit in the daily routine is not lack of sensors, the insufficient data transmission bandwidth or the software insufficiency today. The available info-communication technology ensures a safe operation. The lack of adequate control became the main barrier of introducing in the daily routine, these days. It is important to clarify the legal and ethical questions of substitution of the traditional medicine. What are the conditions and constrains, assumes the health insurance funding some telemedicine procedures? How can be realised the professional supervision, which both the interest of the patient, physician and investor? The present study sketches the outline of a method which can be generally used for preparing eProtocols, on the basics of the traditional methods.**

Introduction

The growing claims to health services in amount and quality signs, that more effective use of resources is needed. The decision making during the cure, collecting, processing and forwarding the data on the status of the patient, or performing the treatment does not need direct, physical doctor-patient contact in every case. The patient surveillance, executing of some procedures does not claim the whole ward infrastructure [1]. The investment in telemedicine and eHealth, as new technology for continuous data collecting in non-hospital environment returns on patient or nation level. Introducing of telemedicine can become an effective and economic way in the healing, technology able to realise, but somehow, the breakthroughs missing.

What is the obstruction of the success? Little management participation? No motivation? Lack of interest? Lack of resources or investment?

Introducing of applying the telemedicine tools in not healing field, such as fitness, sport, entertainment, exists, but only for a narrow market. Healthcare utilisation needs the safety for all the participants, that is, for patient, health provider, technical assistance [2]. There also must be ensured economical and resource saving usage, legal and financial regularisation.

Until the health insurance accept and finance the telemedicine processes and procedures, they will not become accessible generally in healthcare and the usage rate will not guarantee the return of the investment in technology, studies, human resources.

This study uncovers one of the problems of spreading the telemedicine, that is, the lack of accepted and applied telemedicine protocols, so called eProtocols.

Materials and methods

Observing the surrogate and/or supplementary procedures of the traditional healing the point of view and the expectations of the participants are different. Some actors of the healing procedure were reported.

In the point of view of patient, the telemedicine curing should be much more comfortable, time and money saver, and much faster than the traditional way. But in the same time the patient may worry because believing a person that is the doctor is not the same as believing the system [3]. Can the patient oversee who watches, records and procedures his/her vital data? Who can access the data, able to forward – or in a case – delete? Does the patient have possibility to delete or encrypt his/her own data?

In the point of view of the medical doctor or health provider the curing processes should be protect protected by the controlled and supervised eProtocols. It gives protection for the doctor in any later legal procedures about the healing. In the case, if health insurance financed the applied telemedicine procedures, to create valid investment and business plans become much easier.

In the point of view of the health insurance company the safety, that is the needed, adequate and eligible service has been given to the patient with the necessary and sufficient resources, should be guaranteed. There must connect the telemedicine health service to the Patient record, that is, the insufficient procedure may not cause the growth of the cost of the cure of the patient. Or, if it did, the cost holder must be pointed.

The validity and reality, as important aspects of the telemedicine, data communication was also re-evaluated.

The validity of the forwarded data from the sensors or otherwise created input and sent data must be checked. Any individual datum may mislead the doctor at the evaluation of the status of the patient, or the technician at the reliability of the system. The traditional medical protocols contain the checking procedures or data at accepting the results.
Another question is the checking of the reality of the sent data. It is also a serious duty for the telemedicine data transfer agents.
The actors of the telemedicine service has been reported and asked about their suggestions and doubts at fitting this technique in the daily routine. They were also asked for alternatives.

Results

The telemedicine processes must contain their included control and backup processes and systems. Single datum may appear only as part of series or element of a collection. Data packs must be collected as consistent, valuable measure results and sings. These transmitted data packs must be validated before and after the transmission. Digital signature required for the data interchange to identify the patient, the agent and the receiver, that is the health provider. It also ensures the harmless communication.
Regulation is needed to oversee and check the quality of the telemedicine procedures, actors and agents. That is the interest for both of the partners.

The reality and validity of the transmitted and received data must have high priority.

Principles of eProtocols

Applicability/validity fields of protocols

Where and when is telemedicine applicable for healing, that is, when diagnostic or therapeutic activity may be substituted by telemedicine tools? That means, that the substituting or surrogate method for the traditional medicine supposes keeping or raising the level of the healing. It also increases the economical and social efficacy for the individual patient or the population.
Stipulations to introduce the protocols

The keeping on level the efficiency and efficacy of the healing is basically important. Continuous medical and technical supervision should be implemented.
Must be determined

- Data, created by the telemedicine, to execute and analyse the cure and to support the medical decision.
- Metadata, defining the data-communication.
- Input and output interfaces.

Algorithms of diagnostics and therapy

The must to be identified those algorithm, which can be substituted whole or particularly by the methods and tools of telemedicine.

To build in and fit the telemedicine processes into the algorithm and data flow.

Complete the algorithm with the potentials and possibilities (analysis', aggregations, patient-oriented reports, alarming).

The questions of implementation and maintenance should be cleared before start the realisation.

Conclusion

As the National Guideline, eProtocol also must have a supervised and checked system for qualification and acceptance. To apply the eProtocol the certification must renewed time by time, both in medical and financial aspects. The technical background must be certificated too. There must be found or named an authority to realise and supervise this process. The existence of eProtocols is not sufficient conditions of the introduction of the telemedicine generally and big amount in the daily routine, but creating them may help to solve some problems of barriers.

Acknowledgement

Here we thank the cooperation of Peter Kozma and Janos Kornafeld for the consultation on the several aspects of the telemedicine actors.

References

[1] Szabó Csaba Attila, Jávor András: Távgyógyászati alkalmazások, Hiradástechnika, LXIII., 2008/2, 9-14.

[2] András Jávor, László Daragó: Standards of Clinical Guidelines in Telemedicine, Med-E-Tel 2009, 2009. 04. 1-3.

[3] Dr. Jávor András: Panopticon - egy régi elképzelés új köntösben, A Magyar Bioetikai Társaság 19. Nemzetközi Konferenciája, 2009. szeptember 14-15, Budapest

András Jávos is a Medical doctor, IS system analyst. Director of the Institute for Medical Informatics, Semmelweis University. President, then member of the board of the Hungarian eHealth and Telemedicine Association.

László Daragó, PhD is physicist, doctor of computing sciences. Associate professor on the Institute for Medical Informatics, Semmelweis University. Participation in the education of medical informatics since 1993.

Information and Communication in Medicine through On-Line Advanced Solutions

A. Alexandru, C. S. Alecu
National Institute for Research and Development in Informatics,
adriana@ici.ro
8-10 Averescu Avenue, 011455 Bucharest, Romania

Abstract: **This paper presents an IT system with an operative and user-friendly patient-medical system interface. The system (named MeDist) will be a useful instrument for healthcare services for persons in rural areas (where specialist medical assistance is reduced) and for persons located in remote or isolated places (for example: marine oil rigs, ships etc.). The MeDist system has been designed to be accessible to all possible users (design for all), including people with special needs (elderly, people with disabilities etc.). MeDist is in the development stage. It provides tele-consultation (remote medical assistance), monitoring of chronic patients in need of locally unavailable specialist, orientation of the patient towards the best place of treatment, medical care and recovery, facilities for making patient appointments.**

Introduction

Communication is the most important component of intelligent life, and particularly so remote communication. The use of the Internet for various services has become a commonplace in the developed countries and tends to become in Romania as well during the following years.

Telemedicine [1] can be defined roughly as health services provided through telecommunication networks. Telemedicine is registering a high increase of popularity in many countries with considerable interest and investments in the computer and telecommunications industry.

There are multiple definitions of telemedicine based on its application in health care. Sood et al. [2] reported over 100 distinct definitions in a review of the literature, suggesting that telemedicine is a multidisciplinary, continually evolving, tool in medicine that can overcome issues of uneven care distribution and labour and infrastructure shortages.

The transmission of information and communication over geographic distances enables enhanced care coordination and promotes informed autonomous care on the part of the patient and their family members [3].

The reality of geographical and socio-economic barriers for the access to healthcare in the rural environment has been recognized long ago, hence the

necessity for these barriers to be removed in Romania also [4]. Health workers in the rural environment find themselves in a professional isolation and incur additional expenses for sending patients to specialist consultations.

In this context, the development of an IT system that should offer an operative and user-friendly *patient-medical system* interface is necessary. The **MeDist** system will provide medical assistance through the Internet. It will be a useful instrument for healthcare services for persons in rural areas and for persons located in remote or isolated places.

The **MeDist** system is in the development stage. The system provides tele-consultation [5], monitoring of chronic patients in need of locally unavailable specialist, orientation of the patient towards the best place of treatment, medical care and recovery, facilities for making patient appointments.

Users

The main users of the system will be the patients. It will be also possible for family physicians, specialist physicians, hospitals, clinics, spas etc. to benefit of the facilities provided.

The **communication** between a user (patient or physician) and the system is of two types:

1. **unidirectional** (for obtaining information) – the user will have access to information regarding patients (if the uder is a physician), family and specialist physicians, hospitals, clinics, spas etc.
2. **bidirectional**:
   - **tele-consultations -** the users will be able to communicate through Internet in order to adjust the treatment for untransportable patients and for patients residing in remote areas. The communication can be between:
     - patient - family physician/specialist physician;
     - family physician - specialist physician;
     - specialist physician – another specialist physician.
   - **tele-monitoring** – the measurement of some parameters, specific to the chronic disease of the patient, and the surveillance of the patient in order to detect the occurrence of pathological levels.

The **MeDist** system is accessible to all possible users (**design for all**). The design for all approach is addressing a broad spectrum of users: elderly, disabled people etc. So, during the process of designing the **MeDist** pages, we took into account the **WCAG (Web Content Accesibility Guidelines)**

reccomendations [6] in order to facilitate the access of the people with special needs to the services provided by the system.

All users can consult the informative pages of the system. In order to access the appropriate interactive functions of Medist (to communicate with other users), the user need to register (to enter a username and a password).

System's structure

The **MeDist** system comprises the MeDist database and a package of ASPX pages for the management of the database through the Internet. The database has been developed in *SQL Server 2005* and the application under Visual Studio.NET.

The **MeDist** database has been structured to contain users data, tele-consultation and monitoring data, data about appointments and reservations and also consultative data (information from the healthcare domain, data about physicians, hospitals etc.).

For the faster access of the user to the personalised pages, a page named **Personal MeDist** has been created (figure 1).

Figure 1. Personal MeDist

The patient may chose the family physician, the specialist physicians etc. and add them to his personal lists if they agree. So the user will consult only the personal data, the physicians, healthcare units etc., patients (if the user is a physician) from the personal lists. This page offers access to the main

services: teleconsultation, monitoring, appointment for consultation, reservation for treatment and recovery.

The system will be open, offering the possibility of registration (through the Internet) of physicians, hospitals, clinics, spas etc. with information about the available services of each medical provider.

Conclusion

The development of such a system is in accordance with the national strategy of informatisation of the society in Romania and especialy of providing access to public information. The MeDist system will contribute to the development of the logistic infrastructure in the public health field having thus high chances of success.

The implementation of the system will result in:

- increased quality and efficiency of the medical services by offering a better and faster connections among all factors involved (patients, physicians, clinics, spas, etc.);
- increased life expectation of the population by provision of fast access to physicians in emergency cases (especially in cases in which the physician and the patient cannot meet face to face sufficiently promptly).

References

[1] D. A.Perednia. "A brief introduction to telemedicine system evaluation and the Clinical Telemedicine Co-operative Group (CTCG)". Oregon Health Sciences University, 1993.

[2] S. Sood, V. Mbarika, S. Jugoo, R. Dookhy, C.R. Doarn, N. Prakash, and R.C. Merrell, "What is telemedicine? A collection of 104 peer-reviewed perspectives and theoretical underpinnings", Telemed. e-Health 13 (5) (2007) 573–590.

[3] P.A. Jennett, L. Affleck Hall, D. Hailey, A. Ohinmaa, C. Anderson, R. Thomas, et al., "The socio-economic impact of telehealth: a systematic review", J. Telemed. Telecare 9 (6) (2003) 311–320.

[4] D. Banciu, and A. Alexandru. "Innovative Research Concerning eHealth Products and Services in Romania". WIRELESS WITAE '09 – The 2009 1st International Conference on Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronic Systems Technology, May 17-20, 2009, Aalborg, Denmark, Special Session — Telehome Care for Easy Life, Page 68–72.

[5] A. Dermatol. "Patient looking for information on the Internet and seeking tele-advice: motivation, expectations, and misconceptions as expressed in e-mails sent to physicians", 1999.

[6] E. Jitaru, and A. Alexandru. "Content Accessibility of Web documents. Principles and Recommendations", Revista *Informatica Economică* nr. 2(46), Bucharest, Romania, 2008, pp. 117-124.

Adriana Alexandru is Head of Research Department in National Institute for Research and Deveopment in Informatics, Bucharest, Romania, She coordinated several national research projects and was scientist in charge of 12 European projects. She is author of 3 books, coauthor of 6 books and wrote over 100 articles published in Romania and abroad. She is member of EFMI, VDI, etc. and evaluator of Romanian, and EU research programmes.

Cristina Simona ALECU is senior researcher in the Research Department of National Institute for Research and Deveopment in Informatics, Bucharest, Romania, She coordinated several national research projects and was in the research team of other projects. She is author / coauthor of over 40 articles published in Romania and abroad, and she is member of EFMI.

TNHSP - TamilNadu Health Systems Project Successful Implementation of HMIS across Government Hospitals

S. Vijayakumar[1], P. K. Amarnath Babu[2], Kala Rao[3]
[1]Department of Health and Family Welfare, Government of Tamil Nadu
vijay_krs@yahoo.com
[2]Health Management Information Systems, dramarnathbabu@gmail.com
[3]Tata Consultancy Servicekala.rao@tcs.com

Objective of the Project

The broad objective of the project is to use ICT in improving the ability to collect, store and analyze real time health data across the state. The project was conceptualized to provide the critical health data across the health chain for quick and timely intervention by the health administrators.

Health Management Information Systems (HMIS) is expected to work as the unified Health Reporting platform across the State of Tamil Nadu including information reporting, Decision Support Systems, Expert systems, and Executive dashboards.

Hospital Management System (HMS) represents the computer systems (hardware and software) that aid in effective management within the hospitals. This comprises various phases in patient care from Registration to Preparation of Discharge Summary including online entry of diagnosis and prescription by the doctor in the examination room, maintenance of drug inventory in pharmacy, stores, maintenance of linen accounts, laundry, diet, lab services etc. The patients received in the hospital and referred out of the hospital are also accounted for under HMS.

Scope of the Project

The HMIS project comprehensively covers the key functionalities and processes within the hospitals (HMS- Hospital Management System) as well as provides for an online reporting system (HMIS-Health Management Information System) for all health information.

1. The services covered for hospitals as part of the **HMS** comprise 10 modules including Registration (outpatient, inpatient, casualty), Lab services, Pharmacy, Stores, Wards, Blood Bank, Linen management, Diet, Biomedical waste management, Equipment Inventory and Clinical module covering patient Outpatient (OP) record, In patient (IP) record, Nurses

notes, Operation notes, discharge summary, Ante Natal Records (ANC) record, Natal & Post Natal record, Family welfare services and Referral services. Patients receive printouts of the OP slip, lab results, and prescriptions.

2. The HMIS comprises four modules namely Clinical, Ancillary, Program Information and Administrative Information system.

Highlights and Innovations of this project:

The project brought in institution-level changes and provides for the following

1. Unique Patient identification Number (PIN)
2. Unique Institution codes across all government hospitals and offices
3. Unique employee numbers/ user names and passwords
4. Usage of standardized State level drug codes & Treasury codes.
5. Uniform and standardized reporting formats
6. TNHSP has proposed to link the PIN to the UID-Unique Identification Number that is to be developed by the Government of India.
7. Online availability of patient health records across referral chain.
8. OP record entry by doctors online including online prescriptions, lab investigations, diagnosis.
9. No Data entry support by ensuring the end users themselves trained for online usage of the system.
10. The final diagnosis is linked to International Disease Code- 10.

Achievements of this Project:

- Pilot project implemented in five secondary care Hospitals – lessons learnt and suitable changes in infrastructure planning and support planned for next phase procurement and implementation.
- Phase 1 successfully completed with 41 hospitals online and HMIS training completed in 5 districts.
- Over 2.8 million patients registered in the system, with around 20,000 patients being processed through the system online. Over 1.4 million patient health records available online.
- Phase 2 procurement in progress to cover 222 hospitals in 25 districts of the State
- Funds for Phase 3 expansion to Tertiary Care hospitals and Medical Colleges from World Bank approved.
- HMIS project awarded the **e-India 2009** award for Best Government

Initiative for the year 2009 in the e-Health category.

- Invited to present paper at e-Asia conference in Colombo, Sri Lanka in December 2009.
- Nominated for the Government of India e-Governance award under category for Exemplary Horizontal Transfer of ICT based best practices in health care

S. Vijayakumar is Project Director of Tamil Nadu Health Systems Project & Special Secretary to Government, Department of Health and Family Welfare, Government of Tamil Nadu.

P.K. Amarnath Babu is Project Coordinator in Health Management Information Systems, Tamil Nadu Health Systems Project.

Kala Rao is consultant at Tata Consultancy Services.

The Approach to Individualized Teleconsultations of Patients with Arterial Hypertension

F. T. Adilova[1], N. A. Ignat'ev[2], Sh. F. Madrakhimov[2]
[1]Institute of Mathematics& ICT, National Academy of Sciences
[2] National University of Uzbekistan

***Abstract*: In present study is proved hypothesis that homeostasis of organism can be identified by set of features, which are not conventional norm. We affirm that in general case the set of allowable values of the features can be dissected on disjoint intervals, reflecting conditions of homeostasis equilibrium of normal functioning organism, but these values of features are not norm. We named these conditions "zones of health" because in them organism supports the necessary balance with external environment. It is shown, that partition on intervals of the quantitative features can be also use for calculation of arterial hypertension heaviness generalized rate.**

Introduction

Partition of the measured factors on intervals is broadly used at data analysis in medical research. Using the interval was considered useful at homeostasis study of live system. Really, the organism can function under comparatively small range deviations of the different features of the internal environment (physic-chemical, physiological) from determined average value, which was considered as norm, but condition of the organism in this interval was considered as condition of homeostasis equilibrium. In many investigations one can find the concept of individual norm. From homeostatic point of view this norm is such status of arterial hypertension patient in which conditions of homeostatic equilibrium provides compensated type of clinical course. Main goal of our study is to define a set of features' intervals which form individual norm of patients with arterial hypertension. As opposed to known approaches we offer to analyze only data of examination, using methods of data mining [1]. So input information for partition the quantitative features on disjoint intervals and calculations generalized rate are used standard tables "object-feature", describing the status of every patient under study.

Material and methods

The research was based on the data of patients' examination from Central Military Clinical Hospital, Republic Uzbekistan. 29 quantitative features were used, reflecting clinical and functional condition of 147 patients. There are two groups: 36 patients have diagnosis of arterial hypertension, 111 were practically healthy [2].

The formal description of the problem in general case (quantitative and qualitative features) is reduced to the problem of the pattern recognition in standard statement. The fixed set of objects $E_0 = \{S_1,...,S_m\}$, contains representatives of two disjoint classes K_1, K_2. The description of objects are produced by means of n two type features (intermix,-qualitative and quantitative), ξ from which are measured in interval scale, $n-\xi$ in nominal.

Let us name the representatives of the class K_1 (patient with arterial hypertension) as "*event*", representatives of the class K_2 (practically health) - "*not events*". Need of consideration problem of the pattern recognition on two classes is done under following reasons: any generalized rate (the rate of heaviness of the disease) is relative. The objects each of classes are opposed to object of the opposite class; there are absent the classes of analytical functions for recovering the dependencies in space of intermix features.

Let us mark I, J a set of number accordingly quantitative and nominal (qualitative) features $X = \{x_1,...,x_n\}$, $|I+J| = n$. On set E_0 are selected disjoint intervals for each quantitative feature in border of which dominate values of the class "*events*" or "*not events*". For this is produced of c-th feature ($c \in I$) ascending ordering.

$$r_{c_1}, r_{c_2}, ..., r_{c_m}. \tag{1}$$

According to criterion defined below, sequence (1) is split on τ_c disjoint intervals $\left[r_{c_u}, r_{c_v}\right]^i, i = \overline{1,\tau_c}$. Values of feature, within interval $\left[r_{c_u}, r_{c_v}\right]^i$, hereinafter can be considered as gradation of the nominal feature.

Let $d_1^i(u,v), d_2^i(u,v)$ - number of the representatives accordingly classes K_1, K_2 in interval $\left[r_{c_u}, r_{c_v}\right]^i$. For selection of features r_{c_u}, r_{c_v} on index of the dominant class $t \in \{1,2\}$ we offer criterion:

$$\frac{d_t^i(u,v)}{|K_t|} - \frac{d_{3-t}^i(u,v)}{|K_{3-t}|} \to \max . \qquad (2)$$

The recursive process of the choice of dominant intervals we show on example of the class K_2. The borders of the first interval $\left[r_{c_u}, r_{c_v}\right]^1$ in the sequences (1) are calculated on maximum of criterion (2) under $t = 2$. The similar are defined borders for $\left[r_{c_u}, r_{c_v}\right]^p$, on values (1), that not belong to $\left[r_{c_u}, r_{c_v}\right]^1, ..., \left[r_{c_u}, r_{c_v}\right]^{p-1}$. The criterion of the stop of the process serves the absence of the interval with positive value (2) under $t = 2$. Minimal covering of all values (1), disjointing with intervals of class K_2, form the intervals of dominances of class K_1.

Let us label $\eta_{1i} = \frac{d_1^i(u,v)}{|K_1|}, \eta_{2i} = \frac{d_2^i(u,v)}{|K_2|}$ results of optimal in means of (2) of the partition for each interval $\left[r_{c_u}, r_{c_v}\right]^i, i = \overline{1,\tau_c}$. Values of the membership function c-th feature to K_1 on interval $\left[r_{c_u}, r_{c_v}\right]^i$ define as:

$$f_c(i) = \frac{\eta_{1i}}{\eta_{1i} + \eta_{2i}} . \qquad (3)$$

If feature, $c \in J$, then η_{1i}, η_{2i} in (3) can be considered as number of values of i-th gradations in classes K_1, K_2, accordingly. The generalized rate of the object $S \in E_0 \cap K_d, S = (b_1, b_2, ...b_n)$ is calculated under formula:

$$R(S) = \frac{1}{|K_{3-d}|} \sum_{S_j \in K_{3-d}} \left(\sum_{c \in I} \begin{cases} f_c(i), & b_c \in \left[r_{c_u}, r_{c_v}\right]^i \ \ and \ \ x_{jc} \notin \left[r_{c_u}, r_{c_v}\right]^i \\ \frac{f_c(i)|b_c - x_{jc}|}{|r_{c_u} - r_{c_v}|}, & r_{c_u} \neq r_{c_v} \\ 0, & r_{c_u} = r_{c_v} \end{cases}, \ b_c, x_{jc} \in \left[r_{c_u}, r_{c_v}\right]^i + \sum_{c \in J} \begin{cases} f_c(i), & b_c \neq x_{jc} \\ 0, & b_c = x_{jc} \end{cases} \right) \qquad (4)$$

Where $S_j = (x_{j1}, x_{j2}, ..., x_{jn})$ and values τ_c gradation, $c \in J$ of each nominal features belongs to the set $\{1,2,...,\tau_c\}$.

Results and discussion

Partition of 29 quantitative features on intervals of dominances and values of the membership function of each interval to arterial hypertension is shown that was revealed brightly expressed two "*zone of health*", [2.5,3.2], [3.9,3.9], got for feature "*size of the left auricle cavity*", where values of the membership function in each of which less 0.5.

The suitable way for analysis of heaviness rate of disease is mapping of values of the generalized rate from (4) in interval [0, 1]. Such image allows comparing the generalized rates, got on different sets of features.

Conclusion

1. Homeostatic conditions of patient with arterial hypertension, named as "*zone* of health" can be formed by set of some interval values of traditional features. This set of values can be considered as individual norm of patient. The organism of patient (at some people and not always) can find such homeostatic equilibrium, in which regulation of features, in magnitude deviating from norm, however realized in mode of the compensations. For the first time we offer approach based of the clinical data and methods of the artificial intelligence.

2. The calculation of the generalized rates by offered methods allows define the level of disease heaviness on specified set of the features, regardless of expert estimation by physicians. Thereby, we have shown that this computing method gives the objective estimation of the patient status, but discovery potential "*zone of health*" allows define the individual norm for every patient.

References:

[1] N. A. Ignat'ev Syntheses of factors in artificial neural networks// Computing technologies, - Novosibirsk, 2005. - V. 10, pp. 32 – 38(in Russian).

[2] P. P. Chernysh System-symmetric approach in estimation of the individual rate and efficiency of the treatment of chronic heart insufficiency // Thesis on Doctoral Dissertation – Tashkent, 2003, 156 p. (in Russian)

The Peculiarities of Clinical Information in Light of the Novelty Brought by e-Health: A Review of Some Italian Projects

G. Rinaldi[1], L. Carnevali[1], A. Gaddi[1], L. De Mattè[2], P. Busca[2],
[1]University of Bologna, giovanni.rinaldi@cup2000.it
[2] CINECA, Department of Health, l.dematte@cineca.it
Via del Lavoro 65, 40033 Casalecchio di Reno, Bologna, Italy

Abstract: Nowadays three dimensions must be considered to define Clinical Information (CI): 1. The management logic. It is the logic of aims, schedule, efficiency and control 2. The clinical science logic. Clinicians have different expectations and make different requests out of the clinical information. It must produce knowledge and be understandable. It requires to manage the logic of causes and effects, of risks and benefits; 3. The patient choice logic. There is no CI outside the patient-physician relationship. Patients surf on the net searching CI, take part to blogs and in the care of their own disease. CI is used for creating Electronic Health Records (EHR). Managers have information for performing epidemiological analysis and planning the delivery of health services, but the comparison of data and the correctness of the data chain management are often lost. This reflects the fragmentation of the information systems. Here we analyze four approaches to CI.

ARNO epidemiological observatory

ARNO observatory has been activated in 1987 with the aim of providing advanced IT resources to the local and regional programs dedicated to the monitoring of medical prescriptions. It is an on-line multicenter prescription observatory of a population of almost 11 million of inhabitants characterized by an epidemiological approach. The system has been conceived to combine and aggregate huge masses of data, collected for each single patient for administrative use: general practitioner's prescriptions, hospital admissions and discharges, diagnosis tests and examinations by medical specialists. Many efforts have been made to improve data quality, cross-checking of the original data bases (drugs, patients, physicians) leading to the creation of a population oriented database which assures a high degree of confidence to both general and stratified analyses. During its long history, ARNO observatory [1], [2], [3] have shown helpful in many clinical research applications, beyond its downright scope of supporting the daily work of Local Health Units. However, administrative data exchanged

among the various health caregivers lack a reliable and standardized way of representing and exchanging clinical information, thus imposing limitations on the possibility to conduct epidemiological studies. For instance, digitalization of drug prescription usually involve at some step the manual input of data, with an obvious impact on the data quality. But an even worse problem is represented by the lack of any indication or diagnosis. A similar problem is faced with hospital discharge records, since the clinical data are expressed in a form suitable for the reimbursement systems but totally unfit for scientific research. Cross-linking all data flows helps greatly in overcoming some of these drawbacks, though the usefulness of clinical data would be greatly enhanced just by adopting a more rational representation of clinical data. The number of LHU involved is 32 and the total population is 10,498,545; the number of patients with prescription is 7,453,967 with prevalence of 68.4 %, GPs involved are 8,307 whereas pediatricians are 1,260, the number of prescription per year are 90,193,000 and the total prescription managed are about 640,000,000.

OLDES project in Bologna

In modern health care systems, a large number of agencies participate in the care process which provides individual services. These services often need to be combined into packages and plans. The challenge of OLDES project (co-founded by EU FP 6 under Ambient Assisting Living theme) is that this problem cannot be dealt by using the classical enterprise approach made of solutions closely integrated with proprietary mechanisms. Due to these challenges we referred to a federal approach which supports, and at the same time depends on, the trust and co-operation between agencies. This allows each agency to maintain its responsibility and management of the individual relationship with patients, while exchanging information and coordinating actions in the interest of their shared clients. Clients can actively participate and give their consent to such actions. CI needs data produced not only within the organization boundaries, but also data that can be produced and owned by other agencies within the federation. A specific attention is paid in the analysis of the relationship among the different agencies which own data and define procedures for the governance of this exchange flow and the composition of CI. Specific services are dedicated to recovering information from different sources which belong to different agencies. Information are then composed in a transparent way on the user interface of the stakeholder. From a logical point of view, we have to introduce a service for data management whose scope is not to aggregate

every type of information in a single data base, but to extract information and compose them from federated databases. We achieved this aim by using a master data management that connects information with important semantic meaning to the others.

High Learning Course for GPs at Bologna University

The High Learning Course (HLC) for GPs organized by Bologna University highlights the importance for clinicians to know the new opportunities offered by web2 in healthcare. More and more patients use the tools made available by web2 and claim to discuss their pathology with clinicians. This requires the generation of CI to be revised. In HLC on e-Health, a new attempt to evaluate different sources of CI was performed. This approach resulted in a complex vision, due to the absence of standardization within GP's. However, it actually represents the more reliable approach to evaluate CI usefulness, taking into account the problem of individual and population outcomes we mentioned above. The internet era has currently brought a lot of opportunities for the consumer of health data [4]. Patients surf the net and claim to discuss medical issues with physicians. However, in order to make the involvement of patients well accepted by physicians, we need personal care to have a clear governance and this implies a more strict physician-patient relation. CI used for healthcare is composed by both structured and un-structured data coming from different sources, even non conventional sources like images and videos. Medical profession is a collaborative work and the CI managed by one doctor could be important in different health pathway. In this scenario the relationship between doctor and patient is changing. ICT solutions are often focused on data and not on the relationships that produce those information. In conclusion the patient involvement is needed in health care practice and web2.0 can offer great opportunities to this involvement, but the privacy and accuracy of information must be guaranteed. It seems that traditional stand-alone health information system has to be revisited in the light of this novelty.

ICT for managing EHR by GPs

EHR used by GPs are focused on the management of clinical pathways and not on the generation of CI. Data are exchanged using HL7 messages where the intelligence of the communication is embedded in the message. CI "must" produce positive and measurable outcomes, both in population (epidemiological approach) and in individuals (clinical approach) and for

both perceived and objective needs of individuals and society. Obviously, the integration of three "dimensions" (management logic, science logic, patient choice) is a complex process and any interference in this process might modify the final result improving or worsening the outcomes. In several experimental set the type of data recorded largely depends on personal interest of the researcher, availability of low-cost data, or methodological issue, such as the idea of preferably recording well-standardized data in spite of more complex information. As a result, valuable CI about diseases are usually lost.

Conclusions

This analysis has pointed out a few critical situations in the correctness of the information management chain. CI is flat and does not consist of contextual information. Data stored in different applications are built for management aims and lack the whole context. A single data has different meanings: the privacy context, the disease management background, the compliance to a guide line. So knowledge must be embedded in the information process and not left to a communication framework. The new opportunities offered by web2 require to change the conceptual frame of the world of data bases. Access control services must be replaced with publication and syndication services, in which the communication of health information is an active process, based on the recognition by the two sides of the importance of information and their desire to share them. In this system the subject of information is an informed and active participant. We have learnt that it is necessary to introduce collaborative tools in the work of GPs in order to involve the patient,, but this process must be accompanied by guide lines which guarantee patient's privacy, governance and compliance.

References

[1] Barbui C et al "Antidepressant drug prescription and risk of abnormal bleeding: a case-control study" Journal of Clinical Psychopharmacology 2009 Feb; 29:33-8.

[2] A. Clavenna, A. Berti, L. Gualandi, E.Rossi, M. De Rosa, M. Bonati "Drug utilisation profile in the Italian paediatric population" European Journal of Pediatrics 2009 Feb, 168:173-80

[4] A.Clavenna et al "Increase in non-evidence based use of antidepressant in children is cause for concern" – Letters to BMJ Vol. 328, 20 March 2004, pag. 711-712

[5] G. Eysembach "Meedicine2.0: Social Networking, Collaboration, Participation, Apomediation and Openness," – J. Med. Int Research Vol. 10, 20 March 2008

Giovanni Rinaldi obtained a Physics Degree at Bologna University. He is the coordinator of projects in the area of e-Health and telemedicine in Emilia Romagna Region (Italy). His research area concerns the development of EHR and the mechanisms of generation of Clinical Information. Mr. Rinaldi lectures at the University of Bologna on ICT topics under the department of Medicine. Furthermore, he has managed high-level university courses for GPs.

Virtual Epidemiology – Application of Information Technologies for Creation and Management of Epidemiology Medical Information Program and Databases

E. Kldiashvili, A. Burduli
Georgian Telemedicine Union (Association), ekldiashvili@yahoo.com
75 Kostava str., 0171 Tbilisi, Georgia

Abstract: **Epidemiology is actual and important task of healthcare in the world. Natural or man-made incidents of infectious diseases can cause serious healthcare problems. It is well known, that at 2001 during anthrax incidents healthcare system in USA was overloaded due to high intensity of requests of investigation of suspicious powders and population calls regarding possible outcomes of contact with infectious agent. At present the questions associated with epidemics acquire more and more importance. After September 11 different projects have been implemented for the aim to create an effective approach for epidemiology control. Despite of variety of realized projects, the tool has not been created till now. One of the most actual areas of research is the application of information technologies for epidemiology aims, and especially creation and management of epidemiology medical information program and databases. Existed solutions mainly focus on distance education. The amount of projects and initiatives, which aimed usage of information technologies for epidemiology, except of distance education, is limited. As a result the creation and practical application of epidemiology medical information program and databases needs further investigation. This objective significantly detains the process of creation of adequate approach of early warnings system. The present article aims presentation of the project which will investigate application of information technologies for epidemiology purposes, in particular for creation and management of epidemiology medical information program and databases. In the frames of the project there will be created as epidemiology medical information program organized in accordance with the principle of clinical information system / digital medical history, so virtual learning center. The last one will realize distance education on actual topics of epidemiology, bioinformatics and application of information technologies in the field of epidemiology. The epidemiology medical information program will ensure the realization of the modern concept of infectious diseases' management. The application of information technologies for epidemiology tasks and especially for creation and management of epidemiology medical information program and databases, distance**

education on actual tasks of epidemiology and bioinformatics, is actual and perspective approach. The project "Virtual Epidemiology – Application of Information Technologies for Creation and Management of Epidemiology Medical Information Program and Databases" will stimulate usage of information technologies for medical purposes, development of telemedicine and eHealth in Georgia.

Introduction

Epidemiology is actual and important task of healthcare in the world. Natural or man-made incidents of infectious diseases can cause serious healthcare problems. It is well known, that at 2001 during anthrax incidents healthcare system in USA was overloaded due to high intensity of requests of investigations of suspicious powders and population calls regarding possible outcomes of contact with infectious agent. At present the questions associated with epidemics acquire more and more importance. After September 11 different projects have been implemented for the aim to create an effective approach for epidemiology control. Despite of variety of realized projects, the tool has not been created till now. One of the most actual areas of research is the application of information technologies for epidemiology aims, and especially creation and management of epidemiology medical information program and databases. Existed solutions mainly focus on distance education. The amount of projects and initiatives, which aimed usage of information technologies for epidemiology, except of distance education, is limited. As a result the creation and practical application of epidemiology medical information program and databases needs further investigation. This objective significantly detains the process of creation of adequate approach of early warnings system.

The present article aims presentation of the project which aims investigation of application of information technologies for epidemiology purposes, in particular for creation and management of epidemiology medical information program and databases. In the frames of the project there will be created as epidemiology medical information program organized in accordance with the principle of clinical information system / digital medical history, so virtual learning center. The last one will realize distance education on actual topics of epidemiology, bioinformatics and application of information technologies in the field of epidemiology. The epidemiology medical information program will ensure the realization of the modern concept of infectious diseases' management. By it will be realized organization and management of database, statistical analysis of

data and also management of separate structural units of healthcare system those are focusing upon infectious diseases control and biosafety tasks as well as their coordination with each other. During project's implementation there will be implemented possibilities of medical information program, management of databases and distance education. Mentioned information program will be created on the background of .Net technology; for database SQL Database will be used. Epidemiology medical information program will have multilingual interface, possibilities of local (intranet) and distant (internet) usage.

The application of information technologies for epidemiology tasks and especially for creation and management of epidemiology medical information program and databases, distance education on actual tasks of epidemiology and bioinformatics, is actual and perspective approach. The present project is innovative and progressive. The project will stimulate usage of information technologies for medical purposes, development of telemedicine and eHealth in Georgia. Project's results will serve as the background for establishment of systems of national epidemiology control, biosafety, public health and etc.

Goals and Objectives

The project aims application of information technologies for creation and management of epidemiology medical information program and databases. In the frames of the project "Virtual Epidemiology – Application of Information Technologies for Creation and Management of Epidemiology Medical Information Program and Databases" teaching programs focusing on actual tasks of epidemiology and bioinformatics will be realized distantly. The project's goals are:

1. Creation of epidemiology medical information program organized in accordance with the principle of clinical information system / digital medical history;
2. Creation of educational programs focusing on actual topics of epidemiology and bioinformatics;
3. Distance education.

The objectives of project are:

1. Creation of epidemiology medical information program organized in accordance with the principle of clinical information system / digital medical history;
2. Creation of epidemiology database;

3. Preparation of educational programs focusing on actual topics of epidemiology;

4. Preparation of educational programs focusing on actual topics of epidemiology;

5. Establishing of virtual learning center;

6. Distance education of medical personnel on actual topics of epidemiology and bioinformatics;

7. Organization of conferences.

Expected Results

Application of information technologies in medicine is the most perspective and actual. Usage of information technologies in epidemiology is effective. But concrete technology or practical recommendation has not been worked out till now. In the frames of the project will be elaborated epidemiology medical information program, distance education on actual tasks of epidemiology and bioinformatics will be realized. This is innovative and perspective approach, which is the prerequisite of development of effective systems of epidemiology control and public health in Georgia.

Through the project a core facility of computational biology will be created which will represent synthesis between epidemiology and medicine from one hand and biostatistics and bioinformatics from other hand. In this core facility bioinformatics tools will be applied for early identification of pathogenic organisms on the basis of Internet searching and analysis of nucleotide sequences. Multivariate biostatistics methods will be applied for establishment of modern syndrome surveillance system.

References

[1] A. Zelicoff, J. Brillman, D. W/ Forslund, J. E. George, S. Zink, S. Koenig. The Rapid Syndrome Validation Project (RSVP). Proc AMIA Symp; 771-5, 2001.

[2] Syndromic Surveillance for Bioterrorism Following the Attacks on the World Trade Center – New York City, 2001. MMWR Morn Mortal Wkly Rep 2002; 51: 13-5.

[3] M. Greenberg, S. Jurgens, E. Gracely. Emergency Department Preparedness for the Evaluation and Treatment of Victims of Biological or Chemical Terrorist Attack. Journal of Emergency Medicine, vol. 22, No3, pp.273-278, 2002.

[4] G. Eysenbach SARS and Population Health Technology. J Med Internet Res, 2003 Apr-Jun; 5(2):e14.

[5] Pavlin JA, Mostashari F, Kortepeter MG, Hynes NA, Chotani RA, Mikol YB, Ryan MA, Neville JS, Gantz DT, Writer JV, Florance JE, Culpepper RC, Henretig FM, Kelley PW. , Innovative Surveillance Methods for Rapid Detection of Disease Outbreaks and Bioterrorism: Results of an Interagency Workshop on Health Indicator Surveillance. Am J Public Health, 2003, Aug; 93 (8): 1230-1235.

[6] C. Bourret Data Concerns and Challenges in Health: Networks, Information Systems and Electronic Records. Data Science Journal, vol. 3, 17 September 2004, pp.96-113.
[7] E.H/ Shortliffe, J,J. Cimino. Biomedical Informatics: Computer Applications in Health Care and Biomedicine (3rd edition). New York, Springer, 2006.

Kldiashvili Ekaterina, Ph.D. holds a MSc in Biology (1995) and Ph.D. in Histology, Cytology and Embryology (2003) from the Tbilisi State University. Ekaterina works as Executive Director in Georgian Telemedicine Union (Association), Head of Lab and Telemedicine Group in Medical Center "Neoclinic", managing NATO Networking Infrastructure Project (2005-2006, 2007-2009), BSEC tender (2005-2006), telemedicine pilot actions, whole activity of GTU and also creation of eHealth network in Georgia. Prior to joining GTU Ekaterina worked at department of Pathology of Central Clinic of Tbilisi State Medical University, establishing and leading the electron microscopy laboratory. She was trained in cytological diagnosis of malignant tumors at department of Oncology of the Tbilisi State Medical Academy. Ekaterina also acted as Clinical Cytologist at department of pathology of Central Clinic of Tbilisi State Medical University and Virologist at Republic Center of AIDS and Clinical Immunology. She participated as researcher in Neuroscience project funded by Soros foundation. Ekaterina Kldiashvili represented GTU's activity and pilot actions at Med-e-Tel (2004, 2005, 2006, 2008).

Burduli Archil, MS holds a MSc in Computer Systems and Networks (1992) from the Tbilisi Technical University. Archil works as programmer in Georgian Telemedicine Union (Association), participating in NATO Networking Infrastructure Project (ongoing), eHealth pilot actions focusing on creation and practical application of clinical / medical information system.

WikiFood: Establishment of an Online Information Portal for Patients with Food Allergies

R. Herbst[1], N. Rösch[1], A. Arens-Volland[1], F. Feidert[2], R. Mösges[3]
[1]CRP Henri Tudor – CR SANTEC, Luxembourg;
[2]Centre Hospitalier de Luxembourg, Luxembourg;
[3]University of Cologne, IMSIE, Germany

Abstract: **Patients with food based allergies or intolerances have to live on an individual diet. This has a big influence to their quality of life. They have to avoid food that contains particular allergens or ingredients. To support these people the CRP Henri Tudor launched the WikiFood website that provides an independent product database that helps to find compatible food.**

Introduction

The prevalence of food allergies in the population has been estimated to be around 1-3% for adults and 3-6% for children [1]. Food allergies have a wide range of symptoms beginning with a mild indisposition to a life-threatening anaphylactic shock. Patients suffering from food based allergies or intolerances have to live on an individual diet. That means they have to avoid food that contains particular allergens. For people that are extremely sensitive even smallest traces can cause allergic reactions. Food producers are obliged to provide the ingredients of their food products by printing them on the product packages. But they are not forced to provide ingredient lists to any governmental or private institution for consumer information or protection. Allergic Patients have to read the ingredients lists very carefully during shopping or before consumption to minimize the risk of a potential allergic reaction. This is not an easy task as labels are often hard to read and to understand. That is one reason why allergic persons often avoid buying new products or visiting a restaurant. Food allergies concern both the allergic person itself and all those supplying and preparing food [2]. Therefore the WikiFood initiative has started to build up an information portal for people with food allergies and intolerances.

The WikiFood Website

WikiFood is part of the MENSSANA project (Mobile Expert & Networking System for Systematic Analysis of Nutrition based Allergies) which will analyze how Information and Communication Technologies (ICT) can support allergy disease management [3]. The MENSSANA goal is to use electronic patient diaries for allergy diagnostics and diet management purposes [4]. To achieve this, reliable information about products and their ingredients is needed. As mentioned before, food producers are not forced to provide this information electronically. This is why the CRP Henri Tudor launched the WikiFood website (www.wikifood.eu) in September 2006 to build up a central and independent database. This product database provides detailed information about ingredients, allergens and nutrition facts of foodstuffs. WikiFood builds up a volunteer network where producers and consumers generate the content of this product database (see Fig.1). Producers and retailers can demonstrate their care and interest in food security by publishing their products. As of December 2009 there were about 14,000 products of about

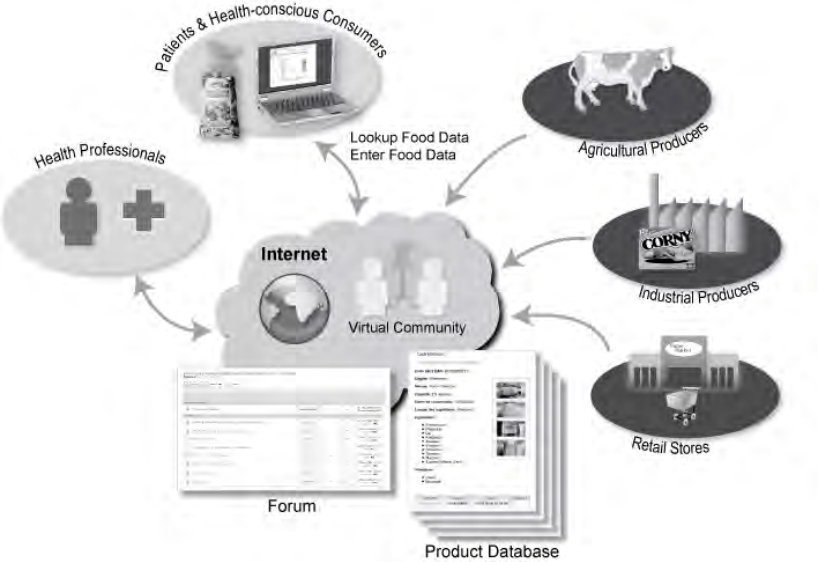


Figure 2: The WikiFood Community

2400 brands entered in the database. Food producers or retailers entered about 11,300 of these products. All other entries were created by other registered users. This transcription of product labels requires a lot of

concentration and diligence and is rewarded with points for the user. Digital pictures of the packages and the ingredient lists help to validate the data entries. Similar to the free encyclopaedia Wikipedia (www.wikipedia.org) every registered user can edit entries of other users except entries directly provided by producers. However, the users have the opportunity to report errors via a contact form. This ensures the data quality as all information will be peer reviewed by the user community. An editing history of each database entry helps to track changes of each product entry. This database helps allergic persons when planning their shopping by identifying products they need to avoid due to incompatible ingredients. Now they have the possibility to get detailed information about food products at home before the purchase. The website offers advanced search functionalities to exclude particular allergens or ingredients to speed up the product search. But WikiFood is not only helpful for people with food allergies. Also non-allergic people can use the information for a conscious handling of foods and supporting a healthy way of living.

WikiFood is even more than a single product database. It also offers a discussion board where allergy patients have the opportunity to exchange their experiences. It also provides the opportunity to exchange private messages. This leads to the establishment of social contacts between the members.

Conclusion

Food allergies and intolerances are of high interest not only for people with food hypersensitivity but for all supplying and preparing food e.g. family members and friends, restaurants and food producers. The WikiFood website provides an independent information portal where everybody can find and publish information about foodstuffs and their corresponding ingredients. Since 18th of July, 2008 there were 284.496 visitors (December 2009) on the website. This is an indicator for the success and need for this kind of information platform. But there is still a lot of work to as the product database only contains a fractional amount of the huge food marked so far. To cover the whole market more input of food producers is needed.

Outlook

Current work is done on the general page layout to improve usability and user satisfaction. In the future the users will have even more benefit of the product database. It's planned to provide a WikiFood client for modern mobile phones, like Apple’s iPhone or Windows Mobile based smartphones. The users will be able to access the database in the

supermarket and can directly check if a product contains incompatible allergens or ingredients. First prototypes have been developed and are now in their testing phase.

Acknowledgement

This work is funded by the Fonds National de la Recherche Luxembourg.

References

[1] European Food Safety Authority: Opinion of the Scientific Panel on Dietetic products, nutrition and allergies [NDA] on a request from the Commission relating to the evaluation of allergenic foods for labeling purposes. EFSA Journal (2004) 32, 1-197.

[2] World Health Organization - International Food Safety Authorities Network (INFOSAN): INFOSAN Information Note No. 3/2006 – Food Allergies, 2006.

[3] N. Rösch, F. Feidert, A. Arens, R: Mösges MENSSANA Mobile expert & networking System for systematical analysis of nutrition based allergies. Abstract Book XXVI Congress of the European Academy of Allergology and Clinical Immunology. Allergy. 2007;62(Suppl. 83);565-566.

[4] N. Rösch, F. Feidert, A. Arens, R. Mösges. Barcode based food identification improves the value of electronic diaries in nutrition based allergy, Proceeding of the 10th international symposium on immunological, chemical and clinical problems of food allergy. Parma (Italy), May 26-29, 2008, p. 128-129

Ralf Herbst studied Computer Science at the University of Applied Sciences in Trier. He graduated with a Master of Science (M. Sc.) in 2007. Since 2008 he works as a software engineer at the Public Research Centre Henri Tudor - SANTEC in Luxembourg. Currently he is working for the MENSSANA project. His main focus are open-source software solutions for mobile and server-side applications.

Mobile eHealth

Building Virtual Care Communities Supporting Elderly Socialization and Independent Living by Integrating Mobile Wireless ICT Based Services

E. Christodoulou[1], G. Samaras[2], E. Polydorou[3] , C. Tsiourti[2] , M. Belk[2]
[1]Citard Services Ltd, Eleni_Christodoulou@cytanet.com.cy
Evrytanias str. 1, 2064 Nicosia, Cyprus,
[2]University of Cyprus, Computer Science Department, cssamara@ucy.ac.cy
Kallipoleos 75, 1678 Nicosia, Cyprus
[3]Ellderly Social Services Centre, poledenamo.a.d@cytanet.com.cy
Laerte 22, 2365 Nicosia, Cyprus

Abstract: **The main aim of the presented research is the development of a Virtual Care Community around the elderly consisting of people of different ages and roles that assist, collaborate and actively communicate with the elderly to improve their daily life in an ad-hoc and informal way stimulating thus and prolonging their independent and active living in an outward environment. The solution integrates different mobile wireless ICT based services addressing the elderly social interaction context categories of Care & Wellness, Guidance and Mobility Monitoring and provides for personalized care and adaptation of social relationships and contexts of the elderly people as they age.**

Introduction

Demographic studies show that the number of people aged from 65 to 80 will rise by nearly 40% between 2010 and 2030. State of the art technologies can play an important role in addressing the challenge to support the elderly to live autonomously and remain active for longer. Even though, different efforts have been undertaken regarding the development of ICT solutions supporting the elderly, such efforts are mainly focusing on elderly that are in a rather advanced disabilities state. As a result the provided solutions and technologies aim mainly at restoring the lost independent living, allowing the elderly to have a glimpse of independence in highly controlled and constrained environments. Related research [1], [2] focuses mostly on systems aiming to assist the elderly people in coping with everyday life without giving emphasis on the elderly socialization needs.

The presented research, carried out in the framework of the MELCO project which is collaboration among the industry, care providers and academia, takes a proactive action providing a solution for elderly people at

the very early stages of capabilities degradation, when they are still capable to have a non-assisted independent living. The target group is the big group of healthy elderly with light physical or psychological health problems, who are self-supporting, able to move around, and find pleasure in getting help or stimulation to be active in an outward environment. The project builds an innovative Virtual Care Community around the elderly aiming to support and stimulate the elderly to remain longer active and live independent. It encourages and supports active participation, communication, socialization, mutual assistance and self-organization of the elderly, promoting seamless integration and interaction of different people (family members, caretakers, medical professionals, friends etc.) from all ages. The project places the elderly in the centre of personalized care provision by integrating different mobile wireless ICT based services addressing the elderly social interaction context needs of Care & Wellness, Guidance and Mobility Monitoring. Special attention is given on end-user's trust and individual privacy protection requirements.

Scientific and Technological Innovation and Main Objectives

In the research carried out innovation emerges not only from the area of new technologies, but also from the development and support of an innovative elderly social practice-oriented community model integrating new types of user experience and advance elderly social interaction with new ways of services design thinking and delivery. It focuses on the identification of elderly particular wishes and needs in terms of what factors, relationships, communication issues and roles are meaningful and generate the greatest impact on their self concepts and ability to self actualise. It goes beyond simple computer mediated interaction and 'technology push' services design thinking.

The developed practice-oriented community model paved the way through the achievement of the project's main objective of building around the aged person a Virtual Care Community consisting of Virtual Dynamic Collaborative Care Teams [3]. Such teams are **virtual**, i.e. they assist and provide care to the elderly without being physically present, **dynamic**, i.e. care provision changes dynamically in order to match the elderly people's needs, and **collaborative** the various team members combine their knowledge and work interactively to provide effective elderly care

In the work carried out particular importance was given on human-to-human computer-mediated interaction and trust. Elderly support is provided by his/her assigned virtual social care team through close interpersonal,

meaningful, and positive social connectivity affected by the quality, quantity, frequency, diversity and reciprocity of social contacts as well as the possibilities and opportunities for establishing them.

MELCO ensures that the elderly has a unique personalized profile of disabilities and abilities, special needs and preferences promoting thus personalized care provision. Behavior analysis is used to adapt social relationships and contexts of the elderly people as they age and adaptive user profiling techniques and interfaces, considering user feedback and historical data, are used to change the elderly preferences and capabilities regarding the provision of care services.

Main innovative objective of the MELCO project is also the integration of the elderly virtual care community with different mobile wireless ICT based services addressing the three main areas of the elderly social interaction context: i) **Care & Wellness** providing basic informal care empowering and encouraging the elderly people to undertake physical exercises and activities; create meeting groups for leisure activities and exchange their competence/knowledge/skills with the other members of the assigned elderly virtual care team. This will guarantee that valuable experience of elderly people does not cease to contribute to the wealth of the society by the simple fact that people retire and age ii***)*** **Guidance** services providing instructions, explanation and information supporting the daily activities of the elderly and iii) **Mobility Monitoring** services supporting early detection of limitations in mobility and physical fitness and elderly daily activity follow up based on predefined plans.

MELCO's System Design and Implementation

Based on the identified elderly social interaction care needs and the definition of the practice-oriented social community model, usage scenarios have been specified, capturing the most appropriate use cases that are implemented by the MELCO system. The UML (Unified Modeling Language) has been used to identify roles and analyse and formalise collaboration scenarios between virtual social care team members.

MELCO's system architecture is a Service Oriented Architecture (SOA) making use of web-services and a robust and persistent database management system. The main aim was to provide the elderly with the appropriate ICT based services, at the most suitable time, in the right place, in the most effective manner. An important issue is the protection of privacy and confidentiality interests of the users. Role access control is designed to provide a series of mechanisms and services to ensure that information will

only be shared among authorized users directly associated with the delivery of the relevant services. Throughout the MELCO's system implementation different state of the art technologies have been used including : the Internet Information Services (IIS) providing a secure, easy-to-manage Web platform, the Microsoft Active Server Pages (ASP) enabling the creation and run of dynamic, interactive web server applications and the Microsoft .NET Compact Framework (.NET CF) designed to run on Windows CE based mobile/embedded devices. Wireless sensor technologies and monitoring devices and wireless mobile devices, are seamlessly integrated and made available to the ICT services. MELCO does not only provide a unique system adaptable multi-modal interface that operates on any state of the art mobile wireless device, but all the different ICT based services are working as a unique federated service.

Conclusions

The presented work provides an answer to the emergent demographic challenge. Through the use of a Virtual Care Community, integrating different mobile wireless ICT based services, addressing the elderly social care context categories, MELCO enables a rich stimulating social environment around the elderly people, that supports them to live independently and actively for longer. This impacts positively their wellbeing and quality of life. The project's outcome has intrinsically also a high positive impact in improving the work load of the elderly families and care personnel, by prolonging the time the elderly can live autonomously in a socially integrated community manner thereby reducing the demand for care and the associated care cost.

Acknowledgment

The presented work has been carried out in the framework of the MELCO project that was funded by the Cyprus Research Promotion Foundation.

References

[1] G. Virone and A. Sixsmith, "Monitoring activity patterns and trends of older adults," in Conference proceedings: IEEE Engineering in Medicine and Biology Society., vol. 2008, pp. 2071-4

[2] J. Nehmer, M. Becker, A. Karshmer, and R. Lamm, "Living assistance systems: an ambient intelligence approach," International Conference on Software Engineering, 2006

[3] A. Pitsillides, G. Samaras, B. Pitsillides, D. Georgiades, P. Andreou, E. Christodoulou, Virtual Collaborative Healthcare Teams for Home Healthcare, Journal of Mobile Multimedia (JMM), special issue on Advanced Mobile Technologies for Health Care Applications, Vol.2, No.1, pp023-036, 2006.

