Global Telemedicine and eHealth Updates: Knowledge Resources

Vol. 6, 2013

Editors
Malina Jordanova and Frank Lievens

ISfTeH
International Society for Telemedicine & eHealth

Publisher

International Society for Telemedicine & eHealth (ISfTeH)
Coordinating Office
c/o Frank Lievens
Waardbeekdreef 1
1850 Grimbergen
Belgium
Phone: +32 2 269 8456
Fax: +32 2 269 7953
E-mail: info@isfteh.org
http://www.isfteh.org/

Global Telemedicine and eHealth Updates: Knowledge Resources
Vol. 6, 2013
Editors: Malina Jordanova and Frank Lievens
ISSN 1998-5509

All rights reserved. No part of this book may be reproduced, stored in a retrieval system or otherwise used without prior written permission from the publisher, ISfTeH.

© ISfTeH, 2013, Printed in G. D. of Luxembourg

Preface

Dear Reader,

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

With 133 papers from 44 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” provide a glimpse and summarize 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. If carefully realized, 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 control 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 listed alphabetically;

- The original style of the authors was respected as much as possible;
- In the content, after the title of papers a maximum of 3 to 4 co-authors are listed, while the rest are marked as “et al.”;
- “How”, “Where”, “When” and especially “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 most valuable as well.

Enjoy your reading!

Editors

Malina Jordanova, MD, PhD
Educational Program Coordinator, Med-e-Tel
Space Research & Technology Institute, Bulgarian Academy of Sciences
Bulgaria

Frank Lievens
Director, 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 **ii**

Biomedical Informatics & Benefits of Free/Libre Open Source Software in Health Care (FLOSS-HC) **1**

Analyzing the Evolution of Semantic Correspondences between SNOMED CT and ICD-9-CM 2
J. C. Dos Reis, C. Pruski, M. Da Silveira, C. Reynaud-Delaître

From Many to One: Analysis of Information Models for Telemedicine in Patient Centric Perspective 7
S. Urazimbetova, M. Kyng

Mconf: A Webconference System Applied to e-Health 12
V. Roesler, F. Cecagno, L.C. Daronco, A. Marins

Open Innovation in Health Care: The Role of ICT 17
T. Karopka, K. Takaluoma, P. Frank, W. Blank

Optimization of Medical Decision: An Approach of Medical Decision Analysis 22
E. Muteba

Proposal of a Multi-Layer Data Model for Electronic Health Care Record 27
M. Huptych, L. Lhotska

Semantic Intelligence interfaces for Ambient Assisted Living 32
M. Macedo, L. Billonnet, J.-M. Dumas

eHealth & Social Wellbeing **36**

Actigraphy for Measuring Activity Levels to Support the Treatment of People with Depression 37
S. Estévez-Cruz, M. Wolters, D. Pérez-Díaz de Cerio et al.

An Online Platform as a Tool for Surveys by Patient Associations 41
C. Lygidakis, C. Vögele, S. Cambiaso et al.

Arrhythmia and Ischemia Detection for a Sportsperson Monitoring System 46
G. L. de Lima, V. Roesler

Improving Mental Health Care in Afghanistan, Badakshan Province through e-Health - Phase 0 50
S. Khoja, R. E. Scott, H. Durrani et al.

Perception of eHealth Services by Health Care Professionals (A Case Study of Federal Medical Centre Owerri, Imo State, Nigeria) 54
U. L. Nnodum, A. Ogini

Social Aspects of Telemedicine 58
T. Eliseeva, M. Amcheslavskaya, A. Selkov,V. Stolyar

Teleconsultation Service to Improve Access to Specialized Care in Physiotherapy: The Experience of the Telehealth Network of Minas Gerais, Brazil 61
P. P. Geisel, V. R. Neves, J. X. Maia et al.

The Need for a Clearer European Vision for Telehealth 66
M. J. Fisk

The Social Worker in TMC 72
M. Amcheslavskaya, T. Eliseeva, A. Selkov, V. Stolyar

The UK NIHR Health Technology Co-operative (HTC) in Mental Health and Neurodevelopmental Disorders – 'MindTech' 74
J. A. Crowe, C. Hollis, R. Morriss et al.

Treatment for Mobbing Victims by Telepsychiatric Services 78
M. Stojakovic, B. Stojakovic, S. Vukadinovic

User Profiles of a Smartphone Application to Support Drug Adherence - Experiences from the iNephro Project 82
S. Becker, A. Kribben, S. Meister et al.

eHealth for Low Resource Settings and Developing Countries 85

e-Health for Training Aboriginal Healthcare Workers 86
K. Schill, R.E. Scott

Integration Model Applied to Healthcare Services 90
L. J. R. López, Y. P. Vanegas

Pilot Telehealth Project Brazil-Angola: Success Factors and Perspective 95
M. Gaspar, M.B. Akmim, R.M. Figueira et al.

Sustainable 24/7 Rural Healthcare with Eco Conservation 101
D. Lavanian

The Medical ICT Utilization for Perinatal Telemedicine in Remote Areas 106
Y. Ogata, K. Hara

eHealth in Emergency Care 111

An Android-Enabled Mobile Framework for Ac-cessing Holistic Emergency Medical Services on the Cloud 112
V. Koufi, F. Malamateniou, G. Vassilacopoulos

Determination of the Relevant First Aiders within a Volunteer Notification System 117
J. Elsner, M.-T. Schneiders, D. Schilberg, S. Jeschke

Four Existing Emergency Medical Dispatch Centres Working as one Virtual Emergency Operation Centre (VEOC) 122
O. Eielsen, B. Nordboe

Implementation of Neonatal Intensive Unit Care Telemonitoring in Minas Gerais State, Brazil 128
N. L. C. Silva, M. R. Botelho, M. G. Milagres et al.

Telehealth in Post Conflict Zones: Six Year Findings from a Cross Border eHealth Program 133
H. Durrani, A. Jan, N. Mohammadi et al.

Telehealth to Provide Support for Healthcare Practitioners in 137

Situations of Floods: A Brazilian Experience
F. R. Pereira, M. S. Marcolino, E. V. Santos, M. B. M. Alkmim

eHealth in Support of Routine Medical Practice **142**

Automatic Triage of Electrocardiograms 143
R. V. Andreão, T. Sarti, J. Celestrini, M. Q. Schimidt

Health Care Management with KeepCare 148
R. Sousa, M. Alves, G. Gonçalves

Organization, Workflow and Technical Issues of School Screening Telediagnostics of Faulty Postures and Scoliosis 154
B. Glinkowska, A. Żukowska, K. Walesiak et al.

Teleconsulting Inserted in a Moodle platform: The Experience of UERJ Nucleus of Brazilian Telehealth Networks Program 159
R. Santos, W. Santos, M. Santos et al.

Telerehabilitation for Patients Suffering Musculo-Skeletal Disorders – Own Experience Based on Implementation Projects 162
W. Glinkowski, K. Krawczak, D. Cabaj et al.

The Bioresonanse Approaches for Telediagnosis and Telecare 167
I. E. Ivanov, V. E. Gueorguiev, D. V. Georgieva, S. Gerova

The Experience of Research and Development of Second Opinion in Health: UERJ Nucleus of Brazilian Telehealth Networks Program 171
M. Santos, R. Santos, W. Santos et al.

Towards Applying Cloud Computing Technologies to Support PACS in the Public Hospital Routine 174
M. C. Oliveira, L. H. S. Simoes-Almeida, N. Rossetti et al.

eHealth: Junior Doctor's Perspective and Future Implications **179**

e-Health: Junior Doctor's Perspective and Future Implications 180
M. Capizzi, T. Laaveri

Electronic Tools in Continuous Professional Development (eCPD) for Junior and Senior Finnish Physicians 184
K. Patja, T. Litmanen

ePortfolios in Postgraduate Medical Training – from European Junior Doctors' Perspective 188
L. I. Lanczi

Harmonizing Postgraduate Medical Specialist Training In Europe: A European E-Platform Supporting Quality in Mobility 191
Z. Fras, F. Destrebecq, J-B.Rouffet

Modern Methods and Materials in the Undergraduate Education of Medical Imaging – How to Implement in Postgraduate Medical Training? 195
L. I. Lanczi, M. Nagy, M. Beres et al.

eLearning **198**

E-Learning Asynchronous Activities: Access and Interest Profile in Teledentistry 199
M. M. P. Rendeiro, A. M. Monteiro, P. R. V. Dias

Evaluation of the Content of Teleconsultations Conducted by the Telehealth Nucleus of the Medical School of the Federal University of Minas Gerais, Brazil 203
M. A. S. Dias, A. F. Santos, R. C. Oliveira et al.

Evaluation of the Virtual Course in Telehealth for Latin American Countries 207
A. F. Santos, J. Nogueira, M. C. B. Melo et al.

Evidence Based Medicine in HIV/AIDS and Reproductive Health Research: Piloting Two Distance Learning Courses in Low-Resource Settings 211
M. Zolfo, B. Ingelbeen, R. Aryeetey et al.

Impact on Learning and Medical Practice of an Online Community of Practice for Rural Physicians in A Developing Country 214
G. F. R. Restrepo

Increasing Telehealth Knowledge in U.S. Veterans through Video Education 219
J. Nelson

Learning Objects, Professional Competencies for Health Professional and eLearning: Main Elements for Developing a Taxonomy 224
L. B. Brasil, M. C. Skelton-Macedo, C. L. Wen et al.

The e-Learning Platform Developed by Clinique Bohler 229
O. Christian, B. Atanasova

The Experience of the Implementation of a Telehealth Resource Management Course in Brazil 232
A. F. Santos, R. M. Torres, M. A. M. Silva et al.

The impact of Using the Social Web for Pedagogical Actions in UERJ Telehealth: UERJ Nucleus of Brazilian Telehealth Networks Program 237
M. Rocha, M. Santos, J. Neves et al.

The Teledentistry Center of the Dental School of the University of São Paulo: Better Education for a Better Health in Times of ICT 240
M. C. Skelton-Macedo, J. H. Antoniazzi, C. L. Wen et al.