Eleni Christodoulou is the Director of Citard Services Ltd focusing on advanced technologies in the areas of Ambient Assisted Living and eHealth. She gained a M.Sc.and Ph.D. in Medical Informatics from the Technical University of Munich, Germany in 1989 and has an over 24 years working experience in the IT business and academia sector in Germany, including Siemens and Digital Equipment GmBH, and also Cyprus, especially in the coordination and implementations of IT solutions in the eHealth and elderly care fields. She has been involved as an expert and as a project coordinator in over 20 related internationally research funded projects and studies.

George Samaras is a Professor at the University of Cyprus at the Computer Science department. He is currently the Chairman of the CS Department. He received a PhD in computer science from Rensselaer Polytechnic Institute, USA, in 1989. He taught at the University of North Carolina (adjunct Assistant Professor) and was also at IBM Research Triangle Park, USA. His research interests span the areas of Mobile and Wireless Computing, Sensor Networks, Database Systems, Transaction Processing, and Resource Recovery, Personalization and Context based Systems, and Web Computing. He has published more than 150 articles in conferences and journals and co-authored two books and a number of book chapters.

Mario Belk is currently a senior assistance and a PhD Candidate at the Department of Computer Science, University of Cyprus. He obtained his B.Sc. and M.Sc. in Computer Science from the same department. His research interests are in Web Adaptation and Personalization Environments and Systems, Internet Technologies and the Semantic Web. He actively participates in numerous National and EU funded research projects and has a number of publications in journals and book chapters in the field.

Christiana Tsiourti is currently a research and teaching assistant at the Computer Science Department from the University of Cyprus. She got a B.Sc. degree from the same department and has also studied at the University of Rey Juan Carlos, Madrid. Her research interests are Mobile Wireless Computing, Collaborative Environments and Ageing Homecare technologies.

Elena Theodoulidou-Polydorou achieved her Master degree in Sociology from the Pantios University of Athens in 1990. She has an over 14 years working experience in different Cyprus Government social programs and participated as an expert in a number of related international funded projects. Since 2005 is the director of the Cyprus Ayios Dometios Social Services Centre for elderly care. She has a number of publications in the Social care area, especially in the homecare field.

In-Flight Pathologies and Medical Emergencies Assisted By Centro Internazionale Radio Medico (CIRM)

F. Amenta[1], I. Grappasonni[2], A. DiDonna[1], F. Sibilio[2]
[1]Centro Internazionale Radiomedico (CIRM), Roma
[2]Centro di Ricerche Cliniche, Telemedicina e Telefarmacia, Università di Camerino, Camerino, Italy

Abstract: **The rate of medical emergencies aboard commercial flights is increasing. This is probably due to the higher number of chronically ill and/or old travelers. This study has analyzed files of patients assisted by Centro Internazionale Radio Medico (CIRM) on board airplanes from January 1st 2001 to December 31st 2008. In this period CIRM has assisted 165 patients on board aircraft (50.91% males, 49.09% females). Passengers accounted for the 89.70% of cases, crew members for the 10.30%. Pathologies assisted involved to a greater extent digestive system (18.18%), circulatory system (13.94%), respiratory system (12.73%), nervous system (12.12%) and genitourinary system (10.91%) disorders. Approximately 57% of patients improved and 28.5% were unchanged, whereas in the 6.7% of cases flight diversion was necessary. The availability of epidemiological data may help for developing standardized operative procedures and approaches for guaranteeing the best care to ill patients on board airplanes.**

Introduction

Data on the number of in-flight medical emergencies or deaths are sparse as no established databases providing this information is available [1,2]. In view of this, statistics on this topic are based only on the few studies published in the literature [1,2]. It is reported that in-flight illnesses are uncommon and in general are related to not serious problems. The rate of medical emergencies aboard commercial flights is increasing probably due to the rising number of chronically hill or old travelers. On the other hand, serious illnesses including deaths may also occur. Centro Internazionale Radio Medico (CIRM), the Italian Telemedical Maritime Assistance Service (TMAS), besides providing medical advice to ships without a doctor on board, since 1952 assists also people on board commercial flights. In view of the limited information on pathologies on in-flight medical illnesses, the present study has analyzed files of patients assisted by CIRM on board airplanes from January 1st 2001 to December 31st 2008.

Epidemiological analysis

Analysis was made by reviewing 21,869 files of patients assisted by CIRM from January 1st 2001 to December 31st 2008. Diagnosis of CIRM physicians was classified according to the International Classification of Diseases (ICD)-10 [3]. ICD is the International Classification of Diagnoses. This standard is used worldwide for general epidemiology, health management and clinical analysis. Causes of illness were referred to the age of individuals, their rank on board if crew members, to the circumstances and to the number of crew members in the aircraft where it occurred. These data were then analyzed statistically according to the basic standards of epidemiology.

Results

In the elapse of time considered, CIRM has assisted 165 patients on board airplanes (Figure 1). The male-to-female ratio was approximately 1:1 with 84 (50.91%) male patients and 81 (49.09%) females. The majority of patients assisted was represented by passengers (148 people - 89.70%). The remaining 10.30% were crew members.

People transported by airplanes asking for medical advice to CIRM included 29,518 passengers and 1,667 crew members. Hence, a total of 31,185 people was on board flights assisted by CIRM. This indicates that the frequency of diseases involving passengers on board airplanes was 5.3/1,000. The frequency of diseases involving crew members was 10.2/ 1,000.

Age of patients assisted was between 1 to 87 years (mean 42.48 ± 21.55 years). Pathologies assisted involved to a greater extent digestive system (18.18%), circulatory system (13.94%), respiratory system (12.73%), nervous system (12.12%) and genitourinary system (10.91%) disorders (Figure 2).

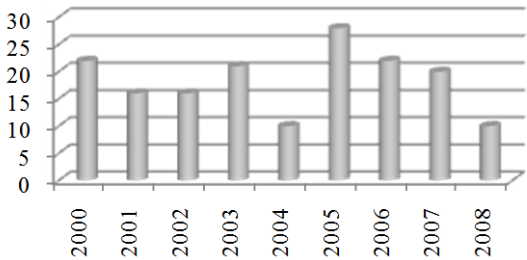


Figure 1: Number of patients on board airplanes assisted by CIRM from 2000 to 2008

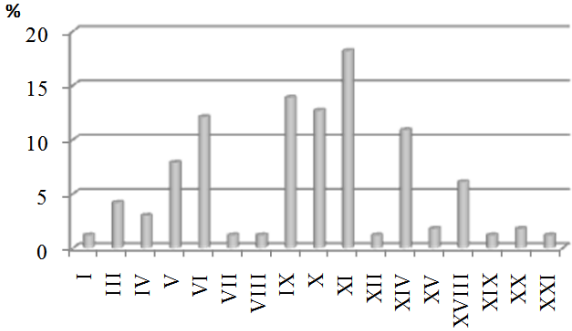


Figure 2: Pathologies involving patients on board airplanes assisted by CIRM in 2000-2008 classified according to ICD-10

(**I**-infectious diseases; **III**-Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism; **IV**-endocrine, nutritional and metabolic diseases; **V**- Mental and behavioural disorders; **VI**-Diseases of the nervous system; **VII**-Diseases of the eye and adnexa; **VIII**-Diseases of the ear and mastoid process; **IX**- Diseases of the circulatory system; **X**- Diseases of the respiratory system; **XI**-Diseases of the digestive system; **XII**-Diseases of the skin and subcutaneous tissue; **XIV**-Diseases of the genitourinary system; **XV**-Pregnancy, childbirth and the puerperium; **XVIII**- Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; **XIX-** Injury, poisoning and certain other consequences of external causes; **XX**-External causes of morbidity and mortality; **XXI**- Factors influencing health status and contact with health services).

In terms of outcome, 57% of patients improved and 28.5% were unchanged. For 11 patients (6.7% of cases) flight diversion was necessary for their hospitalization. One case of death on board following a severe crisis of asthma in a passenger of 27 years was also noticeable.

With a few exceptions medical advice was required almost exclusively by intercontinental flights operated by Italian airlines.

Discussion

The problem of providing medical care on board aircraft is quite complex and is approached differently by various carriers [4,5]. Some use their own medical services to provide medical assistance on board of their flights, others have contracts with centers providing a subscription service, others are affiliated to public hospitals [4,5]. In view of the heterogeneity of possible providers of these services and of the increasing potentialities of telemedicine for assisting remote patients , the availability of wider epidemiological data may help for developing standardized operative

procedures and approaches for guaranteeing the best care to ill patients on board airplanes.

References

[1] Baltsezak S. Clinic in the air? A Retrospective Study of Medical Emergency Calls From a Major International Airline. J Travel Med 2008, 15: 391-394.

[2] Goodwin T. In-flight medical emergencies: an overview. BMJ 2000, 321: 1338-40.

[3] International Statistical Classification of Diseases and Related Health Problems. 10th Revision Version for 2007. World Health Organization, Geneva, 2007.

[4] Sand M, Bechara FG, Sand D, Mann B. Surgical and medical emergencies on board European aircraft: a retrospective study of 10189 cases. Critical Care 2009, 13: R3 (doi:10.1186/cc7690)

[5] Silverman D, Gendreau M. Medical issues associated with commercial flights. The Lancet 2009, 373: 2067-77

Francesco Amenta was graduated in Medicine and Surgery and specialist in Neurology. Full Professor of Human Anatomy. School of Pharmacy, University of Camerino. Director of the Centre for Clinical Research, Telemedicine and Telepharmacy, University of Camerino. Scientific Director Centro Internazionale Radio Medico (C.I.R.M.), the Italian Telemedical Marittime Assistance Service (TMAS). Chairman of Master University Courses in e-Health and Oil and Gas Telemedicine and Telepharmacy.

Iolanda Grappasonni is associated Professor of Hygiene. School of Pharmacy, University of Camerino. Teacher at the PhD Course in Environmental Sciences and Public Health of the School of Advanced Studies of the Camerino's University. Member of the Board of the Italian Society of Hygiene and Public Health. Main field of interest: Epidemiology and Pharmacoepidemiology, with particular reference to Occupational Medicine, Disaster Medicine, Environmental Hygiene, Telemedicine and Telepharmacy.

Agostino Di Donna was graduated in Medicine and Surgery and Specialist in ORL. Former General Director of Health Services of Italian Navy and of Italian Armed Forces. Presently President of C.I.R.M., the Italian TMAS.

Fabio Sibilio. Undergraduate student at the School of Pharmacy, University of Camerino. In the frame of a collaboration between Centre for Clinical Research, Telemedicine and Telepharmacy of his University and C.I.R.M. he is preparing his thesis focused on different aspects of pharmaceutical services delivered to patients on transportation systems via telemedicine.

Integrating Mobile Data with GIS for Strategic Diseases Control in Public Health

P. P. Escobar[1], M. Santiago[2], M. Del Fresno[3], J. Massa[4]

[1] INTELyMEC, Fac. of Engineering, pescobar@fio.unicen.edu.ar
[2] CONICET, IFAS, Fac. of Exact Sciences, msantiag@exa.unicen.edu.ar
[3] CICBA, PLADEMA, Fac. of Exact Sciences, mdelfres@exa.unicen.edu.ar
[4] INTIA, Fac. of Exact Sciences, jmassa@exa.unicen.edu.ar
[1,2,3,4]Universidad Nacional del Centro, Argentina

Abstract: **Although the mapping of health data is well known in epidemiology, advances in geographic information systems (GIS) provide new opportunities for developing applications for strategic control and decision making in public health, specially in developing countries, using interactive digital mapping techniques to help planning the utilization of limited economic, physical and human resources.**

In this pilot project, a GIS is enhanced with new health layers created from data received from a mobile phones network strategically distributed along the country. Each node of the network reports all cases detected over a region of interest, using traditional SMS. These formatted reports feed the GIS which fuses fixed geographic data with dynamic data coming from the mobile network to create health layers. These new layers are managed by a web-based GIS application with different mining tools and specific features, like a situational awareness tool for quick information display, where users can see in real-time the spatial distribution of cases, get statistical reports, compare disease rates across regions, trace the number of cases and obtain trends for assessing the disease evolution and making strategic decisions by adopting new and strong preventive or corrective actions.

These combined technologies can be used to develop health plans and public health policies regarding to endemics, epidemics or pandemics situations, such as Dengue, HIV, Malaria, Chagas, AH1N1 influenza and others. It will also help to manage other concerns such as chronic diseases (diabetes, cardiac, obesity, etc), birth control, health education, epidemiology and disease control.

The potential use of GIS needs to be discussed. Information of weather, environment conditions, potable water availability, electricity, and other factors can be added to enhance the capabilities of GIS using correlation among different factors in order to match significant data. Regarding to its use in health, it is becoming a great valuable tool for disease control and strategic decision making in public health.

Introduction

Relationships between health issues and its spatial references it is not so recent. In 1853, Dr. John Snow showed the importance of spatial dynamics in the understanding of disease, and the use of maps to describe and analyze it, predicting the evolution of cholera in London, assuming that cholera might be spread by infected water supplies more than a century ago. Nowadays, technologies allow for real time information analysis and mapping using computational tools like GIS. These advantages have a significant relevance in many fields, where timely information on the course of an event or place is needed, among other related events, to take decisions and to implement appropriate actions [1].

GIS Basics

A GIS is commonly defined as a computer-assisted information management system of geo-referenced data, integrating the management (acquisition, storage, maintenance), analysis (statistical, spatial modeling) and display (graphics, mapping) of geographic data, which are presented as interactive information layers [2]. There are many open source and proprietary solutions and resources, and also we can integrate both philosophies into a combined solution. From a technical point of view, the two main components of a GIS are the spatial database and the set of tools allowing for management and visualization of different GIS layers.

Health Perspective of GIS

The application field and objectives of a GIS can be varied, and concern a great number of questions linking social and physical problems. The spatial modeling capacities offered by GIS can help to understand, for example, the spatial variation in the incidence of disease, and its covariation with environmental factors and the health care system. Thus, GIS will be here considered as a tool to assist in health research, in health education, and in the planning, monitoring, and evaluation of health programs.

Design

The GIS Platform

A *PostGIS* database (*PostGre SQL* with spatial data management features) allows for handle a solution with general public license, in addition environments like *MapServer* bring solutions for building up an open source GIS.

Combining both tools, we develop a GIS with free licenses, strongly decreasing development costs and providing a working collaborative scheme helping for the interaction between developers. Nevertheless, during

the implementation phase of this kind of technologies, it must be considered the need of a corporative backup, or the advice coming from developers and users community.

A Tool for Healthcare Management

Many countries from South America share common problems specially regarding to healthcare and infectious diseases control. For instance, Brasil, Peru, Chile and Argentine have large territorial extensions with uneven distribution of population causing unequal access to healthcare, education, water, transportation and other key services. These common problems lead to the need of unifying efforts in order to produce valuable health tools [3]. Hence, the **ATLAS** Network (*Advances in Telemedicine for Latin America Society*) is rising up as a research group with members from universities of different countries in order to provide solutions to health problems.

In Argentine, one of these problems is how to detect, control and prevent the propagation of infectious diseases, which naturally occur in distant regions, with low population density, poor economic and health resources, and also with great difficulties for accessing to information. The early detection of diseases is a key tool for the national health system because it allows for designing preventive strategies, setting up efficient vaccination programs and focusing health resources towards strongly affected areas [4].

Public HealthMmonitoring System

Using mobile technologies such as GSM, GPRS and 3G, we have a reliable and fast way to collect information about cases of a disease, at the point it take place. In this running pilot project, a mobile phones network strategically distributed along the country feed new health layers of the GIS. Physicians from each point (a health institution) of this network, acting as sentinels of diseases, report all cases detected over a region of interest. These formatted reports provide demographic data, time and date, type of disease, number and severity of cases, spatial location, etc. The GIS fuses fixed geographic data elements with the dynamic data coming from the mobile phones network and draw up maps for visualization and early detection of potential epidemic diseases. Information is sent using traditional SMS service and it is received by a software application which processes the data adding it to a specific GIS layer.

Health layers are managed by a web-based GIS application with several mining tools which provide specific features, like a situational awareness tool for quick information display, where users can see in real time the spatial distribution of cases and the propagation profile, get statistical reports, compare disease rates across regions of the country, obtain trends

for assessing the disease evolution, to study its relationship with services availability (water, waste zones, health centers, transportation, etc.), and to make strategic decisions to control this evolution by adopting new and strong preventive or corrective actions. Information can be accessed from any computer using a web browser to visualize the maps and related data.

These combined technologies will be used shortly to develop health plans and public health policies regarding to endemics, epidemics or pandemics situations, such as Dengue, HIV, Malaria, Chagas, AH1N1 influenza and others. It will also help to manage other concerns such as chronic diseases (diabetes, cardiac, obesity, etc), birth control and health education.

Discussion

GIS use in public health is still in a formative stage; its potential use in health needs to be discussed considering methods and limitations. The growing need for reliable environmental geospatial databases is a fundamental concern. Collected information of different factors can be added to enhance the capabilities of GIS technology using correlation among them in order to match significant data.

These kind of integrated technologies are becoming a great valuable tool for disease control and strategic decision making in public health, to ensure rational utilization of investments allocated for the sector, as health is largely determined by environmental factors (including the sociocultural and physical environment, which vary greatly in space) [5].

The monitoring system will be tested and deployed in all the countries members of ATLAS network, considering some regional variations.

References

[1] Mokbel, M.F., Aref, W.A., Hambrusch, S.E., Prabhakar, S.:Towards scalable location-aware services: Requirements and research issues. In: GIS (2003)

[2] Devary, J.L., Rice, W.A.: Geostatistis software user's manual for geosciences research and engineering. Pacific Northwest Laboratory, Richland, Washington (1982).

[3] Scholten, H.J.; de Lepper, M.J.C. 1991. Benefits of the application of GIS in public and environmental health. *WHO Statistical Quarterly*, 44(3).

[4] Moore, D.A., Carpenter, T.E.: Spatial analytical methods and GIS: Use in health research and Epidemiology. Epidemiol. Rev. **21**(2), 143–161 (1999)

[5] Nondasuta, A.; Chical, R. 1988. *The basic minimum needs guiding principles the foundation for quality of life*. Ministry of Public Health. Bangkok, Thailand.

Mariana del Fresno received her Ph.D. (2008), MS (2001) and Systems Engineering (1992) degrees from the Department of Computer Sciences, Universidad Nacional del Centro (Argentina). Currently she is a Professor of Computer Science at Universidad Nacional del Centro. Her research interests include medical image processing, digital image segmentation and 3D visualization.

José Maria Massa received his Master in *System Engineering* (2008, UNC), he is currently taking a Computer Science Doctorate (UNC). Work Place: INTIA - Fac. Of Exact Sciences, UNC. His work comprehends Signal Processing, Medical Image Processing, Radiotherapy absorbed dose calculation, MonteCarlo. He has been Teacher Assistant since 2000 to present at University in the courses of Image Processing I, Image Processing II, GIS. He has been Assistant Professor since 2005 to present at UTN University.

Pedro Pablo Escobar received his Biomedical Engineer degree at Faculty of Engineering, National University of Entre Ríos (UNER, 2002). He worked as a researcher at UNESCO Chair Of Telemedicine, in Univ. of La Laguna, Tenerife, Spain in 2003. He is Assistant Professor at Faculty of Engineering, UNC, in the courses of Computing Science, Medical Imaging, Medical Ultrasound, Nuclear Medicine and Critical Areas Equipment. He is member of the Telemedicine Group at UNER, since 2000. He is also member or the INTELyMEC research group at UNC since 2006. His research interests include telemedicine, medical informatics and robotics.

Martin A. Santiago received PhD degree in Physics from the Center of Buenos Aires Province University, Tandil, Argentina, in 2003. He is professor of the course of Physics I, and he currently has a permanent position as researcher of the Argentinean Council for Scientific and Technological Research (CONICET) at the same university. His research interests include luminescence of solids applied to radiation dosimetry, medical images processing, PACS and medical informatics.

Managing Health Information on Mobile Devices

Claudia Tessier

mHealth Initiative, USA

More and more patients and clinicians are adopting and benefiting from mobile devices (mDevices) in healthcare. Their mHealth expectations will require organizations to adopt strategies toward mHealth integration that maximizes the benefits of mHealth while mitigating associated risks and meeting government and accreditation requirements.

Of note, it is not the voice/telephone capabilities of mDevices that are most appealing and beneficial but rather the improved electronic data communication and connectedness that they enable across the spectrum of healthcare stakeholders. mDevices offer not just portability but also real-time, anywhere communication capabilities far beyond those of EMRs.

Patients and their healthcare providers are embracing the opportunities that mDevices and related applications offer for improved disease management, triage of emergency patients while en route to the emergency center, public health collection and dissemination of disaster as well as epidemic data, easy access to expert advice from remote third world villages, and text message appointment reminders. mDevice apps also connect them with Web resources both in and outside the exam room for patient education, link them to their colleagues for advice, permit real-time eligibility determination and charge capture, and much, much more.

mDevices can be used for patient care documentation access, entry and transmission. Patients can document ODLs, observations of daily living, allowing both them and the physician to relate signs, symptoms, and treatment to the circumstances surrounding their occurrence rather than addressing them only in sporadic and brief conversations possible in an office visit. Pharmaceutical companies not only are using mDevices for clinical trials, but they are also becoming aware of the “informal clinical trial” data that come from patients sharing information and experiences online, thus alerting pharma to medication-related experiences that they might not otherwise be aware of.

This mHealth movement will profoundly change communication patterns and expectations of patients, clinicians, and other healthcare stakeholders. For example, in order that clinicians and institutions not drown in a flood of email and text messages and more from patients and among themselves, systems must be developed that prioritize and effectively manage access,

storage, and transmission of this growing communication stream. Other management issues related to mHealth include

- integrating mDevice-based and –accessed personal health records into clinical records
- selection and implementation of mDevices and mHealth applications
- security of mDevices and apps, as well as the information on or accessed through them
- authorization and authentication of mDevice and mHealth application users
- patient authorization to use electronic communications (text messages, email, instant messaging, social networks, etc.)
- audit trails of access to protected health information through mDevices and mHealth applications
- restricting camera functions on mDevices
- and synchronization of mDevice-data with institutional systems.

Thus, the deluge of communications and communication types generated and accessed through mobile devices – far more, from far more sources, and far more frequently than through EMRs – will require expanding health information management to include health communication management.

Claudia Tessier is president of mHealth Initiative, a not-for-profit organization that envisions the emerging mHealth revolution and the benefits it will bring to all healthcare stakeholders. Previously, she was vice president of Medical Records Institute (2006-2009), executive director of MoHCA, the Mobile Healthcare Alliance (2001-2006), and CEO of the American Association for Medical Transcription (1986-2001). She is author of the soon-to-be published Management and Security of Health Information on Mobile Devices, as well as The Surgical Word Book and the 1st edition of The AAMT Book of Style for Medical Transcription.She has co-chaired the ASTM Continuity of Care Record (CCR) Task Group since its formation in 2002.

mHealth: Bridging the Health Divide

K. Ganapathy

Apollo Telemedicine Networking Foundation, 21 Greames Lane, Chennai 600006, INDIA drganapathy@apollohospitals.com

Abstract: **mHealth offers exciting new opportunities to bridge the health divide. Worldwide, innovative methods are being used in emerging economies, to leap frog. This paper will review actors in the mHealth value chain and the cutting edge applications in mHealth. Mobile phones can promote wellness, transform healthcare outcomes, reduce costs, extend health knowledge into remote areas and reduce hospitalizations. GSMA estimates that mHealth services alone could save up to €78bn by 2015 in Europe alone. Mobile phones can be used as a communication, support and training tool for healthcare workers, in disease and epidemic outbreak tracking and in diagnostic and treatment support. In addition to reviewing the status of mHealth globally, the article will touch upon the results of a few proof of concept validation studies carried out in India by the author.**

Introduction: The Global Scenario

After centuries of delivering health care in hospitals, healthcare providers are shifting towards treating patients in their homes and communities. Advances in biosensor miniaturization and mobile wireless communications technologies hold the key to this change, enabling the introduction of highly usable mobile-health devices to enhance elderly care The potential for mHealth to transform health care is great. The challenge is to determine where and why mHealth has been successful; remove impediments to broader mHealth use and adoption; and encourage more innovation throughout the developing world. [1]According to the United Nations Foundation four-fifths of the world's population lives in an area with mobile phone coverage, and about 64 % of mobile phone users are in developing countries.[2]Healthcare is a major reason why cell phone subscriptions worldwide will hit 5 billion this year, ITU Secretary-General Dr. Hamadoun Toure, has observed [3]McKinsey & Co projects the global mHealth opportunity to be worth up to $60 billion. During a panel session at the Mobile World Congress at Barcelona in February 2010 , associate principal Ajay Bakshi presented a review of 3,000 households, about their interest in mHealth products. The survey, covering India, China, South Africa, Brazil and United States, found that 70 % of respondents were

interested in at least one product. 25 % in the U.S. were willing to pay 20 times what they currently pay for their wireless airtime. In India, people were willing to pay 10 times more for a service that would provide 24-hour access to a doctor. Introducing mHealth in emerging economies has several advantages. The wheel does not have to be reinvented. Expensive unwiring programmes are unnecessary.

The Cell Phone as a Peripheral Medical Device

Many innovative products have been designed to enhance the concept of an mDoc a pocket hospital as it were. These include deploying a cell phone as a microscopes using specialized software and a small sensing device. [4]Anemia, tuberculosis and malaria can be diagnosed remotely by remotely looking at a smear. Inexpensive light-emitting diodes added to the basic cellphone ,shine their light on a sample slide placed over the phone's camera chip. Light waves hit the cells suspended in the sample, scattering off the cells, and interfering with other light waves, producing a hologram. Images similar to those seen under a microscope are then produced [5] Epocrates Rx is a continuously updated drug database available on mobile phones. The BlackBerry version includes monographs for more than 3,000 drugs.[6] Coughing into one's mobile phone to get a diagnosis of the common cold, flu, pneumonia or other respiratory ailment may one day be possible. The user's cough will be compared to a database of prerecorded cough sounds. [7]The Radiological Society of North America (RSNA) has reported that acute appendicitis was diagnosed accurately on a mobile phone The scans were zoomed, contrast and brightness adjusted with full resolution as in a PACS system. Remote diagnosis aids in surgical planning.[8]AT&T is providing wireless r connectivity to Vitality's Glow Caps device, which is a pill box cap that fits standard pill boxes and glows when the user fails to take the medications.. The Glow Cap can also alert caregivers when a person forgets to take their medication and even call the pharmacy to get a refill.[9] Yuechun Chu has reported a tele trauma system that can provide continuous real time voice, video, and medical data input between an ambulance and a level I trauma center. A mobile phone relays the information, collected from sensors on the patient to the healthcare provider using a 3G-based wireless network. Wireless telemedicine projects have also been developed in management of stroke [10]Clinical applications in mobile Teleradiology have been reported

[111Recently the White House endorsed the Text 4 Baby program for low income, expectant mothers.The Center for Connected Health estimates that text message reminders will be very powerful for 30% of the population. 19% or more of Americans now have smart phones with

potential access to about 5,000 health and medical applications Manhattan Research , expect 81% of physicians to use smart phones in 2013 as against 64 % today. Verizon Wireless recently estimated that mobile broadband solutions resulted in savings of almost $6.9 billion for U.S. health care. (? $27.2 billion in 2016). Verizon offers video consultations for “tele-stroke” allowing physicians to review cases via live video to determine whether emergency care is required. Mobile phones have multifarious uses in health care. Adherence and compliance are facilitated with simple SMS from the simplest, low-end phone. Mobile phones have multifarious uses in health care. Adherence and compliance are facilitated with simple SMS from the simplest, low-end phone.

mHealth : Personal Experience

(Figs 1-4) [12] [13] In a pilot effort called *Gramjyoti*, Ericsson India obtained a special license to use 3G spectrum in a pre-defined area, 100 miles from Chennai, to showcase the power of 3G and its role in providing value-added services. These included e-governance, e-education, e-entertainment, and m-Health. Text, audio, and video data were transmitted on a realtime basis through 3G. This enabled consultants at the Apollo Hospitals, Chennai to interact with patients in villages at the remote end. Doctors at the tertiary hospital were able to clinically “examine” the patients, through a high-quality Web cam. Medical history was made available. Live blood pressure readings , heart and respiratory sounds and ECGs were transmitted. In 240 patients evaluated, a clinical diagnosis could be made. The potential of 3G to facilitate healthcare was also demonstrated in pilot projects in Bhutan and in Bangladesh. A study was conducted at Madurai District (State of Tamil Nadu in southern India), ,where EDGE Technology was used to provide teleconsultation to a village, using a Hospital on Wheels . A chest x-ray film was taken on board the HoW. The film was processed and developed on board. The x-rayfilms were then mounted on an illuminated lobby inside the HoW,and using a 10-megapixel digital camera on a tripod stand, images were taken and transferred to a wireless enabled laptop computer Each image of about 9 MB was compressed to 600 Kb and transferred with FTP Ultrasound examination was done on 20 women.. As live video streaming could not be conducted due to bandwidth constraints and specific software unavailability, the video was recorded on CD., compressed, and sent through the wireless network to the tertiary hospital. A reasonable clinical examination was done through a Web cam.

Home Telecare thro wireless enabled Internet

[14,15] Home telecare systems will become necessary even in emerging economies due to increasing numbers of elderly individuals living alone. Video visits are easier than physical home visits. With increasing availability of broadband at home, the middle- and upper-class Indians can have access to home telecare. The author has embarked on pilot studies. Patients requiring constant and close monitoring are provided with a Multiparameter Digital Acquisition Unit (MDAU). The MDAU connected to an Internet-enabled computer can record and transmit a 12-lead ECG,BP, pulse rate, temperature, and heart and respiratory sounds. A Web cam facilitates a real-time two-way video interaction. The MDAU can store individual medical records. Prescriptions generated by the doctor can be viewed and printed at the patient's bedside. The prescription can also be sent electronically to the nearest Apollo pharmacy, so that drugs are delivered at the patient's home. In an innovative programme " Call– a Doc" a paramedic makes a home visit and using a wireless enabled modem accesses the internet and obtains a teleconsultation.

Conclusions

The formation and growth of several bodies like the mHealth Alliance, the observations of several think tanks that though the youngest of the mServices, mHealth has the greatest growth potential clearly indicates that integration of mHealth in the health services may significantly help bridge the existing health divide. [16] According to a recent Wall Street Journal article m Entertainment, m Advertising , m Banking and m Commerce are the m Services growing rapidly in India. ,mHealth is conspicuous by its absence.

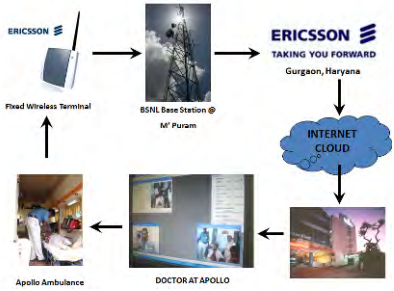


Fig.1 Schema 3G healthdata transmission Fig.2 Transmitting health data

Fig. 3 Rural wireless telecamp

Fig 4 Wireless telecamp

Acknowledgments

I wish to place on record the invaluable assistance rendered by Mrs.Vijayalakshmi Ganapathy in the preparation of this manuscript.

References

[1] Phones- driving-Health-IT-Innovation-in-Developing-Countries.aspx.
[2] http://www.fiercewireless.com/story/mhealth-potential-more- questions-answers/2010-02-18#ixzz0gAmHqx7F
[3] http://reviews.cnet.com/8301-13970_7-10454065-78.html#comments
[4] http://www.nytimes.com/2009/11/08/business/08novel.html?_r=3
[5] http://rk.md/2009/epocrates-rx-mobile-phone-medical-software/
[6] http://www.telegraph.co.uk/health/healthnews/6530704/Cough-into- your-mobile-phone-for-instant-diagnosis.html
[7] http://www.fiercehealthcare.com/press-releases/smart-phones-allow-quick-diagnosis-acute-appendicitis-0#ixzz0gMhmxRK
[8] http://mobihealthnews.com/4839/att-inks-deal-to-provide-connectivity-for-glowcaps/
[9] Chu, Y., Ganz, A. A mobile teletrauma system using 3G networks. Information Technology in Biomedicine, IEEE Transactions. 2004, vol 8 (4), 456 – 462
[10] Lim EY, Lee C, Cai W, Feng D, Fulham M. Development of an electronic medical report delivery system to 3G GSM mobile (cellular) phones for a medical imaging department. *Conf Proc IEEE Eng Med Biol Soc.* 2007;2007:6727-30
[11] http://mobihealthnews.com/2543/voxiva-cdc-white-house-to-launch-text4baby/
[12]Ganapathy K, Ravindra A : Telemedicine in India: The Apollo Story Telemedicine and e-Health, 15, 577-585, 2009
[13 Ganapathy K and Aditi Ravindra : mHealth: A Potential Tool for Health Care Delivery in India http://www.comminit.com/en/node/277163/307
[14] Ganapathy K. mHealth in 2015: A peep into the future. Presentation at http://www.transformhealth-it.org/agenda.html
[15] Ganapathy K M Health: Bridging the Health Divide http://www.ghf10.org/reports/157
[16] http://vitalwave.blogspot.com/2009/12/rural-india-provides-new-lab-for.html

K. Ganapathy was past President of the Neurological Society of India, is currently President Elect Telemedicine Society of India. An Adjunct Professor at IIT Madras & Anna University Chennai he introduced Telemedicine in India in 1999 and recentlycommenced pilot projects in m Health. He is President of the, Apollo Telemedicine Networking. Foundation.

The Automobile: A Source of Inspiration for the Intelligent eHealth Environment and the Assistance to the Person

M-N. Dokhelar[1], D. Lesage[1], O. Bouya[2], L. Billonnet[1],
E. Desbordes[2], J-M. Dumas[1]
[1]University of Limoges, Limoges, France, laurent.billonnet@unilim.fr
[2] Jean Favard High School, Guéret, France

Abstract: **The new embedded technologies used for the automobile are now extremely advanced and are adequate to assist and secure the driver and the passengers. An evolution of the same style is at now outlined in the same way, in the field of the intelligent houses and e-health technology in particular within the framework of the assistance to the persons in loss of autonomy.**

Introduction

The new embedded technologies used for the automobile are now extremely advanced. The regulation encourages and accelerates this evolution; it is in particular the case for CO2 emissions. This regulation supports the industrial initiatives to make vehicles at the same time safer, more efficient and more environment-friendly. Such is the object of the initiative 2010 " intelligent Vehicle " of the European Commission, which works on this subject since September, 2001. The objective is to offer an outfit of technical means intended to assist the driver (and indirectly the passengers) in their driving comfort and safety. This technology can be described as e-assistance and e-comfort services.

An evolution of the same style is at now outlined in the same way, in the field of the intelligent houses and e-health technology in particular within the framework of the assistance to the persons in loss of autonomy. The French law of February 11th, 2005 for the equality in rights and chances, participation and citizenship of the disabled persons defines the handicap as “any limitation of activity or limitation of participation in the society undergone in its environment by a person because of a substantial or definitive change of one or several physical, sensory, mental, cognitive or psychic functions, a poly-handicap or an invalidating health problem”. In the new political and social approaches, the handicap is thus connected

strictly to the environment of the person (included its housing and e-health environment) and to its project of life.

Automobile and intelligent house toward e-health services

In this frame, we can legally think to draw a parallel between the e-technologies used for the automobile and those who could be integrated into the housing and e-health environment, in particular by means of the home automation and the technologies of information and communication (ICT) and so to compensate for the situations of loss of autonomy and encourage the development of e-health services: the motor disability, the effects of the ageing, the health monitoring and the perceptive handicap.

With this objective, we have listed the technical solutions chosen in terms of safety, comfort and survey for the automobile, and confronted them with problems met by the persons in situation of handicap or in loss of autonomy in their housing environment very often needing e-health assistance. The aim is to drive a coherent action plan in terms of comfort, safety, autonomy and communication for the elderly and disabled people.

We first listed the various difficulties met in the housing environment by the motor disabled persons, the visual deficient persons, the hearing-impaired persons and the elderly persons. The cognitive deficiencies were not considered because too numerous. It was thus difficult to establish a typical profile of a person affected by these deficiencies. Then, we have thought about the way the embedded technologies for the automobile could be adapted to facilitate everyday life for disabled people in their housing environment and retained some solutions for every type of handicap. All the proposed solutions can be also of help to design any assistive system for the elderly and disabled people. Telemedicine and telecare systems can take great advantages of such disposals.

Concerning first the motor disability, we retained solutions allowing to facilitate the circulation in the housing environment as well as outdoor. One adequate solution consists in installing on a wheelchair a tri-functional system allowing at the same time to detect the obstacles and to avoid them, to detect a potentially dangerous lowering and to forbid the crossing, and finally, to warn of the impossibility to climb a too important slope. We leaned for it on the system of control of stability of movement developed by Volvo [1] as well as the assistant of trajectory control by Honda [2] and the adaptive speed regulator developed by Mercedes-Benz [3].

Concerning the visual handicap, the purpose was to try to reduce the risk of falls, to allow the person to find a way in an unknown environment and

to inform about possible incurred risks. To do that, one technical solution could be a portable system allying a millimetre-length sensor as well as a speech synthesis which would allow to detect the obstacles and to warn the person. Moreover, the use of a voice command could allow this person to interact with this system but also with all the equipments managed in the house. It is also advisable to maintain a good level of lighting in the house: we thus used a luminosity sensor used in the system of automatic ignition of the car lights, and use it in the housing environment to adjust automatically the lighting level according to the natural lighting.

Concerning the hearing handicap, the main technical solutions are centred on the communication with the environment and the coupling of the sound signals with visual signals. One technical solution is inspired from the speech synthesis system used on some vehicles models of Renault Laguna. It proposes an interface of management made in a same way as the code colours and the icons of a car dashboard. The icons formalism system, which could be displayed for example on the television screen or on a screen in the kitchen, could clearly allow the person to understand that an important event has occurred. In the same manner, another additional possibility is to consider flashing zones adequately placed within the house that can alert the person about important events that have to be taken into account urgently.

Concerning the old persons, features mentioned above can obviously be used. However, another interesting technical solution consists in this case in a monitoring system of the attention of the person developed for the truck drivers [4]. This system could be useful in the privative housing environment to watch the degree of attention of the persons and detect an unusual behaviour. This system could thus notify the telecare and telemedicine services in a hard real-time context.

References

[1] « Roll Stability Control » by Volvo
http://www.canadiandriver.com/articles/jk/021127.htm

[2] Mini-camera and electronic programme from LKAS System by Honda
http://world.honda.com/factbook/auto/motorshow/200310/10.html

[3] Millimeter-wave Radar – A LIDAR by Mercedes-Benz
http://www.tcs.ch/etc/medialib/main/rubriken/auto_moto/pdf/andere.Par.0016.File.tmp/adaptative_cruise_control_fr.pdf

[4] « Driver's Mate » by Effective Control Transport
http://brossardeclair.canoe.ca/webapp/sitepages/content.asp?contentid=112240&id=829

Jean-Michel Dumas received the Diplôme d'Ingénieur degree from the Institut National des Sciences Appliquées, Toulouse, in 1973 and the Doctorat d'Etat degree from the University of Limoges in 1985. Member of the technical staff of France Telecom research centre till 1994. Then, Professor at the Ecole Nationale Supérieure d'Ingénieurs de Limoges (ENSIL), University of Limoges. Teaching and research topics on high bit rate communication systems and IT for people in loss of autonomy.

The mHealth Revolution

C. Peter Waegemann
Vice President, mHealth Initiative, Boston, MA, USA
peter@mobih.org

Over the past 30 years, efforts in health information technology (HIT) have been directed toward using computers and other communication devices to improve various healthcare processes. Electronic systems have been the basis for eHealth. The five sections of eHealth, i.e., eAdministrative, eFinancial, eClinical (including electronic health record systems), ePharma, and ePublic Health systems, have been achieved with varying success.

mHealth differs from eHealth by addressing necessary structural changes in healthcare that are enabled by new communication technologies, including mobile phone systems and other mobile devices (mDevices). The focus of mHealth is on new communication systems between clinicians and patients, among clinicians, and among various wellness and care providers and other healthcare stakeholders. Connecting healthcare providers for patient-centric care and providing remote patient monitoring and treatment have been the core activities toward a connected health system. But interoperability has been a moving target, and decades of standards efforts and systems work have not helped much in improving the situation. Images can be transmitted and integrated into receiving systems, but context-related text is still causing interoperability problems between two or more systems. As systems are moving to a 'machine-to-machine' mode, simple connectivity is no longer adequate. Further, new security methods allow encryption-based safe transmission of information via the Internet, costing a fraction of the costs related to telemedicine over dedicated lines. When the new phenomena of mobile computer devices and communication are added, completely new communication systems and rules emerge.

In most countries, patients are using the Internet as a source of expanded wellness and healthcare advice. Recent reports show that more than 70% of patients in the United States are using the Internet as a second opinion. A wealth of 'personal software' is emerging to assist patients in managing certain aspects of their health. mHealth Initiative's research showed that in October 2009 there were almost a thousand apps on the iPhone alone for consumers and patients. Parallel to these developments, new

communication patterns are emerging that will make the visit (encounter) secondary, placing communication by mail, text, and voice in first place. In other words, rather than communicating for a few minutes every few weeks or months with a provider, a patient reports symptoms, pain, and other observations when they occur in order to allow the healthcare professional to recognize and respond to trends and influencers that might not otherwise be apparent. The work of Robert Wood Johnson Foundation's Project Health Design on patients communicating and clinicians managing Observations of Daily Living (ODLs) is ground breaking. Of course, such systems require a new communication management system as clinicians do not want to be overwhelmed by hundreds of emails per hour. Easy, intuitive email systems of "clinical grade" are still not easy to find. But easy teleconferencing and digital networking systems are emerging to create a new kind of 'group consultation'. Another form of networking consists of specialists exchanging information on specific medical topics.

It may take some time until all these new communication methods are implemented in many counties. But the changes will be dramatic and disruptive. They will affect every doctor or nurse and every healthcare professional. The impact of these profound and historic changes gives us reason to call this phenomenon "the mHealth revolution".

The authot C. Peter Waegemann is Vice President of the mHealth Initiative (www.mobih.org), a Boston, MA, USA based not-for-profit organization.

Peter Waegemann is CEO of the Medical Records Institute. For over 25 years Medical Records Institute (MRI) has provided guidance to physicians, nurses and other clinicians, hospital and healthcare executives, as well as consultants, IT professionals, and medial records specialists facing difficult health IT decisions. Through conferences, seminars, workshops, online programs, audiocasts, newsletters and surveys, MRI has served as a forum for sharing knowledge, experience, and solutions about the current and future state of health IT.

MRI holds the annual TEPR+ Conference. This event is the ideal place to network and get advice about EMRs, EHRs, PHRs, implementation, mobile healthcare, cell phone technologies, information capture, and related aspects of HIT.Education

Sabel/RKW/Dokumnetations und Organisationsschule

The Use of a Psycho-technology Mobile Application in a Mindfulness-based Post-intervention Program for Women with Fibromyalgia

Miguel Quintana[1], M. Esther Rincón[2]

[1] Faculty of Psychology, Complutense University of Madrid. O3 Wellbeing Solutions S.L. Psychotechnology R + D+ i Laboratory. Madrid Technology Park (PCM). C/ Santiago Grisolía, 2, 28760, Tres Cantos, Madrid, Spain
[2] O3 Wellbeing Solutions S.L. Psychotechnology R + D+ i Laboratory. Madrid Technology Park (PCM). C/ Santiago Grisolía, 2, 28760, Tres Cantos, Madrid, Spain

Introduction

In the last few years mobile phone usage is being explored also in the mental health field [1]. Mindfulness is defined as the capability that consists of focusing one´s attention on purpose in a particular object of the present moment experience without judging it [2]. Mindfulness Based Stress Reduction (MBSR) is an intervention program of 8 weekly sessions that focus on relaxation, and mindful physical exercises which aims to reduce stress in patients with a variety of illnesses such as fibromyalgia [3].

Moreover, it has been pointed out the importance of continuing the practice of those exercises once the intervention program has been completed [4]. The objectives of this pilot study were: 1) to assess whether the MBSR positive effects were maintained in a post-treatment period lasting for one month; and 2) to appraise the user experience of a psycho-technology mobile application to facilitate the adherence of practice.

Methods

Thirteen women with fibromyalgia participated in this program lasting for 8 weeks. A follow up session was conducted one month after the program was completed. Participants had been advised of the importance of continuing practicing the relaxation, yoga and meditation exercises that were taught during the 8-weeks program. A psycho-technology software application was install in the mobile phone of 6 participants, who were instructed in how to use it. The application monitored on-going mediation

session and recorded daily practice at patient´s home once the program was concluded.

Results

Positive results were found just after the 8-weeks program. However, those patients who did not practice relaxation and meditation exercises during the post-program, did not maintain the positive effects one month later (n=7). Likewise, women who maintained their practice of meditation exercise post-program (n=6), kept the positive effects one month later. Furthermore, 5 out of these 6 women (who used the psycho-technology mobile application), reported that this tool facilitated them to continue with the regular practice (100%) and to better self-regulate their focus of attention to manage pain (100%).

Conclusion

Preliminary data of this pilot study suggests that the implementation of mobile applications facilitates the adherence of mindfulness meditation practice which is necessary to maintain the benefits of the MBSR program [5]. Mobile applications are efficient alternatives to traditional paper-and-pencil recording procedures, as previous studies state [6]. These promising results encourage us to continue investigating in this specific field.

Acknowledgment

We acknowledge the collaboration of Madrid Fibromialgia Association (Afibrom). We thank to O3 Wellbeing Solutions Co. Ltd. (Technological Based SME). Likewise, our gratefulness to the collaboration of the psychologist Mrs. Laura Ortega Agea.

References

[1] A. Preziosa, A. Grassi, A. Gaggioli, and G. Riva. (2009). “Therapeutic applications of the mobile phone,” Br J Guid Counc, vol. 37, pp. 313-325, 2009.

[2] J. Kabat-Zinn. Full Catastrophe Living, Ed., Nueva York, Delta, 1990.

[3] P. Grossman, L. Niemann, S. Schmidt, and H. Walach. “Mindfulness-based stress reduction and health benefits: A meta-analysis,” J Psychosom Res, vol. 57, pp. 35-43, 2004.

[4] P. Grossman, U. Tiefenthaler-Gilmer, A. Raysz, and U. Kesper. “Mindfulness Training as an Intervention for Fibromyalgia: Evidence of Postintervention and 3-Year Follow-Up Benefits in Well-Being,” Psychother Psychosom, vol. 76, pp. 226-233, 2007.

[5] J. Carmody, and R. A. Baer. “Relationships between mindfulness practice and levels of mindfulness, medical and psychological symptoms and well-being in a mindfulness-based stress reduction program,” J Behav Med, vol. 31, pp. 23–33, 2008.

[6] H. Chen. “Digitization of the experience sampling method: Transformation, implementation, and assessment,” Soc Sci Comput Rev, vol. 24, pp. 106-118, 2006.

Miguel Quintana is responsible for R+D+i in the Affective Psychotechnology Laboratory in O3Wellbeing Solutions Co. Ltd. at Madrid Scientific Park. Four years scholarship holder as International Researcher in Psychology at University of Tsukuba (Japan). Master in Health Promotion, University of Tsukuba (Japan). Ph. D. Candidate 2010 in Psychology at Complutense University of Madrid. Publications in psychology professional manuals and relevant international congress presentations since 2004.

María Esther Rincón is co-responsible for R+D+i in the Affective Psychotechnology Laboratory in O3Wellbeing Solutions Co. Ltd. at Madrid Scientific Park. PhD in Psychology at University of Seville (Spain). Master of Psychooncology at Complutense University of Madrid (Spain). One year Researcher in Clinical Psychology at Mental Health Service of Valme University Hospital of Seville. Three years Researcher and Psychooncologist at Clinical Oncology Service and Plastic Surgery Service at Macarena University Hospital of Seville. Two years Researcher and Psychooncologist at Radiation Oncology Service at San Carlos University Hospital of Madrid. Six months Researcher and Psychooncologist at Psycho-Oncology Unit at Gregorio Marañón University Hospital of Madrid. Publications in nationals and internationals psyho-oncology congress and numerous articles journals since 2005.

Open Source Software in Health Care

Borboleta and SaguiSaúde - Open Source Mobile Telehealth for Public Home Healthcare

G. Duarte, R. Correia, P. Leal, H. Domingues, F. Kon, R. Kon, J. E. Ferreira
University of São Paulo, Brazil
gduarte@ime.usp.br; rafaelj@ime.usp.br; pedrombl@ime.usp.br; helves@ime.usp.br; kon@ime.usp.br; jef@ime.usp.br; rkon@usp.br

Abstract: **Healthcare Centers play the role of primary healthcare providers under the Brazilian Unified Health System (SUS). One of its relevant activities that is proving to be effective in increasing the quality of life of the population is home care. To further improve the quality of the health service provided by these public programs, we are developing an integrated system composed of a mobile module, Borboleta, and a fixed module, SaguiSaúde. They support a mobile Electronic Health Record system that can be accessed both via smartphones in the homes of the patients and via a desktop with a regular Web browser in the Health Center. As we cannot count on Internet connectivity in the patient's home, the system supports a replication and synchronization process to provide offline data access for both reading and updating health information.**

Introduction

Healthcare Centers play a major role in the Brazilian public healthcare system as they are responsible for the primary healthcare in their geographic region. Governmental initiatives such as the Family Health Program have produced very significant results in the improvement of health indexes by focusing on preventive medicine. In these programs, health professionals and specially-trained community agents visit the homes of patients (mostly in low-income neighborhoods) to provide health services. However, at the current stage, these actions are carried out with almost no support from Information Technology. All the data is hand-written in forms that are stored in piles of thousands of pages of paper that are hardly ever used for any significant health action or study.

The Borboleta project conducted by the University of São Paulo, Brazil, aims at developing a mobile Open Source Integrated System for management of health information in the context of public Healthcare Centers and home healthcare service. The hypothesis we want to verify is that automating data collection and processing can improve significantly the quality of the service provided to the population. To achieve that objective,

the system we are developing includes a multimedia electronic health record (EHR), which stores patient personal and health data, including treatment history. The mobile EHR improves the quality of the health service, facilitating access to patient health information and guaranteeing that less data is lost due to hand-written records that are not processed. It also brings the opportunity to study the evolution of diseases as the health information database is linked to temporal and geographical information.

System Architecture

The system is composed of two major parts: Borboleta, that runs on smartphones, and SaguiSaúde, that runs on the Healthcare Center. During home care, health professionals visit patients carrying smartphones with Borboleta to consult the patient's historical health records and to collect new information. SaguiSaúde is responsible for centralizing health information of all patients and making it easily available for health professionals. Different from existing IT systems for primary healthcare that focuses mostly on billing, the goal of SaguiSaúde is to improve the quality of the health service that is provided. Developing such a complex and innovative system in which the requirements are not completely known is a challenge.

SaguiSaúde - the Central Module

SaguiSaúde is developed as a Web system using the Ruby on Rails framework and is accessed by health professionals via commodity Web browsers. It is composed of three main modules: users registry, health appointments, and administration. Users registry contains personal and socioeconomic data of users, including patients, doctors, nurses, and other Healthcare Center employees and community members. Everyone is seen as a user in the system and their specific types and relationships among them are represented with its specific semantics. The health appointments module contains scheduling and history of health appointments. One can search records by user name, registration number, and/or date. A health appointment record contains written and oral notes from the health professionals taken during a visit and they cover issues such as the patient's health situation, daily activities, environment, treatment, and illness evolution. We try to keep this data structured as much as possible, but wherever it is necessary we give to the health professional the opportunity to register stories as free text or oral reports.

The administration module is divided into two parts: support data and management. Support data comprises the set up of static data, including diseases, drugs, streets, religions, types of documents, education levels, etc.

We never couple these data with static codes so that we can evolve the system just by reconfiguring it. There is not yet in the Health community a clear agreement about the terminologies to be used; making these data rigid would practically preclude the adaptation to Healthcare Centers in other contexts, for example, in other Brazilian state or another country. The other part of the administration module comprises user management and fine-grain access control. A major concern during the development of a health system must be security and privacy. SaguiSaúde manages sensitive data, and needs to assure that only permitted users will have access to these data. To achieve this, the system has a role-based access control module that gives the administrator the ability to manage users and what data each one has access to.

Borboleta - the Mobile Module

The Borboleta module aims to be a mobile Electronic Health Record system, which runs on smartphones and PDAs, replacing the paper forms that were used before. In this manner, health care providers gain mobility, because a mobile device is smaller than a bunch of paper forms, and agility, as the system is optimized to not need so much typing on the inputs.

The module carries a subset of the information stored in the central database. This subset is defined based on the homes that are visited in a particular day, and the data is transfered to the mobile system through the WiFi network of the Health Center. After this step, Borboleta works disconnected from the central module, as at the patient's home, the health professional has no network access. At the end of the day, the health professionals go back to the Health Center and synchronize the collected data.

The module is implemented on the Java ME platform using the LWUIT framework for the graphical user interface to achieve a more uniform look and feel across different types of smartphones and operating systems.

Synchronization

The synchronization process is composed of three phases: replication, evolution, and reconciliation. In the replication phase, selected records are copied to the mobile device and, when applicable, data locks are applied. Data locks are meant to avoid data conflicts when a record can be updated in more than one device while replicated. Another approach is to tolerate data conflicts, treating them during reconciliation, resolving automatically or with human help. In the current stage, we assume there will be no data conflict as this is consistent with the current use of the system. We assure this by replicating records as disjoint sets between mobile devices and reconciling it right after the home visits. The evolution phase happens when

local updates are applied to the mobile database, during home visits. In the reconciliation phase, updates are propagated from the mobile module back to the central database, a PostgreSQL database in our case.

During the development of Borboleta and SaguiSaúde we realized that it would be difficult to maintain exactly the same data model for the mobile and central databases. Having heterogeneous data models enables the independent development of both systems. However, synchronizing heterogeneous databases implies the addition of another step in the replication and reconciliation phases: data transformation. The synchronization process is implemented as module of SaguiSaúde and it is responsible for transforming data from the central to the mobile model during replication, and back to the central model during reconciliation.

The synchronization protocol was implemented based on REST (Resource State Transfer) over HTTP, representing data as XML documents. For the data transformations we have used XSLT (eXtensible Stylesheet Language for Transformations).

Results

The software is currently being developed using an Agile Methodology in which preliminary versions of the system are tested by real doctors and nurses monthly and several releases are produced each year. Although SaguiSaúde and Borboleta are not yet in production, some of their modules are already usable and tests are being conducted with a 120,000 people database from the University Healthcare Center. The system is available as open source software and is freely distributed under a BSD license from http://ccsl.ime.usp.br/borboleta .

Acknowledgments

This research is supported by FAPESP, Microsoft Research, and CNPq-Brazil. Borboleta is an official project of the USP Qualipso FLOSS Competence Center (http://ccsl.ime.usp.br).

Gustavo Duarte is a graduate student in Computer Science from the University of São Paulo. He has been working with Borboleta Project since 2008. His research interests include database integration, asynchronous transactions, data model transformations, and distributed systems.

Pedro Leal is an undergraduate student in Bachelor of Computer Science from the University of São Paulo. He's been working with Borboleta Project since early 2009. His interests include agile software development and web development.

Rafael Correia is a graduate student in Computer Science from the University of São Paulo. He works on the research and development of the mobile module known as Borboleta since 2007.

Helves Domingues is Graduated in Bachelor of Computer Science from the University of São Paulo (1995) and Masters in Computer Science from the University of São Paulo (2001). He is doing a doctorate in computer science. Main lines of research are: Database and Agile Methods.

Fabio Kon is an Associate Professor of the Department of Computer Science at the University of São Paulo and Director of the USP FLOSS Competence Center. His research interests include distributed systems, agile software development, telehealth, and Free and Open Source Software. He is a member of ACM, SBC, and the Hillside Group and has published over 100 refereed scientific papers.

Rubens Kon, MD. Masters in Preventive Medicine from the University of São Paulo College of Medicine. Specialization in Information and Health Informatics at the National School for Public Health, Brazil. Technical Director of the Primary Healthcare Center Prof. Samuel B. Pessoa from the University of São Paulo College of Medicine.

João Eduardo Ferreira is a faculty member at the Department of Computer Science at the University of São Paulo. He has been researching in the very large database modeling and integration since 1996. His research interests also include process algebra, Petri nets, business process management, scientific workflows, data warehouse environment and Bioinformatics database system.

Exploration of Open Development Principles for Telehealth Service Platforms

P. A. Cudd[1], S. Judge[2]
[1]SCHARR, University of Sheffield, p.cudd@sheffield.ac.uk ,
Regent Court, 30 Regent Street, Sheffield, S1 4DA, UK
[2] Assistive Technology Team, Barnsley Hospital, simon.judge@nhs.net ,
Gawber Road, Barnsley, S75 2EP, UK

Abstract: **Issues in approaching open development while at the same time attracting end user input to achieve user centered design are presented. These are based on experience from a tele-social application for naïve computer users for which an associated open development community is currently being set-up and a web based innovation broker. This includes some technical, business and promotional aspects. Applicability to telehealthcare is inferred. Barriers associated with lack of shared language and understanding are reported.**

Introduction

Increasingly open source software applications are being advocated by state organisations over proprietary software [1]. Open source software is defined as software where the source code that makes up the software is made freely available. Proprietary or 'closed development' software is where the source code is owned and restricted by the developing company. Some current estimates say that 60% of all software will be open source by 2015. While there are many reasons for adopting the open development model the main motivation seems to be saving costs. As all telehealth systems incorporate software and because the main purchasers are currently state funders, open development may become a necessity.

It is reported [2] that interest is building in open healthcare applications. For instance 'iPath' [3] is an example of current Telemedicine activity. The benefits of open development (OD) are stated to go beyond simple low costs – namely no supplier lock-in, easier development and adoption of standards and the ability to adapt the software to a newly identified/funded use. The latter point is important as a driver towards achieving health service wide solutions that meet the very diverse needs. Certainly if wide adoption of a single open source software platform occurs, then de facto, this will also drive standardization in software. All these gains seem to benefit the technology purchasers and in a well designed solution the

service users too. The loss of ownership of the software code however does remove some business opportunities for manufacturers but several successful business models have been demonstrated that are built around open source products. Business models based around an open product can build on the reduced development burden; cross product compatibility [4]; increased innovation and potential high market penetration and impact of the software. In addition, many companies provide chargeable services around the software, for example customization.

The authors are working on two projects both of which lend them to OD that demonstrate some of the issues that need to be considered. However both these projects draw on user centered design and this has raised further issues to consider.

The Tele-social Application

A tele-social application has been developed based on research concepts and refined through user specification and evaluation to engage elderly people in social activity [5]. The released Mozilla plug-in application, Managed Access to Audio, Visual and Information Services (Maavis) is open source with a copy left protection. An associated OD online community is currently being developed [6]. The choice of implementation of this application was driven by: accessibility through low cost; creating standards; flexibility of the application framework and sustainability. The possible platform choices can be described as developing a standalone application (be it hardware specific or independent), creating an operating system or developing a browser plug-in. The browser plug-in provided the closest fit: many of the application services involve delivery of web content; availability of an open platform-independent browser and well defined standards for web content (i.e. web languages); inherent ability to develop a flexible application to deliver a range of services; and potential : for simple installation alongside other standard software or across a network, to build on an existing open development community, and to ensure compatibility with future media and content formats.

The ubiquitous nature Maavis suggested enormous and diverse scope for tele-applications but two key features here are: the ease of interaction for the user – they not being required to understand computers or the operating system; and the facilitator being able to change content with a very basic knowledge of IT. Both are important to a market where independence and patient self-care are stated goals of customers and where patient or carer users can be people who find IT confusing or threatening. Similar intuitive

interfacing can be seen in so called ‘kiosk’ based interfaces. As such, from the Intellectual property perspective this is not something that has inventive steps that can be protected and so OD seems the better approach.

Issues for Researchers about OD

The initial reaction of many researchers (i.e. academic or health service researchers or innovators) to OD is one of concern over intellectual property – just as for manufacturers. But this is for reasons of kudos (i.e. affect on publications), competition with other research groups and impact on funding sources. In fact the differences seen are : that so called ‘grey’ publication and conferences become more proactive and open than before; and, the nature of content changes – becoming the researcher’s observations and analysis as before, but adding effective management and use of other’s contributions. Open communication if marshaled correctly results in more and early engagement with all stakeholders that leads to a better solution or product. ‘Duplication’ by similar work doesn’t inevitably stop the open project, especially if the ‘copy’ is closed or does not have all the answers. However OD introduces researchers to unfamiliar and for some unwanted challenges such as increased complexity in management of the research and development and its exploitation. The researcher has to think that they and indeed the OD community should seek commercial interest from companies that supply services or add value rather than just manufacture. A precursor to this can include having to persuade employers that OD is the right way to go. Dual licensing can resolve many of researchers’ remaining concerns but is not always appropriate [7]. A problem with the above discussion is that not everyone automatically includes users in the group ‘all stakeholders’.

Bridging the Gap

The ATIB (Assistive Technology Innovations Broker) enables developers (or innovators), manufacturers, and end users to communicate about innovations [8]. The ATIB is a web based test bed and a kind of controlled or limited blog. The design has had to address significant mis-matches between professional and the lay stakeholder users, e.g. use of specialist terms and ensuring end user accessibility. The ATIB is on a single Internet site that uses plain language but segregates those with at least some AT innovation expertise from those who are naïve about it. Assumptions have been made about likely uses of ATIB. For example : AT users will only want to comment on ‘ideas’, ask questions or state needs; innovators will

either want to ask about needs, seek feedback on an idea or 'advertise' a prototype to manufacturers.

During the design phase suggesting to colleagues used to closed research to consider trying their ideas (in particular) or technologies on the ATIB has not had an enthusiastic response, making AT users the likely drivers of innovation through sharing their needs. Therefore the ATIB needs to ensure that lay users are strongly encouraged to sustain their participation. This suggests use of social, financial, functional and altruistic rewards.

When combining OD with user centered design the pragmatic issue of getting lay people who are users to communicate design requirements to a community largely made up of computing and technology experts remains. In most guidance to participation in online OD communities the expectation is for contributions to use technologically (if not software) orientated language. Also there is a likely clash in philosophy. On the one hand a key aspect of user centered design is that only users can truly judge the usefulness of ideas. On the other hand OD communities seem to be often fuelled by innovators getting fun from developing their own ideas. Other attempts have been made to bridge the gap [9-10]. In the OATS project a web library of open source AT software was developed in order to promote this to potential users and provide a forum where contact between stakeholders could occur. The resulting website and community is still maintained but has not yet achieved sustainability. In all projects, to date, involvement of users in specifying their needs has remained the major challenge. In conclusion any viable solution must overcome all these issues.

Acknowledgment

Thanks are due to the Devices for Dignity Healthcare Technology Co-operative and the UK National Institute for Health Research.

References

[1] thenextweb.com/2009/05/04/open-source-governments/
[2] www.ossrc.org.in/education/workshops/oss-for-healthcare.html
[3] sourceforge.net/apps/trac/ipath/.
[4] www.opensource.org/advocacy/case_for_business.php
[5] maavis.fullmeasure.co.uk/
[6] www.assembla.com/wiki/show/maavis
[7] en.wikipedia.org/wiki/Multi-licensing#Business_models
[8] P. Cudd, S. Judge, and M. Hawley. "An Innovations broker that increases availability of Assistive Technology", Conf. Proc: 'Assistive Technology from Adapted Equipment to Inclusive Environments. AAATE 2009, IOS press, ISSN 1383-813X, pp748-753
[9] www.oatsoft.org/Info/Project/ProjectSummary/
[10] raisingthefloor.net

Peter Cudd has been active in medical technology related research for more than 20 years. He is the UK national contact for the Association for Advancement of Assistive Technology in Europe (AAATE). His research interests include user centered design and evaluation, technology transfer, e-inclusion and advanced care technologies.

Simon Judge has worked in the Electronic Assistive Technology (EAT) field since 1999. His research interests cross a number of different areas of EAT, particularly in Usability, Human Computer Interaction, AAC and Open Source Software. Simon's favourite colour is blue, his favourite word is 'disambiguation' and his favourite beer is 'black sheep'.

Improving Health Technology Management: Development of a Model for the Implementation of an Essential Information System for Medical Devices in Low- and Middle-Income Countries

Claudio Zaugg, Martin Raab
Swiss Tropical and Public Health Institute, Basel, Switzerland
claudiozaugg@unibas.ch

Abstract: **The constant increase in the variety and complexity of available health technologies requires good management instruments to allocate resources efficiently. Particularly in low- and middle-income countries, there is a lack of information on medical equipment and related management systems. These shortcomings cause misdirected investment and wasting of scarce resources. The present work aims at identifying and advocating a simple, flexible, and powerful tool that is – in conjunction with training – capable of improving Health Technology Management. An initial survey has shown that 66.7% of international experts would appreciate a new, generic information system. The availability of qualified human resources, over-sophisticated, proprietary software and inadequate use of nomenclature are the biggest obstacles in collecting and processing health technology data. Based on this information, a new web-based open source application (openMEDIS) was developed using php/mySQL. Along with the software, six thematic training modules were developed. Particularly in resource poor settings, the combination of a network system like openMEDIS and a target-oriented training provides a foundation for better Health Technology Management and cost effective planning, and will eventually contribute to better quality of care. At present, this approach is being implemented within cooperation projects in the Ukraine, the Republic of Moldova and Egypt.**

Introduction

In the past few decades, advances in technology and knowledge have lead to significant improvements in the performance of many health care systems. Besides drugs, clinical equipment is one of the major contributors to the rapid progress of healthcare [1]. The vast world of medical technology today encompasses more than 500’000 products and 10’000 generic groups from 13’000 registered manufacturers worldwide [2,3] and

ten years ago 50% [4] of all diagnostic and treatment methods we use today did not exist.

Measured in percent of annual health care expenditure, medical technology accounts for less than 5% among OECD countries and 40-50% in low-income countries [5]. Older studies by the WHO and other agencies suggest that 25-50% of all medical equipment that exists in developing countries cannot be used for one reason or another [6]. In addition to that, inappropriate equipment imposes additional costs and seriously impedes efforts to improve the delivery of health services. Ineffective management, including planning, acquisition and subsequent operations, have been identified as root causes for these shortcomings [7].

The basis for good management practice and policies is good data for decision-making. However, health system planners or other actors (e.g. donors and international agencies) are often not sufficiently informed about the quantity and quality of the present medical device infrastructure to plan for future investments efficiently. Resources to build such an information base are often not available. Hence, there is an urgent need for a simple and flexible IT tool and accompanied training to collect and process health technology data.

Methods

To obtain a more comprehensive picture of the current situation regarding PC based inventories in low- and middle-income countries, a programmed online-survey targeting international experts was implemented and followed by a literature research. The survey was sent to subscribers of INFRATECH – a discussion forum for exchange of information on infrastructure and technology for health services with emphasis on developing countries. The main goal was to investigate system requirements, identify past problems and get a picture of solutions currently in use. Existing open source or proprietary systems identified, and selected through survey results or internet research interviews, were evaluated using selected requirements. A decision table with a point system was compiled and filled in with all information available to identify a possible suitable solution. Based on information collected, key messages, in both software and device information systems theory, were extracted and integrated into practical training modules. Finally, a standard implementation plan was developed.

Results

A total of 27 experts answered the online survey. The respondents worked mainly in Sub-Saharan Africa (33 %), North America (22%) and Eastern Europe, including Caucasus (7.4%) or the Middle East and North Africa (7.4%). A significant concern was the perceived problems in establishing and maintaining equipment information systems. The survey results show that the main obstacles are of human- or organizational nature rather than actual software issues (see Figure 1).

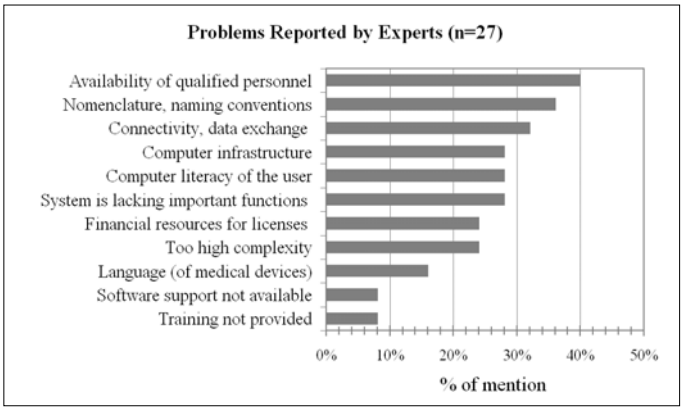


Figure 1: frequent problems with medical device information systems.

Another interesting realization is that roughly two thirds of the experts asked confirmed that no inventory data is used or processed outside the hospital, and 50% not even outside the technical department. Despite the core problem being structural, 66.7% (95% CI: 0.5-0.86) of the respondents still feel a need for a new, generic information system for medical devices.

An evaluation of seven existing open and proprietary software systems has shown that none of them are sufficiently able to meet the claim for simple and flexible systems. Modifying generic open source inventory management software is too time-consuming as there are very specific requirements such as a nomenclature according to ISO [8] standard. For this reason, a new web-based open source application called openMEDIS [9] was created using a PHP interface and a mySQL database. The software provides functions needed for systematic collection and exchange of health technology data. Other information such as a manufacturer database, an integrated, reduced UMDNS nomenclature list, and equipment images further support coherent data collection. Along with the software, six

thematic training modules on, e.g., Health Technology Management, nomenclature use, data management and analysis, etc., were created.

Discussion and Outlook

openMEDIS facilitates the transition from simple equipment inventory towards integrated systems for management and decision-making. This offers numerous opportunities for accurate budgeting and investment planning through the availability of facility-wide equipment costs, analysis and synthesis of data, better standardization through tracking and eventually, reduced variety of medical devices necessary in a country or region.

Figure 2, Example of a data entry page in openMEDIS.

Currently, the effectiveness of the proposed approach is supported by theoretical evidence only, but it is foreseen that, especially in resource poor settings, it will lay the fundament for better practice and evidence-based Health Technology Management, and thus contribute to improvement in quality of care.

Initial experiences are currently being consolidated by the Swiss Tropical and Public Health Institute, which utilizes and promotes the openMEDIS system in its own international cooperation projects with a health infrastructure investment component. Custom solutions were created together with local counterparts and successfully installed in the Ukraine, the Republic of Moldova and Egypt where the positive impact of the intervention on management practice can be demonstrated during the course of the projects.

References

[1] B. Wang, “A Framework for Health Equipment Management in Developing Countries,” *Hospital Engineering & Facilities Management*, 2003, pp. 1-3.

[2] GMDN Agency, “Medical Technology Brief,” 2007.

[3] Medical Device Register, "*The Medical Device Register"*, Grey House Publishing, 2008.
[4] J. Sanders, "*Where is Technology Taking Healthcare? Where is Healthcare Taking Technology?"*, CADTH Symposium, 2007.
[5] World Health Organization, "*The World Health Report - Health Systems: Improving Performance"*, Geneva: World Health Organization, 2000.
[6] Project HOPE Center for Health Information, "Appropriate Health Care Technology Transfer to Developing Countries," Millwood Virginia: 1982.
[7] World Bank, "Proceedings: International Forum for Promoting Safe and Affordable Medical Technology in Developing Countries," 2003.
[8] ISO 15225, "Nomenclature - Specification for a nomenclature system for medical devices for the purpose of regulatory data exchange," 2000.
[9] "openMEDIS at SourceForge.net." http://sourceforge.net/projects/openmedis/, *Accessed on 4 February 2010.*

Claudio Zaugg is a Biomedical Engineer with a Master's degree in International Health. Before joining the Swiss Tropical and Public Health Institute he had worked for several years in EC-funded biomedical research projects. Since November 2008, he is with the Institute and works as a Health Technology Specialist focusing on Health Technology Management and on building up relevant Information Systems in resource-constrained countries.

Martin Raab is the head of the Health Technology and Telemedicine Unit of the Swiss Tropical and Public Health Institute. He has 20 years of extensive international working experience in building health technology capacities for health systems in the Middle East and in various Eastern European countries. At various University Master programmes he lectures on Health Technology Management, Telemedicine and Health Technology Assessment. He is also the acting lead coordinator for the Institute's Task Force "eHealth".

Information on Open Source Solutions in Healthcare - the OSSHealth Repository

H. Demski[1], C. Hildebrand[1], A. Jossif[2], R. Engelbrecht[3]
[1] Helmholtz Zentrum München, German Research Center for Environmental Health, demski@helmholtz-muenchen.de
Ingolstädter Landstraße 1, 85764 Neuherberg, Germany
[2] „Paedi“ Center for Specialized Pediatrics, 120 Athalassis Ave., 2024 Strovolos, Cyprus
[3] National ProRec Centre, Glaslweg 33, 85737 Ismaning, Germany

Abstract: **The application of open source (OS) software in healthcare offers various advantages with respect to independency, affordability, maintainability and reuse. The OSSHealth Repository wants to provide information about existing projects and thus help to select the right software according to the users' needs. It aims to serve as a single access point, providing uniform information on OS solutions in health care. An interactive search and user-friendly listing of the repository's content supports users interested in OS software discovering, comparing and selecting appropriate solutions.**

Introduction

The OSSHealth project is developing an interactive repository on open source (OS) software for healthcare. OS software offers the following rights to the user: to make copies of the program and distribute these copies; access to the software's source code and to adapt the program [1]. This results in an independency from vendors, an improvement on the maintainability of systems, and encourages the reuse of existing works [2].

At present it is hard to get comprehensive information on existing OS solutions. As developers host their projects at many different platforms or even in a lot of cases at proprietary websites, it is cumbersome and time consuming to get details on existing projects. As projects are presented in a different way the records are not suited for a direct comparison and on top of that the information found is often incomplete.

The OSSHealth online repository aims to be a unique place for gaining knowledge about OS software. It complements existing information sources that are sparse or not specific to the healthcare sector. Targeting the users and especially the developers of eHealth solutions it wants to provide the

information needed to get an comprehensive overview on existing projects. Thus it will help to select the right software according to the users' needs.

Method

A repository is being developed that will give a unified view on information otherwise scattered over various sources. A predefined set of data is collected for every registered project and made accessible via the web. This information will be structured uniformly; each entry will have the same features describing the software, e.g. release date, license type and supported languages (see Fig.1). In addition, all entries will be classified according to predefined application categories like practice management and telemedicine. These categories can be used to guide the user while browsing the repository.

An interactive search will allow the user to set filters on certain features, thus limiting the results to individual requirements (e.g. application:

Acronym	GNUmed
Title	-
Description	GNUmed is aiming for a comprehensive scalable software solution for electronic medical practice with emphasis on privacy protection, secure patient centric record sharing, decision support and ease of use.
Category	-
Started	2001
Source	http://www.gnumed.org/
Licence	GPL2
Platform	LINUX, Windows, MacOSX, Python, PostgreSQL
Languages	german, english, italian, french, spanish
Last Release	04.02.2010
Actual Version	Client 0.6
Comments	-

Figure 1: Project Details View

telemedicine, license type: GPL). The search results are listed in a way that allows for straightforward comparison of results and helps the user to interactively explore the information needed.

Discussion and Future Work

The OSSHealth repository can serve as a single access point, providing uniform information about OS solutions in health care. The interactive search and user-friendly listing of the repositories' content supports users interested in OS software in discovering, comparing and selecting

appropriate solutions. This work is based on the experiences of the BioHealth [3] project that developed the BioHealth Standards' Repository, an online repository with information on security standards relevant to eHealth (see Fig. 2).

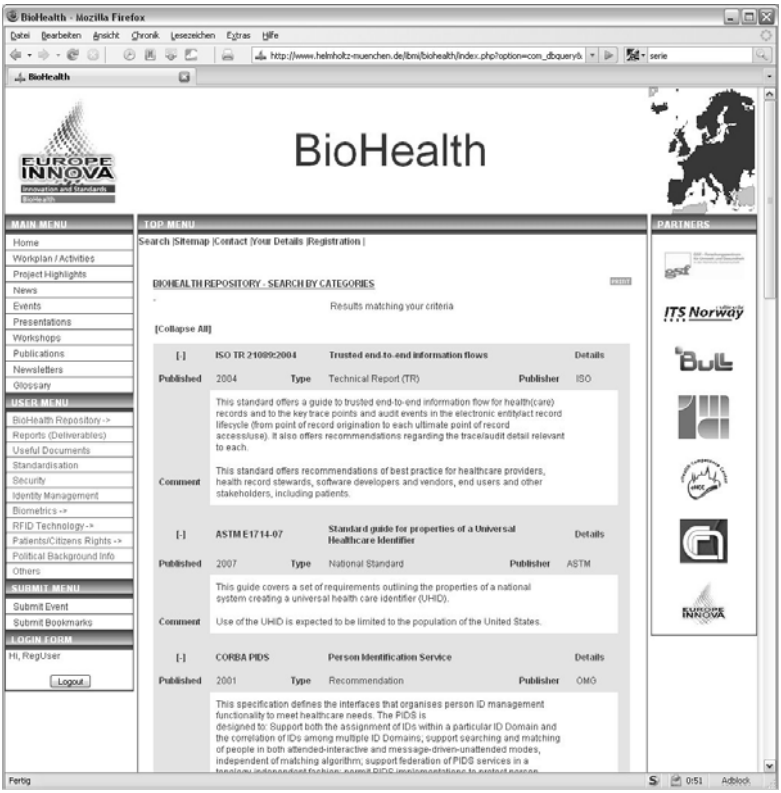


Figure 2: Search Result of BioHealth Repository

OSSHealth is not a platform for distribution or development of code like e.g. SourceForge [4] it will solely provide information on OS solutions.

Other offers in this area exist, like OSOR.eu that is hosting OS projects for the European public administration [5]. As these are working in different domains, the focus on software for usage within the health domain distinguishes OSSHealth from them.

The web-based tool for searching and browsing OS solutions is currently set up and will be available to the public soon at the website

http://www.bymedconnect.de/osshealth-repository. It wants to foster the application of OS software in health care and thus helps potential users to gain the specific advantages like no payment of licence fees and the availability of source code.

As the repository is planned to remain for long time it is vital to take care of keeping the content up-to-date; mechanisms to add emerging projects and to update existing entries according to the development of contained projects have to be discussed. Feedback mechanisms may help in the administration of the content by means of actively including the users.

References

[1] Open Sources: Voices from the Open Source Revolution http://oreilly.com/catalog/opensources/book/perens.html

[2] Why Open Source Software / Free Software (OSS/FS, FLOSS, or FOSS)? Look at the Numbers! http://www.dwheeler.com/oss_fs_why.html

[3] BioHealth - Security and Identity Management Standards in eHealth including Biometrics http://www.bio-health.eu

[4] SourceForce - An Open Source Software Development Web Site http://sourceforge.net

[5] OSOR.eu - Open Source Observatory and Repository http://www.osor.eu

The Author

Hans Demski, Dipl. Ing. (UAS); Hans Demski read electrical and communications engineering at the University of Applied Sciences, Regensburg. From 1995 – 1997 he was programmer at Ganshorn Medical Electronics; since 1997 he has been employed as software developer at the Helmholtz Zentrum München - German Research Center for Environmental Health. His activities concentrate on developments towards the electronic health record: computer based documentation systems, standards for eHealth, secure electronic communication and telemedicine. He managed the technical implementation of several local and european research projects in the field of medical informatics.

Ligne de vie

Ph. Ameline[1], J. F. Brûlet[2], A. Gibily[3], Ch. Hambourg[4]
[1]Odyssée open source project, philippe@ameline.net
16 Rue du Lunain, Paris, 75014 France
[2] Maison médicale Lestrat, jf.b@freesbee.fr
Saint-Martin Lestrat 42110, France
[3] Société Champagne Ardenne de Médecine Générale, agibily@gmail.com
89 Rue Etienne Oehmichen, Châlons-en-Champagne 51000, France
[4] La Case de Santé, charles.hambourg@casedesante.org
17 place Arnaud Bernard, Toulouse 31000, France

Abstract: **Modern societal issues, lighten up by historical perspective, call for a new deal in health where persons will be the center of their health reference frames. Ligne de vie is an open source platform of services designed to help/guide this paradigm shift. It comes with innovative knowledge management technologies and aims to open the way to personalized risk management in health.**

Toward a new deal in health

Historical perspective

From World War 2, a true technological big bang has been considerably expanding the medical knowledge area. Positive outcomes are obvious in term of life expectancy and long term functional status. On the other hand there is also strong evidence that this centrifugal force has deeply shaped the medical domain, leading most actors to hyper-specialization to the detriment of the classical clinical examination.

Nowadays several major trends demand for a genuine new deal in health.

- The downslide of previous technological curve, while next curve, involving genomic treatments and nanotechnologies, is still in labs tubes and is not expected to reach market soon.
- Population ageing, along with an excess in wellness, is reversing the acute versus chronic treatments ratio.

Simultaneously our "modern" vision of the body may be questioned. To the question "What is a body?" a recent exhibition at Quai Branly Museum in Paris [2] introduced the usual answer *"I number it among my possessions and I claim to exercise full sovereignty over it. So I think I'm unique and independent"* and concluded *"Is my body really mine? It's it that determines that I don't belong to myself, that I don't exist alone and that my destiny is to live in a social context."* It is high time to remember that a

genuine person has always been a complex set of relations involving a body and its social environment. Social issues must become plain part of health.

New paradigms and new models of care

Using past to shed light on present we delineated the streamlines of a new deal in health well described by Cohen's [2] New paradigms of care:

The individual	→	The community
Acute diseases dominates	→	More chronic illness/disability
Episodic care	→	Continuous care
Cure of disease	→	Preservation of health
Reactive	→	Prospective
Physician provider	→	Teams of providers
Paternalism	→	Partnership with patients
Provider centred	→	Patient/family centred
Parochial health threats	→	Global health threats

This is a vision where each individual is being taken care of in a highly personalized way by a multidisciplinary team. It demands for fully adapted information system mainly operating in the citizens and their social biotopes reference frame.

About Reference Frames

Current information systems, owned by practitioners or care places, were designed to record information according to the local viewpoint. One's health information is scattered among many systems and viewpoints.

Access rights management clearly illustrates the issue. Data access is controlled from a matrix of rights (usually role based access control) that involves people and roles enlisted inside a given care place. The "square" matrix fits the Cartesian coordinate system that could be used to localize objects inside the care place from a (x, y, z) triplet. It could very hardly follow any outpatient. The time dimension is also usually limited to the discontinuous set of periods when the patient is inside the place.

In order to follow a patient journey, it is mandatory to switch to a polar coordinate system, that's to say a patient centered reference frame where objects are localized around the person, depending on an angle (where around?) and a distance (how close?). This is what has been done to provide access rights to Ligne de vie (LdV) with a system called "access roses". Figure 1 below shows a Health Team Rose (HTR) with the patient inside the central circle and his team members around.

Each object can come with a similar rose where each area is painted with a colour (green for accessible, yellow for details being hidden and red for invisible) and, once stacked on the HTR, defines who can see what.

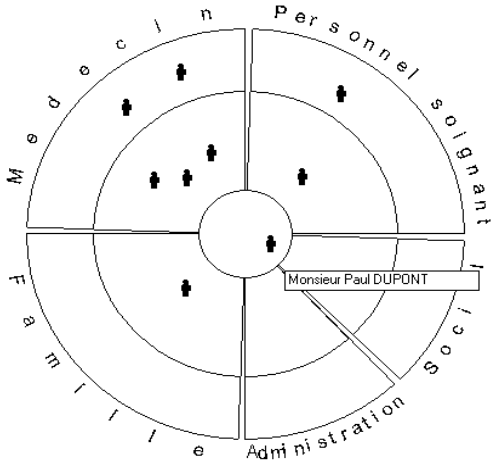


Figure 3: Health Team Rose

Roses clearly demonstrate a truly patient centered system where interactions depend on your place (where you are) in the team. Ligne de vie is probably the first system to be fully designed to operate in citizens' reference frame.

Ligne de vie

Ligne de vie was initially a way to tell someone's health story in a graphical way, according to the artist drawing on figure 2. The purpose was to draw the kind of mental representation that a health professional elaborates from studying the pile of documents a patient health record is usually made of. Our initial ambition was also to benefit from information accuracy in order to have smart agents support LdV users in their daily tasks.

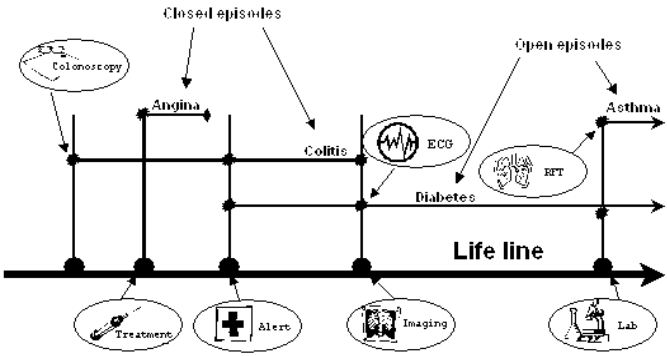


Figure 4: Artist drawing of Ligne de vie

We developed the first agents in the field of personalized cancer early detection (for mouth, cervix uteri, colon, epithelioma, melanoma and breast). It led to extending LdV with health goals for risk management.

Now able to answer three main questions, "what issues are to be addressed?", "what has already been done?" and "what are the goals?", LdV became a true project manager in support of (and giving birth to) the Personal Health Project (PHP) of individuals.

Technologies: Knowledge management (KM) and Risk management (RM)

LdV is altogether a health journey “story teller”, a project manager and the host for smart agents. Several innovative technologies were combined in order to put it at work. LdV data model remains very close from natural language using 50,000 terms ontology and a dependency grammar (DG). Using DG trees, LdV can express any medical discourse with the same accuracy as natural language, but in a non ambiguous and computer process able way. Several innovative Man Machine Interfaces (MMI) are elaborated to build DG trees: Archetypes for deterministic domains (static model trees in XML files) and Fils Guides (on the fly pathway generation) for non deterministic domains. A Blackboard, well known artificial intelligence component, operates agents, called knowledge sources (KS), to solve various problems under the supervision of a Controller.

LdV provides a new vision in risk management (RM). So far RM has been compartmentalized (drug interaction, drug contraindication, primary prevention, etc) and implicit (in peto). LdV now makes RM explicit, thanks to risk lines, and unified because whatever the risk type, KSs can discover risk factors from clinical data and propose personalized health goals.

Open source

LdV is a complex KM environment built to be operated as communication layer between citizen and professionals reference frames (and to federate legacy systems). This ambitious platform of services must benefit from vast support and auditability in order to succeed. The usual assets of open source!

References

[1] “Qu’est-ce qu’un corps ?”, A co-publication by the musée du quai Branly/ Flammarion, isbn 2-915133-17-4

[2] J. Cohen, 21st Century Challenges for Medical Education; 9th International Medical Workforce Conference; Melbourne, Australia; November 2005

Open Collaborative Health

A. Altuna, J. M. López
Andago Labs, E-103 Bizkaia Technology Park, Zamudio, 48170 Spain
ander.altuna@andago.com; josemanrique.lopez@andago.com

Abstract: **Citizens have turned the Internet into a vehicle through which of implement their social relations and the exploitation of these social networks for the communication and discussion of health matters among patients, carers and doctors is envisaged to become an effective way to deal with an otherwise unsustainable system. However, the sensitive nature of health information entails many particular challenges. On one hand, while assuring the privacy of patients is extremely important, a global analysis of their data is necessary in order to induce patterns and extract conclusions from a wider perspective with regard to particular pathologies and treatments among others. On the other hand, the potential impact that the information might have on the health of the patients accessing to it requires an extremely careful handling of the information sources. Consequently, a health social platform needs to implement challenging security and trustability methods that handle information adequately. In this paper, we present how this methods have been modeled and implemented in Open Collaborative Health, an open-source health social platform targeted at serving as a secure and trustworthy communication vehicle between patients, carers and doctors.**

Introduction

A social network website can be considered as groups of individuals (or organizations) connected by some kind of interdependence that manages their relationships on the World Wide Web. In our increasingly dislocated and mobile society, social network websites are proving valuable in bridging distances and facilitating interaction and communications. People are spending a significant amount of time at the top social networking websites in order to manage existing relationships with friends, reconnect with old friends, share media and find new contacts that have similar interests. One example of social networks is those related with health. On these networks, users are patients, caregivers and physicians so they have different roles and the information published by each one could be very different. There are networks where patients share their medical chart, so their profile is associated with pathologies suffered by them. There are user groups based on their roles or even on their diseases. In some cases users

share their experiences [1], give emotional support, or keep in contact with medical staff [2].

Each user creates a personal profile based on their personal information, on who they are connected with, on what they have shared (pictures, posts, comments, etc.). All this information is tied to privacy policies decided by the organization that maintains the social network and in most cases, they can be customized by the users. On the other side, information categorization as reliable is left to the figure of reviewers, if they exist. In many cases, the revision of false information is done when a complaint is filed on it, so the diffusion degree can be high and too late.

Social networks usually include reputation models. In general, reputation models can be based on the number of users that are part of the social network for each user or in the ratings made by users for the comments provided by each user [3]. As a particular case, the reputation of a user may be based on their skills or knowledge in certain area. For example, in health social networks, medical professionals have greater reputation. Usually, it is considered that information provided by reputed users is more reliable than any other. But why does a user rely on the information provided by another user? Consider the following definition [4]:

"Trust is the subjective probability by which and individual A, expects that another individual, B, performs a given action on which its welfare depends" (translation from Italian)

So, in fact, trust is basically estimation, an opinion given by an individual, so it is a personal state. And, based on the definition, is related to another person. On social networks, users usually get reputation based on the information the have provided previously. In other words, an individual *A* trusts on *B*, because the amount of trusted previous information *B* has posted from *A* point of view. There are trust models based on entities [5], but it is rightful thinking that a model based on the information provided would be a better approach [6].

In the next section it will be shown how this model can be applied to health based social networks using semantic description of the underlying information and completed with annotations about trustability.

Semantic Web, Social Networks and Trustability

There are already available ontologies to describe social network elements. FOAF is an OWL vocabulary that describes individuals and the relationships among them [7]. It can be extended adding medical information (medical profile), based on Electronic Health Record models

[9] to describe a complete medical user profile for a social network. SIOC is a vocabulary that describes the domain of interconnected communities [8]. If the user determines its trustability on certain information, SIOC could be extended with a simple property (*gives_credit*) that relates a *User* and a *Post* so, it would be possible to indicate which information is reliable for each user.

With this simple model is possible to develop methods to create and enrich the user confidence profile, using inductive path, through the analysis of user behavior to get trust patterns. On the other hand, applying inference deductive methods is possible to get information that is likely to be reliable for the user. In next section some of the methods developed and implemented will be shown.

Trust analysis methods

Information Confidence Ratio (ICR) can be set as the relationship between the number of users who have claimed the information as reliable and the total of users who have read it. This value can be categorized according to different parameters and used on statistical analysis to get behavior patterns. Information search results can be ordered based on these patterns.

It is also possible to deduce trustability relations from users' relationships and it would work as a recommendation system to get reliable information. If user U_1 finds information I as reliable information, and U_1 knows U_2, it could be assumed that I is likely to be reliable for U_2. On the same way, if all data posted by user U_2 (I_1, I_2, …, I_n) has been deemed reliable by U_1, any new information I_{n+1} published by U_2 could be considered reliable for U_1. These rules could be refined introducing other properties such as information categories, or the groups which authors belong to.

One consequence of applying these methods is the ability to refine trustability user profile, generating new patterns or changing existing ones, as long the user uses the online social network. This point is important for implementing this modelling. A rigid pattern based system, ties each user to the pattern profile that it defines when it signs on the social network.

Ongoing work

Currently, the system proposed for trust management is being implemented in the Open Collaborative Health project. The project aims to develop an open source framework for collaborative management of social and health information and mechanisms for interaction and relationship

between different actors involved. As first stage, the framework is being tested by a group of hepatitis type 1 patients and some medical stuff. On this stage, a social network website is under development with four user groups: general users, patients, medical staff and physicians with patients (in the social network) in charge. Patients can make public any information, like experiences or advices. This information could be useful for any member of the social network and they can rate its trustability.

Future work

Nowadays the implemented system is based on a binary model, “trust” or “not”, where "not" indicates that the information published is "irrelevant" from the user point of view. Looking ahead, we are modeling a more complex system, establishing confidence levels (-1, 0, 1), where 0 or 1, is equivalent to the current model, and -1 would express "*distrust*" on the published information. On the other hand, there is information that could come from reliable sources, and this should be taken into account. There have been some proposed models that could be added to the proposed model [9].

References

[1] J. H. Frost and M. P. Massagli. “Social Uses of Personal Health Information Within PatientsLikeMe, an Online Patient Community: What Can Happen When Patients Have Access to One Another’s Data”, Journal of Medical Research, Vol 10, No 3, 2008

[2] M. Cabrera and J. A. Valverde, “ICT for Health: Social Computing”, Information and Communication Technologies for Active Ageing, IOS Press, 2009, pp 166-187

[3] L Mui, “ Computational Models of Trust and Reputation: Agents, Evolutionary Games, and Social Networks”, Phd dissertation, Department of Electrical Engineering and Computer Science, December 20, 2002

[4] D. Gambetta, editor. Trust. Basil Blackwell, Oxford, 1990

[5] J. Golbeck and J. Hendler, “Inferring binary trust relationships in Web-based social networks”, ACM Transactions on Internet Tecnology, 2006, vol 6, issue 4, pp 497-529

[6] Y. Gil and D. Artz, “Towards content of trust of web resources”, Web Semantics: Science, Services and Agents on the World Wide Web, Volume 5, Issue 4, December 2007, pp 227-239

[7] D. Brickley and L. Miller, “FOAF Vocabulary specification 0.97”, January 2010, http://xmlns.com/foaf/spec/20100101.html

[8] U. Bojārs, J.G. Breslin, A. Finn and S. Decker, “Using the Semantic Web for linking and reusing data across Web 2.0 communities”, Web Semantics: Science, Services and Agents on the World Wide Web, Volume 6, Issue 1, February 2008, pp 21-28

[9] G. Eysenbach, “An Ontology of Quality Initiatives and a Model for Decentralized, Collaborative Quality Management on the (Semantic) World Wide Web”, Journal of Medical Internet Research, Vol 3, No 4, 2001

Ander Altuna heads the research and development department at Andago Ingeniería. He holds a M.Sc. in Telecommunications Engineering from the University of the Basque Country and will submit his thesis for the degree of Ph.D. in Computer Science from the University of Leeds during this year. He has expertise in carrying out research in the area of knowledge representation and reasoning and has an extensive record of related publications, including conference papers and journal articles. In the past, he worked at the research and innovation department of Atos Origin where he led the research activities in the area of eTourism."

Jose Manrique Lopez de la Fuente works as eHealth Area Project Manager at Andago Ingeniería. He holds a MSc Industrial Engineer (Management specialization) from the University of Oviedo and is currently working in his dissertation about Semantic Technologies and data visualization to get the Certificate of Advanced Studies, previous to start Ph.D. in Computer Science. In the past, he has been working with W3C Mobile Web Initiative, and as project and product manager in CTIC research center."

OpenEMPI: An Extensible, Open Source Enterprise Master Patient Index

Odysseas Pentakalos, Yimin Xie
SYSNET International, Inc.
2930 Oak Shadow Drive, Oak Hill, VA 20171, USA
odysseas@sysnetint.com; yimin.xie@sysnetint.com

Abstract: **The Open Source Enterprise Master Patient Index (OpenEMPI) software has undergone considerable enhancements and redesign following the initial contribution by the California Health Care Foundation to provide an extensible architecture that can incorporate various matching, blocking, and string matching algorithms. The new data model, along with the loosely-coupled architecture of the underlying services make it suitable for integration into environments with demanding workloads. Furthermore, its proven compliance with the IHE profiles makes it easy to integrate into heterogeneous healthcare environments.**

Introduction

OpenEMPI is an Open Source Enterprise Master Patient Index (EMPI) that originated from the remnants of the Care Data Exchange software that were turned over to the open source community after the Santa Barbara County (California) Care Data Exchange (SBCCDE) ceased operations[1]. Since it was originally released it has undergone considerable refactoring and redesign in an effort to achieve the following goals: a. decompose the overall system into a collection of services, b. make it extensible so that new algorithms can be easily

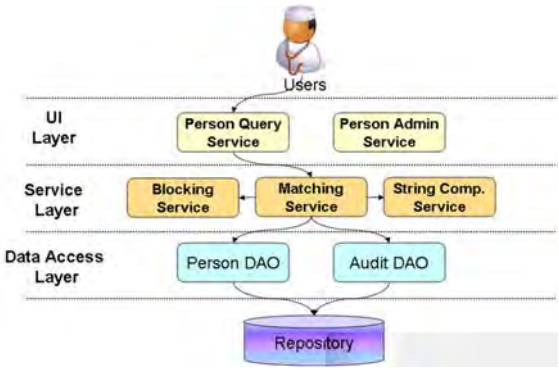


Figure 1 SOA-based Architecture of OpenEMPI

embedded into the system over time, c. optimize the data model to support instances with large numbers of patients, and d. provide standards-based integration access points into the system so that OpenEMPI can be easily integrated into existing healthcare environments.

To achieve the first goal, the system was re-designed so that the overall architecture of the software is now based on Service Oriented Architecture (SOA) principles where loosely coupled components comprise the overall system architecture and interaction among components only takes place through well defined interfaces. Figure 1 illustrates the new architecture of OpenEMPI with only some of the services included in the figure for conciseness. The figure also illustrates the layered nature of the architecture where services are allocated to the data access layer, the service layer or the UI layer and where each layer builds on top of the layer below. Layered architectures provide flexibility by allowing entire layers to be removed and replaced without affecting the rest of the system. For example, moving OpenEMPI to utilize storage in the cloud would simply require implementing the data layer to be deployed on a Storage-as-a-Service (SaaS) infrastructure without requiring modifications to the rest of the application.

Some of the key services that comprise the architecture of OpenEMPI include the Matching Service, which provides an abstraction for the algorithm that determine whether two or more patient records in the system identify a unique patient, the Blocking Service, which abstracts the algorithm that reduces the number of record pairs that need to be compared for matching purposes, the String Comparison Service, which determines the measure of similarity between two strings, and the Standardization Service, which transforms patient attributes into a standard format for the purpose of improving matching performance.

By decomposing the system into components and specifying interfaces as the only means of interaction between those components, the new architecture achieved the extensibility goal. The system can be easily extended by simply implementing a different version of a service and plugging into the system without requiring any modifications to the rest of the system.

An EMPI internally utilizes algorithms from the field of record linkage to detect and link duplicate records. Record Linkage is an area of research whose focus is the development of algorithms for quickly and accurately identifying records that correspond to a single entity. Over the years many algorithms have been proposed with different operating assumptions and

performance characteristics [3],[4],[5]. By utilizing the extensibility of OpenEMPI, multiple, alternative matching algorithms may be implemented and the most appropriate choice may be selected during deployment. The software distribution currently includes a fully functional implementation of both a simple, deterministic algorithm as well as a probabilistic matching algorithm, which is an implementation of the Fellegi-Sunter algorithm that uses Expectation-Maximization (EM) for estimating the marginal probabilities of the model [2][4]. The same extensibility mechanism is also available in the blocking service implementation and in the string comparison service. The current string comparison service provides a number of string distance metrics including an exact string comparator, the Jaro, Jaro-Winkler, and the Levenshtein distance metrics among others [6].

The next objective for the redesign of OpenEMPI was the optimization of the data model to support the persistence and retrieval of patient identifying and demographic data. This objective was selected for two reasons. The intent is for OpenEMPI to be suitable for implementation in large-scale healthcare environments with hundreds of thousands to millions of patient records, and where the system needs to sustain intense user workloads. This goal can only be achieved if the data model is designed from the beginning with high performance as a key criterion. The second reason for the focus on optimization of the data model was to form a solid basis on top of which multiple additional matching algorithms could be developed, tested and deployed in a production environment. With a data model where query performance is not considered during design, it would be impossible to develop matching algorithms that are efficient and suitable for implementation in large-scale environments.

The final objective was the provision of integration points into OpenEMPI in order to facilitate its integration into the Information Technology (IT) infrastructure of existing healthcare environments. To achieve this goal, OpenEMPI provides support for the Patient Identifier Cross-Referencing (PIX) and Patient Demographics Query (PDQ) standards defined by the Integrating the Healthcare Enterprise (IHE) organization [7]. IHE defines the workflow and specifies the standards to be used in the implementation of those workflows for promoting the sharing of medical information. The PIX profile supports the cross-referencing of patient identifiers from multiple Patient Identifier Domains and the PDQ profile provides ways for multiple distributed applications to query a patient information server for a list of patients, based on user-defined search criteria, and retrieve a patient's demographic information [7]. OpenEMPI

utilizes the open source implementation of the PIX/PDQ profiles in OpenPIXPDQ which has been tested successfully at both the 2009 and 2010 IHE Connectathon. To further simplify the integration of OpenEMPI into existing IT infrastructure, there are plans for the development of both a REST-based and a SOAP-based web services interface to the full functionality available by OpenEMPI.

Conclusion

The enhanced OpenEMPI software is currently available from both the official OpenEMPI site at www.openempi.org and as a member project of the Open Health Tools site [8]. Further work involves development of a user-friendly interface for configuration and interaction with the system, exploration of parallel algorithms for further extending the performance of matching algorithms, and the development of additional interfaces for access to the full system functionality.

References

[1] Stuart Turner, et. al., “Creation of an Open Source Master Person Index from Proprietary Code: The Open Source Care Data Exchange Project", AMIA Spring 2008.

[2] Fellegi, I. P. and Sunter, A. B., “A Theory for Record Linkage”, Journal of the American Statistical Association, 64, 1183-1210, 1969.

[3] Winkler, E. W, “The State of Record Linkage and Current Research Problems”, Statistical Research Division, US Bureau of the Census, 1999.

[4] Conchinwala, M., et. al., “Record Matching: Past, Present and Future”, Technical report, PR-OWL: A Bayesian Ontology Language for the Semantic Web. Workshop on Uncertainty Reasoning for the Semantic Web, International Semantic Web Conference, 2001.

[5] Gu, Lifan, et. al., “Record Linkage: Current Practice and Future Directions”, In CMIS Technical Report No. 03/83, 2003.

[6] Cohen, W., Ravikumkar, P., and Fienberg, S., “A Comparison of String Metrics for Matching Names and Records”, KDD Workshop on Data Cleaning and Object Consolidation, 2003.

[7] IHE International, “IHE IT Infrastructure Technical Framework, Volume 1 (ITI TF-1): Integration Profiles”, revision 6.0, http://www.ihe.net/Technical_Framework /upload/IHE_ITI_TF_6-0_Vol1_FT_2009-08-10-2.pdf, August 10, 2009.

[8] http://openhie.projects.openhealthtools.org

Odysseas Pentakalos is Chief Technology Officer of SYSNET International, Inc., where he focuses on providing consulting services with the architecture, design and development of large distributed systems. Most recently his focus has been enterprise application integration in the health care domain. Among other projects, he led the architecture, design, and development of the integration of the VA's MyHealtheVet portal with the 140 Medical Center systems that provided the data for the patient's EHR. He holds a Ph.D. in Computer Science from the University of Maryland, has published dozens of papers in conference proceedings and journals, is a frequent speaker at industry conferences, and is the co-author of the book "Windows 2000 Performance Guide" that was published by O'Reilly.

Co-founder and senior data architect of SYSNET. Ms. Xie has worked on several projects providing data architecture, planning and development to support information sharing and collaboration initiatives specifically in the healthcare domain. She has over 15 years of industry experience in the software development life-cycle including systems analysis, design and development of medium- to large-scaled applications. She has over 15 years of experience in the realm of Data modeling, Data Architecture and Design using UML, Database Indexing, and XML technologies. Mrs. Xie received a Masters Degree in Electrical Engineering and a Minor in Computer Science in 1990 both from the University of Maryland and a Bachelors Degree in Electrical Engineering in 1985 from Xian Jiaotong University in China.

Open-source and Healthcare: Key Factors for the Transfer of R&D Results into Healthcare Solutions

D. Martin, C. Moll, A. Jahnen, N. Rösch
The Public Research Centre Henri Tudor, CR SANTEC,
2A rue Kalchesbrück, Luxembourg, L-1852, Luxembourg

Abstract: **Today's applied research and development projects need to do more than just present their findings back to the scientific community or to a technically minded audience. Today we need to focus more on bridging the gap between research results and the technical problems that modern, knowledge-based economies need to have solved. This paper will profile the activities performed to position open-source medical imaging software for use by local hospitals. We will briefly explore topics such as the disruptive nature of open source R&D, the leveraging of intellectual property rights, and the use of software valuation tools. We conclude our work by highlighting the benefits of creating a viable technology transfer strategy.**

Introduction

Technology transfer, in its simplest form, is the movement of knowledge from those who have developed it, to those that wish to use it for some purpose or to develop it further [1]. However, in many cases, the act of openly publishing research work to a technical journal or on the web does not lead to the automatic adoption of the researcher's work by the public. A "gap" exists in the understanding of how a researcher's work might be leveraged for everyday use. This is especially true of commercial entities that wish to take advantage of R&D results but are unsure of the potential economic value of the results or how to technically secure the appropriate legal rights in order to use these results to create value. The key to closing this gap is found in technology transfer, and it requires its practitioners to develop transfer strategies that will benefit both the researcher and the public at large.

Open Collaboration and Software

Optimage is a medical imaging software package developed as part of an applied R&D project [2]. The software has been constructed using code developed by other research centers in different countries as well as code components developed for other IT R&D projects. As the inherent nature of

research is to share knowledge, software R&D advances tend to be published in such a way that the source code can be analyzed and then improved upon by fellow researchers. Researchers therefore look favorably upon the use of open source software licenses as it provides both a means to openly share their programming contributions while still maintaining specific copyright restrictions on the use and distribution of their work [3]. Therefore, when examining the potential for transferring the results of the Optimage software package, the first critical step was the selection of an appropriate software license that would respect the collaborative nature used during the development of the software while at the same time respecting the copyright of all contributors. For Optimage, the license selected was the GNU Lesser General Public License (LGPL) version 2.1.

The Impact of Open Source Licenses

The LGPL v2.1 license is a derivative of the more commonly known GNU General Public License (GNU GPL) open source license. At its core the license, through its use of internationally recognized copyright law, legally obliges anyone who agrees to use the software to adhere to two specific conditions. The first condition is that everyone has the right to make copies and freely distribute the software. The second condition insures that any modifications or improvements to the software must also be released under a GNU GPL license [4]. The LGPL v2.1 derivative is slightly different in that it contains a special clause that allows the use of proprietary software libraries without exposing software developers to the viral nature of the GNU GPL's modification restrictions. In this way, the Optimage software can use external software libraries developed under nonopen-source licenses and yet still remain open and distributable to the public.

A Gap Develops

Intellectual property rights, such as the use of copyright law to create specific software licenses, are a key component to developing a technology transfer strategy. By selecting the LGPL, we had insured that researchers would be able to continue their collaborative efforts and therefore expand the state of the art in their domain. However, by selecting the LGPL we created two potential barriers for commercial transfer. The first barrier had to do with the exclusivity of resources and the second involved the perception of quality. Under the terms of the LGPL v2.1 license there can be no restrictions on the distribution of the software and derivative works

cannot be developed under a proprietary license. Commercial activities in software are generally based on the granting of limited rights allowing the use the software in exchange for a financial consideration. Open-source licensing changes this equation. And if the software can be distributed or changed by anyone, how will end users who require knowledgeable, on-demand support perceive potential quality issues such as software maintenance and ongoing support?

Bridging the Gap

The second part of our strategy was to develop a value proposition whereby healthcare providers, in this case hospitals, could clearly understand the economic value of what had been created in parallel with an analysis on how the Optimage software would compare to existing commercial solutions. We started our analysis by finding a similar imaging software package that was already available in the marketplace. Information concerning the competing product's licensing fees and annual maintenance costs were obtained as well as information concerning core functionalities. We then performed a software valuation audit on the Optimage project using the replacement cost valuation method. The replacement cost method is used when data concerning a product's market share or future income streams cannot be accurately assessed [5]. By establishing this replacement cost, we created a foundation for our argument that R&D based open-source software does have a tangible, economic value [6]. Next, to answer any potential users concerns about quality and continued development support, we created a series of financial models that detailed different software support scenarios. This was coupled with a cost benefit analysis that showed the estimated cost of ownership for both the proprietary software and the Optimage LGPL licensed software. Due to the ongoing nature of the transfer activities, we are unable to release these models to the public at this time. However, once this process has been completed we plan to follow-up with a more public analysis of our work.

Conclusions

Software developed under open-source licenses benefits the research community by promoting the reuse of existing code and the sharing of new programming techniques and tools. Healthcare providers who would like to implement the results of healthcare IT R&D need to have confidence in both the software quality and the level of available technical support before they will be willing to incorporate any software solution into their

production environment. Without a technology transfer strategy, researchers will have difficulty communicating and demonstrating the value of their work. As applied R&D results are not generally ready for immediate commercial application, a properly executed technology transfer strategy becomes a key component in transferring applied research results to the healthcare domain.

References

[1] T. A. Young. "Academic Technology Transfer," International Journal of Intellectual Property, Law, Economy and Management 1, pp. 13-18, 2005

[2] CRP Henri Tudor – CR SANTEC, "Optimage – Optimal Image Quality for Modalities", http://www.santec.lu/project/optimage, accessed on-line 02/2010

[3] V. Ambati and S.P. Kishore. "How Can Academic Software Research and Open Source Software Development Help Each Other?" IEE Digest, Vol. 2004, Issue 908, pp. 5-8

[4] Open Source Initiative, http://www.opensource.org/licenses/lgpl-2.1.php, accessed on line 02/2010

[5] R. Reilly and R. Schweihs, "Valuing Intangible Assets", McGraw-Hill, 1999, pp. 118 - 128

[6] M. Farcot, and D. Martin, "Valuation applied to Open Innovation: Because Open Source isn't Free Beer", Conference - *On the Route towards Lisbon*, Luxembourg, 2008, (unpublished)

Don Martin is a Technology Transfer Advisor for the Public Research Centre Henri Tudor. He has over 10 years of ICT experience working for companies in the financial and publishing industries. His current role is to develop and execute technology transfer strategies for different healthcare ICT R&D projects. He has a degree in business administration and is also a member of the Centre's Intellectual Property Steering Committee whose mission is to recommend policies and strategy for the use of IP in R&D.

Christian Moll studied media technology and imaging sciences at the University of applied science Cologne (Germany). He graduated in August 2006 with a diploma thesis in "Automated Determination of Measurements in Phantom Images according to PAS 1054 and their statistical evaluation". He currently works for the Public Research Centre Henri Tudor - SANTEC in Luxembourg, as a research engineer since he finished his studies. His main interests are image processing and image quality of medical images.

Andreas Jahnen has studied Computer Science at the University of Applied Sciences in Trier, Germany. He started in 1999 as a research engineer at the Centre de Recherche Henri Tudor - SANTEC. In 2005 he successfully completed his Master of Science - Frontiers in Medical Science - degree from the Open University, UK. He is coordinating the medical image processing activities at his department. His main research activities include topics related to the evaluation of image quality, the associated radiation dose and transfer and management of medical images. He is as well interested in topics related to free and open source software.