Training Course for Experts of Telemedical Network in Russia (conclusions) 245
A. Selkov, V. Stolyar, E. Selkova

Global eHealth Strategy **251**

Change Management – From Conception to Achieve Integration? 252
C. Saunders, R. E. Scott

Economics of e-Health: Measuring the Long-term Effect of Telecare 256
Y. Akematsu, S. Nitta, K. Morita, M. Tsuji

ePORTUGUESe – The Power of a Language Network 260
R. Ungerer

From a Research Project to a Regular Telehealth Service: Redefining 264

Objectives and Strategies
R. M. Figueira, L.R.Cunha, D. S. Neves, M. B. M. Alkmim

Gender Ratio in Engineering Disciplines: Why Are There Differences? 268
L. Lhotska, V. Radisavljevic Djordjevic

New Skills and Knowledge Requirements for Telehealth Staff: A United Kingdom Perspective 273
M. J. Fisk

The Digital Divide: Still a Reality? 277
M. Mars

The EMPOWER Project - Facilitating Self-Management of Diabetes Patients by Intelligent, Knowledge-Based Pathways 281
H. Schmuhl, H. Demski, I. Lamprinos et al.

The Virtual Organization in Telemedicine: Problems and Solutions 286
I. H. Monrad Aas

Value Analysis to Outline the Future of Robotics in Healthcare - PRAMAD Project 291
A. Schiltz, I. Gafton, L. Liauzu et al.

Image Transfer & Data Processing **295**

AIO HD Camera System 296
K. Han

New 3D Vision is the Future of the Telemedicine 298
V. Gueorguiev, I. Evgeniev, D. Georgieva

Remote Quantitative Diagnostics of Radiographic Images of Osteoporotic Vertebral Fractures 302
W. Glinkowski, J. Narloch, A. Górecki

Speed-up the Image Retrieval of Lung Nodules in the BigData Age 306
M. C. Oliveira, D. C. da Silva, K. B. C. dos Santos

Teledermatology: The Experience of a Telehealth Service in Brazil 311

T. G. P. Assis, M. S. Marcolino, M. B. M. Alkmin

Telediagnostic Software for Spinal Curvature Measurement and Vertebral Fractures Classification with a Remote Database 316
Ł. Markiewicz, J. Narloch, T. Miścior et al.

The Virtual International Pathology Institute (VIPI): Idea – Implementation – Work 320
K. Kayser, S. Borkenfeld, A. Djenouni, G. Kayser

Improving Care of the Elderly 325

Dietary Logging and Analysis for Tele-Care Using Harmony Rules 326
I. Vassányi, B. Pintér, M. Nemes et al.

Gerontechnologies: State of the Art and Technology validation 330
C. Lejeune, J. Petermans, D. Gilain

LIFE 2.0: Geographical Positioning Services to Support Independent Living and Social Interaction of Elderly People 334
J. Benavent, J. C. Castro, A. Cervera

Supporting Healthy Ageing with Shared Self-prevention e-Health Stations 338
M. Bogdanski, B. Gluszak, M. Kosiedowski, A. Stroinski

Telescreening of Critical Eye Diseases in Rural Areas in Lithuania 343
A. Paunksnis, L. Valius, K. Andrijauskas et al.

Lessons Learned from National eHealth Initiatives 346

Personal Health Ecosystem: SharingCare 347
T. Namli, S. Postaci, M. Gençtürk et al.

Brazilian Teledentistry Network Experience 351
A. E. Haddad, M.Rendeiro, A. D. M. S. Correia et al.

E-Health and Telemedicine Priorities in Mongolia 356
D. Jargalsaikhan, S. Enkhbold, N. Odongua, E. Enkhtuul

Health Center of Excellence – HCE 360
N. Asllani, K. Brauchli, M. Hubler

Integrated Model for Standardization of Electronic Medical Records by Levels of Hospital in the Telehealth Center in Colombia 364
L. J. R. López, C. Molano, Y. P. Vanegas

National Network of Teleaudiology in Clinical Practice for Cochlear Implant Patients 369
A. Wąsowski, H. Skarżyński, L. Bruski et al.

Security and Privacy Issues for Enabling the Secondary Use of EHRs in Clinical Research 373
E. Eryilmaz, G. B. Laleci Erturkmen

Space Medicine, Telemedical Ecology and Telemedicine: Prospects for Cooperation and Development 377
O. I. Orlov, V. I. Pougatchev, R. M. Baevsky, A. G. Chernikova

Telemedicine and eHealth in Poland: A Review (Polish Telemedicine Society Perspective) 381
W. Glinkowski, M. Karlińska

Telemedicine Service Measurably Reduces the Costs of Healthcare 385
T. Harju, L. Toivonen

Telemedicine Support on Maternal and Newborn Health in Mongolia: Analysis of Content in Communication 390
T. Baatar, N. Suldsuren, S. Bayanbileg, K. Dorjsuren

The Mongolian Model of Telemedicine and Telepathology: Concept and Practice 396
D. Erdenetsogt, M. Oberholzer

Mobile eHealth **400**

A Journey towards Implementation of Innovative mHealth in Health Services 401
O. Oguntuase, P. A. Cudd, J. Elliott et al.

Effectiveness of mHealth Services in the Use of Pictogram to Telemonitor Hypertensive Patients in F.M.C, Owerri, Nigeria 406
H. C. Nwuke, A. N Ogini, N. C. Anyanwu et al.

First Experience in Using Telemedicine System Heart Wizard MARS-500 in Individual Prenosological Health Monitoring in Russia 411
O. N. Isaeva, O. I. Orlov, R. M. Baevsky, A. G. Chernikova

Interactive Mobile Platform Structure to Monitor, Organize and Evaluate Medical Home Care Protocols 415
F. Dérout, C. Gorius, L. Billonnet et al.

mHealth-Based Telecare for the People Affected by Disasters - Organization of Health-related Volunteer Help 420
S. Massah, B. Karimzad Sharifi

Mobile Personal Health Application for Empowering Diabetic Patients: The Case within EMPOWER Project 424
I. Lamprinos, Chr. Papadaki, H. Schmuhl, H. Demski

Mobile Video Transmission System Using IP Network Camera and MiFi 428
T. Kanchanarin, P. Sribuachum, S. Panasuriyasombat, A. Thaiudom

Mobilicare: A Health Monitoring System for Chronic Patients 433
V. Roesler, C. Iochpe, A. Bordignon, L. Tizatto

Roles and Places of Women in eHealth and Telemedicine 438

Closing the Gender and Digital Gaps to Improve Women's Health - Millennia2015 Women and eHealth Study 2010 – 2012 439
V. I. Thouvenot, K. Holmes, L. P. Chavolla

Connecting Nurses Program 445
S. Coumel

Health Multilingual Mobile Communication 447
J. S. Pons, V. I. Thouvenot

Women and eHealth 454
V. Thouvenot, A. E. Schmaus-Klughammer, L. Lhotska, Y. Kwankam

Telecardiology **458**

1,000,000 Electrocardiograms by Distance: An Outstanding Milestone for Telehealth in Minas Gerais, Brazil 459
M. B. Alkmim, M. S. Marcolino, E. V. Santos et al.

Algorithm Evaluation: Identification of Electrocardiogram R Wave 465
J. Rosario, R. Ferreira, E. Marckmann et al.

Android® Based mHealth TeleECG System in Ibiraiaras, Brazil 469
A. Bordignon, V. Roesler, G. Bônes et al.

Arterial Plethysmography Project in a Remote Region: Survey Results from 52 Volunteers in Rural Brazil 474
T. Bohrn, M. Petrlík, A. Sparenberg et al.

Development of Telemedical Practice Platform: Application to Telesurveillance of Cardio-Respirographic Function 477
N. Hamlil, M. Benabdellah

Manufacturer Independent Interface for Cardiac Rhythm Disease Management 482
C. Arthofer, D. Hayn, G. Schreier

The Role of Raised Cosine Shaping Filter Parameters in ECG Transmission Quality via WLAN IEEE802.11b Channel 487
S. A. Chouakri, M. A. Berber, A. Taleb-Ahmed

Wrist-Worn Wearable Pulse Oximeter for the Remote and Continuous Health Monitoring without Fingertip Sensor 491
L. Eisen, L. Goldinov, L. Shenkman

Telemonitoring for Homecare Applications & Management of Chronic Diseases **496**

A Clinical Diary: Supporting Remote Monitoring of Chronic Diseases 497

I. Secci, G. Lanzola

Evaluation of Compliance to Telehomecare in a Group of Patients with Cystic Fibrosis in a Period of 2 Years 502
S. Bella, F. Murgia, F. Bianciardi, C. Cotognini

InspectLife - Platform for Providing Telecare and Telehealth 507
J. Potůček, M. Anděl, T. Korč, P. Koranda

IT System for Alarming of Possible Health Risks Caused by Geomagnetic Storms 512

Monitoring Biosignals with Low Cost Wearable Sensors 516
J. F. Oliveira, G. Gonçalves, R. Sousa

Objective Evaluation of Chronic Dysphonia Laryngeal Origin and Follow-Up of Their Treatments by Implementation of a Telemedical Device 522
S. Abdelouahed, S. Aounallah, M. Benabdellah

Safety Analysis of a Remote Patient Monitoring System with a Guideline Based Decision Support 527
L. Al-Qora'n, S. Sharvia, N. Gordon, Y. Papadopoulos

TelMedHome System and High Signal Resolution Pulse Wave Method – Fast and Cheap Monitoring of the Patients with Cardiovascular Diseases 532
R. Krzyminiewski, B. Dobosz, A. Szymil

Using a Touch Pad without Touching the Screen: Android Application for an Intuitive Increase of the Housing Environment 536
J. Gengo, T. Cardace, S. Jacquelet et al.

Validation of Wi-Fi Communication between Multiparametric Patient Monitor and eHealth Management Platform: A Case Study 541
R. Ferreira, J. Rosario, M. Much et al.

Telenursing **545**

BEIP – Happy, Healthy and at Home Medication Management via 546

Video
M. Tyler, C. Towers, T. Coyne and S. Vido

Effect of Presence and Distance Teaching Methods on Nurses' Knowledge about Pressure Ulcer 552
P. A. L.Cavalcanti, E. M. L. R.Andrade, J. M. M. Neto et al.

Indirect Blood Pressure Measurement: Assessment of a Continuing Education Program Offered on Mobile Device 554
S. H. Tognoli, I. A. C. Mendes, S. Godoy et al.