Stratification of FOSS Communities Specialized in the Provision of eHealth Systems and Technologies

R. Pawelzik
Public Research Center Henri Tudor – CR SANTEC

Abstract: **The Free and Open Source Software (FOSS) production model increases in importance for the supply of eHealth related systems and technologies. Our research group at CRP Henri Tudor, CR SANTEC, applied metrics for the assessment of a community's internal social structure and role differentiation and explored if and how the level of centralization differs between communities of comparable size and age, but differing in their project focus with respect to the relevance for the eHealth sector. Based on three preliminary case studies we observed that in eHealth related projects cohesive subgroups of developers show a tighter level of homogeneity with respect to each individual's centrality within the community at large.**

Introduction

Previous FOSS research [1] found that the level of centralization is negatively correlated with project size, suggesting that larger projects become more decentralized/modular. Several metrics have been suggested, like 'betweenness centrality' [2], 'coreness' [3,4] and 'hub/authority score' [5] to measure centralization and social modularity in networks of social interactions. We applied these metrics to investigate a hypothetical relationship between the stratification of developer communities and the relevance of their projects for the eHealth sector.

We focused on communication interaction data of the developer sub-communities of three FOSS projects (BioConductor, ImageJ, Webkit) over a comparable timeframe of roughly 2000 days and a comparable minimal activity threshold level.

The **BioConductor** community produces an open development software platform "for the analysis and comprehension of genomic data generated by wet lab experiments in molecular biology." The **ImageJ** community produces a public domain, Java-based image processing program developed at the National Institutes of Health. The **WebKit** community produces a layout engine designed to allow web browsers (Apple's Safari, Google's Chrome, KDE's Konqueror) to render web pages.

The level of relevance of these projects for the eHealth sector ranges from strong (BioConductor), to medium (ImageJ) and to low (WebKit). We

compared these three case studies by collecting e-mails from a large e-mail archive (www.gmane.org) and processed these e-mails to ensure unique author identity and thread structure consistency.

Studied FOSS Communities

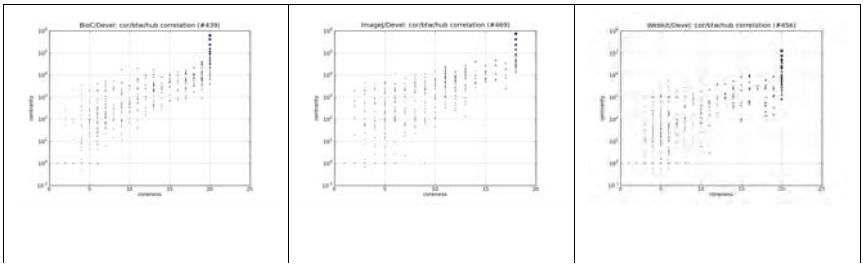
Project Name	E-mails	Threads	Developers (hub-score>0.01)
BioConductor	**23029**	**5238**	**439**
ImageJ	**16197**	**3754**	**469**
Webkit	**10524**	**2143**	**456**

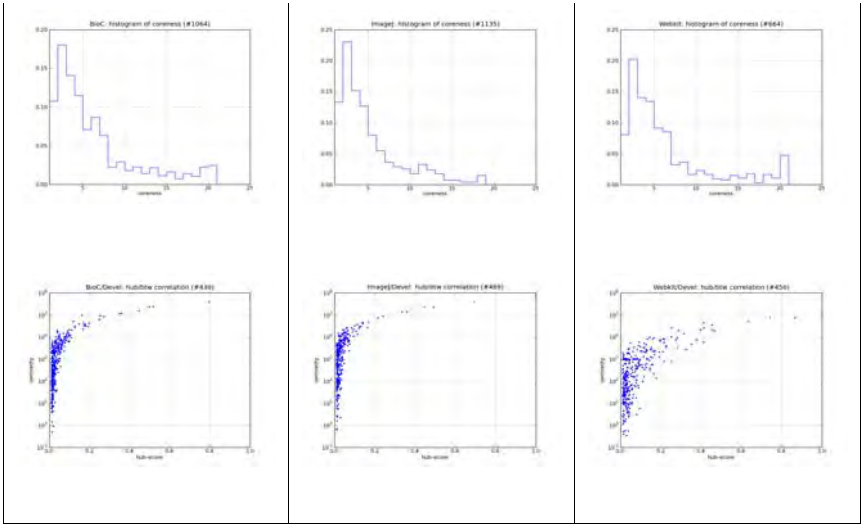
Methodology & Methods

We created a database of e-mail metadata, from the earliest e-mails archived in the repository to today (8.2.2010), and utilized methods from 'Social Network Analysis' to construct a network of interaction ties ('who responds to whom') between minimally active developers, creating a directed network of message exchanges. We then applied, correlated and compared different metrics on each response network with the help of iGraph [6], a tool for network analysis and visualization.

Results & Conclusions

We explored the network of social interactions and observed a slight increase in the variance of the centrality measure of members of the same cohesive subgroup (same coreness) when the project's relevance for the eHealth sector decreases (from left to right). While the histograms of coreness themselves don't reveal any significant differences, the correlation between hub-score and centrality (last row) clearly shows a decreasing tightness when going from eHealth to non-eHealth related projects.





It has to be shown, if this pattern (the change of variance) is statistically significant and can be generalized to the FOSS ecosystem at large when investigations are significantly expanded to more than three communities.

References

[1] Crowston, K., Howison, J. (2006), 'Hierarchy and centralization in free and open source software team communications', Knowledge, Technology and Policy. 18(4):65-85.

[2] Cook, K.S., Emerson, R.M., Gillmore, M.R., Yamagishi, T., 1983. The distribution of power in exchange networks: theory and experimental results. AJoS 89, 275–305.

[3] Borgatti, S.P. and Everett , M.G. 1999. Models of Core/Periphery Structures. Social Networks 21: 375-395.

[4] Everett, M.G. and Borgatti, S.P. 1999. Peripheries of Cohesive Subsets. Social Networks 21: 397-407.

[5] Kleinberg, J. Authoritative sources in a hyperlinked environment. Proc. 9th ACM-SIAM Symposium on Discrete Algorithms, 1998.

[6] Csardi G, Nepusz T: The igraph software package for complex network research, InterJournal, Complex Systems 1695. 2006. http://igraph.sf.net

Rolf Pawelzik has a degree in Computer Science and has worked for more than 8 years as a software developer specialized in Internet applications for large online communities. At CRP Henri Tudor he is involved in projects related to the study of collaboration communities.

Technological Frameworks for Mobile Home Health Care

Mark Hoeller, Thomas Karopka
IT Science Center Ruegen gGmbH,
hoeller@it-science-center.de; karopka@it-science-center.de
Circus 14, 18581 Putbus, Germany

Abstract: **Many countries are facing the challenge of an aging society. Especially in rural areas new models of home health care are needed to guarantee a basic level of primary health care in the future. Information and communication technology (ICT) tools that support the documentation and communication between health professionals involved in patient management are already highly prevalent in the clinical context. Recent advancements in mobile devices as well as in wireless broadband technologies have opened the way to extend the use of ICT tools to primary health care for immobile patients in remote areas. New research areas like Ambient Assisted Living (AAL), mHealth, Personal Health Systems (PHS) are emerging. Several systems to support mobile home health care have been developed in the last decade. However, these systems have not yet been applied on a broad scale. The gap between research and practice is still very large. The authors will give an overview of systems developed for mobile home health care in Europe in the last decade from a technological point of view. Besides the technical problems there is the problem of sustainability. A system will only be applied successfully in the long run if it is economically feasible. The authors argue that it is a prerequisite for a sustainable system to create a win(n)-situation i.e. all stakeholders gain from the application of the system. One way to accomplish this goal is the use of Free/Libre Open Source Software (FLOSS). FLOSS provides a way of lowering the total-cost-of-ownership (TCO) and providing a modular, flexible, high quality system. The aim of this paper is to describe the challenges and possible solutions for a mobile sustainable platform for primary health care. A special focus will be on the question of how FLOSS can be applied for patient centered home health care. To illustrate a possible solution a prototypical platform based on the open source system MEDICAL will be presented.**

Introduction

In Europe almost all countries are facing the challenge of an aging society. The number of people aged 65 years or over is projected to rise from 84.6 million (17.1%) in 2008 to 151.5 million (30.0%) in 2060 [1].

Several studies have shown that home care is more cost efficient than residential care [2, 3]. In Germany 93 % of the people aged 65 years or above are still living in their own homes and most of them prefer to stay there as long as possible [4]. In recent years there has been a paradigm change towards patient centred care where different health professionals (e.g. physicians, community nurses and home help staff) provide the care in a team oriented, collaborative way. This approach requires the effective cooperation and sharing of information between the stakeholders at the point of care. In the last decade several systems for mobile home care have been developed. This paper reviews some approaches and discusses future challenges.

Systems for team oriented home care

Several projects have developed information and communication technology (ICT) tools to support home health care. In this review the following inclusion criteria were defined:

1. Focus on ICT systems that support collaborative home care
2. Participants: nurses, general practitioners (GP) and patients
3. Use of mobile systems to support nurses at the point-of-care

The objective of the SARAH project [5] was the development of a flexible mobile service platform which supports nursing care and social support in the homes of elderly people in a rural area in North Sweden. A district nurse is supported with a field backpack containing a set of different telemedical devices, videoconferencing equipment and a tablet PC allowing mobile access to the electronic patient records. The SARAH project was carried out in the Norbotton County and relied on UMTS.

WOUNDLOG [6] is a medical teleconsultation service for district nurses, dermatologists and GPs in Enschede, Netherlands, offering live videoconferencing for a district nurse in need of advice from a dermatologist and supports documenting the wound in a multimedia file. The system uses either a WLAN 802.11 or a UMTS/GPRS connection.

The DITIS system from Cyprus [7] supports the dynamic creation, management and coordination of virtual collaborative medical teams for the continuous treatment of chronic patients at home. The system was initiated in 1999 and has since been used for the collaborative treatment of cancer patients in their homes. DITIS uses GSM/GPRS to access the electronic medical records (EMR) of patients at the POC. The team members use smart phones and pocket PCs. The unique feature of the system is the

dynamic creation of collaborative teams involved in the care of a specific patient.

The main purpose of the Swedish project "OLD@HOME - Technical support for mobile closecare"[8] was the development of a virtual health record (VHR) that allows all stakeholders access to the full documentation at the POC. District nurses and GPs were equipped with tablet PCs allowing them to access the VHR through a web interface. Although the test region of the project was a rural, mainly non-urban area, a fibre-optical network infrastructure connected all test sites of the project.

COPLINTHO [9] is a Belgian multi disciplinary project at the Interdisciplinary Institute for BroadBand Technology (IBBT). The project's objective is the development of ICT applications for the support of the care process in the home environment. Apart from the technical aspects, COPLINTHO also considers non-technical aspects like liability and social impact. The system is based on a service-oriented architecture (SOA) using web services. An interactive nurse terminal (INT) based on a PDA and an Interactive Patient Terminal (IPT) are at the core of the system. Video and audioconferencing is supported as well as access to the EHR.

K4CARE [10] is an European FP6 project that has developed knowledge-based home care eServices. The project runs from March 1st 2006 until February 28th 2009. The outcome will be a model as well as a prototypical implementation of the proposed platform.

The aim of the Vitabit [11] project is the development of an ICT platform to support the communication and secure information exchange between all participants in the care process. One innovation of this project is the usage of a digital pen allowing a paper based documentation as well as the transmission of the data into the electronic patient record.

Discussion

Most of the above systems were developed in the context of a funded pilot project. Although industrial partners were involved in the system development the routine implementation in a real-world setting has not been accomplished yet. A major barrier is still the unclear financing of such systems. One solution could be a system developed under an Open Source License. This allows the cost efficient usage and the adaptation to different local needs and circumstances. One Open Source platform that could serve as such a system is the "Medical" system. It is based on Open Enterprise Resource Planning (ERP). Open ERP is used in more than 45 countries and over 350 modules for different purposes are available [12]. "Medical" uses

the base functionality of Open ERP and provides different modules for primary and home care [13].

The ICT platforms for the patient centred care should be open for different participants. Therefore the platform should apply standards if available to allow the integration of practice information systems and nursing documentation systems.

Conclusions

From technological point of view platforms providing the functionality needed for a patient centred care have already been developed in several pilot projects. Major obstacles for a routine implementation are unclear financing and the lack of interoperability between the systems. Existing standards have to be implemented instead of developing new standards.

References

[1] K. Giannakouris, "72/2008 Ageing characterises the demographic perspectives of the European societies," http://epp.eurostat.ec.europa.eu, 2008,

[2] M. Hollander and N. Chappell "Synthesis report – Final report of the national evaluation of the cost-effectiveness of home care," 2002 Available from: http://www.coag.uvic.ca/resources/publications/reports/hollander_synthesis.pdf

[3] A. Bowes and G. McColgan, Smart technology and community care for older people: innovation in West Loathian, Scotland, Department of Applied Social Science, University of Stirling, ISBN: 1-874399-99-9

[4] BFW e.V. BFW-Study: "Housing for Senior Citizens A future task for the European Developers", 2007

[5] S. Andersson, A. Andersson, S. Sävenstedt, "SARAH - Greater Trust in Home-Based Care", Proceedings of the Tromsö Telemedicine and eHealth Conference Tromsö. 2007.

[6] H. Benz, M. Biemans, M. Hettinga, E. Slotboom, J. Schuurman, "WoundLog - A Medical Teleconsultation Service for District Nurses, Dermatologists, and General Practitioners in Enschede". 2004. https://doc.freeband.nl/dsweb/Get/Document-43046/HTSF04%20Benz%20ea.pdf.

[7] A. Pitsillides, B. Pitsillides, G. Samaras, E. Dikaiakos, P. Christodoulou, P. Andreou, et al. "A Collaborative Virtual Medical Team for Home Healthcare of Cancer Patients," Istepanian R, Laxminarayan S, Pattichis C, editors. M-Health: Emerging Mobile Health Systems. Kluwer Academic/Plenum Publishers; 2005, pp. 247-66

[8]. S. Koch, M. Hagglund, I. Scandurra, D. Mostrom, "Towards a virtual health record for mobile home care of elderly citizens," Medinfo 2004; 11(Pt 2):960-3

[9] J. ACKAERT, S. van Hoecke, I. Moerman, E. Laermans, K. van Boxstael, "IBBT-COPLINTHO Innovative communication platforms for interactive eHomeCare," Proceedings of the 5th Workshop on Applications and Services in Wireless Networks, ASWN 2005 Paris, France, 2005

[10] K4CARE http://www.k4care.net.

[11] VITABIT http://www.vitabit.org/2/index.php

[12] Open ERP http://www.openerp.com

[13] L. Falcon and L. Simes, "The Medical Project: Implementing an Open Source HIS in Rural Argentina", IST-Africa 2009 Conference Proceedings

Mark Hoeller studied Medical Informatics at the University of Applied Sciences in Stralsund. There he received his Master's degree. He is working as a research assistant at the IT Science Center Ruegen. He is interested in nursing informatics and personal health records.

Thomas Karopka is head of the eHealth Department of the IT Science Center Ruegen gGmbH, a non profit Company in Northern Germany. He has more than 20 years of experience in ICT. His current research interest is Mobile Systems for home health care, Personal Health systems and Free Open Source Software in Health Care. He is currently chair of the EFMI LIFOSS WG and vice chair of the IMIA OS WG.

Telecardiology

A Framework for the Integration and Homogeneous Management of Electrocardiography Formats

J. D. Trigo[1], A. Kollmann[2], A. González[1], D. Hayn[2], A. Alesanco[1], G. Schreier[2], J. García[1]
[1]University of Zaragoza, Communications Technologies Group (GTC), Aragón Institute for Engineering Research (I3A), jtrigo@unizar.es
María de Luna, 1. 50018 Zaragoza, Spain
[2] AIT Austrian Institute of Technology GmbH,
Safety and Security Department, Reininghausstrasse 13, 8010 Graz, Austria

Abstract: **In recent years, a large variety of protocols and standards have been proposed in the context of digital electrocardiography. This multiplicity generates a clear lack of integration and interoperability in electrocardiogram (ECG) standardization. Some pairwise converters have been proposed and developed but such an approach is not cost-effective, since it requires a large number of mappings. Therefore, to efficiently administer the various formats, some management systems are required. In this paper, a framework for the integration and management of the different ECG formats is proposed. This framework is a Java-based application comprising four main parts: a servlet, an applet, a database and a web page. The primary idea of this approach is to provide with converter classes to a central format. Then, since ECGs are stored in the same format, they can be homogeneously managed, stored and visualized.**

Introduction

The electrocardiogram (ECG) is the most commonly performed cardiac test. With the rapid development of new telemonitoring platforms, the transmission, storage and management of digital ECG signals have turned into major topics of debate and investigation.

In this context, a wide range of standards have been proposed as, for example, the Standard Communications Protocol for computer assisted ElectroCardioGraphy (SCP-ECG), HL7 annotated ECG (HL7 aECG), or Digital Imaging and Communication in Medicine (DICOM). But the list of proposed formats seems to be endless: Medical waveform Format Encoding Rules (MFER), General Data Format (GDF), File Exchange Format (FEF), PhilipsXML, ecgML along with some other XML proposals, etc.

In the literature, several projects covering the relationship between two or more of these standards can be found. Examples of those relationships are:

HL7 aECG with Philips XML [1], SCP-ECG with DICOM [2-3]; or SCP-ECG and HL7 aECG with DICOM [4].

However, this point-to-point approach is not cost-effective, since the number of pair converters required is n*(n-1)/2, whilst with a central format approach the number of converters needed is n (being n the number of involved formats). Besides, hospital management services face up to a challenging problem, since they are forced to cope with several different formats and visualization applications.

Some other initiatives have been already carried out in this integrating direction [5-7], but in [5] there is no central format, in [6] the chosen central format is HL7 aECG and some fields for example from DICOM could not be translated into this format, and in [7] only XML files are considered.

Methods

The proposed framework is based on Java and it comprises four main parts: a servlet, an applet, a database and a web page (Fig. 1). The servlet is in charge of the parsing and subsequent conversion of ECG files into the central format. Thus, it contains the different converters that have been developed. In our framework, we have considered the following formats: SCP-ECG, HL7 aECG, DICOM and Philips XML. The applet is basically the visualizer itself. It displays the ECG signals as well as patient and manufacturer information. It also allows taking measurements on the ECG signal. An applet vastly simplifies the accessibility, since only a standard web browser is required to use the system. Within the database, the ECG files are stored. The database is accessed through the web page (to list the stored ECG) and the servlet (to extract an ECG file or to store a new one). Finally, the web page is used to emulate a Hospital Information System. It interacts with the database, the servlet and the applet.

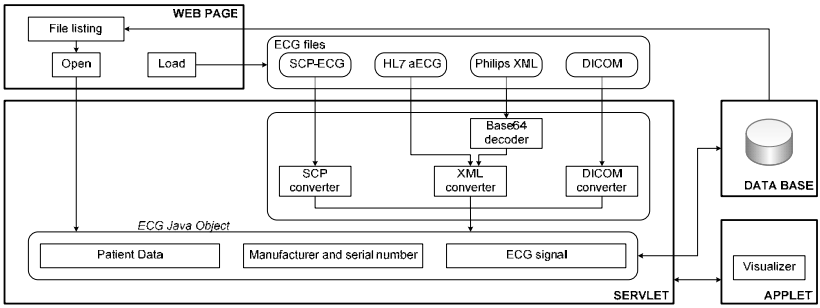


Fig. 1 – Software architecture of the system.

The central Java ECG Class uses an internal XML-based ECG format, which provides versatility and integration. It has been designed by analyzing the common point of the four standards considered.

In Fig. 2 the entity-relationship diagram of the system is shown, including the core classes and methods implemented and the main actions that can be performed. The front-end of the application is shown in Fig. 3.

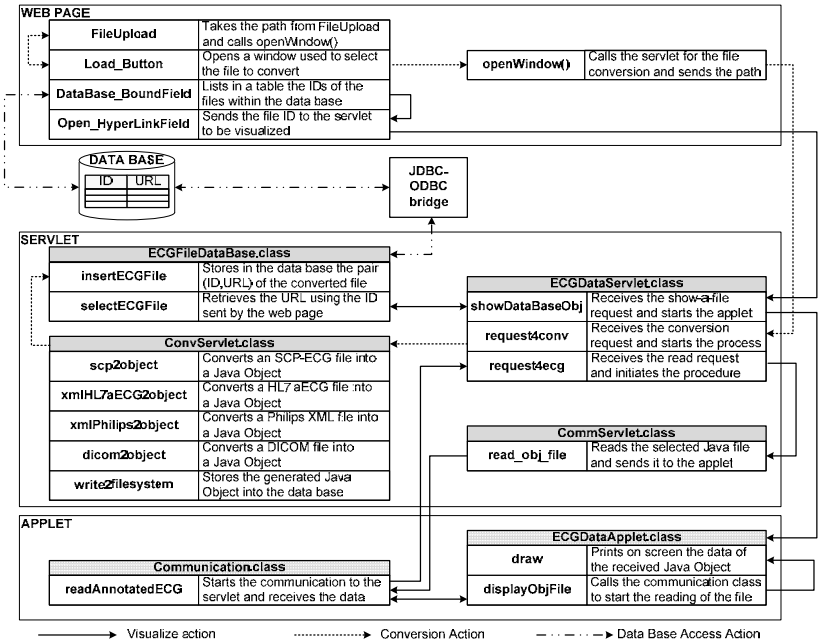


Fig. 2 – Entity-relationship diagram

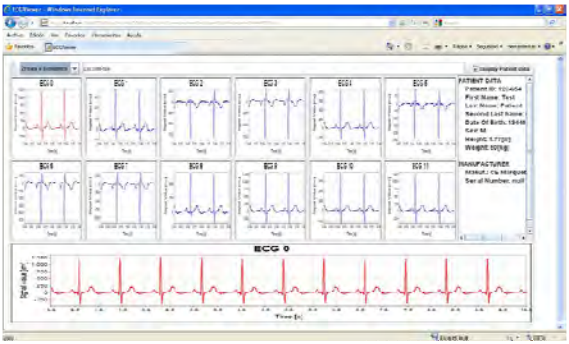


Fig. 3 – ECG visualizer

Conclusions and Future Lines

A framework for the integration and homogeneous management of electrocardiography formats that could arrive to a central hospital server has been designed and developed, solving this way the problem of co-existing ECG formats and avoiding the use of different managers.

After analyzing the varied architectures of the most prominent ECG formats it can be concluded that, in the current context of ECG standardization, there is no consensus regarding neither the structure nor the fields that a digital ECG file should contain. That is the rationale behind the decision of creating a new open central format, able to manage all the different fields of all standards.

The designed framework also provides with modularity (supporting a new ECG format is as easy as developing its converter class) and accessibility (just a web page is required to use the system).

Future lines include adding new converter classes; adding support for comments and annotations; and the design of the central format based on an ECG ontology. Another issue currently under consideration is the inclusion of privacy and security in the system in order to guarantee confidentiality, integrity and origin of the signal.

Acknowledgment

This work was partially supported by projects TIN2008-00933/TSI from *Comisión Interministerial de Ciencia y Tecnología* (CICYT) and *Fondos Europeos de Desarrollo Regional* (FEDER) and PET2006-0579 from *Programa de Estímulo de Transferencia de Resultados de Investigación.*

References

[1] E. D. Helfenbein, R. Gregg, and S. Zhou, "Philips medical systems support for open ECG and standardization efforts," in Computers in Cardiology, 2004, pp. 393-396.

[2] V. Sakkalis, et al., "A gateway between the SCP-ECG and the DICOM supplement 30 waveform standard," in Computers in Cardiology, 2003, pp. 25-28.

[3] L.-L. Wang, N.-N. Rao, L.-X. Pu, and G. Wang, "Developing a DICOM Middleware to Implement ECG Conversion and Viewing," in Engineering in Medicine and Biology Society (IEEE-EMBS), 2005, pp. 6953-6956.

[4] M. J. B. van Ettinger, J. A. Lipton, M. de Wijs, N. van der Putten, and S. P. Nelwan, "An open source ECG toolkit with DICOM," in Computers in Cardiology, 2008, pp. 441-444.

[5] M. de Wijs, M. van Ettinger, S. H. Meij, and S. P. Nelwan, "Integration of multiple ECG databases into a unified framework," in Computers in Cardiology, 2005, pp. 447-450.

[6] P. Marcheschi, A. Mazzarisi, S. Dalmiani, and A. Benassi, "ECG standards for the interoperability in patient electronic health records in Italy," in Computers in Cardiology, 2006, pp. 549-552.

[7] X. Li, V. Vojisavljevic, and Q. Fang, "An XML based middleware for ECG format conversion," Conf Proc IEEE Eng Med Biol Soc, vol. 1, pp. 1691-4, 2009.

Jesús D. Trigo was born in Zaragoza (Spain) in 1981. He received the M.S. degree in Telecommunication Engineering from the University of Zaragoza in 2005, where he is currently a PhD Candidate. His main research interests include eHealth applications and architectures, biomedical informatics, and medical device interoperability and standardization, among others.

Alexander Kollmann received a MSc and a PhD degree in electrical- and biomedical engineering from the Graz University of Technology in 2003 and 2008, respectively. His areas of expertise are in eHealth standardisation (IHE, HL7, etc.), the design of eHealth architectures, and electronic health records. Currently he works as eHealth solution engineer at the ABRAXAS Informatik AG, Zürich, Switzerland.

Alexandra González was born in Alfaro, La Rioja (Spain) in 1983. She received the M.S. degree in Telecommunication Engineering from the University of Zaragoza in 2009. Her main research interests include ECGs standards and formats, management frameworks and ontologies.

Dieter Hayn finished his PhD studies at the University for Health Sciences, Medical Informatics and Technology (UMIT) in 2007. Since 2003 he has been a scientific employee at AIT where he is currently responsible for research on the analysis of biosignals. He has been awarded with the first price in the Computers in Cardiology Challenge for ECG processing algorithm development in 2004 and 2006, respectively.

Álvaro Alesanco received the Master's degree in telecommunications engineering and the Ph.D. degree "with Honors" from the University of Zaragoza. He is currently assistant professor of communication networks in the Telematics Engineering area in UZ and member of the Aragón Institute of Engineering Research (I3A). His research interests are ECG and echocardiography video coding and transmission in wireless e-health environments, network management and other related topics.

Günter Schreier, Head of the eHealth & AAL research field of the AIT Austrian Institute of Technology GmbH. Current research interests: Ambient Assisted Living, telemedicine and eHealth. Scientific and professional activities: Lecturer at two Universities, (co)authored more than 300 scientific publications and presentations, 4 Awards; member of the Board of the Austrian Society of Biomedical Engineering, head of the working group "medical informatics and eHealth" of the Austrian Computer Society, member of the IEEE Engineering in Medicine and Biology Society.

José García is currently Associate Professor and Head of the Department of Electronics Engineering and Communications (University of Zaragoza, Spain). Member of Aragón Institute of Engineering Research (I3A). Founder and responsible of the Telemedicine and e-Health Group in the I3A. Research interests in telemedicine, biomedical signal processing for transmission, e-Health standards, network management and related topics.

AMEDS and PMHS: Technical Innovations for Improvement of Medication Adherence and General Health Care

A. A. Calbo[1], L.van Dijk[2]
[1]SystiMed, calbo101@tele2.nl, GuusTrestorffstraat 22, 1063 VM Amsterdam, The Netherlands
[2]Netherlands Institute for Health Services Research NIVEL, l.vandijk@nivel.nl, Otterstraat 118-124, 3513 CR Utrecht, The Netherlands

Introduction

Patient medication adherence has for a long time been a big problem in healthcare and has been the subject of many research projects in the last decennia. Although some successes have taken place, no real breakthrough has been made to bring a solution for this problem any closer [1]. Telehealth and telemedicine techniques are currently being used in solutions for medication nonadherence with some success [2,3]. AMEDS is a new technical innovation primarily designed as a solution for medication nonadherence. In its extended form, called PMHS, the system is optimally suited to support and enhance the management of healthcare of patients with severe multiple chronic diseases [9].

Medication nonadherence

In response to an initiative of the Dutch governmental healthcare authority a report called "Time for a better use of medication" has been published [2]. In this report an important distinction between several forms of medication nonadherence has been stated:

- Intentional medication nonadherence:
    - Intentional, rational medication nonadherence
    - Intentional, nonrational medication nonadherence
- Nonintentional medication nonadherence

A policy towards reducing medication nonadherence also has been stated in this report to advice the Dutch government: "*…to reduce the intentional, nonrational medication adherence with 50% in the year 2014*". The group of patients with intentional nonrational medication adherence consists of patients who deliberately do not take their medication because of irrational reasons. Mostly these are younger patients. The interventions to accomplish this 50% reduction of medication nonadherence, as stated in the report, lie primarily in enhanced communication and education. An example of this is

the so called “concordance model” as has been formulated by a large number of pharmacological organizations [4,11].

Unfortunately, with the above described policy one important patient group is neglected: patients with nonintentional medication nonadherence. This group of patients consists of people who have the intention to take their medication, but are not able to do this because of physical or cognitive disabilities [5,6]. Mostly this group of patients consists of elderly patients. These patients are most vulnerable: they have to take a large number of different oral medications on a daily basis (polypharmacy), they often have multiple chronic diseases and they are frequently admitted on hospital wards. Due to their inherent disabilities these patients are also vulnerable to have problems with medication adherence and in these situations medication nonadherence can have severe effects and can lead to hospital admissions, need for more or superimposed treatments, more elderly care or even death. There are indications that this group of patients is large and will grow substantially in most Western countries in the near future as it is expected that then the population of these countries will consist of more elderly people [7].

Medication nonadherence is expensive. In the Netherlands it has been estimated that the costs related to medication nonadherence each year are approximately €600-800 million [10]. In the US these costs are estimated to be approximately $300 billion (!) each year [11,12].

In case the population of these countries will consist of more elderly people, as is expected in the near future, these costs will increase substantially. A large portion of the increase of these costs will be related to nonintentional nonadherence. Besides these financial implications it is highly questionable whether health care systems will be able to cope with the increased workload generated by this mechanism, as it is expected healthcare personnel then will be much more scarce.

NIVEL, the Dutch institute for research in healthcare, distinguishes three forms of interventions to enhance and support medication adherence [8]:

- Communicational interventions
- Educational interventions
- Technical interventions

Because patients with nonintentional nonadherence are mostly elderly patients with physical and cognitive disabilities the first two forms of interventions, communicational and educational interventions, can only have minor effects on their medication nonadherence. Due to their inherent

disabilities these patients are best treated by a multidimensional support based on a solid technical solution [6].

AMEDS and PMHS

AMEDS (automated medication dispensing system) and PMHS (personal mobile health system) are innovative technical solutions designed to reduce nonadherence and to support general healthcare management of chronic diseases.

AMEDS is especially designed to support patient care in case of high risks of the occurrence of nonintentional medication adherence. AMEDS consists of patient-bound, mobile dispenser units. As these units are mobile they can be used in almost every situation a patient is in: home situation, during stay in a nursing home or during a hospital admission.

The AMEDS dispenser unit consists of a small computer, electro motors and an ergonomically designed medication chalice. The internal computer has all functionality a regular computer has and all connections regularly found on computers are present. Special medication cartridges (<20) can be attached to the AMEDS dispenser units. These cartridges contain pills (<200) in medication strips. By means of the computer and electro motors the dispenser units are able to expel pills from the medication strips to the medication chalice according to a preprogrammed time/dosage schedule. The dispenser units contain several sensor systems to ensure the pill expel is adequate and safe.

Apart from the purpose of control of the dispensing process by means of the internal computer the dispenser units are also able to communicate with a central server. Authorized health care professionals are able to control the dispenser units by means of the central server or directly by means of a user interface on the dispenser units.

With this system a medical doctor is able to prescribe medication for a patient from a distance (teleprescription) and a pharmacist can be informed by means of the central server to deliver prescribed medication to a patient - in this case medication cartridges to be attached to the dispenser units by the pharmacist. All a patient has to do to take his medication is to react to a preprogrammed voice message or graphic, sound or buzz signal and take the ergonomic medication chalice out of the dispenser unit. This system can thus be characterized as ‘multi-user friendly’.

PMHS is the extended version of the system. In this system the dispenser units contain a more advanced computer and special external adapters. These adapters make it possible to connect other devices to the dispenser

unit. This can be done by two way communication techniques, like USB: input data from these devices can be brought into the dispenser unit or the dispenser unit can send control data to these devices. Although the primary function of PMHS is still dispensing medication, with this system set up the possibilities to support the primary health care process which takes place between medical doctor, patients and other healthcare workers, like pharmacists, are greatly enhanced. Some examples of enhanced possibilities of PMHS:

- Advanced medication prescription support for medical doctors.
- Dispensing and/or monitoring intake of non oral medication, like inhalation medication or injection fluids.
- Telediagnostics and telemonitoring: weight, blood pressure, INR, heart rhythm, blood sugar, electrolytes, FEV1 value, etc.
- Enhanced teleconferencing with desktop sharing.
- Advanced patient information applications supporting the medication dispensing process.

Research projects with AMEDS and PMHS

Research projects with AMEDS and PMHS are designed to study effects of these systems in current practical patient care with special focus on medication nonadherence and efficiency of treatment.

Example of using AMEDS in a clinical trial: Vitamin K antagonist therapy is being done with cumarin derivatives, like fenprocoumon, acenocoumarol, or warfarin. This therapy has special characteristics: regular INR measurements have to be performed and complications, like bleedings, thrombo-embolic problems or medication interactions are structurally registered. This is especially so in case the treatment is done by services, like the thrombosis foundation in the Netherlands.

Due to the special characteristics of vitamin K antagonist therapy medication nonadherence amongst these patients is much more visible for healthcare workers than amongst patients with other forms of therapy. Currently a research project is being set up in which a small group of patients using vitamin K antagonist therapy are treated by means of a simplified form of AMEDS.

Example of using PMHS in a clinical trial: Patients with congestive heart failure are often polypharmacy patients. The medication of these patients are best given in relation to clinical parameters. These parameters include the physical exam, like auscultation of the heart or assessment of ankle edema, or other parameters, like measurement of potassium. In these

situations PMHS can be of great value. Apart from teleprescription and support for medication adherence with PMHS certain essential parameters, like weight, blood pressure and electrolytes are suitable to be monitored from a distance (telemonitoring). This can make the treatment much more efficient. In a clinical trial PMHS will be used to support the treatment of a small group of patients with congestive heart failure.

Conclusion

AMEDS and PMHS are state-of-the-art systems based on the most modern techniques currently available. The systems are designed to reduce medication nonadherence and can greatly enhance communication of patients and healthcare workers. In case these systems are implemented well the impact on healthcare systems can be of utmost value.

References

[1] P. van Megchelen et al, Report: Signals – Good use of medication, ZonMW, the Netherlands, 2009. (in Dutch)

[2] Project Advisory Group "Quartermaker Adherence", Time for a better use of medication, 2008. (in Dutch)

[3] E. C. Wetzel et al, thesis: Patient Compliance in Hypertension; from Measurement to Improvement, Fac. Geneeskunde Universiteit van Maastricht, 2006.

[4] Teichert M, Wit H de, Janssen J, Vermaat H, Recipe for medication adherence, Pharm Weekbl 2008; (12):20. (in Dutch)

[5] K. Insel, D.Morrow et al, Executive function, working memory and medication adherence among older adults, Journal of gerontology: psychological sciences (2006) Vol. 61B, No 2, P102-P107.

[6] M.D. Murray et al, a conceptual framework to study medication adherence in older adults, The American Journal of Geriatric Pharmacotherapy (2004) Vol. 2, nr. 1 p 36-43.

[7] G.C.N. Beets, C.M. Fokkema, Misunderstandings about elderly population increase, NIDI/DEMOS, 2009. (In Dutch)

[8] L. van Dijk, S. van Dulmen, J. Bensink, Made to measure: theoretical and empirical analysis, NIVEL, pharmaceutisch weekblad (2007) nr. 5, p22-25. (in Dutch)

[9] A.A. Calbo, AMEDS and PMHS; Innovative systems to enhance and support cure and care, 2009, Http://SystiMed.com.

[10] M. Dutrée et al, Newsletter: Costs of medication adherence in the Netherlands, Nefarma, the Netherlands, 2004 (in Dutch)

[11] Pharmacy Guild of Australia; Improving medication compliance - literature review, 2008.

[12] New England Healthcare Institute, High costs seen in medication nonadherence: study. August 2009.

Arthur A Calbo worked in the medical field in a broad scope of disciplines: general surgery, internal medicine, cardiology, A&E, orthopedics, experimental surgery and geriatrics. In recent years he was very much engaged as a teacher of clinical skills for senior medical students. He is part of the medical staff of the thrombosis Foundation Netherland and currently is president of SystiMed BV.

Cross-border Home-monitoring of Heart Failure Patients in Luxembourg and North Rhine-Westphalia

N. Rösch[1], P. Harpes[1], S. Kohler[1], C. Moll[1], D. Wagner[2], R. Beckers[3], T. Feige[4], B. Gräfe[4], O. Wagner[4], M. Werner[4], H. Körtke[4]
[1]Public Research Center Henri Tudor, norbert.roesch@tudor.lu
29, avenue John F. Kennedy, Luxembourg
[2]Centre Hospitalier de Luxembourg, 4 rue Barblé, Luxembourg
[3] ZTG Zentrum für Telematik im Gesundheitswesen GmbH,
Universitätsstraße 142, D-44799 Bochum, Germany
[4] IFAT Institut für angewandte Telemedizin Universitätsklinik
der Ruhr-Universität Bochum am Herz- und Diabeteszentrum NRW,
Georgstrasse 11, D-32545 Bad Oeynhausen, Germany

***Abstract*: The adjustment of the Healthcare Systems to the increasing number of chronic diseases is one of the biggest challenges to the European Union. Especially in the rural regions of Europe it is not secured that all parts of the population have equal chances to get adequate care. Congestive heart failure (CHF) has become an important health problem in the western world. CHF is the leading cause of hospitalisation for patients over the age of 65. Current medical therapy has only a modest effect on morbidity and mortality. The most effective therapy for end-stage CHF is cardiac transplantation. However, because of limited donor organ supply, transplantation is limited to younger patients. Numerous scientific studies prove that telemedicine improves the observation of chronically ill patients and can lower healthcare expenses. For smaller countries like Luxembourg, cross-border telemedicine can lead to a cost-effective and improved disease management, but it requires new approaches in ambulatory care and highest standards in data security and data protection.**

Introduction

The adjustment of the Healthcare Systems to the increasing number of chronic diseases is one of the biggest challenges to the European Union. Especially in the rural regions of Europe it is not completely secured that all parts of the population have equal chances to get adequate care for their diseases. The use of communication and information technologies allows offering medical services over great distances. With that, extended parts of

the population can be provided with specialized health services in a health economically reasonable way.

Congestive heart failure (CHF) has become a health problem of epidemic proportion in the western world and is a leading cause of hospital admission. Current medical therapy has only a modest effect on morbidity and mortality. Today, the most effective therapy for end-stage CHF is cardiac transplantation. However, because of limited donor organ supply, transplantation is limited to younger patients.

Numerous scientific studies prove that telemedicine improves the observation of chronically ill patients and can lower healthcare expenses. The TEN-HMS (Trans-European Network initiative – Home-Care Management Systems) study was one of the first large scale randomized prospective telemonitoring trials (426 patients). The study showed that telemonitoring reduces the number of hospital days by 26% and led to an overall 10% cost-saving compared to nurse telephone support.

With the help of the Luxemburgish Fonds National de la Recherche (FNR) the Public Research Centre Henri Tudor has developed a patented device for the homemonitoring of CHF patients (MonICard). This system contains die measurement of blood pressure, heart rate, weight, oxygen saturation and pulse transit time (PTT). PTT reflects the peripheral resistance within the vessels. The peripheral resistance of cardiac patients rises with the degree of severity of their disease and seems to be particularly interesting for high-risk patients.

Fig. 1: MonICard Home monitoring device with PTT measurement

Selected target groups

For CHF patients who are waiting for a cardiac transplantation the identification of a suitable recipient for the scarce donor hearts is of vital importance for the therapy's success and the optimal use of the scarce hearts. About 30% of the patients die while on waiting lists, about 20% of the transplant recipients die during their first year after the transplantation from an uncontrollable rejection reaction. It should be figured out, if the inset of the MonICard home monitoring system helps to detect beginning rejections and to allow timely interventions.

Another application of cross-border telemedicine is the telemonitoring of therapeutic anticoagulation in case of arterial fibrillation. Patients always need anticoagulation therapy after valvular heart operations. Oral anticoagulation takes place by regularly taking tablets, whose dose is set based on the regular taking of blood samples for the determination of the INR. A too low INR increases the risk of an embolism, which can lead to apoplexy, heart attack and death; a too high INR can lead to life-threatening internal hemorrhages. Therefore the determination of the INR-level of chronically ill patients is carried out by the patient himself (the procedure resembles that of blood sugar measurement) and telemedically transmitted to the medical care center.

Establishment of a cross-border telemonitoring pilot project

For an ideal care of heart patients it is important that threatening health statuses are quickly recognized. Currently an own telemedical center would hardly be cost-effective for Luxemburg. A consortium has been set up constituted of the Centre de Recherche Public Henri Tudor, the Centre Hospitalier de Luxembourg, the IFAT (Institut für angewandte Telemedizin Bad Oeynhausen, NRW) and the ZTG (Zentrum für Telematik im Gesundheitswesen). IFAT has already established this telemedical service and can take over the observation of appropriate patients from Luxemburg. Within the pilot implementation, adequate workflows need to be elaborated to assign duties and responsibilities of all partners. The ZTG from NRW is scheduled for the neutral coordination of this task. Cross-border telemedicine requires as well highest standards in data security and data protection. The processes of collecting, sending and storing the medical data have to be adapted to a multinational setting.

Preliminary conclusion

The same access to high-end-medicine for all citizens is one of the aims of the European Social Model. Telemedicine will play major role in the future, because fewer physicians will have to take care of more and heavier affected patients. Telemedicine offers many advantages, but besides compatible medical-technological solutions, comparable structures of accounting must be created in the EU-member states. Furthermore clear regulations for a cross-border transfer of the patients' personal data are required.

Acknowledgements

The authors thank the Governments of Luxembourg and North Rhine-Westphalia for their administrative and financial support.

References

[1.] Ho KK, Pinsky JL, Kannel WB, et al. The epidemiology of heart failure: the Framingham study. *J Am Coll Cardiol* 1993;22:6-13A

[2.] Wagner D., Rösch N.: Pulstransitzeit bei chronischer Herzinsuffizienz, in: Goss u.a., Praktische Telemedizin in Kardiologie und Hypertensiologie , ISBN 9783131499318, Georg Thieme Verlag 2009

[3.] Zannad F, Braincon S, Juilliere Y, et al. Incidence, clinical and etiologic features, and outcomes of advanced chronic heart failure: the EPICAL study. *J Am Coll Cardiol* 1999;33:734-742

[4.] Rich MW, Becham V, Wittenberg C, et al. A multidisciplinary intervention to prevent the readmission of elderly patients with congestive heart failure. *N Engl J Med* 1995;333:1190-1195

[5.] Kasper EK, Gerstenblick G, Hefter G, et al. A randomized trial of the efficacy of multidisciplinary care in heart failure outpatients at high risk of hospital readmission. J am Coll Cardiol 2002;39:471-480

[6.] Stewart S, Marley JE, Horowitz JD. Effects of a multidisciplinary, home-based intervention on unplanned readmissions and survival among patients with chronic congestive heart failure: a randomized controlled study. *Lancet* 1999;354:1077-1083

[7.] Kimmelstiel C, Levine D, Perry K, et al. Randomized, controlled evaluation of short- and long-term benefits of heart failure disease management within a diverse provider network. *Circulation* 2004;110:1450-1455

[8.] McAlister FA, Stewart S, Ferrua S, et al. Multidisciplinary strategies for the management of heart failure patients at high risk for admission. *J Am Coll Cardiol* 2004;44:810-819

[9.] Cleland JG, Louis AA, Rigby AS, et al. Noninvasive home telemonitoring for patients with heart failure at high risk of recurrent admission and death: the Trans-European Network-Home-Care Management System (TEN-HMS) study. *J Am Coll Cardiol* 2005;10:1665-1666

[10.] Arnold JM, Marchiori GE, Imrie JR, et al. Large artery function in patients with chronic heart failure. *Circulation* 1991;84:2418-2425

Improving Automated External Defibrillators Usage with Telecommunication Solutions – A Pilot Project for European Agglomerations

A. Cacko[1], M. Grabowski[1], K. J. Filipiak[1], G. Opolski[1]
[1]1st Department of Cardiology, Medical University of Warsaw,
andrzej.cacko@gmail.com
1a Banacha St, 02-097 Warsaw, Poland

Abstract: **Sudden cardiac arrest (SCA) remains leading cause of death in Poland and in the world. Victims prognosis in SCA is poor despite efforts. Especially poor is prognosis of victim with out-of-hospital SCA – only 5% survive to discharge. According to American Heart Association (AHA) and European Resuscitation Council (ERC) early defibrillation is a part of "chain of survival", sequence of actions crucial for survival of victim with SCA. Public access to Automated External Defibrillators (AED) is recommended, however lack of knowledge about device presence reduces possible benefit of AED public access programs. AED Location System (ALS) was designed to counteract this problem by providing information about devices situation. ALS is being initiated in the city of Warsaw – the capital of Poland with about 2 million citizens and over 120 AED devices. ALS provides information about position of all devices on the interactive map of Warsaw. Moreover, additional system is prepared with collaboration of telecommunication company allowing to receive information about the nearest AED device via Short Message System (SMS) in answer to free of charge empty SMS. Both solutions are being implanted and evaluated in improving knowledge about device location and AED usage.**

Introduction

Sudden cardiac arrest (SCA) remains leading cause of death in Poland and worldwide [1,2]. Every year about 700 000 Europeans die due to SCA. The risk of SCA in general adult population remains stable at 1 case per 1000 persons per year. Especially poor is prognosis of victim with out-of-hospital SCA – only 5% survive to discharge. American Heart Association (AHA) and European Resuscitation Council (ERC) promote a sequence of actions crucial for survival of victim with SCA - "chain of survival" [3]. Early defibrillation is a part of this sequence. The mechanism of more than 40% of all SCA is ventricular fibrillation (VF) or ventricular tachycardia (VT) without pulse, when defibrillation is indicated. In these cases every

minute delay in defibrillation results in 10-15% decreasing of patients chances for survival to discharge [4,5].

Fig. 1. Chain of survival. Adapted from European Resuscitation Council [3].

In common document European Society of Cardiology (ESC) and ERC recommended public access to defibrillation with Automated External Defibrillators (AEDs) and proposed models of AED access [6]. AED is a simply in use device which analyzes heart rhythm and delivers discharge when indicated. AEDs should be located in places, where risk of SCA is at least 1 case per 2 years.

Availability of AED in the City of Warsaw, Main Reason of Low Usability

In the beginning of year 2009 Authors initiated study which aim was to list all the AED in the city of Warsaw [7]. Over 120 devices were found. AEDs are located at the airport, in some of the shopping centers, underground stations, authorities offices, sport centers and museums. Meantime two benefits were performed presenting proper AED usage and results of our study for citizens of Warsaw.

During research and benefits main reason of low AED usability were noted. One of them was insufficient knowledge about proper AED usage and exact device location.

AED Location System

AED Location System (ALS) is a pilot study implanted in the city of Warsaw as an European agglomeration. ALS was designed to counteract the problem of lack of knowledge about AED devices location. The aim of the project are collecting and presenting the data about all AED devices in the city of Warsaw. Access to database is granted with interactive city map for every internet user after logging. A part of ALS portal is an internet course of cardiopulmonary resuscitation with AED based on current ERC guidelines.

Moreover, additional system is prepared with collaboration of telecommunication company which allows to receive information about the nearest AED device via Short Message System (SMS) in answer to free of charge empty SMS.

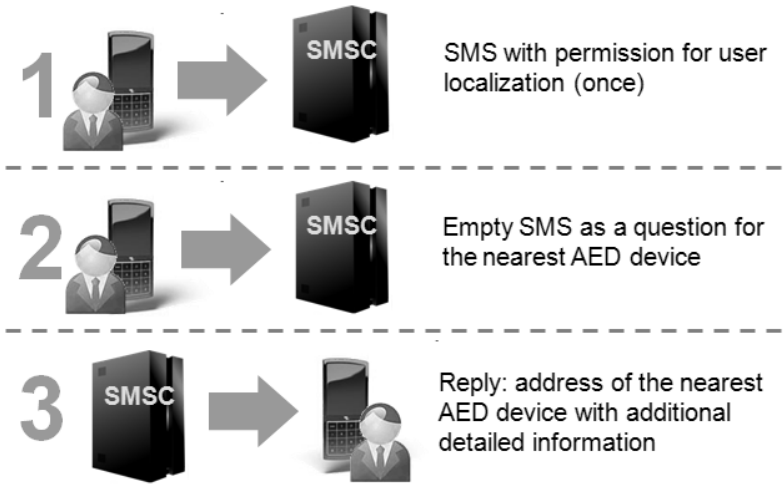


Fig. 2. SMS Center (SMSC) coordinating reporting about the nearest AED.

Evaluation process

The main term of ALS importance is high reliability of the data. Essential for ALS usability are gathering information about all devices and regular data actualization.

The rank of ALS and its influence on citizens safety are conditioned by number of users measured as activity in data input and output. Every user is allowed to add proposition of new location, which is verified by data administrator. Data may by review using internet city map or SMS system. All the information about proper cardiopulmonary resuscitation with and without AED will by available online in educational platform. The data about intervention with AED will be collected during research period to compare AED usage at baseline and after 36 months of the study.

The last part of evaluation process will be initiating ALS in selected other Polish agglomerations on ground of experience and solutions tested in the city of Warsaw.

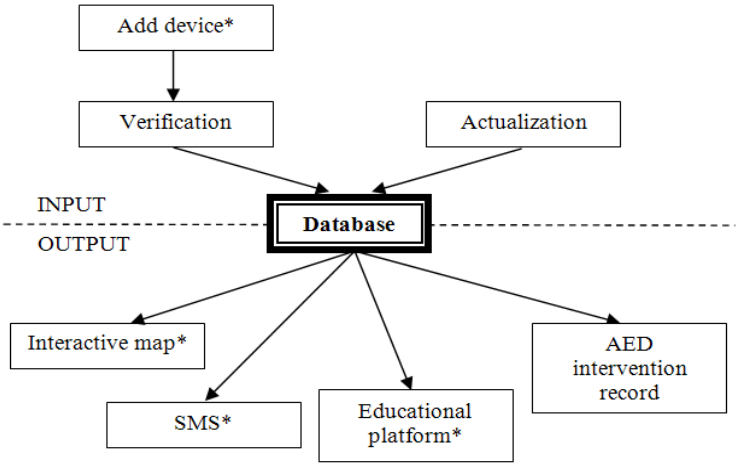


Fig. 3. Structure of ALS: input and output interface. * User activities.

Conclusions

ALS is a pilot project which aim is to provide information about all AED devices in the area. ALS is prior being initiated in the city of Warsaw, but a part of evaluation process is to incorporate selected other Polish agglomerations. Positive impact of telecommunication solutions on AED availability and usability may result in citizens safety improvement.

References

[1] Cobb LA, Fahrenbruch CE, Olsufka M et al. "Changing incidence of out-of-hospital ventricular fibrillation, 1980-2000". JAMA 2002;288:3008-13.

[2] Sans S, Kesteloot H, Kromhout D. Task Force of the European Society of Cardiology on Cardiovascular Mortality and Morbidity Statistics in Europe. "The burden of cardiovascular diseases mortality in Europe". Eur Heart J 1997;18:1231-48.

[3] Nolan JP. "European Resuscitation Council Guidelines for Resuscitation 2005. Section 1: Introduction". Resuscitation 2005;67 (Suppl. 1). S3-6.

[4] Valenzuela TD, Roe DJ, Cretin S et al. "Estimating effectiveness of cardiac arrest interventions: a logistic regression survival model". Circulation 1997;96:3308-13.

[5] Waalewijn RA, De Vos R, Tijssen JGP et al. "Survival models for out-of-hospital cardiopulmonary resuscitation from the perspectives of the bystander, the first responder, and the paramedic". Resuscitation 2001;51:113-22.

[6] Priori SG, Bossaert LL, Chamberlain DA et al. "ESC-ERC recommendations for the use of automated external defibrillators (AED) in Europe". Eur Heart J 2004;25:437-445.

[7] Cacko A, Wyzgał A, Galas A, Grabowski M, Filipiak KJ, Opolski G. "Availability of automated external defibrillators in the city of Warsaw – status for May 2009". Kardiol Pol 2010; 68: 41-46.

Marcin Grabowski is resident doctor and senior assistant at 1st Department of Cardiology, assistant and lecturer at Department of Medical Informatics and Telemedicine, Medical University of Warsaw. Supervisor of Students Research Groups. At present President of Informatics Committee of Polish Cardiac Society and Fellowship of European Cardiac Society. Main science and clinical interest in acute coronary syndromes, intensive cardiac care, biochemical markers in cardiology and telemedicine.

Andrzej Cacko is trainee doctor at Central Hospital of Medical University of Warsaw. In years 2008-2009 V-ce President of Students Research Groups at 1st Department of Cardiology and at Department of Medical Informatics and Telemedicine, Medical University of Warsaw. Since 2008 Member of Polish Society of Cardiology. Interested in acute coronary syndromes, sudden cardiac death prevention and implementation of telemedicine solutions.

Is It Possible to Optimize Treatment of Patients with Acute Coronary Syndrome Using Telemedicine? – A Kardionet Solutions

M. Grabowski[1,2], R. Rudowski[2], J. Sierdziński[2], A. Cacko[1,2], G. Opolski[1], M. Niezgódka[3]
[1]1st Department of Cardiology, Medical University of Warsaw, andrzej.cacko@gmail.com
1a Banacha St, 02-097 Warsaw, Poland
[2] Medical Informatics and Telemedicine, Medical University of Warsaw, 1a Banacha St, 02-097 Warsaw, Poland
[3] Centre for Mathematical and Computational Modelling Warsaw University, 93 Żwirki i Wigury St, 02-089 Warsaw, Poland

Abstract: **Cardiovascular diseases (CVDs) remains the most common cause of death worldwide with the most frequent and dangerous acute coronary syndrome (ACS), particularly myocardial infarction (MI). According to current guidelines in case of ACS time to diagnosis and treatment initiation is crucial. Kardionet is a solution for accelerating process of ACS diagnosis and treatment in situation of centralized cardiology service and spread emergency (ER) and healthcare providers, like in Mazovia district (Central Poland). Kardionet provides connection between ER units, local hospitals and cardiology center. Selected ER units have been equipped with Lifepack defibrillators, which provide electrocardiography (ECG) transmission and tablets for patients data input. In case of ACS suspicion ER unit may transfer patients data together with current ECG to cardiologist on duty via mobile phone with internet connection. Teleconsultation results in patients risk stratification and referring to local hospital or cardiology centre with fulltime invasive cardiology service. Similar teleconsultation is offered to local hospital and may result in high risk patients transfer for treatment or examination. For improving patients data collection and transfer Electronic Patients Record (EPR) has been developed, where patients personal data, medical history, current condition and results of imaging examinations and laboratory tests are set. EPR is supplied with Expert System (ES) module providing rapid patients risk stratification on the ground of current guidelines with high compatibility between ES suggestions and cardiologist treatment decisions in initial assessment of reliability. High utility of ECG transmission, novelty of EPR and high reliability of ES makes Kardionet a very usefulness tool which may result in improvement of ACS patients prognosis.**

Introduction

Among all causes of death in developed and developing countries the most common are cardiovascular diseases, with the most frequent presentation – acute coronary syndrome (ACS) [1]. Particularly dangerous ACS is myocardial infarction (MI), necrosis of heart muscle due to ischemia. According to current guidelines in ACS time from symptoms onset to diagnosis and proper treatment initiation is crucial [2]. For the most cases invasive treatment is the management resulting in the best prognosis. Often the only invasive cardiology centers are located in big cities.

Kardionet is a system created to establish full time communication between invasive cardiology centers, local health providers and emergency (ER) ambulances. Currently it is validated in Mazovia district (Central Poland) and coordinated by 1st Department of Cardiology of Medical University of Warsaw.

Kardionet Infrastructure

Kardionet was based on readily available telecommunication infrastructure. Selected ER units have been equipped in Lifepack defibrillators offering electrocardiography (ECG) transmission, which was assessed as relevant technique [3] and tablets connected by bluetooth with mobile phone with internet connection. Local hospitals are involved into infrastructure by internet connections providing bandwith 512 kbits/s. Faster connections are arranged to enabled imaging data transmission.

In case of ACS suspicion ER unit may transfer patients data together with current ECG to cardiologist on duty in cardiology center. During teleconsultation cardiologist assesses patients risk and decide about referring to local hospital or cardiology centre with fulltime invasive cardiology service. Similar teleconsultation is offered to local hospital and may be used for high risk patients consultation and transfer for treatment or examination, which may not be proceed locally.

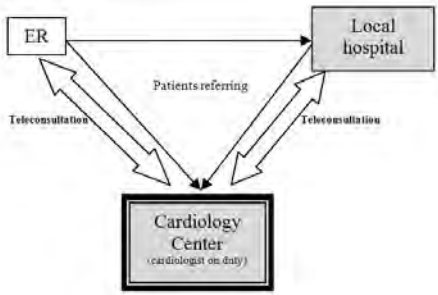


Fig. 1. The structure and idea of Kardionet.

Electronic Patients Record

Full access has been established to patients medical history, present condition and results of his laboratory tests and other examinations with developing of Electronic Patient Record (EPR). EPR is initiated with patients admission by ER unit or local medical provider and completed during hospitalization. EPR consists of two parts: personal data forms and medical data forms (case history, diagnosis, physical examination, transfer events, additional tests and drugs). Special form, called Minimal Cardiological Data Set (MCDS) has been added to obtain as fast as possible consultation in emergency condition. Crucial data fulfilling time does not exceed 5 minutes.

Additional Expert System (ES) module has been implanted to enable rapid patients risk stratification on the ground of current guidelines.

In case of justified ACS suspicion teleconsultation consequence in directly patients admission to cardiology center on behalf of ECG and patients medical data from EPR. System usability has significantly improved by implanting ECG transmission module from ER ambulance to cardiologist on duty using Lifepack defibrillators. In the future efficient transmission of imaging data in DICOM (Digital Imaging and Communications in Medicine) format via 1 Gbits/s connection may result in higher availability of echocardiography, magnetic resonance or computer tomography. The rank of imaging examinations in cardiology and entire medicine has increased in the last years which was confirmed by the new universal MI definition where results of imaging examinations (like echocardiography or computer tomography) may be proofs of hears muscle necrosis with this same strength as results of ECG.

Kardionet in Mazovia District – First Appearance

Kardio.net is being successfully implanted in Mazovia district. All transferred patients data are storage in healthcare providers' databases where it was produced, and available from every part of the system with www interface. One of the principle of the Kardionet is data storage in medical center where it was produced, which is necessary because of Polish legal regulations. After successful logging access to the data is granted only for medical staff treating patient actually or in the past. Recorded data of patients may represent ACS cases from Mazovia district. The initial assessment of ES reliability resulted in high compatibility between ES suggestions and cardiologist treatment decisions. The main difficulty was insufficient computer literacy among the medical staff but medical personnel was positively motivated for feeding the patients data into the

system. Positive results of ECG transmission from ER units to cardiologist on duty has been previously reported, by Polish cardiology centers also [4,5]. Kardionet is much more developed and complicated system providing transmission of much more patients data, unified EPR module and completed during entire hospitalization and allowing access to in

Conclusions

High utility of ECG transmission, novelty of EPR and high reliability of ES makes Kardionet a very usefulness tool.

Its utilization is dependent on results in shortening the time from ACS recognizing to cardiologist consultation finalized with successful treatment and improvement of patients prognosis.

References

[1] "Top ten causes of death". Fact sheet No 310/November 2008. World Health Organization 2008. http://www.who.int/mediacentre/factsheets/fs310_2008.pdf

[2] Van de Werf F, Bax J, Betriu A et al. Management of acute myocardial infarction in patients presenting with persistent ST-segment elevation: the Task Force on the Management of ST-Segment Elevation Acute Myocardial Infarction of the European Society of Cardiology, "Management of acute myocardial infarction in patients presenting with persistent ST-segment elevation". Eur Heart J 2008; 29: 2909-45

[3] Dhruva V.N., Abdelhadi S.I., Anis A. et al., 2007. "ST-segment analysis using wireless technology in acute myocardial infarction trial". J. Am. Coll. Cardiol. 50: 509-513

[4] Bradley E.H., Herrins J.P., Wang Y. et al., 2006. "Strategies for reducing the door-to-balloon time in acute myocardial infarction". N. Engl. J. Med. 355: 2308-2320

[5] Karcz M., Rużyłło W. "Nowe metody w diagnostyce i terapii. Bezpośredni transport pacjentów z zawałem serca do pracowni hemodynamicznej z ominięciem najbliższego szpitala po teletransmisji EKG – doświadczenia z programu pilotażowego na Mazowszu". Post. Kardiol. Inter. 2005; 1, 2: 107-113.

Marcin Grabowski is resident doctor and senior assistant at 1st Department of Cardiology, assistant and lecturer at Department of Medical Informatics and Telemedicine, Medical University of Warsaw. Supervisor of Students Research Groups. At present President of Informatics Committee of Polish Cardiac Society and Fellowship of European Cardiac Society. Main science and clinical interest in acute coronary syndromes, intensive cardiac care, biochemical markers in cardiology and telemedicine.

Andrzej Cacko is trainee doctor at Central Hospital of Medical University of Warsaw. In years 2008-2009 V-ce President of Students Research Groups at 1st Department of Cardiology and at Department of Medical Informatics and Telemedicine, Medical University of Warsaw. Since 2008 Member of Polish Society of Cardiology. Interested in acute coronary syndromes, sudden cardiac death prevention and implementation of telemedicine solutions.

Multiclass Classification of Heart Rate Patterns for Identification of Sleep Stages Using Computational Grids

A. Varoneckas[1], G. Varoneckas[2,3], A. Zilinskas[4]
[1]Faculty of Applied Informatics, a.varoneckas@if.vdu.lt,
Vytautas Magnus University, Vileikos Str. 8, Kaunas, Lithuania
[2]Institute of Psychophysiology and Rehabilitation, giedvar@ktl.mii.lt,
Vyduno Str. 4, Palanga, Lithuania
[3]Mechatronics Science Institute, Klaipeda University, giedvar@ktl.mii.lt,
Herkaus Manto Str. 84, Klaipeda, Lithuania
[4]Institute of Mathematics and Informatics, antanasz@ktl.mii.lt,
Akademijos Str. 4, Vilnius, Lithuania

Abstract: **Directed acyclic graph based multiclass classifier is applied to the problem of identification of sleep stages using heart rate information. Efficiency and reliability of the classifier implemented in Grid environment are investigated. The best classification rate was obtained using polynomial or RBF kernel function, however the training time was faster using RBF kernel function.**

Introduction

Heart rate variability analysis is widely explored in many fields of modern medicine, especially in cardiovascular, pulmonary and sleep clinics. For the diagnostics of sleep related disorders assessment of sleep structure is very important. Contemporary methods are based on polysomnography, however this method is extremely time-consuming and expensive. The results of the recent investigations show dependence between heart rate characteristics and sleep stages. Heart rate variations during the shifts of sleep stages might be a basis for the assessment of sleep stages. The procedure of heart rate (RR intervals) recording is relatively cheap, as compared with a full polysomnography, and might be easily implemented in a hospital and home environment.

In the present paper the results of the experimental investigation of the identification of sleep stages using heart rate data are presented. The records of RR interval sequences during sleep recently published on the Internet (http://www.pri.kmu.lt/datbank/) have been used as experimental data [1, 5].

Identification of sleep stages based on RR interval time series is a multiclass classification problem. Sleep consists of six different states – four stages of non-REM sleep, REM sleep, and wakefulness after sleep onset. Sleep stages can be identified by classification of parameters extracted from RR interval time series. In the experiments we used the following linear parameters of RR time series: mean value, standard deviation, very low frequency, low frequency, high frequency components of power spectrum and ratio between low and high frequencies. Besides of linear parameters the following parameters of non linear dynamics have been taken into account: approximate entropy, sample entropy, short term and long term fluctuation slopes estimated by DFA.

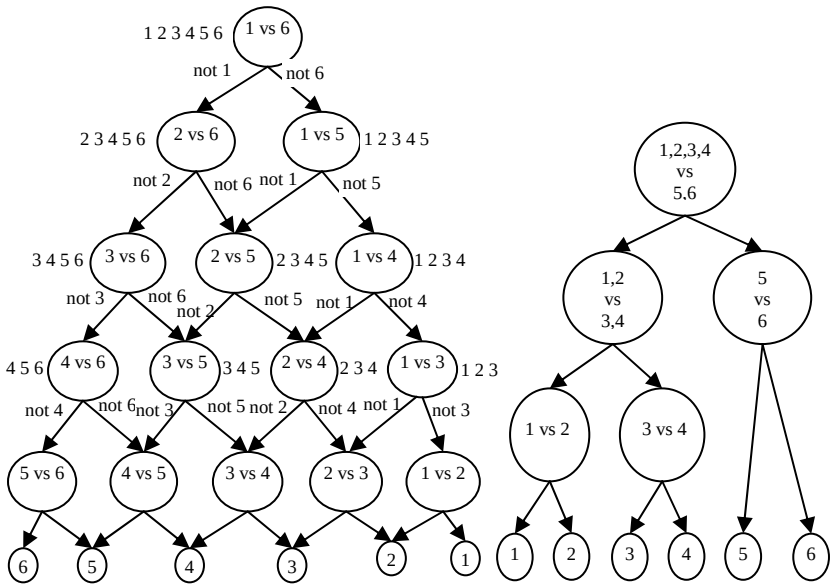


Fig. 1. Full DAG for multiclass classification of six sleep stages. DAG of grouped vertices.

The multiclass problem of identification of sleep stages using RR interval data is reduced to into a set of binary classification problems and then the binary classifications are combined to obtain multi-class classification. The most common approach to multiclass classification one-versus-all, one-

versus-one and DAG methods [2, 3]. One-versus-all approach assumes that for each class there exist a standard binary classifier which separates that class and all other classes. For one-versus-one method the number of (k(k-1))/2 binary classifiers were constructed. An example belongs to the class which assigns to it the highest value. Full DAG algorithm for classification of six sleep stages and DAG of grouped classes are presented in Figure 1. The DAG of grouped classes is formed according sleep stages structure. The main node classifies four stages of non-REM sleep versus REM sleep and wakefulness. Then non-REM sleep is classified into classes 1st and 2nd versus 3rd and 4th.

The multiclass classification problem is reduced to a number of binary classification problems solved in parallel applying Grid computing paradigm. Grid environment can be composed of supercomputers, high performance computing clusters, clusters of personal computers.

Our experimental investigation has been done using the infrastructure of the LitGrid with gLite middleware. Workload Management System (WMS) in gLite [http://glite.web.cern.ch/glite/] is responsible for the distributing and managing jobs across computational resources available on the Grid. The jobs in gLite WMS are defined using Job Description Language (JDL). The multiclass classification was implemented by adapting the SVM light [4] to Grid environment and distributing binary classifiers using DAG type of jobs.

Experimental Results

The Gridified multiclass classification has been used for the classification of six states (1-4 sleep stages, REM sleep and wakefulness) using heart rate data. Experiments were done on two sleep data sets, see table 1.

Table 1. Data sets.

Data set	# training data	# testing data	#attributes
Set 1	252	108	12
Set 2	3448	1477	12

For each data set we estimate accuracy using linear, polynomial and radial basis kernel functions and different parameters γ and C. The summarized results of classification accuracy comparing two methods are shown in Table 2. The classification accuracy is very similar. The best classification rate in data set 2 was obtained using polynomial or RBF kernel function, however the training time was faster using RBF kernel

function. The training time doesn't include the time spent in Grid queues and schedulers.

Table 2. Classification results.

Problem	Full DAG			DAG of grouped vertices		
	Training time	#SVs	Rate	Training time	#SVs	Rate
Linear kernel function						
Set 1	2.51	61	70.91%	1.72	55	73.61%
Set 2	107.15	1678	82.46%	84.62	1573	81.94%
Polynomial kernel function						
Set 1	5.58	57	83.68%	3.24	69	86.63%
Set 2	862.34	1746	91.54%	792.82	1634	91.13%
RBF kernel function						
Set 1	3.48	37	88.47%	2.74	45	82.42%
Set 2	761.52	1342	89.33%	743.59	1476	91.38%

Conclusions

Gridified DAG multiclass classification can be used for identification of sleep states using RR interval data. Analysis of the results shows, that polynomial kernel function has better classification rate, however training time was less using RBF kernel function.

References

[1] G. Varoneckas, A. Martinkenas, A. Podlipskyte, A. Varoneckas, A. Zilinskas, "Web-based data bank of heart rate and stroke volume recordings during sleep", Med-e-Tel 2006: The International Educational and Networking Forum for eHealth, Telemedicine and Health ICT: proceedings. pp. 371-375, 2006

[2] J. C. Platt, N. Cristianini, and J. S. Taylor. "Large margin DAGs for multiclass classification", Advances in Neural Information Processing Systems, vol. 12, pp. 547-553. MIT Press, 2000

[3] C.-W. Hsu, and C.-J. Lin. "A comparison of methods for multiclass support vector machines", IEEE Transactions on Neural Networks, vol. 13, pp. 415-425, 2002

[4] T. Joachims, "Making Large-Scale SVM Learning Practical", in Advances in Kernel Methods – Support Vector Learning. B. Scholkopf and C. Burges and A. Smola (ed.), MIT-Press, 1999

[5] Sleep heart rate and stroke volume data bank. http://pri.kmu.lt/databank, 2010

Audrius Varoneckas was born in Kaunas, Lithuania, in 1978. He was graduated from the Faculty of Informatics of the Vytautas Magnus University in 2000. M.S. studies were completed in business informatics in 2002. Since 2005 he is an assistant in the Applied Informatics Department of the Faculty of Informatics of the Vytautas Magnus University. His research interests include optimization, signal processing, data mining, visualization, Grid computing, parallel and distributed computing, biomedical modeling.

Giedrius Varoneckas was born in Kaunas, Lithuania, in 1949 and received medical graduation from Kaunas medical institute. He is a Professor of Biomedicine (Cardiology), Chief Research associate and Head of Sleep Medicine Centre at the Institute of Psychophysiology and Rehabilitation, Palanga, Lithuania and Chief Research Associate of the Mechatronics Science Institute, Klaipeda University, Klaipeda, Lithuania. Habilitation thesis was deferred in 1991 on “Autonomic heart rate control and hemodynamics during sleep: Results of monitoring and computerization of analysis”. His research activities cover the psychophysiology of cardiovascular system; sleep medicine, application of computerized heart rate variability analysis, operator functional state assessment, and the treatment of sleep disorders.

Antanas Zilinskas is the chairman of Optimization Sector and a principal researcher at the Institute of Mathematics and Informatics, Lithuania. His research is oriented on development of statistical models of global optimization, implementation and investigation of the corresponding algorithms, and their application to practical problems. He is a member of editorial boards of Journal of Global Optimization, Control and Cybernetics, Informatica, The Open Cybernetics and Systemics Journal, and International Journal of Grid and High Performance Computing.

Telecardiology in Clinical Practice: A One Decade Experience

V. D Moga[1], Mariana Moga[2], Rodica Avram[1], T. Ciocarlie[1], L. Bosneag[2]
[1]University of Medicine and Pharmacy „V.Babes" Timisoara
[2]Emergency County Hospital Timisoara, Romania
moga.victor@gmail.com

Abstract: **Started in Romania as a new technology in late 90's., telemedicine and telecardiology emerged as a novel method for clinicians. In countries like Romania with an emerging economy, telemedicine had been proved a useful tool, for diagnosis and therapy. The main areas of interest in telecardiology are: e-health, e-learning and e-management. The contribution in e-health is related to improving the healthcare in various areas, like ageing communities, geographic isolated areas, emergency medicine, and transportation. Also an important target for e-health is to reduce the costs of hospitalization and the costs of specific proceedings, to reduce the waiting times mainly in populations with limited mobility capacities. That for in the last decade we have implemented at the Emergency County Hospital some telemedicine and/or telecardiology projects. This study highlights the implementation, the results but also the reasons for failure of telemedicine projects in clinical practice.**

Introduction

Nowadays, any responsible individual involved in healthcare should be confronted, more or less, with three challenges, namely: promoting high quality medical services, with the lowest costs possible, and with a high accessibility. The e-health concept is more and more a reality, tending to become a day-to-day utility.

E-health is playing an important role in the EU e-Europe strategy and one of the important activities to support this is the deployment of health information networks based on fixed and wireless broadband and mobile infrastructures.

Another increasing social and economic phenomenon noticed in the last decade consists in human mobility. Telemedicine projects have huge qualities that consist in removing barriers between peoples, countries and regions. In our opinion three main areas could have positive impact in

clinical practice: bilateral telemedicine projects, diagnosis and research telemedicine networks, and home or outpatients monitoring systems.

Bilateral telemedicine projects

This type of telemedicine projects could be dedicated, in our opinion, to share medical information between hospitals or healthcare providers located in different areas, for current activity (teleconsulting) or for special emergencies (mobility). A bilateral project that sustains this vision and finances the activities has started between regions from Romania and Italy. The cooperation started between Lombardia and Toscana regions (Italy) and Timis County (Romania) with the intention of enlargement. This bilateral project that was functional since December 2004, was supported by the Italian Ministry of Foreign Affairs, and the project leader is the @ITIM – Associazione Italiana di Telemedicina e Informatica Medica. The University "Politehnica" from Timisoara, Romania and the University Milano-Bicocca from Milan, Italy, ensured the design of the architecture and the technical support. The project had as result the development of a healthcare network between a Romanian hospital, the Emergency County Hospital Timisoara and an Italian Hospital, the Careggi Hospital from Florence. The aim of this study was to increase the quality of medical services, provided by the Emergency Clinical Hospital Timisoara, Romania, in collaboration with departments from hospitals from Italy (Fig. 1).

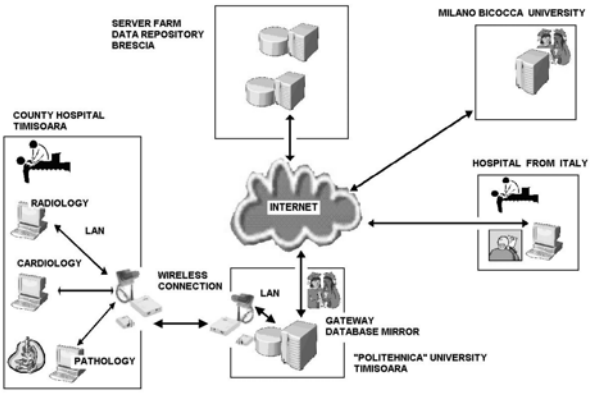


Figure.1 A model for bilateral or a telemedicine network system

Started initially for radiology and cardiology department with transmission of clinical data (case presentations), ECG or X-rays, respectively echocardiography images, more recently (2009) the pathology and hepatology department of the Emergency County Hospital Timisoara, Romania are involved in a bilateral project with medical centers from Brescia (Italy).

Diagnosis and research telemedicine networks

Cardiovascular diseases represent nowadays a major social and economic impact in EU and recent new EU member countries, being the leading cause of death in developed countries. Similar cardiovascular epidemiology aspects are noticed in new EU member countries, like Romania. The main concept of this type of projects is to create and promote a clinical and a telemedicine network, that we have named CARDIOLOGICAL DIAGNOSIS NETWORK (CARDIODIAGNET), for acute and chronic patients with cardiovascular diseases. This network must also offer the possibility to be accessed by various physicians, such as specialists and family doctors or other persons involved in healthcare. CARDIODIAGNET was designed to be oriented in the following main fields: clinical cardiology, in which we proposed to introduce new techniques for ECG signal processing, telemedicine units for rural or isolated areas and family doctors and for continuous medical education, a platform for e-health and e-learning, that has the possibility to be accessed from different locations by the partners involved in the network. Using a user-friendly platform, the network will provide: **Tele-counseling** in which hospital specialist will request the opinion of the tertiary hospital specialists on a clinical case; **interactivity (through video-conferencing facilities).** In this case, the healthcare professionals can talk and see each other and thus share information about the patient. In the case of **e-learning,** through video-conferences, specialists in medical or IT fields will interact with various specialists and participants from other sites outside the partner centers. **Shared clinical records:** A referring general hospital specialist and tertiary hospital specialists will have access to the same set of patient's clinical records during a virtual referral or during the entire stay of the patient in the tertiary hospital. **E-Health:** The CARDIODIAGNET project aims at building a reliable software tool to support health professionals in taking promptly the best possible decisions for diagnosis and treatment.

Home or outpatients monitoring systems

The necessity of a modern telemedicine system mainly for the patients in rural areas is important in the prophylaxy of cardiovascular diseases and to reduce hospitalization. The main aim of the system is to offer a high level healthcare to a basically old population with limited mobility capacities. For that purpose we have implemented in a GP office a digital ECG (electrocardiogram) device (Nihon-Kohden 9132K) with 12 leads. The ECG device has the capacity to record data on paper or in digital format that permit the transmission of the ECG signal to a smart phone HP (Hewlett Packard) iPAQ 614/614c and through Bluetooth or VPN (Virtual Private Network) to an ftp server located in the Cardiology Clinic of a Regional Hospital. We use a wide band network (14 Mbps) for the transmission of data. More recently (2009) we have implemented a bed-side ECG monitoring system using a CARDIAX-PC device with the possibility to share data (ECG) on an original HIS platform SIMIMED, developed by an independent Romanian team.

References

[1] V.D. Moga, T. Ciocarlie, Mariana Moga, Rodica Avram, R. Seromenho, T. Cronje, et al. "Cardiological Diagnosis Network (CARDIODIAGNET)", Luxembourg 2008.

[2] V.D. Moga, Mariana Moga, L. Bosneag, Lacrimioara Stoicu-Tivadar, V. Stoicu-Tivadar, Rodica Avram, et al. "The Relationship between Euroregions and the Modern Hospital." 7th Regional Conference on Environment and Health. Szeged, Hungary 2005.

[3] V.D. Moga, Mariana Moga, Rodica Avram, L. Bosneag. "Wireless Telecardiology System for Rural Areas a Romanian Experience", Luxembourg 2009.

[4] www.euro.who.int

[5] atlas.ici.ro/ehto/doc/Telemed.html

Victor Dan Moga is an asisstent professor in Cardiology at the University of Medicine and Pharmacy. He is also Internal Medicine specialist. He is author and co-autor of parts in the following books and tutorials for students: Hypertension – C. Streian, C. Luca, 1995; Ischeamic Heart Disease – C. Luca, Ş. Brădişteanu, C.T. Luca, Ed. Mirton, Timişoara, Romania, 1996; Cardiovascular Diseases – C. Luca, C. Streian, Ed. Amarcord, Timişoara, Romania 1996; Essentials of Medical Clinics – Respiratory Diseases. Rodica Avram, Livia Brânzan, Mariana Tudoran, V. D. Moga, Carmen Luca, M. Ţurcanu, Viviana Ivan, M. Balint, Florina Pârv. Editura Orizonturi Universitare, Timişoara, Romania, 2004.

Mariana Moga has a PhD in Medical informatics. She is a Programmer Engineer at the Emergency County Hospital of Timisoara, where she is also involved in the medical research, performing several statistics required and using medical informatics tools. The most significant works has been presented at national and international conferences. Since 1997 M. Moga is an Associate Professor at the University of Medicine and Pharmacy, Timisoara.

Telemedicine Using the Example of Practical Models of Health Care with Cardiovascular Disease

H. Körtke, T. Feige, O. Wagner, A. Fliedner, N. Mirow, J. Gummert
Heart- and Diabetes Centrum NRW, Clinic of the Ruhr University Bochum, Georgstr. 11, 32545 Bad Oeynhausen, Germany

Abstract: **Following the implantation of a mechanical heart valve, permanent oral anticoagulation is a must. Thromboembolisms and Marcumar-induced hemorrhages remain frequent complications after mechanical heart valve replacement despite progress in the development of artificial heart valves. The studies ESCAT I and II show that INR self-management in combination with low-dose anticoagulation is able to reduce the rate of thromboembolism and of haemorrhaging. The INR values measured by patients can now be monitored by using telemedicine.**

Background

Today, the second most frequent cardiosurgical intervention is replacement of a diseased heart valve. Approximately in Germany 18.000 patients per year receiving surgery for heart valve. The vast majority of implanted heart valves are so-called mechanical replacements. Yet thromboembolism and hemorrhaging are still frequent complications following the implantation of these artificial valves. The risk of thromboembolism and hemorrhaging can be reduced through treatment with oral anticoagulants.

Butchart et al. [1] were the first to introduce the concept of risk-adjusted anticoagulation intensity. He could show that postoperative oral anticoagulation following mechanical heart valve replacement was not usually adjusted to the levels required.

Anticoagulation with coumarin derivates has become established medical therapy within the framework of secondary prophylaxis. The first step towards improving postoperative anticoagulation is INR self-management. For the reason, that there will always be at least some patients who require long-term medical help with their INR self-control, the institute began to experiment with telemedicine to assist this type of chronic disease therapy.

Material und Methods

Approx. 120 000 people with permanent oral anticoagulation currently perform INR self-management in Germany. Since 1994, we organise a new program at the Heart and Diabetes Center NRW (HDZ NRW) in Bad Oeynhausen for patients who have undergone mechanical heart valve replacement. In December 2003, we founded the Institute for Applied Telemedicine (IFAT). Since then, we registered and medically monitor more than 900 Marcumar patients by IFAT.

They are instructed in INR self-control or self-management 7–10 d after surgery. The patients are shown how to use the device, how to handle the test strips and how to transmit telemedical data. They are also told in terms how anticoagulation therapy (in this case Marcumar) works. They then receive a home monitor, a CoaguChek XS. A module can read the INR self-control data as soon as the test has been performed and transmit it automatically to IFAT. There the data is matched to the corresponding electronic patient file. Physicians and trained staff monitor the incoming results. Also they inform patients about further anticoagulation measures. The Institute works around the clock, 24 h/d and 7 d/week.

Results

The study ESCAT was able to show that patients are capable of learning INR self-management. The qualitative improvements achieved by INR self-management are highly significant.

Because of very low-dose anticoagulation in a follow-up study called ESCAT II, this enabled the stability of the anticoagulation therapy to be complied, while at the same time reducing variability. Further reductions in thromboembolic and especially hemorrhaging complications were evidentiary. The study TeleQin analyzes more than 900 patients. Our evaluation shows that there are no significant differences between patients who practicing self-management and those are telemedically monitored. During late follow-up 83.3% of INR values recorded in Group B were within the therapeutic range of INR 1.8 to 2.8, compared to 82.2% of INR values recorded in Group A ($p<0.0004$). 65.4% of INR values recorded in Group B were within the therapeutic range of INR 2.5 to 3.5, in contrast to 72.0% of INR values in Group A ($p=0.001$).

Conclusion

Sometimes patients with permanent anticoagulation encounter situations, even in their everyday routines, in which they were overextended with this form of therapy. Performing INR self-controls, maybe with the aid of

family members or nurses, with added telemedically doctor's advice was a viable alternative. The combination of medical autonomy coupled with telemedical service can achieve the highest quality intensification in oral anticoagulation following mechanical heart valve replacement. In the studies ESCAT I and ESCAT II, the IFAT were able to show that INR self-management in conjunction with low-dose anticoagulation is able to reduce the rate of thromboembolism and of haemorrhaging [2]. Therapy in close cooperation with local practitioners is possible. The result is a minimum-risk anticoagulation therapy. This can be practiced by and offered to nearly any patient with the relevant indication.

References

[1] E.G. Butchart, P.A. Lewis, J.A. Bethel and I.M. Breckenridge. "Adjusting anticoagulation to prosthesis thrombogenicity and patient risk factors – recommendations for the Medtronic Hall valve," Circulation 84, Suppl III, pp.III61–III69, 1991.

[2] H. Koertke et al. "INR self-management permits lower anticoagulation levels after mechanical heart valve replacement," Circulation 108, Suppl 1, pp. II75–II78, 2003.

Heinrich Körtke, born 1949, studied Human Medicine at the Free University of Berlin, Germany from 1974-1981. In 1988 he got conferral of a doctorate. 1989 he became specialist physician for "Internal Medicine" and in 1990 the specialist area "Cardiology" follows. In 2006 Dr. Körtke habilitated in "Internal Medicine" at the Ruhr-University of Bochum. Since 1998 Dr. Körtke has worked as senior physician at Clinic for Thoracic and Cardiovascular Surgery of Heart- and Diabetes Center North Rhine Westphalia. Since 2003 additional he has been Manager of Institute for applied Telemedicine (IFAT) at Heart- and Diabetes Center North Rhine Westphalia.

Ten Years of a Tele-ECG System in the State of Rio Grande do Sul/Brazil: From a Regional Project to a Multipoint Network

A. Sparenberg[1,2], R. Kalil[2], V. Portal[2]

[1]The Medical Association of Sao Lourenço do Sul (SOMESUL) - Brazil
[2]eHealth Centre of the Instituto de Cardiologia do RS (ICFUC-RS), Porto Alegre – Brazil adolfosparenberg@hotmail.com

Abstract: **Telecardiology is one of the most important areas of e-Health and Tele-ECG systems are very important for cardiological assistance in remote and underserved regions of the world. Since the year 2000, a digital Tele-ECG system works in the State of Rio Grande do Sul (RS), in southern Brazil. Initially, a regional project was established in Sao Lourenco do Sul (SLS) - 44,000 inhabitants. Since 2008, the method was expanded to 11 more towns, coordinated by the eHealth Centre of ICFUC-RS. Now, a larger public telecardiology network is being established in RS.**

Introduction

In recent years, thanks to the development of information and communication technologies (I.C.T.), telemedicine and eHealth heve been incorporated to almost all areas of health practice. Heart diseases [1], mainly coronary heart disease, are the most common causes of death in many countries [2]. Timely assistance of acute cardiac urgencies and emergencies is critical for a successful therapy and patients recovery [3]. For this reason, Telecardiology is one of the most important areas of eHealth, causing significant impact when implemented in remote and underserved areas of the world.

The State of Rio Grande do Sul (RS), located in southern Brazil, has a population of around 11 million inhabitants distributed in 496 cities. Most of them are very small - around 200 villages with less than 5,000 inhabitants - and have a lack of health care professionals, being critically underserved in medical specialties, including cardiologists. In order to improve the quality of cardiological care, a telecardiology project started in the State of Rio Grande do Sul (RS), in the year 2000. Initially, a digital Tele-ECG system was established around the city of Sao Lourenco do Sul (SLS) -

44,000 inhabitants -, with the involvement of 4 health care institutions. Since 2008, coordinated by the eHealth Centre of the ICFUC-RS, a public telecardiology project was implemented in 11 more towns, located in 2 different regions of the state. A recent partnership established between the ICFUC-RS and the State Government, through the Health and Science and Technology Secretariats, will expand the project to a larger public telecardiology network. One hundred towns are expected to take part of the program during 2010/2011.

Objectives

The objectives of a telecardiology network in RS can be divided into 2 stages:

(1) Since 2000: the establishment of a regional Tele-ECG system based in the city of SLS, for the diagnosis of both urgent and routine cardiac diseases, with the participation of four regional health care institutions;

(2) From 2008: the implementation of a public multipoint Telecardiology network throughout the state of RS, coordinated by the eHealth Centre of the ICFUC-RS, with progressive coverage of a large number of towns.

Methods

Regional Project SLS - The Digital Tele-ECG System of SLS started in the year 2000, progressively connecting 1 cardiologist to 3 small regional hospitals (2 urban and 1 rural) and 1 outpatient care unit. as described: 1. Santa Casa Hospital (year 2000): main regional hospital, located in the city of SLS; 2. Walter Thofehrn Rural Hospital (year 2001): located around 20 Km from SLS; 3.Outpatient Care Unit of Turuçu (year 2003): public institution of Turuçu city (4,000 inhabitants), located 25 Km from SLS; 4. Hospital Ernesto Arndt (year 2009): located in Morro Redondo city, distant 100 Km from SLS.

Technically, during the first year, the ECG data were transmitted point-to-point via conventional phone lines. After 2001, thanks to the availability of data transmission via mobile phones (tdma) in the region, the Rural Hospital was connected to the cardiologist. Since 2003, DSL (urban regions) and radio based (rural area) Internet facilities became the teletransmission standard.

The equipment included: Standard PCs, laptop, conventional and mobile phones (tdma, cdma, gsm), digital ECG machines, Internet facilities (Radio, DSL, Mobile: Edge/3G) and a telecommunication software.

Telecardiology Network in RS - Coordinated by the eHealth Centre of the ICFUC-RS, since 2008, the program can be divided into 2 phases:

Phase I: The implementation of a Telecardiology network connecting 2 cardiology referral centres (Instituto de Cardiologia of Rio Grande do Sul, located in Porto Alegre (capital city) and the Hospital de Cardiologia of Rio Grande, located in the city of Rio Grande) to eleven health care institutions (small hospitals and outpatient care units): 6 located in the north-western and 5 in the south-eastern region. Both Federal and State level funding support the 2-year phase project. Technical infrastructure include the implementation of Internet access of at least 512 Kbps, the acquisition and installation of the equipment (computer, webcam, headset, digital ECG machine and respective softwares). The equipment of the referral centres are located in the respective emergency room sectors. Also, a training program consisting of lectures and printed material with project guidelines was prepared by the the ICFUC eHealth team. The telecardiology method offers: 1. Immediate digital ECG signal acquisition, Internet teletransmission from remote areas , and specialized ECG diagnosis from 2 referral centres; 2. Internet based live second opinion in cardiology; 3. Thrombolytic therapy with tenecteplase for ST-elevation Myocardial Infarction, to be infused at the remote point of care and; 4. Public ambulance transport of critically ill patients to tertiary level hospitals. Phase I of this project will be concluded in June 2010.

As part of Phase I, a Mobile Tele-ECG pilot project was tested in a very remote Family Health Program (outpatient care unit and home care setting). The study was carried out by student members of ICFUC-RS in the city of Porto Lucena/RS, during November/December 2009.

Phase II: This stage establishes the expansion of the Multicentre Telecardiology Network to 90 more remote and small towns in RS, during 2010 and 2011. Technological improvements include a new telecardiology central unit for 24/7 operation, a data processing centre and a multicentre webconferencing training program. Phase II is a partnership established between the e-Health Centre of the ICFUC-RS and the RS Government with the participation of its Health and Science and Technology Secretariats.

Results

Around 13.000 Tele-ECGs were transmitted and analyzed during 10 years of a regional Tele-ECG System in Sao Lourenco do Sul, from 3 small hospitals and 1 outpatient care unit. The telecommunication method,

initially based on point-to-point phone transmission via conventional lines and TDMA mobile phones, has changed to Internet based real time and store-and-forward technology, including 3G mobile Internet access in the last 2 years.

Phase I of this program connects 11 remote Institutitons - 6 located in the north-western and 5 in the south-eastern regions - to 2 referral centres (tertiary level cardiology hospitals). The system allows immediate ECG diagnosis and specialized second opinion for acute and severe cases, including medical advice for the administration of thrombolytic therapy in cases of S-T elevation acute myocardial infarction. A training program in the field was organized and carried out by the ICFUC-RS team and consisted of: 2 regional meetings (1 in the northwest and 1 in the southeast regions) and 6 local training sessions that were delivered for the professionals of both the remote teams and the referral centres. A total of 121 professionals were trained in all institutions: 67 in the north-western and 54 in the south-eastern region. Phase I will be concluded in June 2010.

Phase II - expansion to 90 more cities - is under implementation since December 2009. The first steps adopted were: 1. Definition of the program committee, composed by 6 members; 2. Building a new telecardiology central unit in the ICFUC-RS; 3. Selecting professionals to work in the telecardiology central unit, for on duty (24h/7days) analysis of ECGs and for remote (web-based) cardiology counseling in case of urgencies; 4. Constituting a training team, that will include cardiologists, nurses, IT technicians and administrative personel, and; 5. Organizing a training program composed of regional meetings (face-to-face lectures) and of a multicentre webconferencing sessions.

Discussion

Ten years elapsed have elapsed since the first steps of a Tele-ECG Project in RS. During this period, more than 10,000 patients experienced the benefits of a Tele-ECG System, and the method was adopted as a public strategy by the local health autorities. Meanwhile, a significant improvement in IT apparatus was observed, allowing to widespread telemedicine and eHealth services to underserved and far remote areas of the state. At the same time there was a significant reduction in Internet access costs, which guarantee the sustainability of e-Health systems. Recent studies have demonstrated that planning public health assistance and transport strategies can reduce the time spent to offer proper care for cardiovascular urgencies and emergencies [4,5,6].

In Brazil, both Federal and State level authorities are motivated to implement e-health strategies, in an attempt to overcome traditional barriers in health care delivery. Based on the achievements of the SLS regional experience, a larger and public telecardiology network started in RS/Brazil, in 2008, coordinated by the ICFUC-RS. The Multicentre Telecardiology Program of RS, is under establishment as part of a public health program - named "Saude Perto de Você" (Health **N**earer You), aiming to offer better health services to the regions where people live [7]. In order to successfully expand the method to 90 more towns, Phase II of this program is a joint action taken by 3 public institutions - the ICFUC-RS, the State Secretariat of Health and the State Secretariat of Science and Technology.

Conclusion

This public telecardiology program can play a key role in health care delivery. Combining new technological facilities for medical assistance and for educational purposes is expected to reduce the existing gap between underserved areas and the big metropolitan areas and to improve cardiovascular assistance for those living in remote regions.

Acknowledgments

The authors greatly acknowledge the health care professionals of remote RS regions for their strong sense of cooperation and deep commitment to the Telecardiology Program of RS. Also, acknowledge the Health and Science and Technology Secretariats of RS for their continuous support.

References

[1] C. J. Wientjes, J. A. Veltman, and A. W. Gaillard. "Cardiovascular and respiratory responses during a complex decision-making task under prolonged isolation," Adv Space Biol Med, vol. 5, pp. 133-155, 1996

[1] Sans S, Kesteloot H, Kromhout D. The burden of cardiovascular mortality in Europe. Task Force of the European Society of Cardiology on Cardiovascular Mortality and Morbidity Statistics in Europe. Eur Heart J 1997; 18: 1231–48.

[2] The European Health Report 2002: The burden of ill health. WHO.
Available at: http://www.euro.who.int/document/ehr/e76907h.pdf

[3] The Task Force on the management of ST-segment elevation acute myocardial infarction of the European Society of Cardiology: FV. de Werf, J. Bax, A. Betriu et al., "Management of acute myocardial infarction in patients presenting with persistent ST-segment elevation," European Heart Journal 2008, 29:2909-2945.

[4] Kalla K, Christ G, et al. The Viennese Registry on Reperfusion Strategies in ST-Elevation Myocardial Infarction (Vienna STEMI Registry). *Circulation* 2006; 113: 2398-2405.

[5] M. Sejersten, M. Sillesen, PR. Hansen, SL. Nielsen., H. Nielsen et al. Effect on treatment delay of prehospital teletransmission of 12-lead electrocardiogram to a cardiologist for immediate triage and direct referral of patients with ST-segment elevation acute

myocardial infarction to primary percutaneous coronary intervention, Am J Cardiol. 2008 Apr 1;101(7):941-6.
[6] Ting HH, et al. Factors associated with longer time from symptom onset to hospital presentation for patients with ST-elevation myocardial infarction. Arch Intern Med 2008 May 12;168(9):959-68.
[7] Governo do Estado do RS - Programa Estruturante Saúde Perto de Você. Available at: http://www.estruturantes.rs.gov.br/index.php?option=com_programa&task=detalhe&Itemid=29&id=9

Adolfo L. F. Sparenberg, was graduated in the Medical School of the Federal University of Pelotas/Brazil, in 1985. He is a cardiologist and is one of the coordinator of the ICFUC-RS e-Health Centre. Also is the coordinator of telemedicine and e-health projects of the Medical Association of Sao Lourenço do Sul (SOMESUL - ISfTeH associated member). He is one of the coordinators of the ISfTeH Students' Working Group.

Renato A. K. Kalil, is a cardiovascular surgeon and associate professor of cardiology of the Faculdade de Ciências Médicas da UFCSPA. He is a researcher and professor of the Post Graduate Program of ICFUC-RS. Since 2002 he is the Scientific Director of ICFUC-RS. Also a full member of the Sociedade Gaúcha de Cirurgia Cardiovascular, Sociedade Brasileira de Cirurgia Cardiovascular, The Society of Thoracic Surgeons(USA), Sociedade de Cardiologia do RGS, Sociedade Brasileira de Cardiologia, American Heart Association, American College of Cardiology e American Association for the Advancement of Science.

Vera L. Portal, was graduated in the Medical School of the Federal Univeristy of Rio Grande do Sul, in 1988. She is a cardiologist and one of the coordinators of the ICFUC-RS eHealth Centre. Also a researcher and one of the coordinators of the Post Graduate Program of ICFUC-RS and an editorial board reviewer of the Revista Brasileira de Cardiologia. She coordinates the transdiscipline ambulatory service of myocardial infarction at ICFUC-RS.

The Experience of Integration between a University Telehealth Center and the Public Health Sector: Achieved Results

C. Souza, G. Cancela e Penna, M. C. B. Melo, R. M. Torres, H. J. Alves

Introduction

The Federal University of Minas Gerais (UFMG), together with the Belo Horizonte City Health Department, had an important role in structuring the Brazilian National Telehealth Project. The model of telehealth for the Brazilian public health system was applied initially in Belo Horizonte, through teleconsultation and web conferencing. This model was developed in the scope of the @LIS Project of the European Community.

The National Telehealth Project, which will also incorporate activities in distance training using 3D modeling, will promote the incorporation of telehealth practice in the UFMG School of Medicine, one of the 9 university cluster project coordinators. Moreover, the collaboration of the municipal health department will allow various telehealth models to be tested, in order to select the most appropriate for Brazilian requirements, thus allowing for a project design adapted to the needs of the Brazilian public sector.

Objectives

The aim of this paper is to describe the structure of the Telehealth Centre of the UFMG School of Medicine, its activities and achievements.

Results

The creation, in 2006, of a telehealth centre at CETES ("*Centro de Tecnologia em Saúde*" - Health Technology Center, School of Medicine) has enabled the convergence of experience in telehealth services with an education and information technology structure, facilitating the quick establishment at UFMG, of:

Laboratory of content production, using telehealth resources. The Health Technology Center, School of Medicine, allows the realization of earned value courses by using platforms of distance learning via video, animation and organic 3D modeling. The use of 3D modeling of organic structures permits the construction of virtual learning objects that simulate physiological, pathological and anatomical events in a dynamic way.

The use of organic modeling in the School of Medicine becomes crucial for the production of content with a sharp level of incorporation of technological resources. The School of Medicine chose a files package of 3D models of human anatomy, for editing in Maya 3D software, in which each of the files (systems) represents the human anatomy on the same scale and proportion and contains the necessary textures, groupings, and UV coordinates.

The complex task of installing a content production laboratory in a medical school, where virtual objects will be used for learning, has distinct components - besides the 3D modeling, infrastructure hardware (computers with monitors and specific features, servers, video cameras, editing and videoconferencing rooms, lighting) and software for the incorporation of video resources, animation and content production.

Also the structure of human resources requires multiple skills. In addition to teachers who know the subject in depth, for the operation of the laboratory, the Medical School hired two professionals trained in fine arts, responsible for the animation and 3D modeling, experts in video editing and technical personnel specialized on platform Moodle, so that distance education courses were likely to be produced, incorporating all the potential available in the content production laboratory.

The process of structuring the content production laboratory of the Medical School can quickly relate to the needs of the public service, offering innovative products prepared in a timely fashion. This process is highly structured for the education of professionals, and has the ability to facilitate mass distance education courses through the use of modern technologies. It also creates, progressively, an internal dynamics in the School Medicine that allows the training of professors in developing distance learning courses.

Currently, the content production laboratory has already produced the following distance learning courses available to several municipalities of the state of Minas Gerais, Belo Horizonte City Health Department, Ministry of Health and UNIMED (a private health insurance company): course of hypertension, ECG, Dengue, H1N1, superficial Trauma and Emergency. At this stage, in conjunction with PAHO, we are translating into Spanish and starting the availability of a course on dengue to Latin American countries.

Structuring activities of the Laboratory of Excellence and Innovation in Telehealth Latin America – Europe

The structure of the Laboratory of Excellence and Innovation in Telehealth Latin America - Europe is a milestone in the consolidation of

UFMG and the Municipality of Belo Horizonte as an important international benchmark in the area of telehealth. The structure of the laboratory is a result of a combination of European and Latin American institutions who participated, in the area of telehealth, in the @LIS Project of the European Community.

The launching of the proposed Laboratory occurred in December 2006 and it was attended by representatives of 20 countries from Europe and Latin America. The Second Workshop was held in 2009, with the same number of participating countries.

Project Telehealth Public Policies in Latin America - PPT-LA-IDB

In order to coordinate the activities of the Laboratory for Latin America, UFMG School of Medicine and the University Telehealth Network (RUTE) signed an agreement with the IDB in December 2009 to develop the project "Telehealth Public Policies in Latin America - PPT-LA".

Structuring of the Latin American Journal of Telehealth ("Revista Latinoamericana de Telesalud")

The journal *Latin American Journal of Telehealth* was launched on early 2009, it is now in its third edition, using the SEER system - the Electronic Journal Publishing - which is a Brazilian adaptation of the OJS - Open Journal Systems software, developed by the University of British Columbia.

The publication of the journal has been achieved by a multidisciplinary group of UFMG, involving professors in the areas of medicine, nursing, dentistry, libraries, information technology, and also the participation of the Belo Horizonte City Health Department. The journal has an international editorial board, involving participants from 20 countries, in addition to the 9 universities of the Brazilian National Telehealth Project. Brazilian representatives and UFMG staff participate of both the editorial board and various committees that publish the journal.

Telehealth research ongoing projects

The UFMG School of Medicine develops the following research projects in the area of telehealth: Brazilian National Telehealth Project - Minas Gerais cluster (distance course, webconferencing, teleconsultation. It involves 50 municipalities of the State of Minas Gerais); Tele-emergency project (incorporating multiparametric monitors, 3G data transmission technologies used by SAMU's ambulance to transmit information to emergency hospitals in Belo Horizonte), development of distance courses, with 3D modeling for the UNIMED, Belo Horizonte City Health Hepartment, state health department and PAHO and project of retinography in diabetes and project of telemonitoring of diabetic and

hypertensive patients and telehealth project for the Amazon region and indigenous populations. Currently, the discipline of telehealth is taught every semester in the School of Medicine. A proposal for a professional master's degree in the area of telehealth was structured and is ongoing in the UFMG.

Incorporating telehealth resources to rural internship in medicine, nursing and dentistry

Professors at rural boards of these three areas, as well as many of the students, are trained in the use of telehealth resources in the municipalities where these activities are being developed. This is an initial process but it predicts that in future, all students of these areas will be proficient in these new technologies before the end of their course.

Conclusion

The existence of a structure focused on telehealth activities within the UFMG School of Medicine, coupled with international partnerships and regular interaction with the public service, has enabled a rapid development of Telehealth actions.

References

[1] Santos, A. F., Souza, C., Alves, H. J., Santos, S. F. Telessaúde - Um Instrumento de Suporte Assistencial e Educação Permanente. Belo Horizonte/MG : Editora UFMG, v.1., p.502, 2006.

Alaneir de Fátima dos Santos is Vice – coordinator of Telehealth Nucleus of the Federal University of Minas Gerais - School of Medicine, Brazil. Coordinator of the Laboratory of Excellence and Innovation in Telehealth - Latin America and Europe. Editor Chief of Latin American Journal of Telehealth. Member of the National Telehealth Brazil and the Brazilian Council of Telemedicine / Telehealth.

Claudio de Souza is Coordinator of Telehealth Nucleus of the Federal University of Minas Gerais - School of Medicine. Coordinator of Brazilian National Telehealth Program in Minas Gerais State. Vice-chairman of the National Telehealth Brazil. Professor of Surgery Department at Federal University of Minas Gerais - School of Medicine.

Web Based Database for the Assessment of Effectiveness of Thromboembolic Prophylaxis in Orthopaedic Surgery: Preliminary Study

W. M. Glinkowski[1,2,3], A. Górecki[1]

[1]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", w.glinkowski@teleorto.pl
Medical University of Warsaw, 02-005 Lindleya 4, Warsaw, Poland
[2]Department of Descriptive and Clinical Anatomy, Center of Biostructure Research, Medical University of Warsaw, Warsaw, Poland
[3]Polish Telemedicine Society, Warsaw, Poland

Abstract: **The objective of the study was to assess the effectiveness of thromboembolic prophylaxis strategies in Orthopaedics through a systematic review utilizing Web based database. Thromboembolic prophylaxis national registry in orthopaedic surgery and traumatology has been invented since 2001 and provided consecutively. Data were collected using Internet accessible database. An effectiveness of prophylaxis was analyzed comparing two periods before and after evidence-based national guidelines for venous thromboembolism (VTE) in orthopaedic surgery publication. Most of patients received a form of recommended prophylaxis mostly (Low Molecular Weight Heparin) LMWH. Deep venous thrombosis (DVT) symptoms were observed in 22 (0,5%) orthopaedic patients in 2001 mostly while receiving prophylactic regime. Similar symptoms have occurred in 13 patients only (0,3%) at the end of observation period. This large-scale prospective web based registry was confirmed as a useful instrument for the assessment of thromboembolic prophylaxis. It was also used to show how the guidelines are followed.**

Introduction

Over one million people in the EU each year are affected with venous thromboembolism (VTE) that includes deep vein thrombosis (DVT) and pulmonary embolism (PE). Over 540,000 VTE-related deaths are estimated per year in Europe with VTE [1]. Web based databases belong to eHealth domain that are not frequently used in orthopaedic trials. The objective was to analyze data from the multicenter Web-

Based Orthopaedic eRegistry (RECORD) to evaluate the prophylaxis level and assess how the guidelines of VTE prophylaxis recommendations influenced on VTE occurrence and present the usefulness of internet based tools for orthopaedic surgery.

Material and method

Thromboembolic prophylaxis national registry in orthopaedic surgery and traumatology has been invented since 2001 and provided consecutively. Data was collected using Internet accessible database. Despite guidelines for venous thromboembolism (VTE) prevention in orthopaedic surgery elaborated on evidence-based approach, many patients may not receive effective prophylaxis [8]. Web based collected data derived from 50 medical centers in 2001 and from 62 medical centers in 2007. Registry of primary venous thromboembolic prophylaxis in orthopaedic departments had collected data on patient's age, sex, height, weight, and patient's health status including VTE risk factors. 1949 patients were admitted to orthopaedic departments who had undergone a primary, unilateral, elective THA or TKA in 2001 and compared with 2061 patients in 2007.

Results

In the first analyzed period the average hospital stay was 15 days and in 2007 was 16 days. Most of patients received a form of recommended prophylaxis mostly (Low Molecular Weight Heparin) LMWH. Evidence-based national guidelines for venous thromboembolism (VTE) in orthopaedic surgery were elaborated and accepted in 2002 as an official document undersigned by National Specialist of Orthopaedic and Traumatology of Locomotor System and President of Polish Society of Orthopaedics and Traumatology (PTOiTr). The document was updated twice in 2004 and 2007. Total hip replacement was performed in 28% of orthopaedic patients and 4% total knee replacement in 2001 and for 30% and 10% respectively in 2007. Deep venous thrombosis (DVT) symptoms were observed in 22 (0,5%) orthopaedic patients in 2001 mostly while receiving prophylactic regime. Similar symptoms have occurred in 13 patients only (0,3%) six years later. The VTE prophylaxis was prescribed to 97,17% of patients prior guidelines publication and to 98,38 of patients later.

Discussion

Implementation strategies are key factors in determining the overall success of clinical guidelines. They are important for changing physician

practices and expected to result in clinical improvement or cost savings [2]. The dissemination of guidelines was postulated as influential on VTE prophylaxis practice. The web based database enables the collection important information that derives from multiple remote centers. It may show DVT risk assessment, population, and other important variables of appropriate prophylaxis. It may be utilized as analytic and decision support system to result in the achievement of optimal outcomes. Having Web based database, sufficient evidence was available to make useful comparisons of regimen and medications utilization. Clinical management guidelines (CMGs) [3] were used to standardize physician practices and ensure safe and cost-effective patient care. Its use empowered to monitor and coordinate physician behavior improves compliance with CMGs. National Guidelines for proper VTE prophylaxis are recommended in many countries [4-7]. They recommend how to use available prophylaxis medication in certain condition taking into account reductions in VTE events, reducing morbidity, mortality and costs to the public health care system. Large differences in clinical practice on venous thromboembolism prophylaxis are reported between the USA and other countries [8]. Yu et al. [9] conducted study to evaluate compliance with the Sixth ACCP Consensus Conference on Antithrombotic Therapy guidelines for the prevention of VTE in hospitals. They found that overall compliance rate with ACCP guidelines was 52.4% for orthopedic surgery. Recently, Jameson et al. [5] compared complication rate with data from the National Joint Registry of England and Wales regarding the use of LMWH during the same periods. They found a significant increase in the reported use of LMWH (59.5% to 67.6%, $p < 0.001$) following the publication of the guidelines. Friedman et al. [8] analyzed data from patients who had undergone a primary, unilateral, elective THA or TKA, and had at least 3 months of follow-up. They confirmed compliance with guidelines for 47% of THA and 61% of TKA patients in the USA, and 62% of THA and 69% of TKA patients outside the USA. However, they found that received prophylaxis was not followed with treatment in accordance with the ACCP guidelines [6,7].

Conclusion

This large-scale prospective web based registry was found as a powerful eHealth tool. It has confirmed that dissemination of guidelines becomes useful instrument for the unifying and improving thromboembolic prophylaxis protocol. No considerable variation in venous

thromboembolism prophylaxis practices employed by orthopedic surgeons in THA and TKA patients was found. Despite statistically significant raise of prescribing prophylaxis observed after publication of guidelines the already achieved level of prescribing was satisfactorily high. Web based database observations reinforce the continuing monitoring of clinical practice and exploration the compliance with recommended prophylactic regimens. Utilizing similar mechanisms an assessment of risk factors and thromboembolic prophylaxis could be evaluated.

Acknowledgments

The project was supported by Sanofi – Aventis educational grant number XRP4563G/5001. Authors thanks to all contributors of RECORD project.