Telehealth and Person-Centered Care: Exploring the Possibilities 558
C. C. Bartz

Telenursing: Advancing Care Delivery, Education and Research 563
C. C. Bartz

Telenursing as a Health Promotion Strategy 569
V. D. Souza Júnior, I. A. C. Mendes, A. Mazzo, S. Godoy

Teleoncology **573**

An Awareness System for Follow-Up Care after Breast Cancer Treatment 574
B. Karimzad Sharifi, S. Massah

CANSCREEN – Early Stage Cancer Screening Based on Analysis of Blood Proteins, Evaluated by Special Cluster Analysis 578
J. Jansa, M. Cesal

Improving Breast and Cervical Cancer Screening in Developing Countries Using Telemedicine 582
A. E. Schmaus-Klughammer

Melanoma Screening Using Telemedicine & eHealth: How an Organized Service Worked in an Effective Way 586
M. Barreiros, S. Nunes, M. Barbosa

Telesurgery & Woundcare **591**

Impact of Telewound Monitoring on the Quality of life of Out-patients in Federal Medical Centre, Owerri, Nigeria 592
A. N.Ogini, H. C. Nwuke

Tailored Patient Information Using a Database System: Increasing Patient Compliance in a Day Surgery Setting 597
J. Grode, U. Steinsøe, D. Skarregaard et al.

Virtual Reality Platform for Simulate Bariatric Surgery and Predict Patient Evolution 602
A. Cervera, J. Benseny, J. Benavent et al.

Winner of the 2012 ISfTeH Student Videoconference Session 606

Validation of Physiological Data Transmission System 607
R. Ferreira et al.

Biomedical Informatics & Benefits of Free/Libre Open Source Software in Health Care (FLOSS-HC)

Analyzing the Evolution of Semantic Correspondences between SNOMED CT and ICD-9-CM

J. C. Dos Reis[1,2], C. Pruski[1], M. Da Silveira[1], C. Reynaud-Delaître[2]
[1]CR SANTEC, Public Research Centre Henri Tudor julio.dosreis@tudor.lu, cedric.pruski@tudor.lu, marcos.dasilveira@tudor.lu
6, Av. des hauts fourneaux, L-4362, Belval - Luxembourg
[2] LRI, University of Paris-Sud XI, PCRI, bat 650, Université Paris-Sud rue Noetzlin 91190 Gif-sur-Yvette, France, chantal.reynaud@lri.fr

Abstract: **The combined use of Knowledge Organizations Systems (KOS) including ontologies, terminologies or codification schemas has widespread in e-health systems over the past decades due to semantic interoperability reasons. However, the dynamic aspect of KOS forces knowledge engineers to maintain KOS elements, as well as semantic correspondences between KOS up-to-date. This is crucial to keep the underlying systems exploiting these KOS consistent over time. In this paper we provide a pragmatic analysis of the evolution of mappings between SNOMED CT and ICD-9-CM affected by the evolution of these two KOS.**

Introduction

The growing quantity of the produced medical data requires a new generation of tools to exploit this data to reduce costs and optimize the quality of care. To this end, automatic interpretation of data, information retrieval and sharing are of utmost importance. They implement Knowledge Organization Systems (KOS) like ontologies, thesaurus or classification schemas to automatize the treatment of digital information. However, the size and characteristics of the domain make impossible the definition of a single KOS able to represent the entire medical knowledge. This is why managers of information systems are forced to use a combination of KOS in order to optimize the coverage (*e.g.*, use ICD-9-CM (ICD) for classifying diseases or SNOMED-CT (SCT) for clinical knowledge). This is done through the definition of semantic correspondences (or mappings) between KOS [1]. It consists in defining the semantic relation (*e.g.*, equivalence, subsumption) that exists between elements (*e.g.*, concepts) belonging to

different KOS. But, due to the dynamic aspect of the medical knowledge [2], KOS have to follow this evolution and are likely to be modified over time, which can potentially invalidate previously created mappings. In consequence, modifications occurring in KOS must be propagated to mappings in order to keep the underlying information systems consistent over time [3].

We focus on the mapping maintenance problem (*i.e.*, the adaptation of existing mappings according to the changes affecting underlying KOS elements). Our final objective is to propose a formal framework able to propose new semantic correspondences between concepts of medical KOS when those evolve [4]. The goal is to automatize as much as possible the maintenance process reducing the validation time as well as the quantity of errors. We have empirically analyzed the evolution of the mappings between several KOS in order to identify correlation between the way KOS evolve and the impact of this evolution on the behavior of mappings. In this paper we report on this aspect. We have investigated 4 successive versions of SCT, 2 versions of ICD and 4 versions of their associate set of official mappings. Our study highlights such correlation between the way KOS evolve, and especially the type of change affecting elements (*e.g.*, split or merge of concepts), and the way mappings behave.

Understanding Mappings Maintenance

Our first set of experiments consisted in analyzing successive releases of ICD in order to identify the various types of changes that can affect its elements with a particular attention paid to concepts. The analysis of the obtained results shows that two kinds of changes can occur:

- *Atomic changes* like the addition or removal of concepts [5].
- *Complex changes* corresponding to a combination of atomic changes.

In our work, we focus on complex changes. We observed that most of complex changes can be characterized as merge or split of concepts and can have various forms (see figure 1 below). These experiments revealed 9 types of major changes (7 complex and 2 atomic modifications) leading to a release of a new version of ICD. In the figure 1, *S* and *T* represent concepts; *Sim* indicates the existence of a similarity between the two involved concepts while *code* denotes the concept ID in its respective KOS.

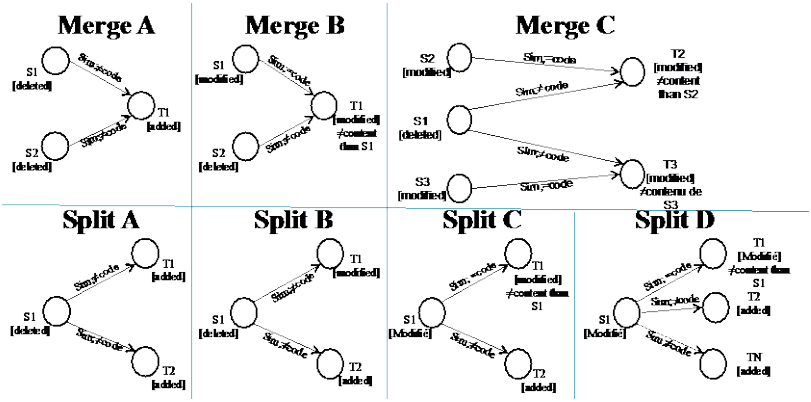


Figure 1: Types of complex changes affecting ICD concepts

Through the second set of experiments we have conducted, we crossed the results obtained during the first phase, and the analysis of the mappings evolution in order to understand the impact of KOS evolution on mappings. We, therefore, analyzed the impact of complex changes on the way mappings behave over time. To do so, we have isolated the concepts of ICD involved in one of the seven complex changes, which contained a mapping with an element of SCT. Then, we regrouped the elements of ICD that have evolved according to the same type of complex change. Afterwards, we analyzed how their associated mappings have evolved. As results, we have identified three types of changes for mappings (see table 1 below in which *(s, t, r)* represents a mapping, *s* denotes the source concept, *t*, the target concept and *r* the semantic relation between *s* and *t*).

Table 1: Behavior of mappings

Type of behaviour	Formalization	Link with types of changes in KOS
Full transfer	Before evolution *(s, t, r)* After evolution *(s', t, r)*	100% (2/2) Split C 27% (3/11) Split D 28% (16/57) Addition of concept
Partial transfer	Before evolution *(s, t, r)* After evolution *(s', t, r')*	55% (6/11) Split D 14% (8/57) Addition of concept
Full duplication	Before evolution *(s, t, r)* After evolution *(s, t, r)* $\wedge$ *(s', t, r)*	18% (2/11) Split D 58% (33/57) Addition of concept

Results (Table 1) show that the strength of the link between the type of changes affecting KOS concepts and the behavior of mappings varies. In

consequence, a split of type C gives always place, according to our observations, to a full transfer of mappings. In most of the cases, a split of type D gives place to a partial transfer, while an addition of concepts causes a full duplication of mappings. Additional investigation on the formal definition of the type of changes affecting KOS concepts is still needed in order to fully define the previously evoked link, as well as the way an automatic process for maintaining mappings can exploit it. Ongoing work on similarity measures between two successive versions of a concept would bring more information in order to better characterize this phenomenon.

Conclusion

In this paper we have highlighted, through a set of experiments, the role played by the type of evolution affecting KOS in the maintenance of mappings. Our future work will focus on the formal definition of change patterns for a better characterization of KOS evolution, as well as a set of heuristics for driving the maintenance of mappings. We also plan to integrate other KOS like NCI thesaurus or MedDRA to understand the importance of the KOS model in the mapping maintenance problem.

Acknowledgment

The research presented in this paper has been entirely funded by the National Research Funds of Luxembourg.

References

[1] J. Euzénat, and P. Shvaiko, “Ontology Matching”, 2007.
[2] A. Baneyx and J. Charlet, “Évaluation, évolution et maintenance d’une ontologie en médecine : état des lieux et propositions méthodologiques” Revue Information - Interaction – Intelligence, 2006 (in French).
[3] L. Stojanovic “Methods and Tools for Ontology Evolution,” PhD thesis Universitat Karlsruhe (TH), Institut AIFB, D-76128 Karlsruhe, 2004.
[4] J.C. Dos Reis, C. Pruski, M. Da Silveira, and C. Reynaud-Delaître, “Analyzing and Supporting the Mapping Maintenance Problem in Biomedical Knowledge Organization Systems,” in the proceedings of the Semantic Interoperability in Medical Informatics (SIMI) workshop, 2012.
[5] M. Klein and N. Noy, “A Component-Based Framework for Ontology Evolution,” in the proceedings of Workshop on Ontologies and Distributed Systems at IJCAI-03, 2003.

Julio Cesar Dos Reis is a Ph.D. Student at CRP Henri Tudor (Luxembourg) and Ph.D. Candidate in Computer Science at University of Paris-Sud XI (France). In 2011 he obtained a M.Sc. degree in Computer Science at University of Campinas (Brazil). Julio's research interest focuses mainly on the areas of Knowledge Engineering and Human-Computer Interaction. He investigates topics related to knowledge representation, evolution, integration, retrieval and visualization taking semantic, pragmatic and social aspects into

account.