References

[1] Turpie A.G.G. Thromboprophylaxis After Major Orthopaedic Surgery: State of the Art; in Bentley G. (Ed.) European Instructional Lectures, European Federation of National Associations of Orthopaedics and Traumatology, Springer Berlin Heidelberg, 2009, 9, pp. 29-38

[2] Brox WT. Implementation of guidelines for prevention of deep vein thrombosis in a managed care environment. Orthopedics. 1996;19 Suppl:12-4

[3] Frankel HL, FitzPatrick MK, Gaskell S, Hoff WS, Rotondo MF, Schwab CW. Strategies to improve compliance with evidence-based clinical management guidelines. J Am Coll Surg. 1999;189(6):533-8

[4] Górecki A, Marczyński W, Chmielewski D. Zasady profilaktyki żylnej choroby zakrzepowo-zatorowej w ortopedii i traumatologii narządu ruchu Ortop Traumatol Rehabil. 2004, 6,6

[5] Jameson SS, Bottle A, Malviya A, Muller SD, Reed MR. The impact of national guidelines for the prophylaxis of venous thromboembolism on the complications of arthroplasty of the lower limb. J Bone Joint Surg Br. 2010;92(1):123-9

[6] Geerts WH, Bergqvist D, Pineo GF, Heit JA, Samama CM, Lassen MR, Colwell CW. American College of Chest Physicians. Prevention of venous thromboembolism:American College of Chest Physicians Evidence-Based Clinical Practice Guidelines(8th Edition). Chest. 2008;133(6 Suppl):381S-453S

[7] Geerts WH, Pineo GF, Heit JA, Bergqvist D, Lassen MR, Colwell CW, Ray JG. Prevention of venous thromboembolism: the Seventh ACCP Conference on Antithrombotic and Thrombolytic Therapy. Chest. 2004;126(3 Suppl):338S-400S

[8] Friedman RJ, Gallus AS, Cushner FD, Fitzgerald G, Anderson FA Jr; Global Orthopaedic Registry Investigators. Physician compliance with guidelines for deep-vein thrombosis prevention in total hip and knee arthroplasty. Curr Med Res Opin. 2008;24(1):87-97

[9] Yu HT, Dylan ML, Lin J, Dubois RW. Hospitals' compliance with prophylaxis guidelines for venous thromboembolism. Am J Health Syst Pharm. 2007; 1;64(1):69-76

Telemonitoring

A Virtual Research Environment (VRE) to Support Sharing and Collaboration in Internet Intervention Projects

S. Williams[1], L. Yardley[1], G. Wills[2], S. Samangooei[2], L. Gilbert[2]
[1]Centre for Applications of Health Psychology, S.Williams@soton.ac.uk
School of Psychology, University of Southampton, UK
[2] School of Electronics and Computer Science, University of Southampton, United Kingdom

Abstract: **This presentation describes our Virtual Research Environment (VRE) which we have called the LifeGuide Community website. This VRE aims to facilitate collaboration for those involved in creating internet interventions using the open-source LifeGuide software. The aim of this presentation is to describe the methods and results of an ongoing qualitative case study detailing how the VRE can contribute to new ways of working collaboratively on internet intervention projects.**

Introduction

Internet intervention projects (i.e. projects developing interventions for promoting or changing health behaviours or to train health professionals over the internet) involve many different types of collaboration and sharing of interventions, including:

- Collaboration between a large research team which requires input on content, format and study design from lead investigators, clinical experts, expert patients and researchers
- Supervision between PhD supervisors or lead investigators and their students or research assistants
- Sharing between researchers who are working together to develop an intervention
- Sharing intervention files with the wider e-health community to disseminate work and facilitate future collaboration

We are developing a VRE to enable people using LifeGuide working within a variety of disciplines to collaborate in sharing and reviewing components of internet-delivered interventions. The aim of a VRE is to facilitate researchers in "managing the increasingly complex range of tasks involved in carrying out research" [1]. A VRE will enable LifeGuide researchers to collaborate in internet intervention research and share intervention components, research data and expertise. This will reduce the

resource requirements (time and funding) that can make collaborative research difficult. VREs are considered to be growing in importance as more and more research is conducted with larger, geographically dispersed teams, enabling researchers to make “real scientific advances” [2].

This project uses a co-design and co-deployment approach to the development, deployment and revision of the VRE. This involves both target end-users of the VRE and website developers working closely together to ensure that the end-product is “both feasible and useful” for the user [3].

Method

This presentation reports an ongoing qualitative case study that aims to inform the co-design and co-deployment process of developing the VRE and evaluating its use. The first author (a psychologist and therefore a target end-user of the VRE) learnt to use the LifeGuide tool and assisted on a number of LifeGuide intervention projects to obtain first-hand experience of using the software and to help inform how a VRE may be beneficial for the target population. Semi-structured interviews were also conducted with perspective target users (n = 7) to obtain others’ perspectives of how the VRE may facilitate their research.

The results from the interviews and observation were then used to inform the production of ten personas and scenarios (Fig. 1). These are fictitious characters that represent the different types of target users and descriptions of how they might use a VRE which highlight their requirements.

Persona

Georgina is 28 years old and is a research assistant at the University of Manchester. She has just begun a new project developing an online intervention for helping people with sleep problems. She has never developed an online intervention before and although she has a keen interest and enthusiasm for online interventions she admits to feeling terrified at the prospect of creating a working intervention. She would like to use the VRE to gather ideas for implementing an intervention and to ask questions should she get stuck with using LifeGuide. In preparation for this research project, she is keen to read anything that can bring her up to speed with using the tool. She is hoping to be able to find research papers and articles about developing online interventions on the VRE and possibly even be able to read about other people’s experiences of using LifeGuide.

Scenario

Once she has registered for the VRE, Georgina is able to find a comprehensive help-manual for using LifeGuide. The introductory chapter puts her at ease a little but she is still curious to find out more about what it is actually like to use the tool. The help-files are linked to some discussion boards where users can post their queries to one another and discuss their experiences. Georgina finds this very reassuring as although she can see there are some frustrations with using the tool, she can also see the levels of support that users are giving one another. Before she logs out of the VRE she downloads some publications to read on the train home to bring her up to speed with using LifeGuide before she begins to tackle her intervention.

Fig 1: Example personas and scenarios

Results

Participant observation and semi-structured interviews highlighted four types of sharing that need to be supported by the LifeGuide VRE:

1) Peer support - For many health researchers, developing an online intervention is a new experience therefore the opportunity to share and discuss experiences of using LifeGuide with others in a similar situation will be of benefit to target users.

2) Technical support - Although LifeGuide is designed to be used by any person without any programming experience, there may be times (for example, when a new logic command is needed) when technical support is required. Users have suggested having a discussion forum dedicated to sharing technical issues and logic commands with one another.

3) Collaboration and Supervision - Providing feedback on an internet intervention can be difficult. Previously, users would have to write feedback on printed screenshots or write detailed e-mails trying to explain where changes to an intervention are required.

4) Dissemination - One of the objectives of LifeGuide is to advance scientific knowledge of interventions, therefore one aim of the VRE is to enable researchers to share their completed interventions and the results to examine what types of intervention components are most effective. The LifeGuide Community website can therefore act as a repository of online interventions to allow researchers in the field to play, review and re-analyse existing interventions.

Discussion

A beta version of the LifeGuide Community website is available from www.lifeguideonline.org. To meet the requirements for a VRE we have designed the LifeGuide Community website to enable people to:

- Download the LifeGuide authoring tool and the accompanying researcher help manual
- Securely upload interventions that they have developed to share with team members or the wider e-health community.
- Comment on interventions. This commenting system enables others (i.e. members of a research team, supervisors or other members of the LifeGuide Community) to comment on each part of an intervention right next to the page where it occurs. This commenting system also facilitates real-time discussions which can be utilised for virtual team meetings about an intervention.
- Find examples of existing interventions to help form ideas for their own intervention development or to use in intervention research.

The development of user-friendly discussion boards to facilitate the sharing of peer and technical support at the more general level is planned, as is a system to allow users to share their research papers relating to online intervention research.

The qualitative case study will continue to run over the following months whilst we evaluate the effect the LifeGuide Community website has had on facilitating a collaborative research environment and to identify any new requirements for improving the VRE.

Fig 2: Screenshot of the VRE

Acknowledgements

The VRE project is funded by JISC. LifeGuide is funded by the Economic and Social Research Council (ESRC).

References

[1] JISC "Virtual Research Environment Programme". Retrieved from the World Wide Web 3rd July 2009 http://www.jisc.org.uk/whatwedo/programmes/vre.aspx

[2] S. Collinson. & Z. Corbyn "Research intelligence – log on to a global laboratory," Times Higher Education, 1st January 2009.

[3] D.Milliard, Y. Howard, L. Gilbert and G. Wills "Co-design and Co-deployment Methodologies for innovative m-learning systems. In: *Multiplatform E-Learning Systems and Technologies: Mobile Devices for Ubiquitous ICT-Based Education*, IGI Global. 2009.

Sarah Williams is a postdoctoral research fellow at the University of Southampton. She is currently working on the LifeGuide project where she is involved in collecting user's experiences of using the software and their needs for a Virtual Research Environment. Sarah's research interests include e-health, online research methods, eating disorders and gender. She is also visiting lecturer on the undergraduate Cyberpsychology module at Glasgow Caledonian University.

Lucy Yardley is Professor of Health Psychology at University of Southampton and leads the LifeGuide programme of research to develop and evaluate software for creating web-delivered behaviour change interventions. She is currently creating and testing interventions to promote health (e.g. smoking cessation, weight reduction), self-manage illness (e.g. multiple sclerosis, flu) and change health professional behaviour (e.g. antibiotic prescribing).

Gary Wills is academic staff in the School of Electronics and Computer Science at the University of Southampton. He graduated from the University of Southampton with an Honours degree in Electromechanical Engineering, and then a PhD in Industrial Hypermedia systems. He is a Chartered Engineer, a member of the Institute of Engineering Technology and a Fellow of the Higher Educational Academy. He is also a visiting professor at the Cape Peninsular University of Technology, South Africa. Gary's main research interests are in Personal Information Environments (PIEs) and their application to industry, medicine and education. He is also conducting research into assessment systems, serious games and the use of mobile technology for development.

Sina Samangooei was awarded his MEng in Computer Science by the Department of Electronics and Computer Science at the University of Southampton in 2007. He is currently studying a PhD in Semantic Biometrics under Prof. Mark Nixon at Southampton University. His research interests include content based image retrieval, biometrics, anthropometry and semantic augmentation. Sina is a student member of the IEEE.

Lester Gilbert is academic staff in the School of Electronics and Computer Science at the University of Southampton. His research focuses on e-learning and technology-enhanced learning with particular emphasis on pedagogy and the use of technology in teaching and learning in adult and Higher Education. Lester's book "Principles of e-Learning Systems Engineering" (2008) integrates his business-oriented practical experience of Information Systems development with Multimedia and Computer Aided Instruction development. Recent conference presentations include papers in the areas of e-learning, competence modelling, and virtual environments for teaching and research.

Advanced Telemedicine System of Systems for Remote Monitoring of Patients and Elderly People

V. Petcu[1], A. Petrescu[2], I. Nastase[3]
[1]UTI Systems SA, Research and Technology, viorel.petcu@uti.ro
Soseaua Oltenitei 107-111, District 4, 041303, Bucharest, Romania
[2] Politehnica University, Faculty of Automatics and Computer Science,
adrian.petrescu@cs.pub.ro, Splaiul Independentei 313, Bucharest, Romania
[3]UTI Systems SA, Human Resources, ioana.nastase@uti.ro,
Soseaua Oltenitei 107-111, District 4, 041303, Bucharest, Romania

Abstract: **This paper presents the developments on the telemedicine technology undertaken by the Research and Integration Centre - UTI Group (UTI), in partnership with the Faculty of Automatics and Computer Science from the "Politehnica" University of Bucharest (UPB), Romania. The partnership aim is to develop solutions to improve the access, efficiency, effectiveness, and quality of clinical and business processes utilized by healthcare and social care organizations, practitioners, patients, and consumers in an effort to improve the health status of patients.**

Introduction

One of the biggest challenges of the modern society refers to the demographic changes, including ageing and diseases pattern changing, which place a great pressure on the sustainability of the health systems. Pandemics, major physical and biological incidents and bioterrorism pose potential major threats to health while the climate change is causing new communicable disease patterns. All those issues, correlated with the rapid development of new technologies which are revolutionizing the way we promote health and predict, prevent and treat illness, have triggered a major development of the telemedicine. The work described in this paper is based on the UTI large experience in R&D activities for system integration and product development for personnel, assets and vehicles monitoring, e.g. the KTrackP [1] used for patients remote monitoring.

The current telemedicine platform, a result of the scientific partnership between UTI and UPB, responds to most actual requirements of the telemedicine and serves as a technological enabler to help elderly people to stay independent into their own houses and to allow those suffering from chronic diseases and those living in isolated sites to be helped.

System of Systems Approach

Due to the large scale and distributed architecture, a system of systems (SoS) approach was adopted in order to achieve operational and managerial independence, geographic distribution, emergent behavior and an evolutionary development of the components: patient monitoring, hospital care, ambulance service guidance to intervention and on route patient assistance, first responders emergency management. The overall system of systems architecture is presented in Fig. 1.

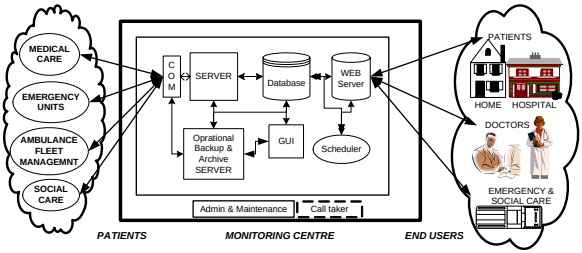


Fig. 1 System Architecture

At the patient level, vital signs are monitored as well as data related to the daily activities patterns (see Fig.2). This framework is applicable on both home and assisted care facilities monitoring. Even at this level, the system is considered as a SoS: the vital signs monitoring and activity monitoring are two autonomous systems, each of which have their own capabilities.

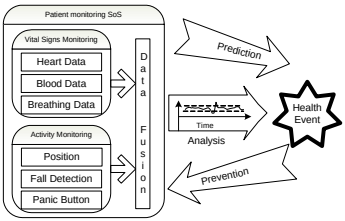


Fig. 2 Patient monitoring

By combining the data from both of them and analyzing the time series data, the relationship between the health and physical condition will be revealed and, in this way, allowing disease prevention and health improvement adapted to specific individuals. The same vital monitoring system is also considered as part of the patient in-transit monitoring SoS (PT SoS), this time together with ambulance data (position, speed, heading, status, etc.). Thus, valuable statistical information related to the effectives of the service may be obtained. At a larger scale, all the patient monitoring

SoSs are part of the physician/doctor patients monitoring SoS (PsM SoS). All together are included into the hospital's or clinic's SoS (H SoS)(Fig. 3).

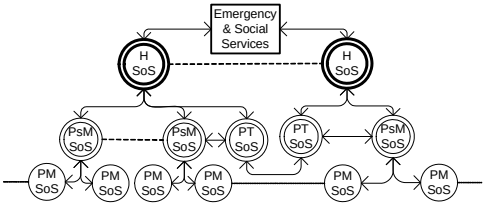


Fig. 3 SoS topology

The overall heterogeneous system of autonomous systems has an emergent behavior which, with a heuristic management, is generating synergies among its components for the benefit of a much wider social scale. Thus, by strategic connections with other applications for human life protection (security, emergency and disaster management services, etc.) the quality of the medical and social services is improved as well as the social awareness and preparedness for disaster management.

In order to deal with the high risk of heterogeneous data structure and semantic problems, a federated data management model [2] is used (Fig. 4).

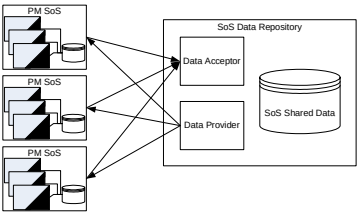


Fig. 4 Data management

The overall SoS data repository contains shared data owned by the partner systems and posted to the repository into a predefined format.

The Sensors Integration Platform

The sensors integration platform performs remote acquisition for multiple sensors, intelligent local processing and transmission of the data via the UTI's home monitoring systems, vehicle tracking and monitoring platforms and the deployable tele-monitoring kits (Fig. 5). The platform is build around a Texas Instruments CC981H device which includes a reconfigurable sensor interface, digital sub-system with embedded 8051 microprocessor, power efficient Hardware MAC and a RF transceiver. On-

chip program and data memory permits local processing of signals which can significantly reduce the transmit data payload.

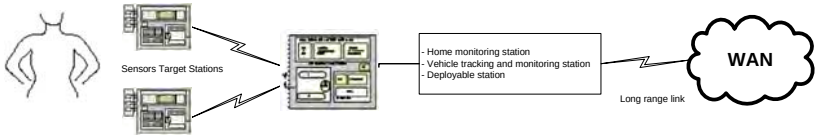


Fig. 5 Sensors integration platform

Human Factors Approach

Decrements in vision, hearing, strength, manual dexterity, and memory are to be expected with age and illness; because of illness, poor reading ability, inadequate facilities, insufficient assistance, and inexperience, the patients addressed by this platform often represents a special challenge to designers [3]. Among the methods used to assess the needs of this particular population are interviews, surveys, focus groups and experimental research. The results proved that an integrated monitoring system can both help the person who's using it by providing around the clock assistance, and lifts an evermore heavy burden off the medical care system.

Conclusions

When taken one by one, the architecture of each system component might appear simple, but the overall system eventually leads to a very complex SoS. According to the individual characteristics of the systems, important heterogeneous information and emergent developments are extracted. The amount of the sensed data is very vast and complex, due to the large number and types of sensors which are continuously monitored in order to collect data over long periods of time. All those multiple entities have different goals, making the integration and system governance a critical issue. The overall approach presented in this paper is enabling extremely powerful strategies for preventing diseases and improving health and the overall quality of life for elderly and chronically ill persons leaving alone into their homes.

References

[1] V. Petcu, "*Advanced Security Technologies for Remote Surveillance In Distributed Systems*," Proceedings of IntelliSec 09 – The 1st International Workshop on Intelligent Security Systems 11-24th November 2009, Bucharest, Romania, pp. 199-204, 2009

[2] R. Cole, "Systems of Systems Architecture", in *Systems of Systems Engineering – Principles and Applications*, CRC Press, 2009, pp.37-70

[3] D.W. Repperger, "Human Factors In Medical Devices", in *Encyclopedia of Medical Devices and Instrumentation, Second Edition*, J. Wiley & Sons, Inc. 2006, pp. 536-547

Viorel Petcu is the Chief Technology Officer of UTI Security and Defense Division. He has graduated the Faculty of Electronics and Telecommunication in 1993; he is PhD student at the Faculty of Automation and Computers, Politehnica University of Bucharest. He has been leading research activities on both Romanian and European RTD programs; his main research interest includes telemedicine and security systems.

Adrian Petrescu is a professor at the Faculty of Automation and Computers Science, Politehnica University of Bucharest, and a member of the Academy of Technical Sciences from Romania. His research interest includes the reconfigurable digital systems design, the VLSI design and telemedicine. He received a PhD in Computer Science from the Power Institute-Moscow, in 1964.

Ioana Năstase is a psychologist at UTI Security and Defense Systems Division. She graduated the University of Bucharest – Faculty of Psychology and Education Science, Organizational Psychology in 2007; she is student at the National School of Politic and Administrative Studies – Managerial Communication and Human Resources. Human factors analysis is her main telemedicine research interest.

Alpha System: A Multi-parameter Remote Monitoring System to Cover the Requirements of a Polymorbid Aging Population

I. Kósa[1,2], I. Vassányi[3], Z. Butsi[1], B. Végső[3], T. Dulai[3], Gy, Kozmann[1]
[1]Research & Development Centre of Medical Informatics, University of Pannonia, butsi@mik.uni-pannon.hu, kozmann@irt.vein.hu, Egyetem u. 10, Veszprem, Hungary, [2] F Csolnoky County Hospital, Veszprem, kosa.istvan@vmkorhaz.hu, Korhaz str 1, Veszprem, Hungary, [3]Department of Electrical Engineering and Information Systems, University of Pannonia, bvegso@irt.vein.hu, tibor.dulai@irt.vein.hu, Egyetem u. 10, Veszprem, Hungary

***Abstract*: Prevention and rehabilitation efficiency can greatly benefit from the application of intelligent, 24 hour tele-diagnostics and tele-care information systems. Tele-monitoring also supports a new level of medical supervision over the patient's lifestyle. In this paper we briefly present the aims and first results of the Alpha remote monitoring system. The novelty of the system is beside the unified and flexible processing of various signals retrieved from body-worn devices, passive sensors, physiological signals as well as software sensors (patient responses in tests performed on the central home unit), the open architecture of the system toward every participants in the health care facing the monitored patient. We are currently testing the prototype system; public experiments will begin by the spring of 2010 involving volunteers with and without neurologic degenerative diseases.**

Introduction

The development of telemedicine looks back to decades, but most of the marketed systems refer a special patient population, not seldom only special sensors. So systems exist for patient with hypertension[1], diabetes mellitus[2] as well as for patient subpopulations having special type of implanted devices[3]. The recorded data consequently are available only for dedicated medical services participating in the monitoring, and not for emergency facilities facing the patients in urgent cases. Similarly, when the monitored patients attend a specialist not involved in telemonitoring program, the consultation could not capitalize from the overview of the recorded data.

Objective

Our purpose was to develop a telemonitoring system with active and passive sensors, as well as software sensors for an elderly population, which is open for all the physician serving these patients.

Methods

Our system is being developed by a consortium including academic, healthcare and industrial / sensor manufacturer partners. The system is based on a Home Hub which is a robust laptop category computer with only a touch screen and internet connection, and wireless links to the sensors installed in the home or worn by the patient (Figure 1.). Data is collected, from several Home Hubs representing a patient each, by the Data Centre. The centre provides a web GUI for the supervising medical personnel, analysts, and the family. The system is flexible to host any new type of sensor, but we propose a base configuration as follows. Physiological and activity sensors are Bathroom scales, Blood pressure meter, ECG recorder, Blood glucose meter, Wrist-worn fine motion sensor (consortium's own development), passive sensor network including fridge open/close, PIR relays, room temperature and lighting. The software components available on the Home Hub GUI are Cognitive and speech therapy software, Personalized dietary log and analysis and Physical exercise coach for post-stroke rehabilitation; all developed by the consortium.

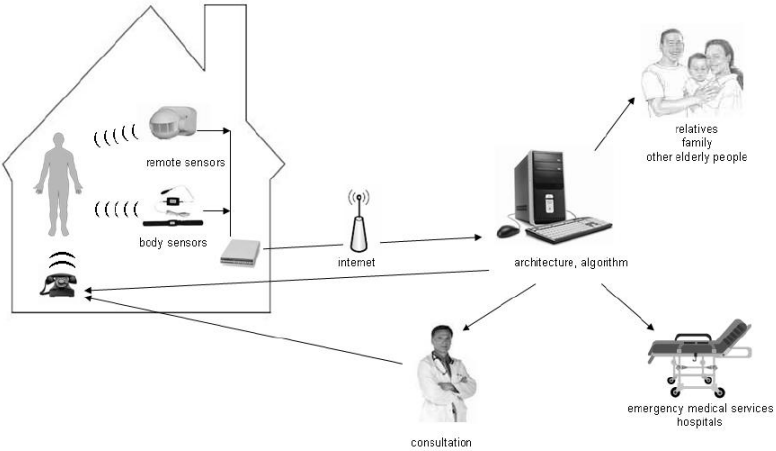


Figure 1.

The system uses Lifestyle Support Patterns (LSP) to effectively find and highlight complex events and meaningful, high level physiological states. The LSP governs the monitoring episode. It is composed from a set of sensor configurations, measurement workflow definitions, abstract signal definitions and alerts. Abstract signals, like “deviation of conventional daily activity”, “calory intake in relation to physical activity“ can be presented for the monitoring personel. The user can drill down into the ‘roots’ of an abstract signal, check the eventual artifact, and if necessary, relabel the alarm episode.

The collected data are stored by the Data Centre. Only data relevant for urgent interventions are presented on the monitor of the 24 hours/7 days working monitoring center. The system consist of two further type of display utilizing web browser technology. One is aimed at nurses of the home care service, to help the identification of slow changes in the patient status, to schedule the check-ups of the patients by the specialist. The other display supports the work of specialists,, including physicians from neurology, cardiology, diabetology and so one. The physicians can overview the results of measurements in time graphs in relation to time of drug intake, or meal, the calorie and carbohydrate contain of the nourishment etc. The messaging integrated in the system makes the consultation between physicians as well as nurses and physicians easy. If the patient requires a medical supply in any medical service, which is not involved in the telemonitoring system, the patient can easily authorize the physician in charge to get overview about her/his data, stored in Data Centre. Data regarding previously monitored parameters, as well as medication history can help the physician to evaluate the current status of the patient and decide about further management of the case. The admittance to data for this physician last, however, only for 24 hours. If the physician will participate in long scale in the disease management of the patient, she/he should perform a full registration based on the approval of the patient. In this case, he/she will get the right to modify the therapy of the patients and document it within the system, as well as to adjust the alert level of individual sensors.

Results and Conclusion

We implemented the prototype using a workflow and a rule engine built into a service-oriented architecture, both on the Hub and the centre. We have also validated our custom devices with respect to commercial alternatives. We have developed a set of LSP’s and a full episode configuration GUI is in progress. Living lab experiments with ca. 30

dementia/Alhzeimer/ Parkinson/post-stroke patients will begin in june 2010. More information is available on the project website at http://www.proseniis.com

Acknowledgment

The work presented was funded by the Hungarian National Research project No. OM-00191/2008 (AALAMSRK).

References

[1] McCant F., McKoy G., Grubber J., Olsen M.K., Oddone E., Powers B., Bosworth H.B.: Feasibility of blood pressure telemonitoring in patients with poor blood pressure control. J Telemed Telecare 2009 15: 281-285

[2] Powell J., Jennings A., Armstrong N., Sturt J., Dale J.: Pilot study of a virtual diabetes clinic: satisfaction and usability. J Telemed Telecare 2009 15: 150-152

[3] Sinha A.M., Koos R., Markus K.U., Diem B.H., Urbaszek A., Hanrath P., Stellbrink C.: Multicentre evaluation of a rule-based data filter for home monitoring of implanted cardioverter defibrillators. J Telemed Telecare 2006 12: 97-102

An Agent-Based System for Meta-Monitoring

Sylvie Trouilhet, Ali Rammal, Nicolas Singer, Jean-Marie Pecatte
IRIT, firstname.lastname@irit.fr
Route de Narbonne, 31400 Toulouse, France

Abstract: **we describe a large scale agent-based system which can monitor elderly people. Such a system requires particular protocols for distributed data gathering and partial results aggregation between agents. It is based on a variety of sensors carried by monitored people or installed in their homes. Data about daily activities, positions and physiological information are collected by data-processing agents constituting the system. The system uses a multi-agent classification method in three steps. Our method is illustrated by a case study with ten monitored people.**

Introduction

In the year 2020, more than 20% of the population of industrial countries will be over 65 [1]. This leads to organizational and financial problems for the healthcare systems. To reduce costs, and to improve their welfare, home monitoring systems can bring solutions to help elderly people staying at home.

Our project takes place in this context. It aims to help professional home care teams by increasing the number of elderly people looked after in their homes with an adaptive and non-intrusive remote assistance.

Our approach tackles the home monitoring issue in a collective and cooperative way. As described in [4], it is based on a study of several state-of-the-art home care systems, and differs from them in that it is centered on groups instead of individuals.

We collect individual monitoring with the aim of detecting global behavior patterns. A multi-agent architecture is suitable because the monitored population is strongly distributed and changing [2]. Patterns collected are used to estimate the state of elderly people, to link them to their community, and to try to forecast the evolution of their activity.

The next sections present the multi-agent system and its classification method. An experimentation on ten people closes the article.

The system is based on a whole of sensors carried by monitored people or installed in their homes. Those sensors are presence and movement sensors or medical measuring apparatus. The data coming from sensors are transformed into indicators. Some indicators can also come from human information: notes of a nurse or patient's answers.

Indicators are information on which the system will generate its classification. It is important to note that the functioning of the system is independent of the type and the number of the indicators.

Indicators are collected by data-processing agents constituting the system. Because the system is strongly distributed, indicators of two people will not be inevitably collected by the same agent. There may also be some overlaps, if the same information is collected by several agents.

Thus, agents have indicators concerning several individuals. With its indicators, each agent calculates a local, partial classification. This classification does not take into account all the indicators and is related to a reduced sample of the population. Since the data input are numerical values, statistical classification methods are applicable; in our tests, the system uses the ISODATA method.

To compute the global classification, the agents communicate each other. The groups are constituted in matching agents which made similar classifications. The agents of a group measure the distance between their classes using the weighted Euclidian distance, merging or splitting some classes.

This classification is actually multi-agent because the classification result is not the work of a simple agent, as it is the case in other multi-agent systems (choice of the most skilled [3]) but well a collective work.

This multi-agent classification makes possible to dynamically increase the system scale: for example, when the number of entries changes.

Thus our method satisfies the requirements of our application because it does not depend of the type of the indicators and does not require preliminary categories.

The management of the monitored people continues throughout the functioning of the system, as the agents collect more indicators values. Thus patterns evolve and the class of people can change.

Nocturnal overactive

Normal people

	P1	P6	P4	P2	P8	P3	P10	P5	P9	P7
I_1	37.5C	40C	37C	37.5C	39C	37.5C	37C	37C	37C	37.5C
I_2	190	180	170	110	100	150	140	145	138	190
I_3	120	110	120	60	50	90	80	90	70	120
I_4	6h	4h	6h	13h	12h	6h	7h	8h	7h	7h
I_5	10	11	7	2	3	0	1	1	3	2
I_6	7	14	7	6	5	8	7	6	7	8
I_7	1h30	45mn	2h	30mn	15mn	1h30	2h	1h30	2h	3h
I_8	3h	2h	1h	4h	3h20	2h	3h	2h	2h	3h
I_9	2	1	2	0	1	2	3	3	2	6
I_{10}	2h	1h30	2h	4h	3h	1h30	2h	1h30	2h	15mn
I_{11}	true	false	true	true	false	false	false	false	false	true

Daytime underactive

Wandering people

Fig. 1 – Classification tests

Case Study and Perspectives

Our system has been tested with several agents collecting eleven indicators (corporal temperature, blood pressure, number of times the person gets out of bed during the night or goes to the toilet, time spent in the kitchen or in the living room…) concerning ten people. Four group of people emerged from the final classification as shown on Fig. 1.

The medical aspect of the classification has to be confirmed by organizations of assistance to elderly people. These organizations often use an evaluation grid of the dependence degree to determine the service needed by people. The matching of the two evaluation ways should validate our approach and also could consolidate the relevance of the grid criteria.

Later, medical organizations can use the system to follow the evolution of the dependence degree of people. Thus, somebody leaving his original class to enter a new one could be re-evaluated by the organization, and the assistance could be adapted to his new behaviors.

Finally, this dynamically updated classification could have other main uses like:

- Having global and anonymous statistical data about old people looked after in their own homes.

- Allowing generating specialized alarms depending on the detected event. Once the classification is set up and people status is known, decisions can be taken to personalize the monitoring of someone - activated sensors, generated alarms and danger zone.
- Remote monitoring of people suffering from chronic problems of health like cardiac and pulmonary insufficiencies, asthma or Alzheimer disease. The possibility of having a global vision of several monitored people can bring richer and more relevant information on the follow-up. The distribution in classes and the historic of the patterns evolution should allow new people entering the system to get a better service; in particular, it should make it possible to generate more appropriate alerts according to the incurred risk.

We have now to validate our empirical study in a more real-life framework, which will be possible thanks to our actual project "homecare in rural environment" relying on several professional partners.

Acknowledgment

We thank the C'VITAL association (provider of a platform of coordination of care and services for the elderly and infirm) for their help. We also thank the Midi-Pyrénées region for their financial contribution.

References

[1] Mc Morrow K., *The Economic and Financial Market Consequences of Global Ageing*, Springer Editor, 2004.

[2] Moreno A., Nealon J. Application of Software Agent Technology in the Health Care Domaine, Birkhauser Verlag Editors, 2003.

[3] Mukhopadhyay S., Peng S., Raje R., Palakal M., Mostafa J., Multi-agent Information Classification Using Dynamic Acquaintances Lists, Journal of the American Society for Information Science & Technology, pp 966-975, 2003.

[4] Rammal, A., Trouilhet, S., Singer, N., Pécatte, J.M.: An Adaptive System for Home Monitoring Using a Multiagent Classification of Patterns.International Journal of Telemedicine and Applications, 2008.

Jean-Marie Pécatte received his Ph.D. degree in computer science, from the University of Paul Sabatier at Toulouse in 1992 on natural language processing. Since 2003, his researches focus on multi-agent system in in the field of e-health, especially in the area of large scale multi-agents systems for deployment of massively distributed systems.

Ali Rammal is a Temporary Teacher and Researcher (ATER) and is preparing his Ph.D. in computer science at the University of Paul Sabatier at Toulouse (France). He is a member of research team ERISIS. His research focuses on using multi-agent technologies to define a distributed classification method in the domain of the home health care by learning behaviors of people followed in their homes.

Nicolas Singer received his Ph.D. degree in computer science, from the University Blaise Pascal at Clermont-Ferrand (France) in 1997. After having worked on multi-agent system and web technology for five years, he was appointed to the school of engineering ISIS in 2001. Since, his researches focus on information systems in the field of e-health, especially those that need to be massively distributed and where multi-agent technologies can bring efficient solutions.

Sylvie Trouilhet received her Ph.D. degree in computer science, from the University of Paul Sabatier at Toulouse in 1993. This is one of the first French theses on the Multi-Agent Systems (MAS). She has been involved especially in interactions and communication between agents. She is a member of the MAS French research group since its foundation in 1995. She is a lecturer in programming engineering in the University of Toulouse. She is working in the area of large scale multi-agents systems for the last ten years. Her current research focus is on deployment of massively distributed systems and on knowledge gathering in the field of health.

Auricular Electrical Stimulation (P-STIM) for Insomnia Treatment Using Remote Control

J. C. Szeles[1], G. Varoneckas[2, 3], E. Kaniusas[4]
[1]Vienna General Hospital, Department of Surgery of the Medical University of Vienna, j.szeles.akh@aon.at, Währinger Gürtel 18-20, Vienna, Austria
[2]Sleep Medicine Centre, Klaipeda University Hospital, giedvar@ktl.mii.lt, Liepojos Str. 41, Klaipeda, Lithuania,
[3]Mechatronics Science Institute, Klaipeda University, giedvar@ktl.mii.lt, Herkaus Manto Str. 84, Klaipeda, Lithuania,
[4]Vienna University of Technology, kaniusas@tuwien.ac.at, Gusshausstrasse 27-29/E354, Vienna, Austria

Abstract: **We have developed a new type of device for electrical stimulation of the free nerve endings in the auricle, mainly the vagus nerve, with remote control in which stimulation characteristics of three independent stimulation channels can be adapted to the patient's needs. The effect of stimulation for sleep improvement was demonstrated on 8 female insomniacs. Two-day full polysomnography data demonstrated objectively improved sleep parameters such as a decreased sleep latency time and wakefulness after sleep onset. Normalization of sleep structure – an increase of REM sleep and stage 2 with a decrease of stage 1 while stages 3+4 remain approximately the same duration – was evident.**

Introduction

Auriculotherapy is the stimulation of the auricle of the external ear for the treatment of various health conditions; it is also referred to as electrical stimulation to the ear reflex points. Vagal withdrawal and/or sympathetic overactivity are always accompanied by stress and dysfunction of body's systems which can be treated by the auriculotherapy. It was demonstrated that mild stimulation of the auricular points may effectively enhance vagal activities and suppress sympathetic regulations of the heart in humans [1].

Based on these consolidated findings a specific minimal invasive electrical stimulation method "P-Stim" (Punctual Stimulation) at the free nerve endings of the cranial nerves of the human auricle, amongst others the vagus nerve, emerged. P-STIM is a quasi-continuous stimulation of the vagus nerve in auricle with some short periods of rest in total for about one week. The electrical stimulation of n. vagus afferent receptors may influence gate mechanisms in the central nervous system avoiding the person's perception

of pain. Stimulation of pain receptors and activation of inhibitory pain control systems may be also involved, as well as a stimulated release of neurotransmitters, e.g., endorphins and other endogenous opioids. The advantages of the electrical stimulation over conventional acupuncture with respect to pain relief, well-being and sleep quality were shown [2]. An increase of n. vagus activity during P-STIM was recently demonstrated [3].

It might be expected that reflex stimulation of n. vagus will be effective in the attenuation of anxiety and depression symptoms and will improve quality of sleep in insomnia patients.

New Technologies

We have developed a new type of device with remote control in which stimulation characteristics of three independent stimulation channels can be adapted to the patient's needs. A wireless connection between computer and device manages main stimulation parameters such as:

• Stimulation voltage amplitude of each channel (e.g., 4V in amplitude);
• Stimulation waveform (e.g., biphasic stimulation with changing polarity every 1s and impulse duration of 1ms);
• Stimulation and pause duration (e.g., 120 min active and 20 min inactive stimulation period);
• Number of impulses in the bursts of the respective channels (e.g., 10 impulses within 1s).

A precise positioning of the needle in the vicinity of the vagal nerve was facilitated by local conductivity measurements, for the local conductivity increases in the region of the nerve and its supporting blood vessels.

Methods and Contingent

The effect of P-STIM for sleep improvement was demonstrated on 8 female insomniacs, aged 57.2±13.13 (range 38-78 yrs), using 2-day full polysomnography (PSG). First PSG was reference with applied P-STIM device, but switched off stimulation and second PSG was with activated electrical stimulation.

Pittsburgh Sleep Quality Index (PSQI) was used for assessment of subjective sleep quality [4]. Sleep quality was evaluated: no sleep complaints – PSQI≤5, the result PSQI>5 indicated insomnia. Hospital Anxiety and Depression Scale (HAD) was used for assessment of depression and anxiety. Scores 11 or more on each scale are considered as significant case, while scores 8–10 represents borderline, 0–7 considered as normal [5]. At baseline examination Pittsburgh sleep quality index

(16.0±1.69) showed subjectively reduced sleep quality in all patients, while Hospital Anxiety and Depression Scale revealed only symptoms of anxiety (11.1±4.58), but not depression (4.9±2.17).

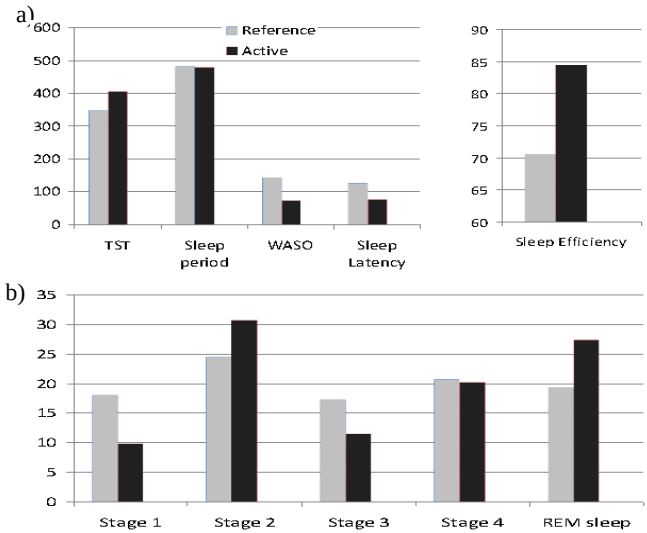
Results and Discussion

Polysomnography data demonstrated objectively improved sleep parameters such as a decreased sleep latency time and wakefulness after sleep onset which determined an increase in total sleep time while the sleep period remains the same (Fig. 1).

The relative values of sleep stages were shifted towards normalization of sleep structure – an increase of REM sleep and stage 2 with a decrease of stage 1 while stages 3+4 remain approximately the same duration (Fig. 2).

In Figure 3 an effect of P-STIM is demonstrated. During electrical stimulation of vagus nerve dramatically decreased sleep latency and wakefulness after sleep onset. The sleep structure was nearly normalized, because of an increase of REM sleep and decreased wakefulness after sleep onset. The sleep efficiency indicating a ratio between sleep period and total sleep time, increased from 50.2% till 71.1%.

Presented data clearly demonstrate, that the first P-STIM procedure



**p<0.05 ; *p<0.1

Fig. 1. Sleep parameters (a) and stages (b) under reference (grey bars) and P-STIM treatment (black bars) nights

substantially improves sleep quality in patients with insomnia. It might be expected that long-term P-STIM treatment is effective measure for insomnia treatment without medication.

Conclusion

The pilot results show that a new type of device for electrical stimulation of vagus nerve endings with remote control has a positive effect for insomnia treatment.

References

[1] J. D. Wang, T. B. Kuo, and C. C. Yang. “An alternative method to enhance vagal activities and suppress sympathetic activities in humans,” Auton Neurosci, vol. 100 (1-2), pp. 90-95, 2002

[2] S. M. Sator-Katzenschlager, G. Scharbert, S. A. Kozek-Langenecker, A. Sibylle, J. C. Szeles, G. Finster, A. W. Schiesser, G. Heinze, and H. G. Kress. “The short and long term benefit in chronic low back pain through adjuvant electrical versus manual auricular acupuncture,” Anesthesia & Analgesia, vol. 98, pp.1359-1364, 2004

[3] L. Gbaoui, E. Kaniusas, J.C. Szeles, T. Materna, and G. Varoneckas. “Effects of the auricular electrical stimulation on heart rate variability assessed in phase space: Pilot study,” Proceedings of IEEE Sensors, pp. 176- 179, 2008

[4] D. J. Buysse, Ch. F. Reynolds III, T. H. Monk, S. R. Berman, and D. J. Kupfer. “The Pittsburgh sleep quality index: A new instrument for psychiatric practice and research,“ Psychiatry Research, vol. 28. pp. 193-213, 1988

[5] A. S. Zigmond and R. P. Snaith. “The hospital anxiety and depression scale,” Acta Psychiatr Scand, vol. 67, pp. 361-370, 1983.

Jozsef Constantin Szeles is head of the special electrical auricular therapy outpatient clinic at the Medical University of Vienna, Department of Surgery (AKH), with more than 100 routine applications every week. His research activities cover cultivation of endothelial cells and production of vascular bio prostheses, NMR microscopy (in combination with SQUID), and long-term electrical stimulation of free nerve endings of the auricle. He is author in over 60 publications, incl. four invited contributions of book chapters. He is currently invited internationally to give lectures and presentations of his new knowledge field of auricular electrical stimulation.

Giedrius Varoneckas was is a Professor of Biomedicine (Cardiology), Head of Sleep Medicine Centre at Klaipeda University Hospital and Chief Research Associate of the Mechatronics Science Institute, Klaipeda University, Klaipeda, Lithuania. Habilitation thesis was deferred in 1991 on “Autonomic heart rate control and hemodynamics during sleep: Results of monitoring and computerization of analysis”. His research activities cover the psychophysiology of cardiovascular system; sleep medicine, application of computerized heart rate variability analysis, operator functional state assessment, and the treatment of sleep disorders.

Eugenijus Kaniusas graduated from the Faculty of Electrical Engineering and Information Technology of the Vienna University of Technology (VUT), in 1997. Dr.techn. study completed and habilitated (venia docendi) in the field of bioelectrical engineering, in 2001 and 2006, respectively. Since 1997 he has been with the Institute of Fundamentals and Theory of Electrical Engineering, VUT, since 2007 as associate university professor and head of the research group “Biomedical Sensing”. His research interests include electric, acoustic, optic, and magnetoelastic sensors for biomedical applications, signal processing, and portable hardware concepts.

Competence Telenetwork for Consultations, Education and Management of Eye Diseases in the Primary Care Environment

A. Paunksnis[1], V. Barzdziukas[1], S. Kopsala[2], M. Paunksnis[1], I.Laurinaviciene[3], A.Maciulis[1]
[1]Stratelus JSC, Naugarduko 3, Vilnius, Lithuania, alvydas@stratelus.com
[2] Optomed, Hallituskatu 13-17D, Oulu, Finland Seppo.Kopsala@optomed.fi
[3]Ziura, Rygos 15, Vilnius, Lithuania, ziura@takas.lt

Abstract: **Introduction: New user friendly mobile digital diagnostic technologies enable implementation of virtual consultative and educational activities in rural areas by recognized experts.**
Purpose: To establish a virtual ophthalmology competence center and telenetwork for consultations, management of eye diseases and training of primary care physicians. Methods: New equipment, handheld fundus camera Smartscope (Optomed OY, Finland), used for image collection and information exchange within the network. Teleconsultations used for patient data evaluation and training of participating physicians. Implementation of new digital diagnostic technologies by primary care physicians who are trained to use new technologies and utilize the possibilities of teleconsultations enables early diagnostics of eye diseases, monitoring of diseases, and bringing of high competence of expert physicians-specialists to rural areas. Joint activity in cooperation between the competence centers, such as ophthalmology, and participating primary care physicians who receive training in using new technologies in a particular clinical specialism enables to extend expert diagnostics and treatment to the primary care environment. In addition to clinical benefits, it also provides economic benefits: ability to provide high quality patient services without sending patients for live consultations to clinical specialist centers offers healthcare savings, and clinical specialist centers can reduce workload associated with consultations that can be provided using telemedicine. A significant shift in practical application of telemedicine is that the new equipment offers high mobility and high diagnostic quality at a reasonable cost accessible even for small primary care offices. It also enables implementation of high impact mobile preventive screenings.

Introduction

Clinical Background

Practical implementation of telemedicine has often been driven by government or large institutions, but we want to show an example and experience of a small local telemedicine network driven by clinical reasons. Urbanization, ageing of population, rising health care costs are global issues and they also encouraged our local telemedicine network initiative. Lithuania is a small country and secondary and tertiary level health care services are concentrated in two major university clinics in Kaunas and Vilnius. In ophthalmology, the Eye Clinic of the Kaunas Medical University Hospital receives approx. 35000 outpatient visits per year, and Vilnius Santariskes Hospital of Vilnius University receives approx. 25000 outpatient visits per year. One of the reasons of the high number of patients at these two centers is that there is a lack of secondary level ophthalmologists in smaller towns and rural areas, and primary care (family) physicians are sending the majority of ophthalmologic patients to the two centers. However, we estimate that a considerable proportion of those patients could benefit from a telemedicine consultation between (and with assistance of) the primary care physician and a tertiary level ophthalmology expert. Wait times for live patient appointments at the university centers can be up to 1 month, while teleconsultation and evaluation of patient data and test results could be done much faster. Speed and quality of diagnostics are important in the clinical outcomes. By various estimates, up to 40-50% of patients received at the two tertiary level University hospitals could be diagnosed and treated by ophthalmologists at the secondary level. Teleconsultations could reduce the workload of the tertiary care centers (university hospitals) by addressing less complicated cases with the help of telemedicine, and allow them to concentrate more on complicated cases, while primary and secondary level physicians using telemedicine could be very effective in screening and early diagnostics, so even in a small urbanized country with strong university hospitals practical implementation of telemedicine can have very significant clinical impact.

Economic Background

Live patient visit with an expert ophthalmologist (and maybe a surgery) will still be needed in many cases. However, for initial assessment, evaluation and diagnosis, teleconsultation is faster, more accessible to patients in rural areas, and more economical. Basic diagnostics is normally done by a primary care physician and does not need to be repeated at a tertiary care center. There are different health care financing models in various countries and it may be difficult to do a precise cost estimate, but

based on observations during our pilot project, cost of a teleconsultation can be significantly less expensive than live visit. Also, there will be an economic reason for a patient who would not need to travel to the tertiary care center but receive service with help of teleconsultation close to home.

Development of a Pilot Telenetwork

We developed a pilot telenetwork in ophthalmology by connecting several small remote healthcare points (2 primary care clinics; a specialist (secondary level) ophthalmology clinic Ziura; and several mobile points) to the compentence center at Stratelus eye clinic in Kaunas, Lithuania. Stratelus is a small healthcare company which evolved from telemedicine activities at Kaunas Medical University but is independent and operates on commercial basis. Stratelus employs experts ophthalmologists from the Kaunas Medical University. We used hardware developed by Optomed OY (Finland) – digital camera Smartscope M3-1 and M3-2 with ophtalmoscopic lens, and (for comparison of methodology) with dermatoscopic lens.

Clinical Results

A number of images were taken by participating physicians during the pilot project in autumn 2009 – winter 2010, and sent to Stratelus for experts' evaluation. The focus was on ophtalmological patients. The focus was on 4 clinical areas – Glaucoma; Diabetic Retinopathy; Aging Macula Degeneration; Intraocular Tumours. These are eye diseases with significant negative impact on patient's health and life prospects while their diagnostics and treatment could significantly benefit from the use of telemedicine.

Glaucoma

Evaluation of the optical nerve head requires experience which primary and often secondary level physicians not always have, while screening for early diagnostics of glaucoma at primary and secondary level is very important for prevention of this disease which may cause loss of vision.

Diabetic Retinopathy

Evaluation of the eye fundus of the patients with *diabetes mellitus* is normally performed by secondary level ophthalmologists but normally an evaluation regarding laser treatment is needed by a tertiary level ophthalmologist – laser treatment specialist.

Aging Macula Denegeration; Intraocular Tumours

Effectiveness and outcomes of treatment of aging macula degeneration and intraocular tumours very much depends on early diagnostics which can benefit from preventive screening by primary level physicians and images sent for evaluation of tertiary level ophthalmologists.

In addition to direct clinical impact (faster/better diagnostics), strong benefit of the telenetwork was ability to follow-up on the patient treatment progress often, and physician learning (e-learning) opportunities as the referring physicians stayed very involved including the teleconsultation session itself. One of the outcomes of our project is development of the database of images with a focus on intraocular tumours which will also be used for learning. Advancements in diagnostics of intraocular tumours is a focus of another ongoing Stratelus project which is supported by the EU Eurostars programme – A Non-Invasive Expert System for Diagnosis of Intraocular Tumours (NICDIT) which includes hardware and software components.

Recommendations and Conclusions

Our project is continuing into a daily practical telemedicine application, and we are expanding the clinical area (adding dermatology, cardiology) and geography (adding more participating locations, including international). Our observations are: available diagnostic equipment already provides with a good quality images at reasonably low investment; software for teleconsultations / electronic patient record is also available, but it needs to be ensured that physicians using various software for electronic patient record can transfer data easily; participating primary care physicians need to be well trained not only how to use the diagnostic equipment, but also some additional specialty (e.g. ophthalmology) knowledge. In many cases, teleconsultations, images evaluation can be as valuable clinically as live patient visits, but more timely and more efficient in terms of time and cost. The highly portable equipment used in our pilot enabled not only to achieve good quality images at the participating locations, but also at mobile points (e.g. preventive screening/monitoring).

Overall, our conclusion is that with the right equipment and motivated physicians, practical telemedicine can be successfully used not only by big healthcare institutions, but also by small offices and individual physicians, it can help optimize patient flows between the primary, secondary and tertiary care level, and demonstrate strong positive clinical and economic impact.

Formative Second Opinion: Qualifying the Primary Health Care in Brazil

A.E. Haddad[1], M.C. Skelton-Macedo[2], E.D. Castro-Filho[3], V. Abdala[4], R.P Andrade[5], F.E. Campos[6]
[1]Education in Health Management Department - Brazilian Ministry of Health, aehaddad@gmail.com
Esplanada dos Ministérios, Brasília - Brazil
[2]SLMandic; FOUSP Teledentistry Center; OPAS; marycskelton@gmail.com; São Paulo, Brazil
[3]UFRGS; RS Telehealth Center - enofilho@uol.com.br
[4]BIREME, BVS - veronica.abdala@bireme.org
[5]Education in Health Management Department - Brazilian Ministry of Health - rosimeira@gmail.com
[6]Education and Labor in Health Management Department - Brazilian Ministry of Health – deges@saude.org.br

Abstract: **Telehealth Program Brazil was implemented on 2007 in nine of the 27 states of the country. Its main objective is to support the decision of the Family Health Teams, offering a Formative Second Opinion[1], qualifying and making the most effective intervention to primary health care[2,3]. It is defined as "Second Opinion Formative" the answer structured, systematic and built from the best clinical and scientific evidence available, from the questions raised by the teams of Family Health, which act at points of Telemedicine and Telehealth advanced position on issues related to diagnosis, planning and execution of actions, individual and collective, on work process or linked to clinical cases treated in the Family Health Strategy[1]. Each core maintain specialists to send structured responses to the connection points distributed among municipalities. The program reached in September 2009 the 8531 collection of Second Opinions Formative, indexed according to the subject addressed and the professional category involved (upper and middle). A Library for Health, with emphasis on Primary was built to provide access to collections of interest and also the collection of Second Opinions Formative built during the implementation of the program. A semi-structured questionnaire on the use of the portal of voluntary participation (200 responses were received), showed that the contents are more accessible in technical areas (37.5%), followed by nursing (28% of votes); Medicine (24%) and Dentistry (9.8%). The category that most responses to the questionnaire was provided to nurses (31.5% of responses), but even the managers of Health participated in the survey (3.5% of respondents), showing the program as a management tool in**

Health. We conclude that the strategy has demonstrated effectiveness in meeting the expectations of the medical and technical staff and has attracted the continuous interest of managers to observe the potential of the tool qualification reduce costs with improved quality to brazilian health care.

Introduction

Brazil occupies an area of 47% of the territory of South America, and has continental dimensions (8.514.876,599 km^2) with a population of 191,480,630 inhabitants. It is the fifth most populous nation, despite having one of the lowest population densities (21.96/km^2), with a concentration of population in the coastal area. It is because of the internalization of large population and areas of vacant land primarily in the forest.

Brazil is structured by the division in 26 states and one Federal District and has borders with Venezuela, Guyana, French Guiana, Suriname, Uruguay, Paraguay, Argentina, Bolivia, Peru and Colombia. The constitution in force determines the health for all citizens and the duty of the state, but regional characteristics determine many challenges to improve quality care to health. The strategy of the Health System - SUS, created by the 1988 Constitution stipulated that the Brazilian population has access to public service. This system includes the centers and health centers, hospitals (including university laboratories, blood banks, services, Surveillance, Epidemiological Surveillance, Environmental Monitoring, foundations and research institutes).

The Primary Health Care in SUS strategy are supported by Family Health Teams - FHT. Which service teams (1 doctor, 1 nurse, 1 dentist, 1 nurse and a dental assistant and 1 community worker) made visits to a number of families, taking health care to homes. The concern for professional and technical qualifications of the clinical staff FHT moved the Ministry of Health to bring together the initiatives in telemedicine in the country, thus creating the Telehealth Program Brazil, which has built a virtual library bringing together the applications of Second Opinion asked by Family Health Teams.

Strategy

The Telemedicine Brazil was structured in 2007 as a pilot project, serving 9 states (Amazonas, Bahia, Ceara, Minas Gerais, Goiás, Rio de Janeiro, Sao Paulo, Rio Grande do Sul and Santa Catarina) at a state university (Center of Telehealth) and the core goal of create 100 hotspots in Basic Health

Units - UBS - municipal (Telehealth points) and technical schools, hospitals and research institutes (Telehealth Advanced points).

The professional of the Family Health Teams (FHT) allocated to the UBS served by the program can send questions about clinical doubt and the Center of each state has a responsibility to produce a structured response, based on best clinical and scientific evidence, with appropriate references, thereby building library of answers. The structure that gives the name of Formative Second Opinion since it refers not only to answer, but the decision-making and technical training, improving the quality of health care, expanding primary care in solving and reducing costs by reducing the number of unnecessary referrals.

Each Center maintain specialists to structured and sending structured responses to the connection points distributed among municipalities. Specialties include all the thematic areas of health, connecting the professional and technical staff with the producer of knowledge, allocated in the universities. A Library for Health, with emphasis on Primary Health Care was built to provide access to collections of interest and also the collection of Second Opinions Formative[1] built during the implementation of the program. Access to this information is free to all professionals and technicians in health: www.telessaudebrasil.org.br [5] (the site is being translated to Spanish and English).

In 2009 we applied a semi-structured questionnaire with the users of the site Brazil Telehealth Program in order to verify if the content were appropriate to the needs expressed by the medical and technical staff, evaluating the necessary adjustments and relevant updates.

Results and Conclusions

The program reached in September 2009 the collection of 8531 Formative Second Opinions, indexed according to the subject addressed and professional category involved (the professional, technical or community worker). The average transmission of requests for second opinion in the two-year pilot project was approximately 8-by-point applications implemented (currently 900 points distributed among 9 states). The most salient issues determine the production of teaching materials for each professional category, to be used in distance education. The survey on the use of the portal was a voluntary one (200 responses were received), and showed that the contents are more accessible in technical areas (37.5%), followed by nursing (28% of votes); of Medicine (24%) and Dentistry (9.8%). The category that most responses to the survey was

provided by nurses (31.5% of responses), but even the managers of Health participated in the survey (3.5% of respondents), showing the program as a management tool in Health.

The thematic areas of greatest number of requests for second opinions or issues which are seasonal or epidemic or pandemic may require the production of teaching materials and administration of structured courses. In some of those opportunities it was asked for translation of the portal to Spanish and English.

We can conclude that the strategy of the Formative Second Opinion[1] specialized and structured to qualify the primary health care has demonstrated effectiveness in meeting the expectations of the medical and technical staff of the FHT and has attracted the continuous interest of managers to observe the potential of the tool qualification to reduce costs with improved quality in Health[2,3]. The international event crowned the initiative and the need for extended observation of international standards for structuring collaborative work[4].