Cédric Pruski is researcher at the Resource Centre for Healthcare Technologies (SANTEC) department of CRP Henri Tudor. His interests include ontology evolution, matching and evaluation as well as medical knowledge formalization and the use of Semantic Web technologies in biomedical applications. He earned a doctorate degree (2009) from the University of Paris-Sud XI and University of Luxembourg for his thesis entitled "Une approche adaptative pour la recherche d'information sur le Web". His is currently PI of the DynaMO project and is involved in the iCareflow research project where he is advising PhD students and Postdoctoral fellows.

Dr. Marcos Da Silveira is currently working as researcher at the Public Research Centre Henri Tudor – department SANTEC (Luxembourg). He holds a PhD. in Industrial Informatics from Paul Sabatier University, (France). He had worked 5 years as associate professor at Pontifical Catholic University of Parana (Brazil). He was one of the coordinators of the project eHealth Platform for Luxembourg (eSanté-EFES). His main research interests are Biomedical Knowledge Representation, Clinical Decision Support Systems, Adaptive Careflow, and Ontology Evolution&Validation.

Chantal Reynaud is a professor of Computer Science in the Laboratory of Computer Science (LRI) at the University of Paris-Sud. She is the head of the Artificial Intelligence and Inference Systems Group which addresses problems raised by modern information and knowledge management systems that deal with numerous, highly heterogeneous, and distributed information. Her areas of research are Ontology Engineering and Information Integration. In particular, she works on ontology alignment, entity discovery and annotation, enrichment of repositories. She has been involved in recent years in several projects combining artificial intelligence and database techniques for information integration. She is the author of more than 90 refereed journal articles and conference papers.

From Many to One: Analysis of Information Models for Telemedicine in Patient Centric Perspective

S. Urazimbetova, M. Kyng
Center for Pervasive Healthcare, Aarhus University, Denmark

Abstract: **ICT enablement of information sharing and exchange between health employees and citizens across organizations and private homes is one of the mechanisms to enhance patient empowerment. However, heterogeneity of information models and the employee-centric nature of most healthcare systems make information exchange, with a focus on the interests of patients, non-trivial. For example, it is not clear how the free-text and patient initiated interaction features of emerging patient empowering telemedicine can integrate to the many employee centric systems with heterogeneous information models. From the perspectives of enabling patients' read/write initiatives across health related standards, from a unified interface, we conduct analysis of the following information domains that support: (A) healthcare employees and are specific to formal procedures inside a healthcare scope; (B) patient and care givers and are also specific to formal procedures in a healthcare scope; (C) any group and are outside the scope. In particular, we look at: (A) Shared Medicine Card (SMC) – a standard embedded in a Danish national service for management of citizens' medicine; (A) HL7 CDA and (B) PHMR, which are international standards for clinical document exchange; (B) Data Set for Chronically Ill (DSCI) – a national proposal for a standardized exchange of notes on e.g., lab results, diagnosis of long-term patients; C) iCalendar – international standard for calendar events. Analysis is made with purpose of investigating requirements for the design and implementation of a patient centric information model that will enable patients to read and write information from a unified integration point or service interface and further contribute knowledge on patient empowerment through proof of concept demonstrators. In this paper the emphasis is placed on: analysis of glossary of concepts and equivalence relations for the standards. Further details on investigation of requirements for the future patient-centric model, architecture support and demonstrators can be traced at telehealth.dk.**

Introduction

According to ethnographic studies on the use of telemedicine, patients who make status notes on health, have a better understanding of their health. For example, eDagbogen [1] for the pregnant woman with diabetes, allow patients to make their own status notes.

However, there is no simple way to integrate the patient centric systems like eDagbogen with the traditional medical IT systems, since there are no service interfaces from the technological perspective that could enable patients to navigate across or annotate existing heterogeneous health documents in a generic way and most of the patient involvement is framed into specific questionnaires, diaries or calendar slots of health employees. The project (telehealth.dk) aims at demonstrating opportunities of enabling patient initiated interactions e.g., generic read/write, by designing and implementing shared service interface, information model and middleware support for the above-mentioned national and international standards.

Information Model Analysis

Investigation of information models is made through: conceptual, user/external and the computer/internal views [2]. The three-view approach, allow to better understand the purpose, strength and weaknesses of models in a patient centric perspective. XMLSpy EE was used to analyze XML schemas, instances, identify equivalence groups, user views and mappings.
Computer View: The table below summarize on quantitative analysis of XML schemas of the domains. E.g., SMC, for exchange of medicine cards

Standards/Terms	**SMC**	**DSCI**	**HL7CDA**	**iCalendar**	**Total**
#Elm/types	441	128	1526	309	**2454**
#XSD modules	600	1	6	9	616

and overview, uses 600 schemas to describe its domain (last row). DSCI for exchange of data of long-term patients uses a single schema (column 3). The most quantitatively heavy information model is the one of HL7 CDA/PHMR (hl7.org), which includes more than thousand terms. If the shared interface should support: navigation and search and annotation across documents, a join of all model elements, would be one approach. However, a join would result in 2454 terms, for use in the service interface. This could negatively influence the quality of meaningful navigation and search across documents, e.g. a search for “Surayya” would return a whole document, instead of parts that describe a “Patient”. Hence, we propose to identify equivalence groups for diverse information models. Note, the

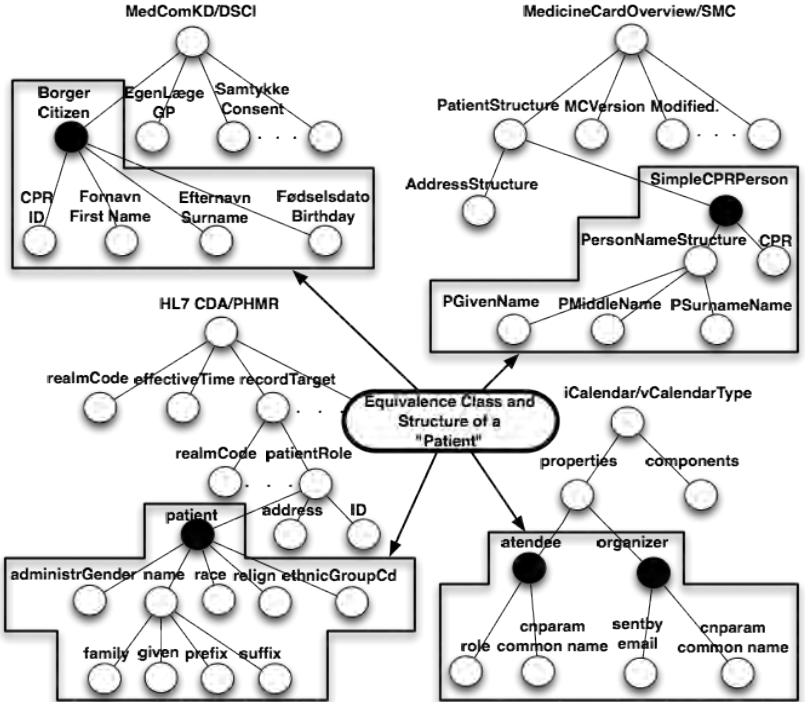
proposed concept, known as annotations or tagging, relies on equivalence relations between heterogeneous information models, while the support of ease of navigation relies on the tree-based structure of XML documents. Finally, the possibility of querying and getting meaningful results is based on the keywords and future evolution of groups. Next, we present a simplified view, in Backus Normal Form (BNF) of the models.

MedComKD := PersonIDCards| DataNote
PersonIDCards := **Citizen**| Next-of-Kin| CareGiver
DataNote := Properties| DataSegments*
Properties := Date| Text| ResponsibleOrOrg*| ID
DataSegments := Consent| Diagnosis| Diary| Medication| Ca
MedicineCardOverview := Properties| Document
Document := PrescriptionOverview*| MedicineCardOverview
Properties := Status| Actor*| **Patient**| Consent| Version| ID
Status := Modified| Reviewed| Created| Paused| Suspended

HL7CDA/PHMR := Header| Body
Header := Title| **RecordTarget**| Author| DateT| ID| Versic
Body := Text| StructuredDataSegment
StructuredDataSegment := Properties| Text| StructuredDat
Properties := Title| Subject| Author| DateTime| ID| Version
iCalendar := Properties| Component*
Properties := **Atendee**| **Organizer**| Categories| Class
Component := Attributes| vEvent| vJournal| vFreeBusy| vT

SMC [3] can be characterized as a document-based information model, where document status and document actors are important for the application and administration logic. Schema tree is relatively high. DSCI [4] is considered as a set of data segments. It starts with visit card like structures of people involved in the patient's care and proceeds with a sequence of HL7 CDA like types for healthcare related notes: e.g., diary and lab results. A shared set of attributes: date of the note, id, responsible person and other. Schema tree is rather flat, compared to the one of SMC. HL7 CDA/PHMR for exchange of various clinical documents, supports a possibility of describing involved parties in the header of the message, in a fine grained role based manner: payee, authority, author, second author. The body has structured/unstructured content of health-related acts observations, notes, assessment, and administrative procedures. The structured body has nested components, with subsequent act/class codes of HL7. Header and body may force integrators create duplicate information across the document. Due to nested structure of the components, the schema tree can become high. iCalendar: is an international standard for managing calendar specific tasks for private and collaborative needs. It has properties of the calendar event and the components, which describe simple to complex calendar events. The structure is without deep nested components.

Once the many equivalence relations are identified into groups, one can think of new meaningful keywords for the groups or use e.g., HL7 CDA or SMC terms. An example of the identified equivalence groups, key/root nodes and candidates for structures are given in the figure below, for a "Patient". For example, the structure of Patient may include many attributes, for future use (e.g., "religion" in HL7 is rare in Danish context) or be simple and contain few attributes (e.g., SMC). The main point is that



the equivalence approach and the underlying architecture should allow the Patient structure to evolve with time. For example, the middleware based architecture allows new domain models to "attach" and contribute new information e.g., on religion based food preferences, which may further extend the structure of Patient with the "religion" attribute. Thanks to the tree-based structure of the internal schemas and the separation of concerns of equivalence groups from keywords the future evolution of the patient centric information model can be supported. The equivalence relation can be directly translated into a single simple interface that can be used for integration of patient centric telemedicine: navigation can be done by "jumping" up and down in the BNFs, between equivalence groups. Search and annotations can be done at the identified points of the equivalence groups across the different health-related employee centric systems.

Summary

We identified opportunities of how ICT-based patient involvement through navigation; search and annotations, in a meaningful way across

health-related models can be supported from a single interface. Concept demonstrations and architecture can be followed at telehealth.dk.

References

[1] R Aarhus, S. Ballegaard, T. Hansen ”SundtHjem projektet”, 2009 (Danish)
[2] Y. Tina Lee ”Information Modeling: From Design to Implementation”, 1999
[3] DSCI, MedCom ”Fælles Kroniker Data (KD) V0”
[4] SMC,Statens Serum Institut, “Fælles Medicin Kort” at ssi.dk

Surayya Urazimbetova has a degree in nursing and an MSc in Computer Science. She is a PhD student at the Center for Pervasive Healthcare, at Aarhus University in Denmark. Her vision is to make telemedicine accessible, usable, reliable and affordable for people.

Morten Kyng is a Professor at the Department of Computer Science at Aarhus University in Denmark, and Head of the Center for Pervasive Healthcare, www.pervasivehealthcare.dk. He has a longstanding track record of research in participatory design, computer supported cooperative work and human-computer interaction. He is currently doing cross-disciplinary research within healthcare and welfare.

Mconf: A Webconference System Applied to e-Health

V. Roesler[1], F. Cecagno[1], L.C. Daronco[1], A. Marins[2]
[1]Federal University of Rio Grande do Sul, {roesler, fcecagno, lcdaronco}@inf.ufrgs.br
9500 Bento Gonçalves Av, Institute of Informatics, Porto Alegre, Brazil
[2]National Education and Research Network, RNP, amarins@rnp.br
116 Lauro Muller st, room 1103. Rio de Janeiro, Brazil.

Abstract: **Health professionals, as physicians and surgeons, need to communicate in order to exchange experiences and improve their knowledge. One way of doing that is through videoconference systems. This paper presents an open source distributed, scalable and federated global webconference system called "Mconf: Multiconference for interoperable access between web and mobile devices" (https://mconf.org). This system can fulfill many communication needs, like: a) it works via web browser, not requiring software installation; b) it works with mobile devices; c) has a global infrastructure, with high availability and low delay; d) is open source; e) allows streaming to hundreds of participants; many add-in features, like slides presentation, chat, notes, custom layouts, and so on.**

Introduction

Mconf is a complete webconference system, with features such as real-time sharing of voice, video, slides, desktop, and chat. It provides a distributed and scalable solution for communication that proves to be useful in several distinguished scenarios, many of those that can be applied to e-health. An in depth view of Mconf system can be seen in the book chapter of Roesler [1].

The Components of Mconf

Mconf has four main components: 1) the webconference server Mconf-Live; 2) the web portal that is the entry point to the system; 3) a mobile client; 4) and the monitoring and load balancing infrastructure. These components are explained in the subsections below.

Mconf-Live

Mconf-Live is the webconferencing component of Mconf, the server where the webconferences are held. It is based on the open source solution BigBlueButton (BBB) [2] and includes several improvements developed by the authors. This component provides the following features: real-time sharing of voice, video, presentations, desktop, shared notes and chat. It also allows the recording of sessions for playback on demand.

Figure 1: The interface of Mconf-Live

Mconf has a mobile client for the Android platform called Mconf-Mobile. The application allows users to connect to a meeting using a mobile Android phone/tablet and it includes most of the functionalities present in the desktop client.

Web Portal

The web portal, called Mconf-Web, is the entry point of Mconf. It is a web application that authenticates users and provides means for them to create and access webconference rooms. Every user has a permanent personal webconference room that can be freely accessed and shared with other people. The access is very simple: once a meeting is created, the users only have to access a URL (e.g. http://mconf.org/webconf/username) to enter the meeting.

In the web portal users can also create communities, groups where people with similar interests can communicate via webconference (communities also have webconference rooms), share documents and schedule events.

Load Balancer and Monitoring Server

The load balancer and the monitoring system are the core of the infrastructure of Mconf. The load balancer is a server that, in brief, selects the most appropriate server to create a meeting when one is requested. This decision is based in several factors, including the CPU load, the memory

available and the geographical position of all webconference servers in the network. The server select is the one that's more appropriate for the user that is creating the meeting. The load balancer also provides a dashboard interface that shows the current state of the network (seen in Fig. 2) and usage reports, that contain detailed information about the usage of the network (e.g. the servers that are being used more often, the number of meetings, the average duration of meetings).

Figure 2: Dashboard in the load balancer

Mconf Global Network

In June 2012 the Mconf project launched a global network with distributed servers around the world. In January, 2013, this network counted with 11 servers distributed in three continents and other servers already in a pre-deployment phase (see more in http://mconf.org). Currently, any institution that agrees with the terms of use can become a member of the network (http://mconf.org/m/about/network/terms).

The users can access the network via mconf.org, and see the state of the network in the load balancer's dashboard (http://lb.mconf.org/dashboard).

Use Cases of Mconf

Group Meetings

The focus of Mconf is on group meetings with several participants that interact equally in the meeting (full-featured clients). It has no limits in the amount of audios and videos that can be shared in a single session, so a meeting with dozens of people able to interact is possible.

Streaming

Besides group meetings, there is the streaming scenario, that occurs when a meeting (e.g. a lecture) has to be transmitted to hundreds or thousands of users that will only visualize it (restricted clients that can only interact via chat).

Currently Mconf supports hundreds of users in this scenario, and improvements are being developed in several areas that will increase this number to thousands of users. The most important developments are: 1) a lightweight HTML5 client that will only visualize the meeting; 2) the integration of more than one webconference server to hold a single webconference.

Mconf Usage in Health Programs and Final Remarks

Regarding e-health, one initiative was in a program of the Brazilian government called "Telessaúde Brasil", which focuses on the exchange of experience and remote education between health centers in country areas and big hospitals in urban areas. With Mconf, medical institutions in country areas, that usually lack specialized doctors, can easily communicate and cooperate with doctors from bigger urban areas.

Other initiative was with the Institute of Cardiology of RS (ICFUC), which used the system to communicate with several small cities in Brazil, under a project to provide remote interpretation of electrocardiograms.

It can also be used for tutoring, be it in real-time (e.g. a doctor teaching a remote student live) or asynchronously (e.g. a doctor records a tutoring section and shares it with remote students).

Furthermore, with Mconf it is possible to perform remote attendance, second medical opinion, sharing of images and documents, dealing with images synchronously (pointing and writing), among other possibilities.

Acknowledgment

The authors would like to thank the staff from the project Telessaúde Brasil and from the Institute of Cardiology of Porto Alegre that have dedicated their time to use, test and provide feedback for this work.

This work is funded by RNP (Rede Nacional de Pesquisa) and CLARA (*Colaboración Latino Americana en Redes Avanzadas*).

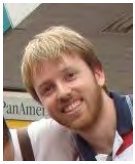
References

[1] V. Roesler, F. Cecagno, L. C. Daronco, and F. Dixon. Mconf: an open source multiconference system for web and mobile devices. *Chapter of the book "Multimedia / Book 2", ISBN 979-953-307-866-2*. Intech: Open Access Publisher. http://www.intechweb.org. 2012.

[2] BigBlueButton: http://bigbluebutton.org/ (accessed on 29/01/2013).

Valter Roesler has Bachelor´s degree in Electrical Engineering (1988), Master degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at Federal University of Rio Grande do Sul, Brazil. He coordinates the PRAV laboratory (Projects in Audio and Video) – www.inf.ufrgs.br/prav, with about 30 researchers and projects related to Remote Education and E-Health, in traditional computers and mobile devices.

Leonardo Crauss Daronco has a Master's degree in Computer Science from the Federal University of Rio Grande do Sul (UFRGS), Brazil (2009). Currently he is a researcher and developer in the Mconf project at the PRAV laboratory at UFRGS. He has experience in multimedia, video encoding, software development and web development.



Felipe Cecagno has a Bachelor's degree in Computer Science (2010). Since 2008 he works at PRAV Laboratory (Projects in Audio and Video) as researcher and developer on many projects related to Multimedia and Distance Education. He is Mconf-Mobile project team leader, and he is part of the BigBlueButton development core team.

André Marins is graduated in Computer Engineering at Pontifícia Universidade Católica do Rio de Janeiro – PUC-Rio (1996), with MBA in Executive Management at IBMEC Business School (2001). MSc in Computer Science from PUC-Rio (2008). IT Manager at Cadê (1996-1999). IT Manager and Director at Starmedia (1999-2002). IT Consultant at Vogal (2003-2006). IT researcher at TecGraf, PUC-Rio (2007). R&D project manager at RNP since 2008.