The process of expanding the program throughout the country will continue the production of structured material, increasing the Virtual Library and enabling the service described by the FHT.

References

[1] C.L. Wen; E. Castro-Filho. "The Formative Second Opinion." Access on http://www.telessaudebrasil.org.br/agendas/seminac/activity.php?lang=pt&id=5, viewed on Feb, 2010.

[2] D.A. Ludwick, C. Lortie, J. Doucette, J. Rao, C. Samoil-Schelestraete. Evaluation of a telehealth clinic as a means to facilitate dermatologic consultation: pilot project to assess the efficiency and experience of teledermatology used in a primary care network," J Cutan Med Surg. 2010 Jan-Feb;14(1):7-12.

[3] S.E. Perschbacher, M.J. Pharoah, J.L. Leake, E.W. Lam, L. Lee. "A retrospective analysis of referral patterns for oral radiologic consultation over 3 years in Ontario, Canada." Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2010 Feb;109(2):e86-e91.

[4] N.N. Dubler, M.P. Webber, D.M. Swiderski "Charting the future. Credentialing, privileging, quality, and evaluation in clinical ethics consultation." Hastings Cent Rep. 2009 Nov-Dec;39(6):23-33

[5] Brazil Telehealth program, on www.telessaudebrasil.org.br, accessed on Feb 2010.

Ana Estela Haddad is Professor of Pediatric Dentistry- FOUSP. Manager of Education in Health Management Department, Brazilian Ministry of Health.

Mary Caroline Skelton Macedo is Professor of Endodontics – SLMandic Teledentistry Center of FOUSP, OPAS/Brazilian Ministry of Health. She is consultant in telehealth.

Eno Dias de Castro Filho
Family Medicine – UFRGS
Brazilian Society of Community and Family Medicine
RS Telehealth Center, Brazil

Verônica Abdala
Librarian
BIREME-BVS/OPAS

Rosimeira Peres Andrade is from Brazilian Ministry of Health. She is Consultant in Education in Health Management Department

Francisco Eduardo de Campos
Education and Labor in Health Management Secretariat
Brazilian Ministry of Health

Monitoring System of Assessment of Energy Expenditure to Human in Free-living Condition by Mean of Information and Communication Technologies

L. J. R. Lopez[1], D. G. Goroso[1,2]
[1]Scholarship from CAPES/CNPq - IEL National – Brazil, Mogi das Cruzes University, Human Motor Control Lab., leonardo.lopez@alunos.umc.br
Av. Dr. Cândido Xavier de Almeida, 200, Mogi das Cruzes, SP Brazil
[2]Physical Medicine and Rehabilitation Institute of Hospital das Clinicas, daniel.goroso@hcnet.usp.br Rua Diderot, 43 Vila Mariana, SP, Brazil

Abstract: **This work is contextualized currently living on the state of Sao Paulo (Brazil), which is common to several countries in relation to the gradual increase in number of people overweight and need to control the body's energy expenditure (EE) during basal metabolic state, at resting and several physical activities than medical staff required for rehabilitation process in free-living condition. This way, for the design of EE prediction model daily in free-living condition are taken into account the number of subjects to be monitored (>1000 adequate for epidemiological studies), period of monitoring system (daily in free-living) and cost of implementation to the population (lower cost). The main contribution of this new method of monitoring is the insertion of loss body-heat through of measurement of body temperature and its correlation with heart rate, thermal factor of food intake, oxygen uptake, and body's acceleration. Moreover, we have been analyzing the influence of other factors that influence the results as the ambient temperature and altitude, those measured directly through the mobile phone. This way, the use of information and communication technology intended that the population can access this monitoring system through your mobile phone and only two sensors in order to make wide use of this monitoring system, such that design is based on the mobile phone network 3G (UMTS/HSDPA) with main use of Short Message Service (SMS).**

Introduction

Background

Nowadays more and more people suffer to metabolic syndrome, which increase the risk of cardiovascular diseases, obesity, energy imbalance, malnutrition, diabetes mellitus type 2, and others. According to research of World Health Organization (WHO) in 2008, we are witnessing an

"epidemic" of cerebrovascular accident (Stroke) due to the progressive increase in obesity in the world with nearly 300 million people worldwide are obese [1]. In Brazil, according to report of the Brazilian Institute of Geography and Statistics (IBGE), 2007 there is around 17 million people obese, which represent 9.6% of population. Only in Sao Paulo, according to report of Pediatrics Society of Sao Paulo (2008), obesity affected 10% of children and 20% of Brazilian adolescents. Furthermore, report of the Brazilian Health Ministry (2009) confirmed that the rate of obese adults is 13% [2]. This is how, cerebrovascular accident or, for short, a CVA (Stroke), besides being a disease with high death rate, it is also the leading cause of disability in people aged above 50 years. According to Brazilian Health Ministry estimates that between 1990 and 2020 increased 130% from the occurrence of obesity, mainly consequences of Stroke [3].

Thus, this problem is addressed by turning from Sa Paulo State problem and now of national interest.

System Design

Requirement

The requirements for monitoring system in free-living condition begin with the context of performance:

- The system must be practical for long-term period studies, light and does not interfere with the dress or with everyday activities.
- The system must be easy to install and it must have protection from electrical shocks to the subject.
- Its operation must have national coverage. The requirements for model prediction of energy expenditure (EE):
- Specific: designed to assess a prediction of EE in free-living condition.
- Valid: the degree to which the tests actually measures EE.
- Reliable: The test must be consistent and stable in specific measuring.
- Objective: Produce consistent results and distinguishable from those already obtained by other authors.

Signals and Bio-signals

The energy balance involves a balance between the amount of energy intake through food and the amount of EE during the day. Factors such as exercise, balanced diet and clinical monitoring are essential to sustain a healthy life. This model prediction of EEtotal is based on the correlation of heart rate, oxygen consumption, body temperature and physical activity with respect to amount of energy intake through food. With respect to compliance with the requirements, the prediction of energy expenditure

required for collecting the following data. Heart Rate (HR): determines the frequency, variability, and average heart rate. Oxygen Intake (VO_2): ratio of O_2 consumption and CO_2 production. Body Temperature (T_b): assessment of corporal temperature onto skin. Diet-Induced Thermogenesis (DIT): specific dynamic action due to thermal effect of foods. Physical Activity (PA): assessment of quantity and intensity of physical activity. In addition, other measures such as altitude and ambient temperature are needed to prediction model.

Suitable Method of Measurement

Sensory components should be noninvasive not intrusive to the subject during the execution of any physical activity (Fig. 1). We have chosen the position of measuring devices taking into account the comfort and free movement of subject. Device 1: is a wristwatch that records the heart rate signal and body's temperature then transmit its by Bluetooth to mobile phone located at position 3. Device 2: is a wearlink with two sensors inside, EKG and body's temperature. Device 3: is a mobile phone which collects data from to wristwatch or from the waerlink directly. The other measures altitude, environment temperature and global positioning are collected by software from WAP connection.

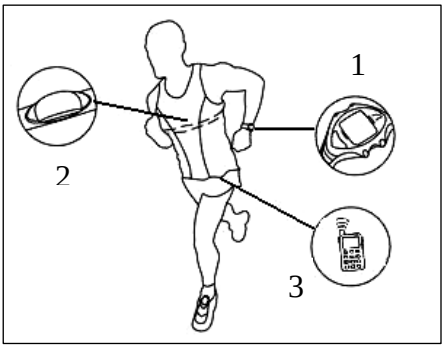


Figure 1. Placement of devices on body

Predict Model Energy Expenditure

There are many main components to assessment EE human how the metabolic rate, the thermal food effect, and Non-exercise Activity Thermogenesis (NEAT) [3]. We began with the premise that for quantify EE under free-living conditions, requiring the use of complementary methods. Therefore, this system allows measures correlate minutes-to-minute heart rate, acceleration and body temperature. Our prediction of EE equation is: $TEE = BMR + AEE + REE + DIT + Q_r$, where TEE: total EE, BMR: basal metabolic rate, REE: EE resting, AEE: EE activity, DIT: diet induced thermogenesis, and Qr: body's radiation. We adopt the method to estimate REE from FlexHR method [4]. In addition, we correlate the extent of acceleration of the body in three dimensions to measure heart rate to

predict the intensity of physical activity [5]. The relationship between HR and oxygen uptake (VO_2) has been used to predict maximal oxygen uptake (VO_{2max}). Determine the heart rate variability with AEE. Thus, with TEE and AEE is estimated that uses a prediction equation to estimate BMR using age, body mass and sex as independent variables [6]. The prediction of heat loss by radiation $Q_r = \varepsilon \cdot \sigma \cdot A \cdot (T_b - T_a)$, Where ε: emissivity coefficient, σ: Stefan-Boltzmann constant, A: body surface, T_b: absolute body temperature, and T_a: absolute ambient temperature.

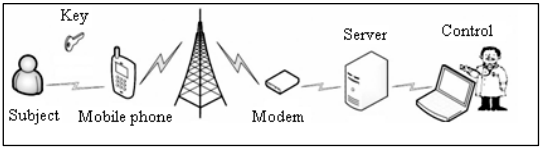


Figure 2. Network flow data

Architecture

The architecture used is composed for layers. The infrastructure layer enables access to mobile phone network 3G (UMTS/HSDPA) with global coverage. The hardware layer is composed of active equipments than allow exchange information with the telemedicine network. In the software layer allow programmed protocols and database. In the data layer are registered with all the measurements. In the safety layer are applied encryption algorithms. The applications layer is offer services to the User layer that have a friendly interface.

Beneficiaries

Patients who need individualized follow-up your treatments. Medical staff and researchers that are indexed using this system as a tool for prediction of EE and thus, validate their procedures.

Conclusions

Briefly this monitoring system meets requirements. Finally, the prediction model included loss body-heat by radiation, as a measurable factor in free-living conditions through the use of information and communication technologies.

Acknowledgment

The authors appreciate the human support of the University of Mogi das Cruzes (UMC) and the Coordination for the Improvement of Higher Level Personnel (CAPES). Furthermore, a special way to the Physical Medicine and Rehabilitation Institute of Hospital das Clinicas (IMREA/HC/FMUSP)

and Secretary of State of the Rights of Persons with Disabilities (SEDPcD), SP who have promoted this researching of monitoring system in partnership with the Foundation of the Faculty of Medicine (FFM) from Sao Paulo University, Brazil.

References

[1] World Health Organization. Obesity preventing and managing the global epidemic. Geneva: Report of a WHO Consultation on Obesity, 2007.

[2] Database of the Unified Health System. Virtual Health Library. http://search.bvsalud.org/regional/index.php 2008

[3] James A. Levine. Non-exercise activity thermogenesis NEAT. Best practice and research clinical endocrinology and metabolism. Vol. 16, No 4, pp 679-702. Doi: 10,1053/beem. 2002.

[4] Spurr GB, et al. Energy expenditure from minute-by-minute heart-rate recording: comparison with indirect calorimetry. Am J Clin Nutr 48: 522-59, 1988.

[5] Freedson PS, Miller J. Objective monitoring of physical activity using motion sensors and heart rate. Res Q Exerc Sport 71 (2): 21-9, 2000.

[6] Washburn RA, Cook TC, LaPorte RE. The objective assessment of physical activity in an occupationally active group. J Sports Med Phys Fitness. 29: 279-84, 1989.

Leonardo Juan Ramírez López was Ph.D. Student of Biomedical Engineering, University of Mogi das Cruzes, Sao Paulo, Brazil. Magister of Systems Engineering, National University of Colombia (2006). University Degree in Electronic Engineering (1997). Membership of International Society for Telemedicine and eHealth (ISfTeH). IEEE member of Engineering in Medicine and Biology Society (EMBS). Associate Professor, Faculty of Engineering, Military University Nueva Granada, Colombia.

Daniel Gustavo Goroso is coordinator of Research and Development Institute of Physical Medicine and Rehabilitation of HC-FMUSP, Brazil. Research Professor, Mogi das Cruzes University, Brazil. Coordinator of Motor Control Laboratory of Technology Research UMC/SP, Brazil. Doctor Magister of Electrical Engineering, University of São Paulo (2004). Magister of Electrical Engineering, University of São Paulo (1999). Full Degree in Physics of National University of Tucumán-Argentina (1994).

Open Health Assistant, a Solution Designed to Support the Evolution of Clinical Practice and Prevention, Transferring Diagnosis and Therapy to the Patients' Homes

J. Román Miralles[1], A. Altuna Palacios[2]
[1]Ándago Ingeniería, Health & Social Care, javier.ramon@andago.com
Alcalde Angel Arroyo, 10, Getafe, Madrid 28904, Spain
[2] Ándago Ingeniería, Andago Labs, ander.altuna@andago.com
Parque Tecnológico de Bizkaia, Edif 103, Zamudio, Bizkaia 48170, Spain

Introduction

Open Health Assistant (OHA) is based on new concepts of Health & Welfare whose main challenges are to achieve citizen and patient oriented services, improve the efficiency of sustainable health financing and the effective integration of levels of health care through telecare and telemedicine. Apply home monitoring systems using including mobile systems and location services, extends the service to all persons who, despite their clinical pathology, develop part of their activities outside the home.

Open Health Assistant

The Andago project, Open Health Assistant (OHA) of home monitoring is aimed at the management of patients by medical specialty and / or patients over 65 who require care in their homes, adapting the service to the real needs of each person. The service incorporates different components and technological devices that facilitate patient attention and treatment.
Patients may have different devices at home that allow detection of the emergency situations or the communication between the user and the Attention Hospital Center.

The technology consists of an easy to use mobile terminal, which sends an alarm signal to the central information process terminal and may use a mobility detector to locate movement within its coverage area via GPS.

OHA Biomedical Devices

Studies conducted by Andago represent a series of advances in telemedicine applicable to different medical specialties including both hospital and outpatient: telesurgery, gynecologists' outpatient, patients with

ambulatory peritoneal dialysis (CAPD), etc

Some of the available wireless telemedicine devices are the sphygmomanometer, the pulse oximeter, the meter, the scale and electrocardiogram recorder sending data to a mobile terminal, which in turn sends it to a terminal registration information or telecare. Finally, there are also mobility devices that include GPS and GSM technology, thus allowing to automatically geolocate the user.

The application of ICT information systems allow different professionals to record and to monitor remote health care of an individual or group of individuals, through the use of diagnostic and therapeutic methods managed remotely and recording them via the Web.

Telecare and Telemedicine Platform

OHA is a generic platform used to develop applications for the management and the intelligent application of outpatient treatment for patients that require health care provision. Its main goals are:

- The management, implementation and monitoring of clinical processes at home: Pharmacy, Pathology, test, scans, etc.
- Provide technology based home monitoring for decision making.
- Reduce the degree of dependence of patients with hospitals.
- Enhance the efficiency of outpatient treatments, registering better monitoring and controlling.
- Active participation of the home patients.
- Conjunction of mobile and biomedical devices for monitoring processes.
- Provide assistance to the health professional to diagnose the patient.
- Provide services for the implementation of the different treatments, taking into account the specific conditions and needs of each patient and their personal context.
- Provide continuous monitoring of the evolution of the treatment applied to the patient through mobility systems (mobile, web, TV, etc).

OHA is based on the development of tools for outpatient care knowledge management, reducing the diversity issues of standards and protocols used in home automation and medical devices. The orientation of the solution is directed towards:

- Patients who need health care provision that do not require hospitalization.
- Patients recovering from medical or surgical procedures.
- Patients with chronic care and monitoring 24 hours a day.

- Monitoring of Hospital Care in homes.
- Mobile/Web Monitoring of Medication or Care (Medicaid).

OHA as home care platform gives us a number of advantages which allow:

- Costs savings, reducing visits to health centers.
- Remote medical history registry.
- Registration of Multidisciplinary team review
- Improved monitoring of patient treatments.
- Service coverage in rural areas
- Quotes automation
- Biomedical Monitoring using devices
- Improved Quality of service
- Integration with back-office hospital (Unique Medical Records).
- Reduction of hospitalization duration.
- Reduction of health spending.

The monitoring of sensors and biomedical devices provides to the patients an absolute peace of mind because of the status follow up which doctors perform daily, making advances in:

- Reaction time to problems arising from any treatment.
- Providing a clinic history of the activities made by patients in their homes and / or outside the hospital to the multidisciplinary team, without having to alter the daily routine of the patient as well as cost savings by avoiding travel.
- Providing tips for “healthy lifestyle”, showing online advice, describing basic exercises, providing cognitive rehabilitation, etc.

Javier Román is Health and Social Care Services Manager at Andago Ingeniería, holds a M. Sc. in telecommunications Engineering from the University of Vigo, a MBA in Planning and Management of Senior Living Residences, a MBA in Management of Hospital Centres, a Master in Management of Infirmary Care Plans. In the past, he worked at the innovation departament of IT Deusto, AZERTIA and INDRA where he led the research activities in the areas of eInclusion and eHealth."

Ander Altuna heads the research and development department at Andago Ingeniería. He holds a M.Sc. in Telecommunications Engineering from the University of the Basque Country and will submit his thesis for the degree of Ph.D. in Computer Science from the University of Leeds during this year. He has expertise in carrying out research in the area of knowledge representation and reasoning and has an extensive record of related publications, including conference papers and journal articles. In the past, he worked at the research and innovation department of Atos Origin where he led the research activities in the area of eTourism.

Pharmacoepidemiology of Drug Prescription on Board Ships Assisted by Centro Internazionale Radio Medico (CIRM), the Italian Telemedical Maritime Assistance Service (TMAS)

F. Amenta[1], I. Grappasonni[2], M. Mancini[2], F. Petrelli[2], F. Sibilio F[2]
[1]Centro Internazionale Radiomedico (CIRM), Roma
[2]Centro di Ricerche Cliniche, Telemedicina e Telefarmacia, Università di Camerino, Camerino, Italy

Abstract: **The present study has analyzed drugs prescribed for treating diseases on board ships by Centro Internazionale Radio Medico (CIRM). CIRM is the Italian Telemedical Maritime Assistance Service (TMAS) and is one of the organizations with the largest experience in the field worldwide. The investigation has evaluated: No. of patient's file, ship's flag and position, language of teleconsultation, age and sex of patient, rank, days of assistance and number of teleconsultations, diagnosis (ICD-10), drug(s) prescribed (ATC) and their dosage. Based on pharmacotherapeutic guidelines for a given diagnosis, treatment prescribed on board ship and optimal (according to the guidelines) possible therapy will be defined. The expected results may serve as a reference for future regulations on the contents of the medicine chest.**

Introduction

According to international regulations, every ship should have an own pharmacy, the contents and the size of which is established by both international and national regulations. Factors such as the type of ship, the number of people on board and the nature, destination and duration of voyages are taken into account in establishing this provision of medicines.

In general, ship pharmacy is named ship's medical chest. In adopting or reviewing national provisions on the contents of the medicine chest and the medical equipment carried on board, international recommendations in this field should be taken into account. These include the most recent edition of the International Medical Guide for Ships and the List of Essential Drugs published by the World Health Organization (WHO), as well as advances in medical knowledge and approved methods of treatment. The last edition of the Medical Guide for Ships with the List of Essential Drugs was published in 2008 [2].

However, the above authoritative guidelines in general are not based on a pharmacoepidemiological analysis of drug use/needs in assisting patients on board ships. The present study has assessed the type of medications most often used in telemedical assistance to ships, by reviewing medical files assisted by Centro Internazionale Radio Medico (CIRM) in 2004-2008

Epidemiological analysis

Analysis was based on the review of files of medical assistance of CIRM in 2004-2008. CIRM, which is headquartered in Rome, is the Italian Telemedical Maritime Assistance Service (TMAS) and has one of the largest experience in the world of medical assistance of seafarers with more than 65,000 patients assisted on board ships. The investigation has evaluated the following items: No. of patient's file, ship's flag and position, language of teleconsultation, age and sex of patient, rank, days of treatment and number of teleconsultations, diagnosis (ICD-10), drug(s) prescribed (ATC) and their dosage [1,3,4].

Data extracted by computerized medical files of the Centre were transferred in an Excel file for further analysis. These data were then evaluated by two investigators independently and matched. In case of classification problems, the opinion of a third investigator was required.

Results

From 2004 to 2008 CIRM has assisted 8,532 patients on board of ships. The number of patients assisted each year is shown in Figure 1. Pathologies involving these patients classified according to the WHO ICD-10 are summarized in Figure 2. ICD is the International Classification of Diagnoses. This standard is used worldwide for general epidemiology, health management and clinical analysis.

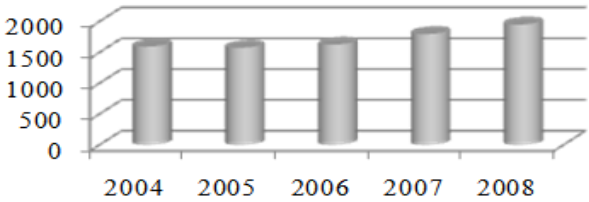


Figure 1. Number of cases assisted by CIRM per single year from 2004 to 2008

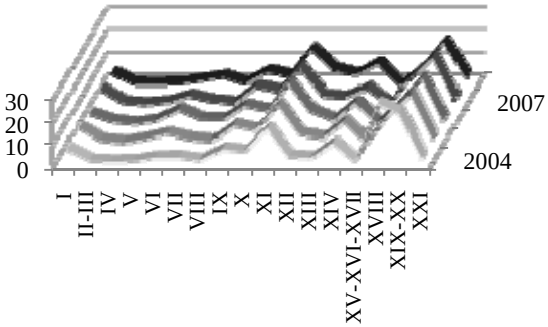


Figure2. Pathologies assisted by CIRM in 2004-2008 according to ICD-10. (**I**-infectious diseases; **II-III**-Neoplasms-Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism; **IV**-endocrine, nutritional and metabolic diseases; **V**- Mental and behavioural disorders; **VI**-Diseases of the nervous system; **VII**-Diseases of the eye and adnexa; **VIII**-Diseases of the ear and mastoid process; **IX**- Diseases of the circulatory system; **X**- Diseases of the respiratory system; **XI**-Diseases of the digestive system; **XII**-Diseases of the skin and subcutaneous tissue; **XIII**-Diseases of the musculoskeletal system and connective tissue; **XIV**-Diseases of the genitourinary system; **XV-XVI-XVII**-Certain conditions originating in the perinatal period-Congenital malformations, deformations and chromosomal abnormalities-Pregnancy, childbirth and the puerperium; **XVIII**- Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified; **XIX-XX-** Injury, poisoning and certain other consequences of external causes-External causes of morbidity and mortality; **XXI**- Factors influencing health status and contact with health services).

Discussion

People living ashore may have medical services available within a short time. On board ships the situation is different and the majority of vessels is at sea for days or weeks before they can reach a port. Only few ships carry a doctor or an adequately trained paramedic on board. In this situation, the best possibilities for treating diseases or accidents on board are:

- To provide medical advice via telecommunication systems;
- To guarantee adequate training of personnel with the responsibility of health care on board;

- To have an adequate supply of drugs and essential medical equipment (the so-called also ship's medicine chest).

This investigation which is still in progress is the first study addressing the type of pharmacological care for patients on board ships and can provide important insights into the needs/quality of pharmacare for sailing seafarers and passengers on ships.

Based on pharmacotherapeutic guidelines for a given diagnosis, treatment prescribed on board ship and optimal (according to the guidelines) possible therapy will be defined. The expected results may serve as a reference for future regulations on the contents of ship's medicine chest.

References

[1] Guidelines for ATC classification and DDD assignment 13th edition WHO Collaborating Centre for Drug Statistics Methodology, Oslo, 2009.

[2] WHO. International Medical Guide for Ships.3rd edition, 2008.

[3] International Statistical Classification of Diseases and Related Health Problems. 10th Revision Version for 2007. World Health Organization, Geneva, 2007.

[4] WHO Collaborating Centre for Drug Statistics Methodology http://www.whocc.no/

Francesco Amenta was graduated in Medicine and Surgery and specialist in Neurology. Full Professor of Human Anatomy. School of Pharmacy, University of Camerino. Director of the Centre for Clinical Research, Telemedicine and Telepharmacy, University of Camerino. Scientific Director Centro Internazionale Radio Medico (C.I.R.M.), the Italian Telemedical Marittime Assistance Service (TMAS). Chairman of Master University Courses in e-Health and Oil and Gas Telemedicine and Telepharmacy.

Iolanda Grappasonni is associated Professor of Hygiene. School of Pharmacy, University of Camerino. Teacher at the PhD Course in Environmental Sciences and Public Health of the School of Advanced Studies of the Camerino's University. Member of the Board of the Italian Society of Hygiene and Public Health. Main field of interest: Epidemiology and Pharmacoepidemiology, with particular reference to Occupational Medicine, Disaster Medicine, Environmental Hygiene, Telemedicine and Telepharmacy.

Manuele Mancini was graduated cum laude in Dentistry, at the University of Rome "Tor Vergata". Clinical and Research lecturer at the Department of Restorative Dentistry and Endodontics, at the same University. PhD student in the Department of Experimental Medicine and Public Health, at the University of Camerino. Clinical Research

Consultant at the Department of Oral Pathology at the University Hospital of Rome “Tor Vergata”. Fellow of the “Italian Society of Endodontics” and the “Italian Society of Restorative Dentistry”. Reviewer of the “European Journal of Dentistry”. Author of basic and clinical research papers in Italian and International Journals.

Fabio Petrelli is assistant Professor of Hygiene in the School of Pharmacy (University of Camerino). Member of the Italian Society of Hygiene and Public Health. Scientific responsible of training courses in Continuing Medical Education (ECM). Main fields of interest: Epidemiology, Occupational Medicine, Planning and Organization of Health Services, Environmental Hygiene.

Fabio Sibilio. Undergraduate student at the School of Pharmacy, University of Camerino. In the frame of a collaboration between Centre for Clinical Research, Telemedicine and Telepharmacy of his University and C.I.R.M. he is preparing his thesis focused on different aspects of pharmaceutical services delivered to patients on transportation systems via telemedicine.

Postural Telediagnostics for Elderly Remote Access to 3D Data and Its Assessment

W. M. Glinkowski[1,3,5], J. Michoński[2], R. Sitnik[2], B. Glinkowska[4], M. Witkowski[2]
[1]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", w.glinkowski@teleorto.pl
Medical University of Warsaw, 02-005 Lindleya 4, Warsaw, Poland
[2]Institute of Micromechanics and Photonics, OGX, Warsaw University of Technology, Warsaw, Poland
[3]Department of Descriptive and Clinical Anatomy, Center of Biostructure Research, Medical University of Warsaw, Warsaw, Poland
[4]Department of Physical Education and Sports, Medical University of Warsaw, Warsaw, Poland
[5]Polish Telemedicine Society, Warsaw, Poland

Abstract: **Telemedicine services for the ageing population are expanding recently. Postural screening assessment is usually focused on children and adolescents. Elderly population is endangering on kyphotic deformations due to osteoporotic fractures. Yearly three dimensional (3D) examinations may be applicable to monitor postural deterioration among elderly. Remote assessment of back shape seems to be an option to measure kyphosis angle and postural worsening. The aim of this study is to present the archiving and assessment system and its applicability. The proposed system has two main components: measurement module with data analysis and storage one. The measurement module is based on structured light method. Shape of the elderly patient's backs was acquired and sent over the Internet connection. Presented, originally developed system combines postural telediagnostic screening and monitoring. The development of automatic anatomical structures detection shall be able to prompt final diagnostic procedure and make draw of the trend of measured values changes over the time. The safety and procedure of presented examination method was highly accepted by elderly patients.**

Introduction

Telemedicine services for the ageing population are expanding recently. Remote assessment of back shape seems to be an option to measure kyphosis angle and postural worsening. The aim of this study is to present the archiving and assessment system and its applicability.

Material and Method

The measurement system consists of four modules which simultaneously measure patient's skin surface from four directions. Each directional module is an optical full-field 3D scanner based on structured light projection method. The main components of each module are: projection unit, detection unit or a camera and a PC-class computer. During the measurement process the patient is placed inside a calibrated measurement volume while a series of patterns is projected onto his or her body surface [1]. Directional point clouds originating from measurement modules are merged automatically basted on a global calibration. Measurement data acquired with use of the measurement system along with patient's textual data are stored in a dedicated database. The database is the heart of the system and serves two main purposes - archiving of data and guarding it from unauthorized access. Implemented features altogether form a complete system which can be securely used over any network, be it a local area network (LAN) or the Internet. Communication between system modules is performed over the TCP/IP protocol, incorporating two different channels for each client, dedicated to two kinds of data - text channel, for transmission of the XML documents and binary channel for the transfer of large binary data. Analysis can be carried out in two ways - discrete, based on a set of landmarks on the surface of the body or on a more global shape analysis. The discrete analysis itself can be performed either using manual indication of points or an algorithm of automatic landmark detection. The method assigns an area to each landmark, within which the exact position of the landmark is searched for. The 3D shape contained in each cell is analyzed based on maps of parameters which give general information about surface shape. Specific parameters were developed in order to describe surface shape of full 3D point clouds [2]. Landmarks exhibit specific properties depending on the type of posture which implies the use of different detection paths and an algorithm which would provide some general, coarse information about the posture of the patient.

Early Results

The average age of analyzed patients group was 72 years. Kyphosis angle was measured in the range of 32 to 60 degrees, assessed by the clinical team. Average time for assessment was calculated from logs of user entering the system. Shape of the elderly patient's backs was acquired and sent over the Internet connection. The average 3D image size for each examined patients was 5 MB, which takes about 20 seconds to transfer using a broadband connection. Average time for assessment was estimated

to be around 3-4 minutes based on information gathered by the analysis client module.

Discussion on Kyphosis

Spinal sagital curvatures and their deformities are described in relation to the anatomical planes of the body which are the coronal (frontal) plane, the sagittal (lateral) plane and horizontal (transverse or axial) plane. There are natural curvatures in the sagittal plane. Hyperkyphosis, colloquially called “dowager’s hump”, refers to excessive kyphotic, or anteriorly concave, curvature of the thoracic region of the spine. A kyphosis angle over 40° - the 95th percentile value for young adults - is currently used to define hyperkyphosis [3] that may impair pulmonary and physical function capabilities and increase risk of future fractures [4-6]. Several devices have been developed for kyphosis measurement [4, 7 - 12]. Many study suggested that kyphosis is associated with decreased BMD and loss of height but does not cause substantial chronic back pain, disability, or poor health in older women [13-18]

Conclusions

Presented, originally developed system combines postural telediagnostic screening and monitoring. The development of automatic anatomical structures detection shall be able to prompt final diagnostic procedure and make draw of the trend of measured values changes over the time. The safety and procedure of presented examination method was highly accepted by elderly patients.

Acknowledgment

The project is supported by grant number NR13-0020-04/2008 from the Ministry of Science and Higher Education.

References

[1] Sitnik R, Kujawińska, M, Woźnicki, J. Digital fringe projection system for large volume 360 deg shape measurement Opt. Eng. 2002; 41(2), 443-449

[2] Witkowski M, Sitnik R, Kujawińska M, Rapp W, Kowalski M, Haex B, Mooshake S. 4D measurement system for automatic location of anatomical structures Proc. SPIE, 2006; v. 6191, 61910H, 131-141

[3] Fon GT, Pitt MJ, Thies AC. Thoracic kyphosis,range in normal subjects. Am J Roentgenol. 1980, 134, 979–983

[4] Kado DM, Christianson L, Palermo L, Smith-Bindman R, Cummings SR, Greendale GA. Comparing a supine radiologic versus standing clinical measurement of kyphosis in older women: the Fracture Intervention Trial. Spine (Phila Pa 1976). 2006; 15;31(4):463-7

[5] Kado DM, Huang MH, Karlamangla A, Barrett-Connor E, Greendale GA Hyperkyphotic posture predicts mortality in older community dwelling men and women, A prospective study. J Am Geriatr Soc 2004, 62, 1662–1667
[6] Silverman SL, Minshall ME, Shen W, Harper KD, Xie S. The relationship of health-related quality of life to prevalent and incident vertebral fractures in postmenopausal women with osteoporosis, results from the Multiple Outcomes of Raloxifene Evaluation Study. Arthritis Rheum. 2001, 44, 2611-2619
[7] Lundon KM, Li AM, Bibershtein S. Interrater and intrarater reliability in the measurement of kyphosis in postmenopausal women with osteoporosis. Spine (PhilaPa 1976). 1998; 15;23(18):1978-85,
[8] Korovessis P, Petsinis G, Papazisis Z, Baikousis A. Prediction of thoracic kyphosis using the Debrunner kyphometer. J Spinal Disord. 2001;14(1):67-72;
[9] Weiss HR, Elobeidi N. Comparison of the kyphosis angle evaluated by video rasterstereography (VRS) with x-ray measurements. Stud Health Technol Inform. 2008, 140, 137-9
[10] Sitnik R, Glinkowski W, Licau M, Załuski W, Kozioł D, Glinkowska B, Górecki A. Screening Telediagnostics of spinal deformities based on optical 3D shape measurement system and automated data analysis – Preliminary report Proceedings of the XI International Conference Medical Informatics & Technology Ed, Piętka E, Łęski J, Franiel S. MIT, 2006, 241–245
[11] Huang MH, Barrett-Connor E, Greendale GA, Kado DM. Hyperkyphotic Posture and Risk of Future Osteoporotic Fractures, The Rancho Bernardo Study J Bone Miner Res 2006, 21, 419–423
[12] Ettinger B, Black DM, Palermo L, Nevitt MC, Melnikoff S, Cummings SR. Kyphosis in older women and its relation to back pain, disability and osteopenia, the study of osteoporotic fractures. Osteoporos Int. 1994, 4, 1, 55-60
[13] Ensrud KE, Black DM, Harris F, Ettinger B, Cummings SR. Correlates of kyphosis in older women. The Fracture Intervention Trial Research Group. J Am Geriatr Soc. 1997, 45, 682-7
[14] Milne JS, Lauder IJ. The relationship of kyphosis to the shape of vertebral bodies. Ann Hum Biol 1976, 3, 173-9
[15] Schneider DL, von Muhlen D, Barrett-Connor E, Sartoris DJ. Kyphosis does not equal vertebral fractures, the Rancho Bernardo study. J Rheumatol. 2004, 31, 747-52;
[16] Cowan NR. The frontal cardiac silhouette in older people. Br Heart J. 1965, 27, 231-5
[17] De Smet AA, Robinson RG, Johnson BE, Lukert BP. Spinal compression fractures in osteoporotic women, patterns and relationship to hyperkyphosis. Radiology.1988, 166, 497-500
[18] Singer KP, Jones TJ, Breidhal PD.Acomparison of radiographic and computer-assisted measurements of thoracic and thoracolumbar sagittal curvature. Skeletal Radiol 1990, 19, 21-6
[19] Cortet B, Roches E, Logier R, Houvenagel E, Gaydier-Souquières G, Puisieux F, Delcambre B. Evaluation of spinal curvatures after a recent osteoporotic vertebral fracture Joint Bone Spine 2002, 69, 201-8

Telemedicine Perspectives of Managing Crew Health during Lunar/Martian Extravehicular Activity and Physiological Monitoring of Sorties on the Surface of Other Celestial Bodies

S. N. Filipenkov
Gromov Flight Research Institute (FRI)
Ergonomic & Physiologic Centre of FRI flysim-lii@mtu-net.ru
Moscow Region, Zhukovsky-2, 140182, Russia

Abstract: **To make extravehicular activity (EVA) safe it was important to register in real time the physiological functions of the cosmonaut while he was outside the landing module of the spaceship. And these records are of great scientific interest. Purpose: Especially, for the autonomy of crew activities during a manned mission to Moon and Mars should be developed the remote physiological monitoring system with onboard database, incorporated into the landing module computer complex. Method: The database should include the results of medical support of EVA-crewmembers during long-term orbital flights, the results of previous Lunar expeditions (already realized) and the list of medical off-nominal EVA situations (assumed in the future Martian expeditions) with description of the physiological approaches to their decision. Results: An important problem of space medicine is to ensure the safety of space flights, of emergence of man into space and his landing on the surface of other celestial bodies. A prolonged stay in outer space and especially work outside the spaceship put special requirements to the routine of a reliable medical monitoring during EVA and check-up before sorties. Conclusion: In case of danger both a check-up, and a monitoring of physiological parameters should ensure the adoption of a correct decision in the shortest possible time.**

Introduction

A special biomedical information complex (IC) is implemented in order to ensure a safe and productive extravehicular activity (EVA) of cosmonauts [1,2,5,9]. For the autonomy of crew activities during a future mission to Moon and Mars should be developed the remote physiological monitoring system with onboard database, incorporated into computer complex both onboard the orbiter module of mother craft, landing module, and in a planetary space suit (SS) system of operational control [3,4,6,11].

Method

In the form of telemetry the medical information from the SS operational control system is transmitted to the on-board telemetry system of the Orbital Space Station (OSS) in real time [1,2,7,8], and then the total telemetry flow is transmitted to the on-ground Mission Control Center (MCC). Latter, the medical information is processed and displayed in the workstation of the EVA specialists to control of the microclimate parameters, the oxygen supply, and basic medical parameters [5,9,10]. The 27 life support parameters are assessed in real time through communication link of SS operative control system [1,2]. However, only 3 of these parameters are directly related to following physiological signals: electrocardiogram (ECG), pnevmogram (PG), and body temperature (BT).

At the present time for receiving, processing, display and registration of biomedical parameters used hardware-software complex 'Comastra' [8,9]. In addition to the display parameters in real time complex allows retrospective analysis of all of the information and archives on paper or magnetic media. The microclimate monitoring includes following physic parameters: an atmospheric pressure, the concentration of oxygen and carbon dioxide, CO_2 inlet/outlet difference at the cartridge (ΔCO_2), the ventilation rate (V'), the liquid temperatures in the liquid water cooling loops and in the liquid cooling garment (LCG). The ΔCO_2 and V' multiplication is the basis for calculating the value of the metabolic rate (MR), and the human heat production (HHP) according to the indirect respiratory calorimetric method [5, 9-10]. The human heat removal (HHR) from the skin of the cosmonaut is calculated in accordance to direct calorimetric method by the multiplication of the LCG inlet/outlet temperature differential (ΔT_{LCG}) and liquid flow in LCG with an additional value of perspiration losses [5]. Comparative analysis of the actual MR, BT, and heart rate (HR) values supports a differential diagnostic decision between the emotional and the thermal components of the stress reactions during physical activity [5]. The additional TV images review is possible to evaluate the working posture, the distribution of workload between the cosmonauts during EVA, and to control of the general status with post-EVA assessment of the injures and upper limbs attrition after ending of sorties [9]. The flight surgeon and other on-ground physicians has secured on-line information, to monitor the level of physical activity, the psycho-emotional stress, the adequacy of manual thermal regulation, and thus to predict both the health and the physical status of cosmonauts during the EVA [1-5,9].

Results and Discussions

An important problem of space medicine is to ensure the safety of space flights, of emergence of man into space and his landing on the surface of other celestial bodies [3]. In 1965 academic Vasilij Parin pointed that, a prolonged stay in outer space and especially work outside the spaceship put special requirements to the routine of a reliable EVA [11]. In XXI century his remark is actual for telemedicine usage in Lunar/Martian manned missions.

In order to provide safety, preserve a health and maintain physical capabilities of EVA crewmembers the approach to medical support should include the following stages of biomedical monitoring for human deep space exploration [3, 6]:

- Through (biomedical and psychological) examinations of crew on the Lunar and Martian orbit prior to descent on the planet;
- Medical control for health conditions of crew after landing on the surface (with preparation of medical recommendations concerning application of preventive means, therapeutic and emergency care);
- Medical control for health conditions per EVA day before donning of lunar/planetary suits;
- Medical monitoring during work of crew on the surface, and
- Medical examination at the end of EVA after doffing of lunar/planetary SS.

Based on the Russian mainland tracking posts MCC actualize all decisions in flight control operations [7]. During orbital EVA sorties these tracking posts communicate with the on-ground MCC one by one as the OSS (or spacecraft) travels over them, passing to each other the stable relay communication between the MCC and OSS [7, 8]. The MCC also has links with orbital Lunar and Martian automatically stations through the direct communication and television lines via deep space or through transmitting satellites. At the beginning of EVA program in the USSR the zones of the direct telemetry transmission to the MMC originally did not exceed 20-25% of the total EVA duration [8, 11]. A constant television cannel has been in service since 1979 between MCC and orbital spacecraft (or OSS) for the EVA crewmembers personal communication with the Earth [7]. At first 100% transmission of the EVA cosmonaut's voice communication through direct radio link between the MCC and orbital space complex "MIR" was established by the communication satellite "Luch" [7]. Later, in the introduction the communication satellite "Antares" to the "Mir", the medical telemetry transmission zones were increased to 60-65% [8]. This is a reason why on-board indicators of medical parameters (such, as HR and BT) have been provided in different options of the OSS "Salyut" but not

used by the cosmonauts because of the time deficit and employment of other working operations [9]. In orbital flight of the International Space Station (ISS) with the increasing of the crew to 6 cosmonauts/astronauts it is possible to control HR, BT, and the EVA-crewmembers health status by the crew remaining on board the ISS. Despite the initial planning of the crew of the ISS, number 6 people, and advanced computer power of the Russian segment, these possibilities so far are not fully realized [7-9]. Using NASA S-band channels realize the possibility to listen the voice communication of the EVA-crewmembers via a two-way radio during sorties. However S-band channel can not compensate the absence of the “on-line” medical data and SS telemetry in MMC [7]. The better time division multiple access concept has been developed in joint European/Russian project ‘EVA Suit 2000’, especially, for two EVA astronauts/cosmonauts application on-board mothercraft ‘Mir-2’ [12]. In this concept the communication link can be characterized as 3-node a time division multiple access network operated in Ultra High Frequency band with a frequency range of 400-420 MHz. The transmission characteristics are 160 kB/s and a bit error rate of 10-5 at a distance of 1 km. The mothercraft node became a primary master for network synchronization, each space suit transceiver transmits its digitized voice and digital data as a multiplexed bit stream within time slot in the communication link [12]. This communication system is capable of providing a full conference mode for voice communication, where as telemetry and biomedical data are transmitted unidirectionally from two EVA suits to the mothercraft data management system onboard future selenocentric or areocentric orbital expedition complex [1,2,12].

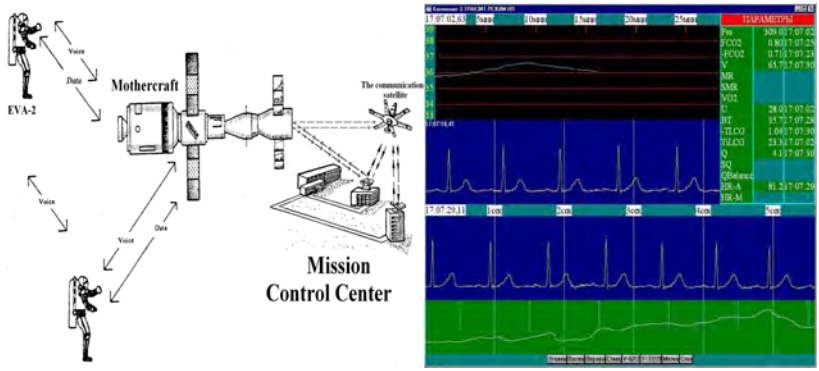


Fig. 1. The space suit communication principle and the biotelemetry data

As shown in Fig.1 the communication and telemetry system is capable of providing a full conference mode for voice communication, whereas telemetry and biomedical data are transmitted unidirectionally from SS to OSS. The MCC computer network receives, processes and analyses the telemetrical data from the mothercraft in real time scale, performs medical operational calculations of BT, HR; and registers metabolic parameters such, as MR, HHP, HHR. The network digests info at an estimated rate of several dozens of millions of operations per second, and its memory stores to several GB of digitized data [7-8].

A versatile computer system 'Elbrus' does complex calculations, solves the navigation tasks, analyses, plans and builds the central databank of the MCC. Specialized high-speed PS-2000 systems process great flows of data. Information complex 'Comastra' registers and recording the medical results of EVA, TV images and voice messages in database, to go back to if and when needed. Furthermore, IC 'Comastra' personal computer displays on the physicians monitors in real time scale both microclimate parameters (airlock and SS pressure modes, gas temperatures in ventilation loop and liquid temperatures in LCG), the physiologic responses (HR, ECG, PG, BT), and operative metabolic information (O_2 consumption, CO_2 production, MR, HHR). Thus, hardware-software complex 'Comastra' is the heart and brain of the EVA medical control group. Telemedicine monitoring of EVA and medical data accumulated in this database during orbital EVA sorties onboard OSS 'Salyut-6', 'Salyut-7', 'Mir' and ISS [6,10,11]. This experience and modern EVA database for ISS are a valuable basis for future medical support of autonomous manned flight onboard expedition complex to Moon and Mars with the remote EVA sorties on the surfaces. In Lunar/Martian manned missions the next generation of data acquisition and management system for EVA spacesuits operational control should include following: 1) the experience of medical support of EVA-crewmembers during long-term orbital flights, 2) the results of previous Lunar expeditions (already realized), and 3) the list of medical off-nominal parameters and EVA situations (assumed in the future expeditions) with description of the physiological approaches to their decision.

Conclusion

In 1965 academic Vasilij Parin mentioned following remarks in his lecture for students from medico-biological faculty of Russian State Medical University: "A prolonged stay in outer space and especially work outside the spaceship put special demands to the routine of a reliable

medical check-up. In case of danger such a check-up should ensure the adoption of a correct decision in the shortest possible time". In the modern state of art his conclusion is most actual for telemedicine application during Lunar and Martian manned missions in XXI century.

References

[1] I. P.Abramov, A.I. Skoog. Russian spacesuits, Springer-Praxis books, 2003, pp. 360.

[2] I. P. Abramov, "The experience in operation and improving the Orlan-type space suits", Acta Astronautica, v. 36, N1, 1995, pp. 9-12.

[3] S. N. Filipenkov, G.A. Rykov, "An universal space suit concept for Lunar and Mars missions", Proceedings of the Fifth International Aerospace Congress IAC'06 Dedicated to the 20th Aniversary of the Orbital Launch of Space Station "Mir", Moscow, Russia, 2006, pp. 227-228.

[4] S. N. Filipenkov, L.A. Kytaev-Smyk, N.N. Timofeev, V.V. Gorin, I.V. Pototskij, "Psychological and physiological researches during simulation of space operations onboard flying laboratories", Abstracts of the 17th IAA Humans in Space Symposium, Moscow, 2009, SSC RF- Institute of Biomedical Problems of RAS, pp. 40-41.

[5] S. N. Filipenkov, Yu.Yu. Osipov, "Metabolism evaluation during extravehicular activity", Abstracts of the 1st International Research Conference "The human survival: Reserv capabilisity and untraditional medicine", Moscow, 1993, pp.197-199.

[6] V. P. Katuntsev, Y.Y. Osipov, S.N. Filipenkov, "Biomedical problems of EVA support during manned space flight to Mars", Acta Astronautica, v. 64, N 7-8, 2009, pp. 682-687.

[7] V. P. Latishev, N.A. Sorokoletova. Spaceflights Control Centre. Moscow, Mashinostroenie, 1990, pp. 3-39.

[8] E. A. Mirkin, V.A. Garshin, I.V. Dunaeva, F.A. Voronin, O.V. Nekrasova, "The development of Orlan Space Suit telemetry complex", Prosieding of XXXIVth Academic Cosmonautic Reading, Moscow, Commission of RAS, 2010, pp. 466 (in Russian)

[9] Yu. Yu. Osipov, V.P. Katuntsev, S.N. Filipenkov, "The operative medical control in aspects of Space Suit monitoring complex usage", Proceedings of International Conference "Life Support Systems as a means for human deep space exploration", SSC Institute for Medico-Biological Problems RAS, Moscow, 2008, pp. 68-69, (in Russian)

[10] Yu. Yu. Osipov, A.N. Spichkov, S.N. Filipenkov, "Metabolic assessments during extra-vehicular activity", Acta Astronautica, v. 42, N1-8, 1998, pp. 123-137.

[11] V. V. Parin. Walk into Space. Press & News Agency, APN, Moscow, 1965, pp.10-16.

[12] A. I. Skoog, I.P. Abramov. "EVA 2000: A European/Russian space suit concept", Acta Astronautica, v. 36, N1, 1995, pp. 60-62.

Sergius N. Filipenkov since 2000 is a Head of physiological sector in laboratory of aerospace medicine at State Scientific Center "Gromov Flight Research Institute (LII)". He received Flight Physiologist certificate for training on the AMST Human Centrifuge at December 22, 2007. That is a reason why he is the Leading Research Scientist at the Aviation Medicine and Crew Life Support Department at the Ergonomic and Physiological Center in LII.

Telemonitoring of Weight and Physical Activity: Efficacy in Obese Humans and in Patients with Diabetes Mellitus Type 2

C. Luley[1], A. Blaik[1], S. Westphal[1], M. Bruhnke[2]
[1]Institut für Klinische Chemie und Pathobiochemie, Germany
[2]Aipermon GmbH & Co.KG, Germany

Abstract: **Telemonitoring of weight and physical activity: Efficacy in obese humans and in patients with diabetes mellitus type 2**

Introduction

Obesity and obesity associated diseases are presently a pandemic in all affluent countries. This problem continues to grow despite efforts of the medical societies, the population and even the governments. Therefore, strategies to fight and to prevent obesity are eagerly sought.

Problem

Obesity and diabetes type 2 rise in most cases from an atherogenic diet plus a lack of physical activity. While there are many approaches to modify the calorie input there are only few measures which can effectively improve and control the calorie consumption by physical activity. This paper describes 2 studies in which a novel program was used for weight reduction in obese humans and in patients with diabetes mellitus type 2. This new approach includes telemonitoring of weight and physical activity and has been shown to be powerful and cost effective.

Solution Approach

The 3 elements of the holistic ABC (Active Body Control) program are:

(1) Telemonitoring of weight and physical activity with weekly feedback letters to inform and motivate,

(2) A combination of 2 diets: calorie restriction plus preference of carbohydrates with a low glycemic index, and,

(3) Cost liability

The carer receives the data via the internet and responds with weekly letters informing the participants about their data and aiming to motivate them (figure 1).

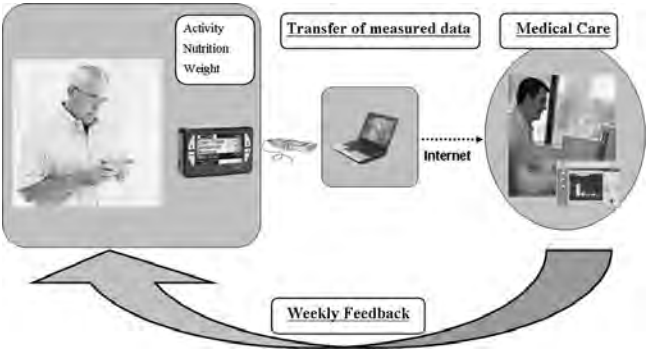


Figure 1: Telemonitoring for diabetes patients

Participants were 20 parents in obese families in the first study and 87 patients with diabetes mellitus in the second study. These participants were initially informed in 3 sessions about nutrition, the importance of physical activity and about the use of the telemonitoring equipment. The first study took 12 months, the second study 6 months. Both studies were controlled by an equal group of participants who were not treated with the "ABC" program.

Results

The obese parents in the first study reduced their weight after 6 months by -7.2 kg, which was almost 3 times more than in the control group (-2,6 kg) without the telemonitoring devices. After 12-months, the intervention group reduced the weight even further without a tendency for a weight regain in contrary to the control group.

The 87 diabetic patients (BMI=35,3kg/m^2, mean age 59 years) showed a mean weight reduction by 10.3 kg after 6 months. Concomitantly, their glucose and HbA1c fell by 1.6 mmol/l and 0.9 % percentage points, respectively. The proportion of patients with HbA1c > 7% was reduced from 66% to 27%. An anti-diabetic drug was discontinued in 26 patients and reduced in 33 patients, which resulted in a reduction of treatment costs by 117 EURO per patient and 6 months.

Table 1: Results in patients with diabetes mellitus type 2

Weight reduction	-10.3 kg	p < 0,000
HbA1c reduction	- 0,9 %	p < 0,001
Percentage of patients in whom the anti-diabetic drug treatment was reduced or discontinued	68. %	

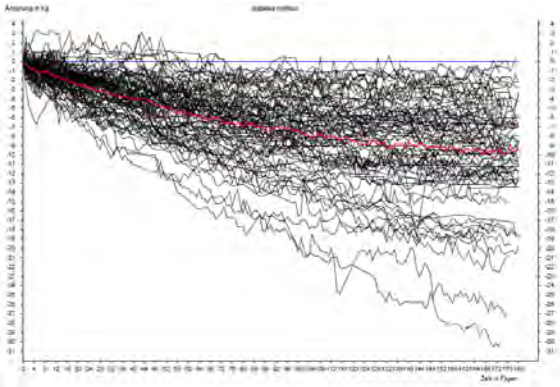


Figure 2: Weight-loss in 87 patients with diabetes mellitus type 2 (red = mean weight-loss)

Summary

The ABC-program is a novel program which improves the atherogenic lifestyle, in particular by enhancing the physical activity by means of telemonitoring.

In summary it provides the following advantages:

- Relevant and sustained weight reductions
- Relevant health improvements
- The program is cost effective. The preparation of a feed-back letter requires on the ABC platform 3-5 minutes (www.abc.diaet.com)
- The program is indicated in other obesity associated diseases like hypertension and the metabolic syndrome
- The monitoring equipment can be combined with other telemonitoring devices such as blood pressure or glucose measurement
- The ABC program can be applied by doctors, oecotrophologist, diet assistants and other health related professions
- Participants can be looked after even over very long distances.

Outlook

The availability of the ABC-program is presently being increased in several german regions. Reimbursement negotiations with health insurance companies have been started.

Further studies with patients with hypertension, the, metabolic syndrome and the Polcystic Ovary Syndrome (POC) are being initiated.

References

[1] T. H. Marwick, M. D. Hordern, T. Miller, D. A. Chyun, A. G. Bertoni, R. S. Blumenthal, G. Philippides, A. Rocchini; Council on Clinical Cardiology, American Heart Association Exercise, Cardiac Rehabilitation, and Prevention Committee; Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; Council on Nutrition, Physical Activity, and Metabolism; Interdisciplinary Council on Quality of Care and Outcomes Research. Exercise training for type 2 diabetes mellitus: impact on cardiovascular risk: a scientific statement from the American Heart Association. Circulation. Jun 30;119 (25):3244-62, 2009.

[2] J. Brand-Miller, S. Hayne, P. Petocz, S. Colagiuri. Low glycemic index diets in the management of diabetes: a meta-analysis of randomizedcontrolled trials. Diabetes Care; 26:2261–9, 2003.

[3] G. D. Plotnick, M. C. Corretti, R. A. Vogel. Effect of antioxidant vitamins on the transient impairment of endothelium-dependent brachial artery vasoactivity following a single high-fat meal JAMA, 278:1682-6, 1997.

[4] I. Frey, A. Berg, M. W. Baumstark, D. König. Gewichtsreduktion bei adipösen Männern - Ergebnisse aus einem interdisziplinären Schulungsprogramm (M.O.B.I.L.I.S.) Blickpunkt der Mann 2009; 7 (3)11-15.

[5] B. Kulzer, N. Hermanns, D. Gorges, P. Schwarz, T. Haak. Prevention of diabetes self-management program (PREDIAS): effects on weight, metabolic risk factors, and behavioral outcomes. Diabetes Care. Jul; 32 (7):1143-6, 2009.

C. Luley study of Chemistry in Frankfurt and medicine at in Berlin. He did several years scientific work at the Oklahoma Medical Research Foundation in Oklahoma City and then at the central laboratory of the university clinic in Fribourg. Since 1994, he is Director of the institute for clinical chemistry and pathobiochemistry at the Otto-von-Guericke University in Magdeburg.

Michael Bruhnke received a degree in electronic engineering from the Technical University in Munich. He had been working for major players in the semiconductor industry and he owns several patents about integrated circuit design and data management. His working experiences cover R&D, project management, product management, sales, marketing and business development in an international environment. At Aipermon GmbH & Co. KG he takes the strategic responsibility as Business Development Manager for identifying and realising business opportunities in the telemonitoring market.