Open Innovation in Health Care: The Role of ICT

T. Karopka[1], K. Takaluoma[2], P. Frank[3], W. Blank[1]
[1]BioCon Valley GmbH, tk{wb}@bcv.org
Walther-Rathenau-Straße 49a, Greifswald 17489, Germany
[2]Culminatum Innovation Oy Ltd, kati.takaluoma@culminatum.fi
Tekniikantie 12, Espoo FI-02150, Finland
[3]SanBalt f.m.b.a., pf@scanbalt.org
Arne Jacobsens Alle 15, 2, Copenhagen 2300 S, Denmark

Abstract: **Innovation has been placed at the heart of the new EU strategy for growth and jobs: the Europe 2020 strategy. Although not explicitly mentioned among the five ambitious goals that focus on employment, innovation, education, poverty reduction and climate/energy, health is certainly a top priority also for the next funding period 2014-2020. Innovation is also seen as a sine qua non to improve health outcomes and effectiveness of health care delivery. In many fields, including the pharmaceutics industry and life sciences, open innovation has become an attractive instrument to accelerate innovation and to improve the market entry success ratio of new products and procedures. In the software industry open source principles have revolutionized the market and have led to new business models and paved the way for new ecosystems like the Android Smartphone operating system. Information and communication technologies (ICT) play a very important role in today's health care delivery systems. However, interoperability is still one of the major challenges and instead of overcoming fragmentation ICT often contributes to the manifestation of the current "silos of information". The reason for this is not a technical one in the first place; the main reason is a wrong business model and a system that is organized in different sectors. In the scope of the EU project HealthPort barriers for innovation in health and life sciences have been identified and a proposal for an innovation ecosystem for health economy has been developed. This ecosystems view is the foundation of the proposed innovation system for health economy and provides new insights when applied to the health care delivery system as such. In this paper we discuss the possible role of open innovation in this system and elaborate on the role of ICT in this context.**

Introduction

Open Innovation (OI) is a concept promoted by Henry Chesbrough in his book "Open Innovation: The new imperative for creating and profiting from technology" [1]. The central idea behind this concept is that knowledge is widely distributed, often across different disciplines and sectors and that most of the knowledge is outside of a particular company. OI provides mechanisms to access this external knowledge. This process is called "outside-in" and is one of the three core processes of OI. The other two core processes are "inside-out" and the "coupling process" which couples the "outside-in" and the "inside-out" process for a joint development. The main motivation behind the "inside-out" process is the commercialization of otherwise unused IP. The OI idea has been adopted by a number of big companies, among them Eli Lilly & Co. [2] and Philips [3]. Philips, as an example, has completely changed from a closed to an open innovation strategy and changed their thinking from "The lab is our world" to "The world is our lab". Through its "SimplyInnovate" [4] platform Philips aims to attract more product-specific innovative ideas. InnoCentive [5], a US based company and spin-off from Eli Lilly & Co. created an "Open Innovation Marketplace" with the aim to create a global network of problem solvers. The main business model is to match someone with a challenge or a research problem with a community of problem solvers and find out the best solution via a prize competition.

Open Innovation in Health Care

In times of financial crises, growing health care costs and ageing populations it is of utmost importance to keep costs for developing products and services low. The OI approach holds the potential of lowering costs, accelerating innovation and sharing the risk through collaborative development [6]. In the scope of the EU-project BSHR HealthPort [7] barriers for innovation have been identified and a new model for innovation in the health sector has been developed. The central part of this model consists of an innovation ecosystem that provides a holistic approach for product and service development [8]. The main idea behind this concept is that all stakeholders in the value-chain, from idea generation to market entry and even to product life cycle management, have to be integrated into an ecosystem where all parts are related and have their specific function. In the following we elaborate on the potential benefit of this ecosystems view and OI in particular for the domain of telemedicine and eHealth. The products in the field of Telemedicine and eHealth mainly consist of hardware, software and services. For software development there is already a related but different methodology available: Free/Libre and Open Source Software (FLOSS). FLOSS aims to cover both free software and open source

software. For the differences between Free Software and Open Source Software see e.g. [9]. For the further discussion in this paper we concentrate on Open Source Software.

Open Source Software in Health Care

Open Source Software is a type of software where the source code is accessible, modifiable and redistributable according to the accompanying license. The Open Source Initiative [10], a non-profit organization, approves licenses that comply with the Open Source Definition [10]. Currently there are 70 OSI approved licenses, among them the European Union Public License (EUPL). FLOSS principles hold a great potential for addressing several of the most critical problems in health care IT, including interoperability in a heterogeneous IT landscape, collaborative development of infrastructure software, and dissemination of standards [11–13]. Open Innovation and Open Source are not identical. Both principles are based on openness and collaboration. Both methodologies rely on the power of a community. However, while in the Open Source movement the aspect of sharing knowledge with the community and collaborative development is one of the core principles, the OI idea is more a crowd-sourcing approach for innovative ideas motivated by accessing and integrating external knowledge to solve a problem or simply for creating new products. Both principles can contribute to accelerate innovation in Telemedicine and eHealth and to bring innovative products and services to the market. However, both methodologies can only be applied successfully when combined with the right business model. The CONNECT community and software [14] is a compelling example of applying FLOSS in health care. CONNECT is an open source software and community that promotes IT interoperability in the U.S. healthcare system. It serves as a basis for the Nationwide Health Information Network which provides common specifications, standards and governance that enable secure health information exchange throughout the US. For more examples of FLOSS systems in health care see e.g. [15].

Conclusions

OI in health care holds great potential to accelerate innovation, lower costs and solve complex problems that are difficult to solve otherwise. An ecosystems approach is particularly useful for the domain of telemedicine and eHealth due to complex business models that comprise service delivery and include fields like regulation and public procurement. FLOSS principles can be adopted for complex software development and especially for infrastructure development and dissemination of standards.

Acknowledgment

The Project BSHR HealthPort is co-financed by the Baltic Sea Region Programme 2007 - 2013.

References

[1] H. W. Chesbrough. Open Innovation: The New Imperative for Creating and Profiting from Technology. Harvard Business Press; 2003.
[2] Open Innovation Drug Discovery [Internet]. [cited 2013 Jan 28]. Available from: https://openinnovation.lilly.com/dd/
[3] Royal Philips [Internet]. [cited 2013 Jan 28]. Available from: http://www.philips.com/?locale_org=de_de.
[4] Philips Simply Innovate - Collaborate with Philips to bring your ideas to life [Internet]. [cited 2013 Jan 28]. Available from: http://www.simplyinnovate.philips.com
[5] Home | InnoCentive [Internet]. [cited 2011 Nov 2]. Available from: http://www.innocentive.com/
[6] Crowdsourcing reveals life-saving potential in global health research | Global development | guardian.co.uk [Internet]. [cited 2013 Jan 28]. Available from: http://www.guardian.co.uk/global-development/2012/aug/15/crowdsourcing-global-health-research
[7] ScanBalt. BSHR HealthPort [Internet]. 2011 [cited 2012 Oct 25]. Available from: http://www.scanbalt.org/projects/scanbalt+health+region/bshr+healthport
[8] T. Karopka, W. Blank. Bridging SMEs and Healthcare Organisations to Foster Development of Innovative Solutions in Healthcare Provision. Quality of Life through Quality of Information. Proceedings of the 24th International Conference of the European Federation for Medical Informatics (MIE2012), Pisa, Italy;
[9] Free and open source software - Wikipedia, the free encyclopedia [Internet]. [cited 2013 Jan 28]. Available from: http://en.wikipedia.org/wiki/Free_and_open_source_software
[10] The Open Source Definition | Open Source Initiative [Internet]. [cited 2013 Jan 28]. Available from: http://opensource.org/osd
[11] T. Karopka, H. Schmuhl, A. Marcelo, J. D. Molin, G. Wright. Towards Open Collaborative Health Informatics - The Role of Free/Libre Open Source Principles. Contribution of the IMIA Open Source Health Informatics Working Group. Yearb Med Inform. 2011;6(1):63–72.
[12] C. J. Reynolds, J. C. Wyatt. Open source, open standards, and health care information systems. J. Med. Internet Res. 2011;13(1):e24.
[13] D. Ingram, S. S. Arikan. The Evolving Role of Open Source Software in Medicine and Health Services. Technology Innovation Management Review. 2013;(January: Open Source Sustainability):32–9.
[14] CONNECT Community Portal [Internet]. [cited 2013 Jan 29]. Available from: http://www.connectopensource.org/
[15] MedFLOSS, [Internet]. [cited 2013 Jan 29]. Available from: http://www.medfloss.org

Dipl.-Ing. Thomas Karopka, project manager of BCV, has a background in medical and bioinformatics. Thomas Karopka is a member of ISfTeH and actively engaged in the ISfTeH Open Sorurce working group. He is currently council member of the European Federation for Medical Informatics (EFMI) and chair of the International Medical Informatics Association Open Source Working Group (IMIA OS WG). He also serves as the

European Liaison Officer for the ACM Special Interest Group on Health Informatics (ACM SIGHIT).

Dr. Kati Takaluoma, project manager of Culminatum Innovation, has a PhD in medical biochemistry and molecular biology. Kati Takaluoma is currently actively involved in national and international projects focusing on PhD training and more effective utilization of clinical innovations.

Peter Frank has a business background in accounting combined with a scientific background as Ph.D. in biotechnology. His experiences are from both academia, industry and cluster management including being a post doc scientist at Biocenter Oulu (FI), heading the secretariat of Danish Biotech association for SME´s, heading the Danish Industries (DI) regional association "Fyn", being DI representative in Brussels in FoU plus working as a lobbyist for the cluster organisation Medicon Valley Alliance. Before that he worked as an auditor and also ran his own company providing services for SME's. He has been involved with SB from its beginning in 2001 and has participated in several EU co-funded project as partner or coordinator.

Dr. Wolfgang Blank, CEO of BCV GmbH and chairman of ScanBalt graduated in microbiology at the University of Tübingen. After gaining 8 years of experience in project management in the chemical industry (Henkel) including 2 years of postdoc research at the University of Kyoto in Japan, Dr. Blank spent 6 years as the Managing Director of BioTechnikum Greifswald before taking on the role as the managing director of BCV in 2001.

Optimization of Medical Decision: An Approach of Medical Decision Analysis

E. Muteba
Researcher and Correspondent of IMIA in DR Congo, emuteba@hotmail.fr

Introduction

Nowadays, it is recognized in most modern hospitals and public health systems, an increasing concern to measure the quality of care. The quality of care [1], can be focused on the characteristics of hospital production and the indicators of performance. These indictors of performance will permit to decrease complication rate, morbidity, mortality and cost of care.

One of the ways to optimize the quality of care is to use medical decision support systems [2-6] based on eHealth and mHealth to serve the un served.

However the difficulty of the decision making, in medicine, come often situations of uncertainly on knowledge, facts and sometimes on the used language. Kenner et al. [7] reveal that "for some diseases, definite and unique causes like certain infections may be found. For other diseases, multifactorial causes have to be assumed, mostly because of lack of knowledge."

The rational approach to decision making for problems where uncertainty figures as a prominent element is a decision analysis.

The concern of this research project as summarize in the paper, is the development of a method of medical decision analysis namely an optimization of medical decision and its online resources.

Methods

Medical Decision Analysis

The Medical decision analysis model [8-11] that we proposed is prescriptive, based on a multicriteria methodology and constructive induction method. It consists of height main steps: specification of the case, indications or problems, actions or treatments strategies, estimative outcomes (benefit and risk), performance measure, decision, result and optimization.

Step 1: Specification of the case: The specification of the case describes basics clinical information relative to a particular patient in consultation such as sex, age, weight, antecedents, allergies, ...

Step 2: Indications: The diagnostic indicates the problems found on the patient. Indication is a set of information related to problems concerning a particular patient.

Step 3: Actions: The actions are different possible treatments referring to the given indications.

Step 4: Estimative Outcomes: The estimative outcomes depend on the information related to similar patients' cases provided by clinicians. This information can be automatically update at the optimization step and can increase the effective of population concerned. There are two kinds of estimative outcomes: the outcome with benefit and the outcome with risk.

Outcome with Benefit - expresses the degree to return to normal health. It is a value compute as frequency of reveal result at the optimization step.

Outcome with Risk - expresses the complication or the death. It is a value compute as frequency of reveal result at the optimization step.

Step 5: Performance Measure: The performance measure is a benefit-risk ratio referring to the action chosen by the clinician.

Step six: Decision: The benefit-risk ratio can permit the clinician to make a decision. Practically, if the ratio is > 1 then the action can give benefit otherwise, if the ratio < 1 then the action have a risk.

Step 7: Result: The result is the really consequence of the decision chosen at the light of the performance measure. The patient can be in the following situation: a. Benefit; b. Risk. The clinician can vote for one of the presented situation and the system automatically will be updated. This information may be considered sufficient and trusted.

Step 8: Optimization: The optimization can allow the clinician to analyze the results and if needed to readjust the actions.

Online Resource

The online system proposed will be built on the three components: Entry Point Component, Organizer Component and Analyzer Component.

The Entry Point Component, in front end, can offers services such as: user's registration and identification, user's interface with the others components, submission of patient data...

The Organizer Component, in back end, can provide services such as: update of member's account, create new patient data with unique identifier, update of patient data, communication exchange, ...

The Analyzer Component, in back end, is as a medical decision support.

Validation Method

A given specification case S and an indication $\{I_n, n=1,..., N\}$area root of solution; where n is an integer between 1and N.

An action $\{A_m, m=1,..., M\}$ is a set of treatments strategies possible and admissible knew as applicable, obtain by means of selected multiple criteria reflecting the specification of the indication: $\max\langle S.I_n = A_m \rangle$ (1). The action A_m implies estimative outcomes; Let the outcome with benefit (*OB*) be a time series and recursive function defined as following $OB_t = (A_m, (\sum_{t=1}^{T} OB))$ (2); where *t* is an integer between 1 and *T*. And, let the outcomes with risk (*OR*) be a time series and recursive function defined as following $OR_t = (A_m, (\sum_{t=1}^{T} OR))$ (3); where *t* is an integer between 1 and *T*.

The decision to choose an action *A* depends on the benefit-risk ratio call the performance measure (*PM*); If the ratio is > 1 then the action can give benefit otherwise, if the ratio < 1 then the action have a risk; Let the performance measure (*PM*) be a function that associate an action to the ratio of the estimative outcomes *OB* and *OR*: $PM = (A_m, (OB_t / OR_t))$ (4).

It comes therefore:

If, $A_1, ..., A_m$ implies effectively, by explicit verification, the estimative outcomes *OB* or *OR*;

Then if, $A_{k+1}, ..., A_{k+m}$ considers as giving the outcomes *OB*, then, A_{k+m+1}, the real result will be *OB*, necessary by constructive induction demonstration;

Or then if, $A_{k+1}, ..., A_{k+m}$ considers as giving the outcomes *OR*, then, A_{k+m+1}, the real result will be *OR*, necessary by constructive induction demonstration.

Simulation: A Case Study

A longtime ago, malaria was one of the most challenging infectious diseases caused by the parasite called Plasmodium and localized in areas of Asia, Africa, and Central and South America. More information can be found in [12-14].

The case study presented in Table I allow the simulation of our system, the data used are not real.

In practice, for the given specification and indications, the system can generate, depending on multiple criteria, one than more actions.

By choosing one of the actions, the clinician can lead the system to compute the estimative outcomes and the performance measure. And after, by voting for an incoming result, the system will update the database with new information.

Table I Medical Decision Analysis

Specification of the problem
Sex: Female
Age: 40
Weight: 72
Antecedents : -
Allergies: Chloroquine
Associated conditions or diseases: 2 months of pregnancy
Localisation: Central Africa

Indication
Type of Infection: Plasmodia Falciparum (CIM-10, B-52)
Severity of infection: Typical (febrile paroxysms with body ache, nausea, ...);
Status : No recurrent

Action:
Typical *P. falciparum* malaria is treated by Coartem, Quinine, Clindamycin and Chloroquine

Action 1 Coartem	Action 2 Quinine + Clindamycin	Action 3 Quinine
Estimative Benefit 1 405 effectives	Estimative Benefit 2 677 effectives	Estimative Benefit 318 effectives
Estimative Risk 1 212 effectives	Estimative Risk 2 312 effectives	Estimative Risk 3 241 effectives
Performance Measure 1 1.9	Performance Measure 2 2.2	Performance Measur 1.3
Decision 1 (t) Choice: No	Decision 2 (t) Choice: Yes	Decision 3 (t) Choice: No
-	Real Result 1 (t+1) Voted: Risk	-
Optimization 1 (t+1) Choice: Yes	-	-

* In the optimization step, the clinician will change the strategy by opting for the action 1

Conclusion

The major interest of the system proposed is to improve quality of health care treatment, in real-time, in secure and direct system by computer or other devices such as iPhone and iPad.

We envision to improve, firstly, a quality of malaria's treatments and to contribute to the realization of malaria vaccine by providing relevant information for vaccine malaria research such as virulence, antigenicity, evolution, and gene and protein interactions.

References

[1] S. Feld. What is the Definition of Quality Medical Care? Online: http://stanleyfeldmdmace.typepad.com/repairing_the_healthcare_/2007/03/what_is_the_def.html

[2] J. Zvarova, H. Heroutova, H. Grünfeldova, K. Zvara, Empowering Clinicians by eHealth Technologies in Decision - Making Tasks, In IOS Press, Medical Informatics in a United and Health Europe, K-P. Adlassnig et al. (Eds), 2009.

[3] M. Tribus. Rational Descriptions, Decisions and Designs, Pergamon Press, New york, 1969.
[4] D. J. White. Fundamentals of Decision Theory, North-Holland, New York, 1976.
[5] E. Karni. Decision Making under Uncertainty, The Case of State-Dependent Preferences, Harvard University Press: Cambridge, 1985.
[6] S. Akter, P. Ray, mHealth - an Ultimate Platform to Serve the Unserved, IMIA Yearbook of Medical Informatics, Pp94-100, 2010.
[7] T. Kenner, L Kenner. Risk Factors, Protective Factors and Medical Decisions, In Script a Medica (BRNO) – 74 (1), Pp 5–10, 2001.
[8] J. W. Payne, J. R. Bettman, E. Coupey, E. J. Johnson, A Constructive Process View of Decision Making: Multiple Strategies in Judgement and Choice, In Acta Psychologica 80, Pp 107-141, North-Holland, 1992.
[9] B. Roy, MultiCriteria Methodology for Decision Aiding, Kluwer Academic, Dordrecht, 1996.
[10] R. E. Steuer, Multiple Criteria, Theory, Computation and Application, John Wiley, New York, 1986.
[11] R. K. Sundaran, A first Course in Optimization Theory, Cambridge University Press, USA, 1996.
[12] A. K. Mbonye, I. C. Bygbjerg, P. Magnussen, Intermittent preventive treatment of malaria in pregnancy: a new delivery system and its effect on maternal health and pregnancy outcomes in Uganda, Bulletin of the World Health Organization . Online: http://www.who.int/bulletin/volumes/86/2/07-041822/en/index.html
[13] J. Schantz-Dunn,N. M. Nour, Malaria and Pregnancy: A Global Health Perspective Online: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2760896/
[14] WHO, International Classification of Diseases (ICD) Online: http://www.who.int/classifications/icd/en/

Proposal of a Multi-Layer Data Model for Electronic Health Care Record

M. Huptych[1], L. Lhotska[1,2]
[1]Czech Technical University in Prague, Department of Cybernetics,
MichalHuptych@seznam.cz
Technicka 2, 166 27 Prague 6, Czech Republic
[2]Czech Society for Biomedical Engineering and Medical Informatics, Czech Republic, lhotska@fel.cvut.cz

Abstract: **The aim of the paper is to describe a data model for medical domain that allows storing and representing signal data type, which is more and more frequently used. It is not sufficient to store measured signals in separate files but this data must be stored in structured way as other patient data enabling easier access and satisfying requirements of semantic interoperability.**

Introduction

At a time when the development of IT and mobile technologies is precipitous, there is needed to communicate much more clearly than ever before. In particular, exchange of data and information in professional activities must be well defined not only on syntactic, but also on semantic level. Thus, the interoperability and the standards are primary assumption. Nevertheless, higher standards to ensure interoperability at the semantic and process level, bring another very important element. It is clear that the formalization of such a complex field such as medicine is an extremely complex task with large outputs. Standardization and unification of terminology in the form of nomenclatures, give rise to a very wide descriptive platform. With some advanced nomenclatures, such as SNOMED CT, it is possible to formalize not only the names of objects, organs, bodily processes, diagnosis or treatments, but also to define relationships between them. Knowledge representation formalisms as ontologies allow transmitting not only data and information, but also their mutual relations. Advanced communication standards, such as HL7 standards, allow defining a large number of possible processes and their links to other objects or processes.

Heterogeneous Data Model

The motivation of our research has been to design appropriate approaches to interoperability in medicine both for the purpose of communication and for knowledge representation; and both for data, and their relationships and the treatment processes; for both categorical data and signals [1]. Integration of the signal in the data model has been never solved in conjunction with semantic description of signals (their behavior), and integration with other inputs of common information systems. This task is becoming increasingly important with the development of new technology and services. Crucial area in this regard is the telemedicine and monitoring of the health status of a patient in home environment. Also hospital departments require increasingly clinical data integration, mainly for the purpose of clinical research. The described research has been focused on the design of data model and system architecture, in accordance with the requirements of procedural and semantic interoperability in healthcare and considering signal linked events.