Thomas Schweizer ist als Geschäftsführer der Aipermon GmbH & Co. KG verantwortlich für die Bereiche Marketing und Vertrieb, Business Development. 2002 folgte der Aufbau und die Leitung von "Innovation and Concepts" im Geschäftsbereich Secure Mobile Solutions innerhalb Infineons. Diese Funktion beinhaltet Innovationsmangement, Strategische Produktausrichtung, Produkt- und Systemdefinition und Systemarchitekturen. Ab 2004 leitete Thomas Schweizer im Bereich Emerging Business bei Infineon den Aufbau der BioCoach Technologie (Telemonitoring).

The Brazilian Telemedicine University Network RUTE

W. Coury, L. A. Messina, J. L. Ribeiro Filho, N. Simões
RNP- Rede Nacional de Ensino e Pesquisa
Rua Lauro Muller 116 sala 3902, Botafogo - Rio de Janeiro
CEP: 22290-906, Brasil

Abstract: **The Brazilian Telehealth initiative enables videoconferencing, diagnosis and formative second opinion, continuous and permanent education and web conferencing, by linking university and teaching hospitals via RNP, Brazil's national research and education R&E network. It operates two significant national projects: The Telemedicine University Network, RUTE (www.rute.rnp.br) and the National Telehealth Primary Care Program, Brazil Telehealth (www.telessaudebrasil.org.br); respectively from the Science and Technology Ministry and Health Ministry. The municipal, state, national and international health institutions coordinate collaborative projects in research, innovation, development, management, education and assistance.**

Introduction

RUTE´s main objectives are:

- Connect the University and Teaching Hospitals to the national R&E backbone through a 1Gbps City Fast Ring for R&E Institutions
- Formally create a Telemedicine Nucleus in each Hospital
- Approve a Videoconference Room
- Create initial infra-structure for Teleconsult and Telediagnosis
- Train Personnel for Video- and Webconference
- Create and stimulate participation in SIGs – Special Interest Groups

In its first phase, started January 2006, RUTE resources were available for 19 University Hospitals [1]. Second phase, January 2007, included 38 institutions involving all University Hospitals from all Federal Universities in all federal states and 26 embrio institutions according to an agreement between RUTE/RNP and Telehealth Brazil. Third phase, started May 2009, selected 75 institutions, involving all public certified teaching Hospitals, federal health institutions and the federal indigenous health department.

The Ministry of Health integrates the initiative through the Telehealth Brazil, implanting initially in 9 states the remote Primary Care Program in

the University Hospitals attending 100 Municipalities in each state, yielding 900 operational at the moment.

Advanced Network Infrastructure

RUTE implements communication infrastructure in university and teaching hospitals in the largest 53 cities in Brazil, enabling the establishment of telemedicine and telehealth centers with investments on equipment, connectivity and ambience preparation. The goal of the project is allowing all participating hospitals to use the National Network for Education and Research in order to operate applications on telemedicine and telehealth, including video and webconference for exchanging information, talks, continuing education, second opinion and teleconsultation, creating a base for collaboration among hospitals and training them for remote collaboration.

The R&E Metropolitan Community Networks (Redecomep) implements communication infrastructure in the 27 brazilian capital cities through its Points of Presence (PoPs - www.redecomep.rnp.br). It expands now to 10 more cities. The goal of the project is to connect all main public universities and research centers in the country, with optical fiber managed by a local consortia made up of these institutions and RNP. However, the participation of state and municipal governments on R&E networks is opening up possibilities including public schools and health care centers.

These metropolitan networks are being installed and full operation is expected by 2010 in the capital cities (Fig. 1). Currently, sixteen capital cities operate the Redecomeps with 290 institutions.

Fig. 1 – RNP national backbone and Redecomep R&E City Network. 607 municipalities covered by the Minas Telehealth in the state of Minas Gerais

Metropolitan networks are connected nationally by the National R&E Network backbone with current Gigabit connection capability in ten PoPs (10Gbps for Rio de Janeiro, São Paulo, Brasília and Belo Horizonte and 2,5

Gbps for Porto Alegre, Florianópolis, Curitiba, Fortaleza, Recife and Salvador) – http://www.rnp.br/backbone/index.php

RUTE Operational Methodology

The following procedures are implemented for setting the structure of the University Telemedicine Network operational methodology:

- Establishment of the organizational and technological infrastructure: national coordination, advisory committee made up of experts of the country's best teaching and research institutions, interest groups on specific health areas and also executive, maintenance, communication and operational teams of the national and local telemedicine and telehealth network;
- The Advisory Committee recommends the procedures for the innovative use of the Telemedicine University Network;
- Each member institution establishes the telemedicine and telehealth Centers with a physical area and a dedicated team;
- Member institutions establish SIGs to promote and develop collaboration activities on telemedicine and telehealth specific topics;
- Organize workshops to encourage everyone's understanding of the collaboration work for the national integration on teaching, research and the improvement of health care service for the population [3].

Network Results

RUTE member projects integrate at the moment 158 health institutions. It connects today 36 Nuclei and 31 embrio-Nuclei fully operational.

RUTE performs daily routine VC or Webconference sessions, each specialty at least once a month, on pediatrics radiology, oncology, urology, children and adolescent health, dermatology, cardiology, oftalmology, etc. There are 30 SIGs operational and at least 12 more in 2010. A total of ca. 500 sessions were held in SIGs in 2009 (Fig.2).

Fig.2: A NOTES transvaginal colecistectomy surgery performed and transmited at ISCMPA by Prof.Dr.Luiz Alberto de Carli on Sept 30th 2008

There has been a 137% increase in the participation of institutions in the groups in 2009, from 89 to 211institutions. In some groups up to 400 people participated from remote areas in specific sessions on intensive nursing.

In addition, as it happens with the added value of the program Tele Minas Saúde (Minas Telehealth Fig.1) financed by the State Government Health Department and coordinated by Prof.Dr.Beatriz Alkmin, ECG formative second opinion is guaranteed for each of the 500 municipalities, on duty service 12 hours, 7 days per week shared with the following National University Hospitals: UFMG, UFU, UFTM, UFJF and Unimontes, yelding more than 900 consults per day.

International Collaboration

The encouragement for the continuous development in this area comes from the following mechanisms:

- Cooperation signed between Internet2 and RNP in Health Sciences;
- Program for Innovative Continuing Medical Education in Dermatology, American Academy of Dermatology and the University of Miami;
- Laboratory of Excellence and Innovation in Telehealth – America and Europe, in Belo Horizonte;
- Establishment of a SICOT Education Center on orthopedics and trauma in Rio;
- Public Policies on Telehealth in Latin America, an IADB project, starting March 2010, with the following countries: Brazil, Colombia, Ecuador, El Salvador, Mexico, Uruguay and RedClara [3].

Conclusion

Previous research projects at the Brazilian universities showing remote assistance, education and collaborative research, also stimulated by the @lis results [4], including RedClara, encouraged government actions and public investments on communication infrastructure, telemedicine and telehealth.

The main reasons for the continuity and success of the network are: federal initiative and coordination, state initiatives, integration and synchronization between the two main complementary projects and members: RUTE (Ministry of Science and Technology) and Telehealth Brazil (Ministry of Health) [5].

Acknowledgments

To all RUTE members, the RUTE Committee, the National Telehealth Primary Care Program, the Brazilian National Education and Research

Network RNP, Brazilian University and Teaching Hospitals Association Abrahue, Ministry of Education, Ministry of Health, Ministry of Science and Technology, and the Brazilian National Studies and Projects Financing Agency FINEP.

References

[1] RUTE - Rede Universitária de Telemedicina, Convênio Encomenda-FNDCT Ação Transversal ref. 2738/05, (UFPR, Unifesp, Pazzanese, Unicamp, Ufes, UFBA, Ufal, UFPE, UFPB, UFC, UFMA, Ufam, FioCruz, HC–FMUSP, HU-USP, ISCMPA, Uerj, UFMG, UFSC), January 2006

[2] MCT, MEC e MS, Seminário "Os Hospitais Universitários e a Integração Educação, Saúde e Ciência e Tecnologia", 1-2/08/07, Brasília. Workshops de Telemedicina e Telessaúde promovidos pelo Conselho Federal de Medicina nas regiões do Brasil: Norte, Março 2007, Manaus; Nordeste, Maio 2007, Recife; Central, Julho 2007, Brasília, e os Congressos da SBIS, Abrahue e do CBTMS em 2006/-7/-8/-9.

[3] ATN/OC-11431-RG, Protocolos Regionais de Política Pública para Telessaúde, LEG/SGO/CSC/IDBDOCS #1893634, 30/10/09, Fundep/UFMG, BID

[4] IV European Union – Latin America and The Caribbean Ministerial Forum on the Information Society, @lis, An Alliance for Social Cohesion through Digital Inclusion, Rio de Janeiro, 22-23 November 2004, Rio de Janeiro Declaration, VI Forum in Lisbon, 28-29 April 2006, Lisbon Declaration

[5] RUTE Forum, HU-UFRJ, RJ, 10-11/08/2009

Dr Messina coordinates the Brazilian Telemedicine University Network (RUTE).He also managed three EU projects in Brazil connecting City Halls in Europe and Latin America (URB-AL program). He ran the e-Health project T@lemed with Fraunhofer-IGD and @lis Program from the European Commission and has coordinated graduate courses at the University of Vila Velha. He has a degree in Electrical Engineering (University of Brasília), a Masters in Automation (University of Campinas), and a Doctorate in Computer Graphics from the Technologic University of Darmstadt where he was Assistant Professor 1984-1989.

Wilson B. Coury studies: Post-graduates in cost-effective engineering - UFRJ in 1968. Director of administration and finance of SERPROS-Social Security Institute of SERPRO-1986 to 1990. General Manager of Administration in Rio de Janeiro SERPRO – 1993 1997. Director in planning and administration of RNP - national network of education and research - 1999 to date.

Telesurgery

Monitoring of Patient's Condition, Actions of Anaesthesiologist and Surgeon in the Operating Room over the Internet

E. V. Flerov, I. N. Sablin, O. G. Broytmann, Sh. S. Batchayev
A. B. Bankov
The Russian National Research Center of Surgery, tele@med.ru
2 Abrikosovsky per., Moscow, 119991, Russia

Introduction

According to the on line survey conducted by the Anesthesia Patient Safety Foundation (APSF), the two factors that contributed most to intraoperative adverse events were believed to be inadequate preoperative information/preparation and communication/teamwork errors[1]. Thus development of electronic medical record and automated anesthesia record keeping systems remains a very relevant task for modern anesthesiology. Even bigger challenge is to ensure compatibility and universal access to the wealth of the acquired anesthesia information. Internet as a common information milieu in combination with new technologies creates the basis for Web integration of anesthesia-relevant information and further advances of anesthesiology, minimizing the "human error" component in the area of patient's safety in the operating room (OR). In the last century this minimizing of human error was secured through adoption and introduction of the Standards for Basic Anesthetic Monitoring. The 21st century calls for systems for remote patient's monitoring, facilitating close cooperation between anesthesia provider and specialist/mentor, creating databases jointly accessible via Internet and modern audiovisual telecommunicating tools for physician's lifelong learning. That contributes to a "second layer of safety", when specialized anesthesiologist is able to supervise and control via any on-line computer physiologic parameters in real time, together with visualizing the actions of the OR team over web cams. This redundancy compensates for the remaining «human factor» («to err is human»), that can be responsible for the anesthesia-related complications even when all the essential hardware of safety monitoring is in use. The same computer can give the videoconferencing capabilities to the supervisor for his teleconsulting and mentoring role. Work in that promising field at the Russian National Research Center of Surgery has been active since 1997 and is reflected at http://tele.med.ru

Study Goal

Development and clinical application of a system for the permanent Internet monitoring of patient's condition, actions of anesthesiologist and surgeon to optimize operating room workflow and to ensure administrative oversight. Piloting of the concept of «remote second safety layer in anesthesia»

Material and Methods

«Home-grown» paperless automated anesthesia record keeping in 8 operating rooms (cardiac, organ transplantation, abdominal/colorectal surgery, thoracic and invasive radiology) with gathering data on the central server and using the proxi-server that presents information over the Internet. High resolution Webcams (736x480 pixels) controlled over the Internet (Sony SNC-RZ30), four-channel video server Axis 241QA for visualization of performance of surgeons and anesthesia providers, as well as screens of the anesthesia monitors, transesophagial echocardiography (TEE), X-ray and endoscopic equipment with resolution of 768x576 pixels. Videoconferencing using H323 and H320 protocols and peer-to-peer Voice over the Internet Protocol (VoIP) «Skype». Database with over 5000 patient's records, 2400 operated during last four years are accessible and available for mathematical analysis from any computer on the world network. Patient's control and performance monitoring of surgical and anesthesia personnel using any web browser on any stationary computer as well as mobile devices from site http://tele.med.ru

Results

This technology allows to receive information that constitute anesthesia record in real time as well as access it for the post-hoc analysis on any computer of the world. It is easy to control the computer monitoring protocol, to discover the technical or instrumental errors, to detect periods of suboptimal anesthesia. The chief of service can oversee the situation in the OR during meetings and conferences, using mobile Internet access from laptop , from home during emergency procedures and even via mobile telephone (s. Fig.1, Quadruple OR view on the iPhone, at the end of this text).

Physician in charge can, without leaving his office, home or even car can monitor the anesthesia provider, give advice and prioritize his/her work, supervising several operating room in parallel with the necessary administrative duties. The comments, remarks, recommendations and diagnostic statements made remotely are recorded in anesthesia record using

specifically designed piece of software that identifies the commenting author as well. To diagnose the patient's condition at the distance quality and comprehensivness of data output are of high importance. From that standpoint displaying the hemodynamic and ventilation trends together with two video server images or simultaneous four-windows picture from Axis 241 QA proved to be the best. Combining the «fly on the wall» view of the OR with operating field, trends of computer anesthesia record and screens of hemodynamic and gas analyzing monitors / TEE permitted to detect hemodynamically significant responses secondary to coarse surgical manipulations or changes in preload (leg elevation) that were not recorded by the anesthesia provider in the room. Based on the results of Internet-monitoring it was posssible to diagnose the patinet's condition and provide recommendations to anesthesiologist in the OR. There were two occasions when disconnection of endotracheal tube from anesthesia circuit was diagnosed remotely using this system. Videoconferencing, Skype in particular, provides the leader reliable opportunity for «telemanagement». We successfully tested telemonitoring of anesthesia's depth by Board certified anesthesiologist stationed in Philadelphia, USA.

Using the system the leading cardiac surgeon follows preparatory stages of the procedure remotely, instructs and consults his team, participates in the TEE study or provided with live X ray images. It is possible to capture video images as digital files to document the key stages of the procedure and create videoclips / podcasts of the operating technique to educate and train surgeons.

Developed system is succesfully implemented in remote medical graduate and postgraduate education of students, surgeons, anesthesiologists and specialists in intraoperative functional diagnostics. It also permits substantial cost savings over installation of commercially available designated systems for videoconferencing often requiring the presence of dedicated staff to ensure their operability. High quality of visualization of operating field is achieved by remotely controlled via Internet, never turned off Web cams or by simple video server. VoIP Skype combined with high definition camera Logitech 9000 Pro delivers a very clear professor's image to the OR, and cordless headset Plantronics CS60db provides quality audio.

Conclusion

Developed at the Russian National Research Center of Surgery system of Internet-monitoring provides reliable remote access to control the condition of patient undergoing surgery, as well as performance of anesthesiologist and actions of surgical team. It provides «informational backbone» of the concept of «Real Time Telemedicine in the OR», that is built up in our

center and may serve as basis for creating National anesthesia database in Russia. «Real Time Telemedicine» implies formation of the digital operating room, in which all gathered information is available to qualified user via secure Internet access from potentially any computer in the world for review, management and teaching, with using available modern communication technologies like videoconferencing and VoIP videotelephony.

References

[1] Anesthesia Patient Safety Foundation: http//www.apsf.org accessed 12 Feb 2010

Fig.1 Real Time View of the 4 Operating Rooms on the iPhone

Alexander Bankov, is a Senior research fellow at the Russian National Research Center of Surgery named after B.V. Petrovsky in Moscow, Russia. He graduated from Urals Medical Academy and received further training in Moscow, where he also studied biomedical engineering at Bauman's Technical University. He trained and worked in Germany, UK and USA. He is interested in airway management, regional anesthesia, computer technologies in anesthesia and medical education.

http://tele.med.ru : Our Solution to Web Integration of Information in Cardiac Anesthesia

A.B. Bankov, Sh.S. Batchayev, E.V. Flerov, I.N.Sablin, O.G. Broytmann
The Russian National Research Center of Surgery named after B.V.Petrovsky, tele@med.ru
2 Abrikosovsky per., Moscow, 119991, Russia

Abstract: **Progress of anesthesiology has been closely related to technological innovation. Implementing telemedicine in cardiac anesthesia has its unique challenges due to potentially rapid changes in patient's state, making necessary constant "hands on" presence. The potential for human error can be reduced by "picking the collective brain" - harnessing the resources and technologies of the Web. We discuss our experience in organizing service enabling a) virtual presence in the operating room for the outside consultant and b) continuous rational access of anesthesia provider to various resources, from anesthesia record database to podcasts from practically anywhere.**

Introduction

The most significant achievement of modern anesthesiology over last two decades is advancement in patient's safety. Nowadays the question of "surviving surgery / anesthesia" is practically always answered with resounding, "yes"- a lot of effort has shifted into postoperative period and quality of the recovery. At the same time the ability to bring sicker and sicker patients to the operating room leads to ever-increasing pressure on the anesthesia provider to be on top of variety of medical and technological issues. It is well known that human error remains the major factor for occurrence of untoward events, not only in medicine.

Roughly the same time frame corresponds to the revolution in informational exchange brought to us by Internet and it's major component, the World Wide Web.

We believe that further improvement in quality of anesthesia care is intricately related to mobilizing the resources and technologies available on the Web. The following presentation describes our approach to Web integration as ideology and innovative means of real-time informational support in cardiac anesthesia.

Introduction

Conceptual development, testing and clinical application of a service that utilizes the Web interface to facilitate real time monitoring, communication, research and education on the basis of cardiac operating rooms (ORs) at the Russian National Research Center of Surgery.

Material and Methods

Developed at our Center paperless automated anesthesia record keeping system rendering data to the central server; proxi-server that presents information accessible by any Web browser. High resolution Webcams (736x480 pixels) installed in the OR lights and controlled via Web browser (Sony SNC-RZ30) with pre-set positions, four-channel video server Axis 241QA for visualization of performance of surgeons and anesthesia providers, as well as screens of the anesthesia monitors, transesophagial echocardiography (TEE), X-ray and endoscopic equipment with resolution of 768x576 pixels. Videoconferencing using H323 and H320 protocols plus peer-to-peer Voice over the Internet Protocol (VoIP) «Skype». Secure on-line access to the intraoperative data (one minute interval) in real time or to the database for the last four years with possibilities of mathematical analysis from any computer on the world network.

Results

As per title, the site http://tele.med.ru reflects the results of our approach to this topic.

Telemonitoring/ virtual presence. Anesthesia requires constant presence of a trained personell that is capable of necessary intervention in response to continually monitored physiologic parameters and demands of the surgery. That is why the main part of our site is dedicated to the real time access to automated anesthesia record. It portrays trends and last minute values of monitored parameters simultaneously with video feed - either from high resolution webcam or panoramic «fly on the wall» view. It is also possible to visualize the screens of the monitors , transesophagial echocardiogram or X-ray's image intensifier screen, depending on needs and configuration of hardware connected to video server. Remote observer is able to change views of the camera, that has preset positions: operating field, anesthesia machine, perfusionist's workplace with possibility of zooming and fine tuning via Web browser. At this stage feedback is delivered either by video and audioconferencing with OR staff or by entering the comments in the anesthesia record after logging in, these entries marked separately to distingquish them from the OR notes. We are aware of the atempts of

providing automated anesthesia and teleanesthesia by other colleagues [1,2], we do rely on the anesthesia provider present in the OR at this stage. It is our belief that creating certain degree of redundancy in the system by utilizing external expert observer should contribute to improvements in safety and quality. It remains to be proven - at the moment we only have anecdotal evidence of near misses when potentially dangerous situation was detected first by the remote observer who notified OR staff.

Searchable Database. Beside virtual presence in the different ORs and keeping track of case's progress anesthesiologist can concentrate on quality of his/ her work by reviewing and analyzing the past anesthesia records, observing trends, performing statistical analysis or research. The database of anesthesia records can be accessed from the same site with graphical output right away; to receive the numerical data one has to request them from database administrators. The archive is organized around individual ORs and spans last 5 years.

Web resources. The anesthesia provider, beside availability of the videoconferencing to obtain real time consultaiton and advice, has an obvious advantage of immediate acccess to the various reference materials – search engines, electronic interactive cardiac anesthesia library and drug databases.

Webcasting. To deliver instructional and educational materials compiled by the professors of our Center we use webcasting, both live and on demand. We widely utilize Adobe Flash to present these materials due to smaller file size and faster loading, they are also viewable across different platforms and operating systems. There is growing library of high definition videos demonstrating anesthetic and operating procedures used for teaching purposes as well; the podcasting also represented.

News/Periodicals. These sections of the site are regularly updated with information about relevant conferences, meetings, emerging technologies etc., one can familiarize with new publications or publish his/her work in this section

Portability/Mobility. The PDA and WAP versions of the site guarantee anesthesiologists's access to the resources while using palm computer or mobile phone.

Conclusion

We believe that effective application of telemedicine in anesthesiology is impossible without organizing of a Web access to crucial anesthesia information. It should allow

- Improved oversight of overall patient's condition and thus contribute to patient's safety during anesthesia

- Effective use of pooled data from different health care institutions for objective analysis and scientific research
- Continous medical education for anesthesiologist
- Time saving when searching for information necessary to perform clinical duties

References

[1] T. Hammerling, "Automated Anesthesia". Advances in Anesthesia, Vol.25, 2007, pp.17-39nesthesia Patient Safety Foundation. http//www.apsf.org accessed 12 Feb 2010

[2] K.Naguib, E.Kochs, J.Schuettler, H. Ihmsen, "Teleanesthesia by Automated Long Distance Anaesthetic Drug Administration". Anesthesiology 2005; 103: A817

Alexander Bankov, is a Senior research fellow at the Russian National Research Center of Surgery named after B.V. Petrovsky in Moscow, Russia. He graduated from Urals Medical Academy and received further training in Moscow, where he also studied biomedical engineering at Bauman's Technical University. He trained and worked in Germany, UK and USA. He is interested in airway management, regional anesthesia, computer technologies in anesthesia and medical education.

Telemedical Systems for the Support of Regional Healthcare in the Area of Trauma

M. Kosiedowski[1], C. Mazurek[1], K. Slowinski[2], M. Stroinski[1], K. Szymanski[2], J. Weglarz[1]
[1]Poznan Supercomputing and Networking Center, kat@man.poznan.pl, mazurek@man.poznan.pl, stroins@man.poznan.pl, weglarz@man.poznan.pl
ul. Noskowskiego 10, 61-704 Poznan, Poland
[2]Poznan University of Medical Sciences, Division of Trauma, Burns and Plastic Surgery, slowik@man.poznan.pl, rofe@tlen.pl
ul. Fredry 10, 61-701 Poznan, Poland

Abstract: **In this paper we present our joint Wielkopolska Center of Telemedicine effort, which aims to establish a telemedical infrastructure supporting the healthcare system in the region of Wielkopolska. We discuss how the proposed ICT-based solutions may help to improve the patient safety and the quality of the delivered medical services in the area of trauma, which has been selected as the pilot medical domain tackled by our project.**

Introduction

Telemedicine shows a huge potential in supporting healthcare with advanced technical solutions allowing to better organize the communication between healthcare stakeholders. Introduction of telemedical solutions is done towards the aim of providing higher quality medical services. At the same time telemedical tools often allow to reduce the cost of a given medical service. These objectives, along the increase of patient safety, are among the major goals of the Wielkopolska Center of Telemedicine (WCT) project (www.telemedycyna.wlkp.pl) realized by Poznan Supercomputing and Networking Center in cooperation with the Poznan University of Medical Sciences and Poznan University of Technology. This project tackles the challenges of improving the organization of the regional healthcare and increasing the quality of treatment in the area of trauma in Wielkopolska.

In this paper we discuss the needs of the regional healthcare in the area of trauma and the activities of the WCT project towards fulfilling them. First, we present the challenges imposed by the current organization of the regional healthcare. Next, we list the activities of the WCT project aimed at

tackling these challenges. Finally, we summarize the project works on the background of similar initiatives undergoing in Poland, Europe and beyond.

Challenges

Current State

Presently, the regional healthcare system in the area of trauma is organized in Wielkopolska in a way that assigns the Division of Trauma, Burns and Plastic Surgery of Poznan University of Medical Sciences (PUMS), together with a few cooperating clinical departments of this university, as the reference center for all hospitals in the region. While this assumption seems the right solution, the technical and organizational means for referring difficult trauma cases, especially the multiple-injury ones, are not sufficient. The only communication means which the first level hospitals located in each county may use to contact the PUMS clinical departments located in Poznan is the telephone. This shows as very insufficient for making educated decisions on the best solution in a given medical case from the patient's point of view.

Evidence

The lack of a standard for communication between hospitals in the area of trauma has a negative effect on the safety of patients with multiple injuries. According to the data we collected during the recent 3 years, on average only 35% of cases referred to the PUMS Division of Trauma, Burns and Plastic Surgery were referred based on a previous contact between the hospitals during which the proper classification of patient state has been conducted. In 40% of referred cases the proper classification of patient state was not possible due to technical limitations of the phone talk. The remaining patients referred from the region arrived in Poznan without previous contact between hospitals; over half of these patients should have never been transported.

Solution

Wielkopolska Center of Telemedicine

To increase the patient safety and improve the communication between the stakeholders of the trauma patient treatment system we proposed to organize the Wielkopolska Center of Telemedicine. This project aiming at establishing the telemedical infrastructure in the area of trauma in Wielkopolska started in May 2009. The objective of the project is to build a regional platform for remote medical teleconsultations allowing to introduce standardized communication in trauma. This platform will connect 26

hospitals from Wielkopolska with 7 clinical departments of PUMS. In addition to the deployment of the platform for medical teleconsultations, the project also constructs the Medical Digital Library, which collects anonymous medical data and provides this information through accompanying telemedical services of the educational nature. Both subsystems are closely coupled with each other to enable sharing data between them and allow users to seamlessly utilize services provided by both of these subsystems.

Regional Platform for Medical Teleconsultations

The goal of the platform for remote medical teleconsultations is to improve the communication between stakeholders of the regional healthcare system in the area of trauma. This platform is aimed to enable seamless transmission of patient data between the participants of the trauma patient treatment workflow. We envisage supporting two scenarios within the constructed platform: (a) a teleconsultation, where one doctor asks another for a specialist opinion, and (b) a telecouncil, where several specialists are able to provide their opinions on a given complicated case. At the time of writing of this paper we are finishing the designing the platform on the organizational and technical layers.

Medical Digital Library

The primary goal of the Medical Digital Library is to enable innovative educational services allowing the members of the regional medical community to share their knowledge and experience between each other. To achieve this goal we proposed to collect anonymous medical data within the registry of medical cases [1, 2]. The collected cases are precisely classified according to the assumed standard of injury classification, thus allowing to relatively easily build added-value services such as clinical decision support and reporting to the regional supervisor. The registry with its carefully designed database forms also an excellent field for future scientific analysis of the collected information. The registry of medical cases is on-line since August 2009.

Summary

In this paper we presented the challenges connected with the improvement of the quality of treatment in the area of trauma in Wielkopolska and how the Wielkopolska academic and medical communities which we represent tackle them. Namely, we were able to apply for and receive a grant for the Wielkopolska Center of Telemedicine project in which we build a regional system for medical teleconsultations

and the Medical Digital Library. The former activity is aimed to allow the improvement of the organization of the communication in the area of trauma in the regional healthcare to increase the safety of patients, while the latter one aims to improve the quality of treatment through providing innovative educational resources and services.

The Wielkopolska telemedical project is one of several projects aiming to establish telemedical centers for various medical domains currently undergoing in Poland. Others tackle the challenges of teleradiology (uct.su.krakow.pl), telecardiology (www.teleintermed.pl) and telelaryngology [3]. A telemedical system supporting communication in the area of trauma is utilized by three provinces in Italy [4]. Complex telemedical systems connecting all medical practices exist in Norway. To our knowledge, however, none of these initiatives includes the development of the organized comprehensive teleeducational effort such as the one we aim to establish with the Medical Digital Library and its innovative teleeducational services closely coupled with the teleconsulting platform. In our opinion only parallel tackling of both these areas carries a potential of a big influence on the improvement of the patient safety and improvement of the quality of the medical services delivered to the patients.

Acknowledgment

The work presented in this paper is supported by a grant from Iceland, Liechtenstein and Norway through the EEA Financial Mechanism.

References

[1] M. Kosiedowski, C. Mazurek, M. Stroinski, and J. Weglarz, “Grid-supported Medical Digital Library”, Studies in Health Technology and Informatics, vol. 126, pp. 127-136, 2007

[2] M. Kosiedowski, C. Mazurek, M. Stroinski, and J. Weglarz, “Medical Digital Library Services as an Improvement of the Teleconsultation System in the Regional Health Network”, in Proc. of the International Conference on eHealth, Telemedicine, and Social Medicine “eTELEMED2009”, pp. 154-159, 2009

[3] H. Skarzynski, “Najnowsze praktyczne zastosowania w telemedycynie”, IT w Sluzbie Zdrowia, Warsaw, 2008 (in Polish)

[4] F. Roccia, M. C. Spada, B. Milani, and S. Berrone, „Telemedicine in Maxillofacial Trauma: A 2-Year Clinical Experience”, Journal of Oral and Maxillofacial Surgery, vol. 63, No. 8, pp. 1101-1105, 2005

Michal Kosiedowski has been employed by PSNC in the Network Services Department since 1997. His professional interests include e-health, service oriented systems and web technologies. Michal has been the project leader of the "Telemedycyna Wielkopolska" and is currently coordinating PSNC's participation in the Wielkopolska Center of Telemedicine project. He is the author or co-author of over 15 publications in professional journals and conference proceedings

Cezary Mazurek is the Head of the Network Services Department at PSNC. His research interests include a wide variety of advanced network services including portal solutions, digital multimedia libraries, streaming technologies, e-health, distance learning and access to grid services. He has coordinated numerous research projects in those fields and has acted as the Technical Coordinator of the Wielkopolska Center of Telemedicine project. Cezary is the author or co-author of over 30 papers in professional journals and conference proceedings.

Krzysztof Slowinski is the head of Division of Trauma, Burns and Plastic Surgery, Poznan University of Medical Sciences. His professional interests include general and trauma surgery, plastic and reconstructive surgery, new technologies in operative surgery, advanced techniques in communication and telemedicine. Currently, Prof. Slowinski acts as the Medical Coordinator of the Wielkopolska Center of Telemedicine project. He is the author or co-author of about 200 papers in major professional journals and conference proceedings.

Maciej Stroinski is the Technical Director of PSNC and Vice President of the PIONIER Consortium. His research interests concern networking, quality of service, network protocols and management, and grid-related topics. He is author and co-author of over 150 papers in major professional journals and conference proceedings. Dr. Stroinski is the co-author of the Pionier Programme, announced as the official Polish programme in 2000. He is also the author and co-author of over 150 papers in major professional journals and conference proceedings.

Karol Szymanski is the assistant in the Division of Trauma, Burns and Plastic Surgery, Poznan University of Medical Sciences. He is also vice-head of the Emergency Department. His medical interests include general and trauma surgery, especially posttraumatic reconstruction of extremities. He is strongly engaged in the Wielkopolska Center of Telemedicine project. He is the author or co-author of about 30 papers in major professional journals and conference proceedings.

Jan Weglarz is the Director of the Institute of Computing Science, Poznan University of Technology, Director of PSNC, President and Scientific Secretary of the Poznan Branch of Polish Academy of Sciences (PAS) and Vice President of the Committee for Computer Science PAS. He is a member of several professional and scientific societies, among others the American Mathematical Society and the Operations Research Society of America. Prof. Weglarz is the author and co-author of 11 monographs, 3 textbooks (3 editions each) and over 200 papers in major professional journals and conference proceedings.

Telenursing – First Experiences with Mobile Phones for Wound Healing Monitoring (Role of Nurses)

W. M. Glinkowski[1,3,4], A. Saracen[2,4]
[1]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", w.glinkowski@teleorto.pl
Medical University of Warsaw, 02-005 Lindleya 4, Warsaw, Poland
[2]Faculty of Medical Sciences, Technical University of Radom, Radom, Poland
[3]Department of Descriptive and Clinical Anatomy, Center of Biostructure Research, Medical University of Warsaw, Warsaw, Poland
[4]Polish Telemedicine Society, Warsaw, Poland

Abstract: **The main advantages of telehealth are health-related activities at a distance between two or more locations, using information and communication technologies by medical professionals including nurses. Wound care management for many elderly patients requires assistance, however the nursing decision making needs also surgeon's assistance frequently. Nurses, usually after teleconsultation with leading physician can assess and monitor wound healing, and make treatment changes without having to visit the home of each patient or order an immediate on site visit if required. The aim of the study was to assess an accuracy, resolution, perspective and clarity of wound images taken by nurses in orthopaedic outpatient clinic and transferred to attending physician for consultation. MMS via GSM technology and Internet were used for transferring images. Research demonstrated that wound assessment using MMS technology is comparable to in-person wound assessment. Our study have confirmed current needs for the training of skills how to use technology to obtain proper quality and resolution of images required for telemedicine. The telemedicine oriented skills should be considered as current direction for nursing education.**

Introduction

The main advantages of telehealth are health-related activities at a distance between two or more locations, using information and communication technologies. These contacts include all branches of medical stuff including nurses. Despite declarations of open attitude to telemedicine obtained while surveying citizens and or health care professionals real implementation is facing various difficulties before its overall acceptance. Wound care management for many elderly patients

requires assistance; however the nursing decision making needs also surgeons assistance frequently [1-3].

Expert wound care is a specialized service that may not be available in every population. Modern approach by telehealth may offer new opportunities for all patients, nurses and physicians. Videoconferencing or photography allows transmitting images of wounds and reaching wound care nurses or physicians in distant locations (1, 3, 4). The route of image transfer need to be tested by nurses to make them familiar with technology for themselves as well for instructing patients. Nurses, usually after teleconsultation with leading physician can assess and monitor wound healing, and make treatment changes without having to visit the home of each patient or order an immediate on site visit if required. The aim of the study was to assess an accuracy, resolution, perspective and clarity of wound images taken by nurses in orthopaedic outpatient clinic and transferred to attending physician for consultation.

Material and Method

MMS via GSM technology and Internet were used for transferring images. Images were immediately read and confronted with real wound. Three experienced and specialized nurses in wound care but unfamiliar with technology were requested to take images by Mobile phone incorporated camera and sent over to attending surgeon. Forty six MMS images were snapped and transferred using Sony Ericson Unit (19 post operative wounds and 27 chronic). Patients both sexes were aged from 37 to 76 signed an informed consent to let their wounds photographed. Five point (1-5) Likert scale based assessment was performed for each image evaluating its quality and resolution, perspective, wound measurement possibilities, and healing advancement. Five point (1-5) Likert scale based assessment was performed for each image valuating its quality and resolution, perspective, wound measurement possibilities, and healing advancement. Directly after making photos, the wounds the patients went to the physician who made face to face assessment. These results were compared to the opinions made from the photos.

Results

Average quality of images was 3.01 in a range from 1 to 5 (std 1,05). The study has had an element of surprise due to ad hoc request for photographs taking by nurses. The average healing was advanced in 3,3 out of 5 (std 0,9). Proper perspective was assessed to ensure the photographed area and

wound vicinity. Average perspective was assessed 2.72 in the range from 2 to 4 (Std 0,621). Measurement possibilities expressed any calibration of size or depth of assessed wound. Average measurement possibilities achieved value of 2,826 (Std 0,598) in a range from 2 to 4. Face to face assessment of the wounds revealed similar results as taken from the photos in 42 patients (91%).

Discussion

Mobile phones due to their usually smaller screens are rarely described as devices for transmission of clinically oriented images. Cellular phones are designed recently to become similar to handheld computers like Personal Digital Assistants (PDA) that are becoming increasingly popular among medical professionals [1-3]. Telemedicine oriented applications are not often installed on mobile phones as well on PDA devices, however their availability, including picture archiving and communications systems PACS have been reported [4]. The use of mobile phone photo-messaging into clinical practice for the assessment of hand trauma was reported as “low cost and easy” [5]. The MMS technology was demonstrated by Ng et al. [6] to be a useful media for the transmission of high-quality images to assist in the diagnostic process and implementation of emergent clinical therapy. Teleconsultations using a mobile camera-phone [7] were feasible to evaluate the severity of digital soft-tissue injury and to triage the injury with regard to management recommendations. Handy mobile controller were able to access the picture archiving and communication system (PACS) to enhance image management for clinicians with nearly no restriction in time and location using various wireless communication modes [8]. MMS services were useful in musculoskeletal injuries for transmitting images from radiological department to orthopedic surgeons within less than 2 minutes and 30 seconds [1,3,9]. Despite, the most of the papers report transmission of X ray pictures [1-3] wound images have similar impact for its applicability. In presented study the nurses transmitted the photographs of wounds in order to assess the quality of images and the proper assessment of wounds. The nurses had not been previously taught how to perform the photographs, and they were novice in practicing telenursing techniques. The study revealed that in most cases the assessment of wounds images were properly taken and sent via MMS services. The evaluation of the process of healing based on transferred photographs was in most patients similar to the opinion made during an eye-made control by the

physician. However, the results could be a little better with more skills in using telemedicine oriented techniques.

Conclusions

Our study demonstrates that wound assessment using video technology seems to be comparable to in-person wound assessment. Simple and daily used multimedia communication using MMS can be feasible for wound management by nurse wound care expert supported by surgeon on remote. Our study confirm the skills how to operate MMS technology are required to obtain proper quality and resolution of images. Gaining new telemedicine oriented skills by learning program can be considered as current direction for nursing education.

Acknowledgments

Authors thanks to nurses from Baby Jesus Hospital in Warsaw who participated in this study.

References

[1] A. Wojciechowski, G. Glinkowski, M. Gołębiowski, A. Górecki. The use of multi-media messaging as supplement information of musculoskeletal injury cases Proceedings of the XI International Conference Medical Informatics & Technology Ed.: Piętka E, Łęski J, Franiel S. MIT, 246–253, 2006.

[2] S. Fischer, T. E. Stewart, S. Mehta, R. Wax, S. E. Lapinsky. Handheld computing in medicine. J Am Med Inform Assoc 10:139–149, 2003.

[3] W. Glinkowski; B. Ciszek, M. Gil. Teleconsultations in orthopedic trauma and neurotrauma utilizing mobile digital assistant International Congress Series, 1281, 1329, 2005.

[4] C. G. Wallace, J. N. Gibson. Mobile messaging: emergency image transfer. Ann R Coll Surg Engl. 86(1):42-43, 2004.

[5] T. K. Lam, A. Preketes, R. Gates. Mobile phone photo messaging assisted communication in the assessment of hand trauma. ANZ J Surg. 74(7):598-602, 2004.

[6] W. H. Ng, E. Wang, I. Ng. Multimedia Messaging Service teleradiology in the provision of emergency neurosurgery services. Surg Neurol. 67(4):338-41, 2007.

[7] C. H. Hsieh, H. H. Tsai, J. W. Yin, C. Y. Chen, J. C. Yang, S. F. Jeng. Teleconsultation with the mobile camera-phone in digital soft-tissue injury: a feasibility study. Plast Reconstr Surg. 114(7):1776-82, 2004.

[8] F. H. Tang, M. Y. Law, A. C/ Lee, L. W. Chan. A mobile phone integrated health care delivery system of medical images. J Digit Imaging. 17(3):217-25, 2004.

[9] Y. Chu, A. Ganz. A mobile teletrauma system using 3G networks. IEEE Trans Inf Technol Biomed.; 8(4):456-62, 2004.

The Remote Range of Motion Measurement Using Still Images Transfer and Freeware Angle Measurement Tool: Preliminary Report

W. M. Glinkowski[1,2,4], K. Krawczak[1,4], D. Cabaj[1,4], B. Glinkowska[3]
[1]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Medical University of Warsaw, 02-005 Lindleya 4, Warsaw, Poland w.glinkowski@teleorto.pl
[2]Department of Descriptive and Clinical Anatomy, Center of Biostructure Research, Medical University of Warsaw, Warsaw, Poland
[3]Department of Physical Education and Sports, Medical University of Warsaw, Warsaw, Poland
[4]Polish Telemedicine Society, Warsaw, Poland

Abstract: **Telerehabilitation promises to change physiotherapy delivery in rural and remote areas. The range of motion is an important measurement in musculoskeletal disorders. The aim of the study was to assess reliability of measurements of endpoint active flexion range of motion. The study group consisted of 15 patients in early postoperative period after total hip replacement due to osteoarthritis. The results were analyzed using Intra Class Correlation Coefficients and kappa statistics. The average value of kappa coefficient calculated for this preliminary group was 0,43. Its significance can be interpreted as moderate agreement. Further investigation is mandatory to develop overall best practice conditions for valid range of motion assessment using telemedicine tools.**

Introduction

Measurement range of joint's motion is one of the fundamental/essential measurements, which is carried out/used during patient's examination with osteoarthritis of locomotion system. The measurement enables the estimation of patient's functional state, moreover, if it is carried out regularly, it is used to estimate progress of the dysfunctions. Telerehabilitation promises to change physiotherapy delivery in rural and remote areas [1-9]. The range of motion is an important measurement in musculoskeletal disorders [10-16]. The aim of the study was to assess reliability of measurements of endpoint active flexion range of motion. Additionally, the study was aimed to estimate the effectiveness and

authoritativeness of the measurement range of motions “from distance” with using free and generally accessible programs.

Material and Method

The study group consisted of 15 patients in early postoperative period after total hip replacement due to osteoarthritis. Collected images were sent via the Internet using safe connection. Images were saved in JPEG format. Freeware Angle Measurement Tool Scale 2.0 was used for measurement. Assessments were made by every investigator included (orthopedic surgeon and physiotherapists) based on images archives collected from patients treated at the clinical facility from September to November 2009. Patients before their discharge from the hospital after Total Hip Replacement Surgery were randomly selected for the study (mean 6 days post surgery). An approval of this study was granted by Bioethical Committee. Range of joint’s motion was examined indirect on snapped images using Angle Measurement Tool - Scale 2.0 freeware. The range of hip motion was assessed using well selected anatomical landmarks [17]. Each measurement was independently repeated by each investigator. Measurements were taken while the patients were supine on a hospital bed with both legs resting on the bed. The most studies [10, 16] have measured flexion in supine position. The goniometric measurements were performed according to the technique of range-of-motion examination accordingly to the SFTR recording method [11]. The centre of the fulcrum positioned over the greater trochanter. The mean and standard deviations were calculated for each RoM assessed and for each observer. The mean difference between the two observers and the SD of this difference were calculated. The magnitude of the SD expresses the extent to which the observers were able to achieve the same value [12]. Subsequently, the 95% limits of agreement were calculated, defined as the mean difference between observers ± 1.96 SD of this mean difference [18]. The intraclass correlation coefficient (ICC) was calculated for measurements and raters [19]. We used online statistical software tools to calculate the ICCs.

Results

The results were analyzed using Intra Class Correlation Coefficients and kappa statistics. Intra Class Coefficients calculated for each rater were significant (ICC 0.894-0.976). The kappa coefficients calculated was calculated for multiple coders generalization according to Krippendorff.

The average value of kappa coefficient calculated for this preliminary group was 0.43. Its significance can be interpreted as moderate agreement.

Discussion

The development of eHealth and telemedicine affects rehabilitation making the delivery of rehabilitation services over telecommunication networks and the internet [1-9]. New services require to introduce modern remote assessment methods of outcomes. Russell et al. [20] have suggested that Internet-based physiotherapy interventions delivered to the home are suitable for further development. Telerehabilitation based assessment of interobserver agreement for Range-of-motion should approximate to similarly good results as achieved with standards methods [13-15]. The reliability and validity study have evaluated knee range of motion via the Internet [21]. Hoffmann et al. presented [22] an Internet-based goniometer which can be used for the remote quantification of joint range of motion (ROM). Further improvement of ROM measurement, that achieved already good enough intraclass correlation coefficient, is expected. It may occur due to following particular photographic guidelines. The Angle Measurement Tool Scale 2.0. is the free program already known and utilized in orthopaedic studies [23, 24].

Conclusions

The results of this study illustrate the preliminary measurements using the same "e-goniometer" over the same joint. Various factors should be taken into account for further improvement of telerehabilitation outcomes assessment namely range of motion in examined joints at a distance. Further investigation is mandatory to develop best practice conditions for valid range of motion assessment using telemedicine tools.

Acknowledgments

This study is supported by project CLEAR (ICT-PSP-224985) Clinical Leading Environment for the Assessment and validation of Rehabilitation Protocols for home care.

References

[1] M. McCue, A. Fairman, M. Pramuka. Enhancing quality of life through telerehabilitation. Phys Med Rehabil Clin N Am.;21(1):195-205, 2010.

[2] D. M. Brennan, S. Mawson, S. Brownsell. Telerehabilitation: enabling the remote delivery of healthcare, rehabilitation, and self management. Stud Health Technol Inform; 145:231-48, 2009.

[3] D. Theodoros, T. Russell. Telerehabilitation: current perspectives. Stud Health Technol Inform. 131:191-209, 2008.
[4] T. Russell. Physical rehabilitation using telemedicine. J Telemed Telecare.; 13 (5) :217-20, 2007.
[5] M. J. Rosen. Telerehabilitation. Telemed J E Health. 10(2):115-7, 2004.
[6] G. J. Grimes, H. Dubois, S. J. Grimes et al. Telerehabilitation services using web-based telecommunication. Stud Health Technol Inform. 70:113-8, 2000.
[7] W. Glinkowski, A. Górecki, K. Mąkosa, M. Wasilewska. Telerehabilitation – Practical Applications in Orthopaedics and Traumatology of the Locomotor System (pol.) in Wróbel Z. (Ed.) Management and Information Technologies 3, 225-241, 2008.
[8] W. Glinkowski, A. Górecki. Musculoskeletal Telerehabilitation via Mobile Phone Electronic Journal of Pathology and Histology 11.2, 052-29, 2005.
[9] T. Hoffmann, T. Russell. Pre-admission orthopaedic occupational therapy home visits conducted using the Internet. J Telemed Telecare. 14(2):83-7, 2008.
[10] J. Z. Edwards, Greene KA, Davis RS, Kovacik MW, Noe DA, Askew MJ. Measuring flexion in knee arthroplasty patients. J Arthroplasty. 19:369–372, 2004.
[11] C. C. Norkin, White DJ. Measurement of joint motion: a guide to goniometry. Philadelphia, FA Davis; 1995.
[12] C. B. Terwee et al. Interobserver reproducibility of the visual estimation of range of motion of the shoulder. Arch Phys Med Rehabil. 2005;86:1356–1361.
[13] A. F. Lenssen, van Dam EM, Crijns YH, Verhey M, Geesink RJ, van den Brandt PA, de Bie RA. Reproducibility of goniometric measurement of the knee in the in-hospital phase following total knee arthroplasty. BMC Musculoskelet Disord. 17;8:83, 2007.
[14] M. Watkins, Riddle DL, Lamb RL, Personius WJ. Reliability of goniometric measurements and visual estimates of knee range of motion obtained in a clinical setting. Phys Ther. 71(2):90-6, 1991.
[15] D. Edgar, V. Finlay, A. Wu, F. Wood. Goniometry and linear assessments to monitor movement outcomes: are they reliable tools in burn survivors? Burns. 35(1):58-62, 2009.
[16] L. Brosseau et al. Intra- and intertester reliability and criterion validity of parallelogram and universal goniometers for measuring maximum active knee flexion and extension of patients with knee restrictions. Arch Phys Med Rehabil. 2001;82:396–402.
[17] Szulc P, Lewandowski J, Marecki B. Verification of selected anatomic landmarks used as reference points for universal goniometer positioning during knee joint mobility range measurements. Med Sci Monit. 2001;7(2):312-5.
[18] J. M. Bland, D. G. Altman. Statistical methods for assessing agreement between two methods of clinical measurement. Lancet. 1:307–310, 1986.
[19] Scientific Advisory Committee of the Medical Outcome Trust. Assessing health status and quality-of-life instruments: attributes and review criteria. Qual Life Res. 11:193–205, 2002.
[20] T. G. Russell, R. Wootton, G. A. Jull. Physical outcome measurements via the Internet: reliability at two Internet speeds. J Telemed Telecare. 8 Suppl 3(6):50-52, 2002.
[21] T. G. Russell, G. A. Jull, R. Wootton. Can the Internet be used as a medium to evaluate knee angle? Man Ther. 8(4):242-6, 2003.
[22] T. Hoffmann, T. Russell, H. Cooke. Remote measurement via the Internet of upper limb range of motion in people who have had stroke. J Telemed Telecare. 13(8):401-5, 2007.
[23] M. Odunze, D. Rosenberg, J. W. Few. Periorbital aging and ethnic considerations: a focus on the lateral canthal complex. Plast Reconstr Surg. 121(3):1002-8, 2008.
[24] C. P. Charalambous et al. Proximal humeral internal locking system (PHILOS) for the treatment of proximal humeral fractures. Arch Orthop Trauma Surg. 127(3):205-10, 2007.

Traumastation, a Telemedicine Tool

D. Rizou[1], I. Sachpazidis[1], L. Salvatore[2]
[1]Fraunhofer Institut for Graphics
Fraunhoferstrasse 5, 64283, Darmstadt, Germany
[2] Medcom GMBH
Rundeturmstrasse 12, 64283, Darmstadt, Germany

Abstract: **TraumaStation II / TeleConsult is an active diagnostic, portable 3D ultrasound imaging device for medical professionals, which is able to acquire, process, display and transfer two- and three dimensional medical images in a telemedical environment. The term "telemedical" here refers to the ability to send and receive image data either offline or in an online mode via a network connection. This medical trauma station is designed as a medical plug and play solution. It can be used in emergency as well as routine medical examinations. The software running on the medical traumastation is an assembly of medical software collaborating in seamless ways.**

Introduction

Telemedicine is the ability to provide interactive healthcare utilizing modern technology and telecommunications. It can be as simple as two health professionals discussing a case over the telephone, or as complex as using satellite technology and video-conferencing equipment to conduct a real-time consultation between medical specialists in two different countries.

Telemedicine is practiced on the basis of two concepts: real time (synchronous) and store-and-forward (asynchronous).

Within this paper, we present an imaging telemedicine application that provides a wide spread of possibilities:

- It is able to acquire ultrasound images (at the same time vital parameters can be acquired - ECG, SPO2, BP) directly from an ultrasound device,
- To enrich a given image material with additional information/annotations and
- To transfer it as a message to distant expert doctors connected to the medical network over Internet, satellite (DVB-RCS) or any other existing telecommunication channel. The application uses both synchronous and asynchronous concepts [1] [2].

Traumastation & Teleconsult Application

The medical trauma station is an ultra light, portable, batteries operated tele-medical first-aid device, which provides the physicians with a number of useful medical devices (ultrasound, ECG, SPO2, BP) seamless assembled within a suitcase, as shown in Figure 1. In addition, the Traumastation is equipped with a telecommunication gateway which supports GSM, UMTS, DSL, Satellite channels, providing a great communication convenience to the physicians.

Figure 1- Traumastation

This medical trauma station is a plug and play medical solution. It can be used in emergency as well as in routine medical examinations [3]. The software running on the medical trauma station called “TeleConsult” and enables online and offline medical assessments and discussions based on acquired and transmitted 2D/3D medical images and vital parameters such as blood pressure, electrocardiogram and oxygen saturation.

TeleConsult provides several functions for setting-up an operation of a health telematics network. Although originally developed for inexpensive Ultrasound equipment, in the latest TeleConsult version a DICOM interface has been incorporated, making possible the use of the TeleConsult application for other imaging modalities (such as X-Ray, MRI, CT images) and making it suitable for a broad range of teleradiology utilizations including direct network access to a local HIS/RIS/PACS [4].

Client/server architecture over any available telecommunication channel enables the central storage of all data and the access from every PC, which is equipped with the client-software. Direct access to the local database is supported and multi-media annotations (cursor movements and voice) are

possible, as well as text annotations and chatting. Members of the health telematics network store their data in their local database and send the queries to the consultant centre via satellite, ADSL, Internet or other available channels that supports TCP/IP. The medical history of a patient, which is necessary for the assessment of any medical case, is sent anonymously and automatically along with the teleconsulation messages.

TeleConsult operates in two different modes:

Off-line: In this mode the software might be used to collect data, form a question and send the data for example over night to a remote consultant centre which can answer either on-line or by an off-line reply.

On-line: The On-line mode can be used to transfer and discuss the case in interactive manner by mean of two connected workstations which display the remote actions (like mouse movements) in real-time. This mode is especially useful together with the off-line mode in order to discuss about previously sent medical data. This mode is supported by a **TelePointing** option that is intended to point to certain details in a graphical image window. If activated a second mouse pointer in both connected workstations is representing the remote pointer. Additionally a separate **TeleChat window**, which allows text-based discussions, can be used as well.

In addition, TraumaStation provides by different functions the construction of a health telematics network. In the connected database patient and image data and all incoming and sent messages will be stored. A client/server architecture provides the central storage of all data of a health telematics centre and the access to this data from every PC, which is equipped with the client-software. Members of a health telematics network store their data in their local database and send their queries to the consultant centre via Satellite and ADSL or other available channels supporting TCP/IP layer [5]. The medical history of a patient, which is necessary for the assessment of a case, will be sent anonymously and automatically with the messages.

In summary, TraumaStation offers the following features:

- Acquiring and handling of 2D and 3D images including the acquisition of 2D/3D ultrasound data and the import of images in DICOM format
- Acquiring electrocardiograms, blood pressure and oxygen saturation parameters and store them into DICOM and VITAL protocol (in progress)

- Sending and receiving of messages with text and image material over Internet, ISDN, Satellite and analogue phone line in offline and online-mode
- Enrichment of the images with graphical and textual annotations and pictograms
- In the online-mode interactive communication via usage of a chat window, mouse, exchanged images and a shared screen view is possible
- Client/Server-architecture of the database. Storage of all images, patients and messages in the database
- Handling of a second opinion service for customers and partners of a health telematics services centre

Conclusion

The presented medical imaging collaboration device (Traumastation) provides medical doctors with all necessary tools for communicating and exchange medical information over different communication media such internet, ADSL, and conventional phone lines. Our application provides a wide spread of possibilities to enrich a given image material with additional information and to send it as a message. In our medical scenarios [T@HIS, T@LEMED, TeleInVivo] several remote nodes making use of the medical trauma station will be able to be connected to any communication channel in “plug and play” way and request medical advice from an expert doctor [6-8].

References

[1] A. Martinez, V. Villarroel, J. Seosane, F. del Pozo, Analysis of information and communication needs in rural primary health care in developing countries, 2005.

[2] S. Kiefer, I. Sachpachzidis, "Telemedicine for Rural and Remote Regions, Optimizing Health Care Resources By Telehealth Platforms, an Example from Latin-America”, 2005.

[3] www.e-mednet.com

[4] Z. Zhang, A. He, and D. Wei, “A mobile teleconference system for homecare services.,”*Conf Proc IEEE Eng Med Biol Soc*, vol. 4, pp. 3935–3938, 2005.

[5] G. Altamirano, F. Pinar, C. Nieto & A. del Campo, Evaluation of DVB-RCS Resource Assignment Mechanisms for Internet Traffic Transport *Satellite and Space Communications, 2006 International Workshop*, 76-80, 2006.

[6] http://www.igd.fraunhofer.de/igd-a7/index.html

[7] http://www.igd.fraunhofer.de/igd-a7/projects/telemed/

[8] http://www.igd.fraunhofer.de/igd-a7/index.html