Extended Approach: Proposal of Multi-layer Data Model

In this section we describe the proposed approach to the representation and storage of information using multi-layer model [2] focusing on signals and their structured description. In terms of standards for communication and information exchange the most common approach is to attach signals by reference. There are a number of formats for storing signals and a large part of them have a complex form header, e.g. format MFER contains complete information about the type of signal, the sampling frequency, sensitivity and size of data block in header. This information is essential for subsequent processing, but it does not allow semantic transmission. The problem is the variability of signals and the fact that the more complex description in the header means more complex parser for the retrieval. The signal contains a number of characteristic points and intervals, which may be important for subsequent evaluation of signal. The finding of these intervals is the goal of most analyses. Further we present briefly the items that are stored with the signal and represent descriptive features.

Firstly, we define the term of lead. We suppose that lead (signal) can be still referenced or one of signal or signals combination can be used as reference and data model considers more signal types. Type of signal is a very important item of concept for the successive processing, because the conditions of processing are depended on type of signal (ECG, EEG, CTG, etc.). Parameters of signal contain basic information about the signal (e.g. sampling rate, sensitivity, maximum value, minimum value, file format).

Time parameters determine the fundamental temporal properties of the signal. It is not only information about the beginning and end of the signal. In many cases, the signal is recorded over a longer period of time and the system does not store the signal to only one file, but to multiple files with a given time span. Signals remain in their original formats. Timeline is formed on the basis of information about the beginning of the recording, the length of the signal and the sampling frequency. By creating this timeline we can then control the analysis and visualization of data and events. All signals recording, segmentation and analysis are addressed through a general interface that allows adding new formats and methods of segmentation and analysis.

We assume need of certain signal preprocessing. This step is also solved using an interface in order to preserve defined variation of more signal sources. Additional items of the structured form of signal representation include characteristic points, events, complexes.

The first way of defining characteristic points is based on the signal. These points are the basic building blocks for the following description of the signal. The second possible way of determining the characteristic points is an event. Events are recorded separately. Their projection on the signal is given by the time of occurrence. Events can be immediate points or they define certain intervals. Hence, events are generally related to characteristic point class and also to complex class. Points (namely points of event) define a complex and a complex is defined by an event. The third link is given by the features that express a specific property of the signal and/or complex.

Processing / Analysis are transformations and analyses intended to infer new signals (spectrogram, wavelet) and to determine automatically characteristic points for definition of complexes. Block of analyses is tied back with a block of derived signals and with block of complexes. It means that processing / analysis can be used repeatedly for derived signals and signal complexes.

Events are defined as observation, measurement or finding of some facts about the focused subject. As an event there can be taken statement of diagnosis, medication or intervention. In the case of the measurement an event may be for example the result of laboratory test, which is carried out on the basis of samples (which is the event type of intervention).

When the model is defined to represent the signal and relationships between events and signal, the next step is the transfer of this information to a semantic form. Here we present the simplest form of the description of a signal using rules. This formalism in the medical field is a very robust tool

and often very effective. The rules represent background knowledge of the given area. The system is composed of four parts – Conditions, Evaluation types, Rules and Evaluation:

- Conditions – set of condition in standard form like complex_length > value_A, complex_maximum < value_B, point_value = value_C, etc. Condition is related to signal type. i.e. for specific signal type there exists specific set of conditions.
- Evaluation types – statement of fact about a given point, complex or signal; it is list of evaluation options; categorical classification of point, complex or signal.
- Rules – condition or conditions and evaluation type in standard form if *condition* then *evaluation_type.*
- Evaluation – assignment of evaluation type to a given item of record.

Conclusion

The main aim of the described research has been to design architecture of a data model, in accordance with the requirements of procedural and semantic interoperability in healthcare, in particular in signal field linked events. This architecture is linked to existing solutions in fields of nomenclatures and standards in health care. Its main part is the multi-layer model that contains the following parts: events (acts), signals, and evaluation representing background knowledge.

We have specified the main represented data types and defined the structure for their representation. Thus, we have obtained the architecture, which allows defining general concept of signal leads with all necessary information, decomposition of this signal into important complexes using definition of characteristic points and derivation of new signals. This signal domain is connected to the background knowledge, represented by a set of signal type related rules.

Acknowledgment

This research has been partially financed by the research program "IGA MZ CR" under grant No. NT/11124-6/2010 " Cardiotocography evaluation by means of artificial intelligence" and by the research program MSM 6840770012 of the CTU in Prague, Czech Republic.

References

[1] L. Lhotska, M. Bursa, M. Huptych, V. Chudacek, and J. Havlik. Standardization and Interoperability: Basic Conditions for Efficient Solutions. In IFMBE Proceedings eMBEC 2011. Berlin: Springer Science+Business Media, pp. 1140-1143, 2011

[2] M. Huptych. Multi-layer Data Model. PhD thesis. Czech Technical University in Prague, Faculty of Electrical Engineering, Prague. 2013

Lenka Lhotska holds MSc. and Ph.D. in Cybernetics. She is the representative of the Czech Society of Biomedical Engineering and Medical Informatics in the ISfTeH and IFMBE Council. Currently she is head of the Biomedical Signal and Data Processing group (BioDat) at the Department of Cybernetics, Faculty of Electrical Engineering of the Czech Technical University in Prague. Her research interests are in artificial intelligence methods and their applications in medicine; interoperability and standardization.

Michal Huptych holds MSc. in Biomedical Engineering. Since 2007 he has been a research fellow in the Biomedical Data and Signal Processing group of the Gerstner Laboratory, Department of Cybernetics, Faculty of Electrical Engineering, Czech Technical University in Prague. His research interests cover processing and analysis of biomedical signals, medical informatics, in particular data models, ontologies and semantic interoperability..

Semantic Intelligence interfaces for Ambient Assisted Living

M. Macedo[1], L. Billonnet[2], J.-M. Dumas[2]
[1]Instituto Politécnico de Tomar, Tomar, Portugal
[2]Université de Limoges, Limoges, France
mario.macedo@ipt.pt, laurent.billonnet@unilim.fr

Abstract: **The development of semantic intelligence interfaces capable of extracting data from speeches and converting structured texts into voice will be the next paradigm of intelligent interfaces for ambient assisted living (AAL). This study explores some methodologies and techniques of extracting expressions and relating them with normalized terms and ontologies. With these techniques it will be possible to promote better systems to promote AAL, conducting epidemiologic studies and increase the patients' safety.**

Subject and Context

Nowadays some of these devices like touchpads have microphones and speakers. So we have another type of interface that could use voice to communicate on both directions.

The usage of microphones as an interface with the software applications has a great advantage of not having the constraints of using the hands to communicate with the device. This will improve the accessibility and ubiquity of the solution and could also improve its efficiency and effectiveness.

Sometimes this could be crucial for our purpose if for instance the user is unable to reach the mobile device or if the user cannot use the hands.

There are some devices that use voice commands to trigger some actions. The cell phones contact lists can be an example of that. However if the user is reporting a situation like for example if a nurse is assisting a patient and is reporting the nursing interventions the system must have the intelligence to recognize the speech, translate it into text and then retrieve information from the text.

There are some libraries with application programming interfaces for different platforms that can be integrated to acquire voice speech and convert it into text.

Our main aim is to convert free text into structured expressions and to convert these expressions in normalized terms. We intend to use intelligent agents to achieve this goal.

Understanding the Domain of the context

The first aim of the intelligent agent should be the understanding of the domain context. This can be done by different approaches. There are some algorithms that be used to do this.

The simplest algorithm can have the following actions:

- Stemming the terms;
- Split the sentences;
- Calculate the Terms Frequency matrix;
- Build the Inverse Document Frequency matrix.

The stemming is an action that has the purpose of extracting the etymologic root of each term. The stemming algorithms [1] can be find in different languages and plugins. Only terms with the same root are comparable and the frequency terms analysis should not split frequencies of terms with the same meaning. The system should also have a thesaurus of synonymous. Each term is converted to the normalized synonym.

To split the sentences an algorithm that will detect punctuation symbols is used. Only terms in the same sentence are related and may belong to the same expression.

The term frequency matrix will measure the relative frequency of each term in each speech. Some terms have a high frequency and they are the less important. The inverse document frequency matrix has the objective the decreasing the importance of terms with a huge frequency.

It is also possible to calculate the distances between terms in each term. Terms that have a low distance and have the same frequency probably belong to the same expression. The single Value Decomposition Algorithm [2] calculates the association of terms that explains the speeches.

The expressions belong to ontologies. Ontologies are associations of concepts linked with relationships and with instances of expressions. Each ontology belongs to a specific domain of knowledge. The algorithm calculates the frequency of the expressions and chooses the ontology that gets the higher score of expressions. The domain of the ontology is the context of the speech.

With the knowledge of the domain other algorithms can be processed. The first choice is the domain thesaurus, the second one is the set of grammar rules and the last one is the annotation ontologies.

The grammar rules are written with a normalized language and they describe the possible association of terms and how some numerical values

should be interpreted. The grammar rules are very important to extract the semantic expressions from text and to retrieve some values that are linked with them. There are some languages to write these grammar rules. We use JAPE, (Java Annotation Patterns Engine). Jape is used by Gate, a text mining tool from Sheffield University[3]. The files that contain the grammar rules are regular text files and are stored in any server.

The central repository of grammar rules can be stored on the cloud and be shared by different devices. These rules are built by semantic experts and are being continuously updated. Every time the systems do not recognize a sentence it will present the known normalized expressions with the same terms. If the user confirms the equivalence, the systems will create the rules automatically. Otherwise the sentence will be selected for a manual analysis.

The ontologies are stored in a normalized language called OWL (Ontology Web Language) [4]. There are some different repositories that can be used to store the ontologies [5]. The ontologies can link each concept with taxonomy. With this technology it is possible construct knowledge on several fields like nursing charts, adverse drugs reactions, diseases reactions and symptoms among others. This normalized data can update the PMR and other monitoring databases.

The intelligent semantics will shift the paradigm of data acquisition and will index defined concepts to drive processes automation and patterns analysis. These tools can also be used to interact with social networks. It will be possible to develop 4th phase clinical trials (tracking of drugs effectiveness and adverse drugs).

It is also possible to analyze from the psychological point of view some tendencies inferred from the presence of some terms and expressions in the speech. We believe these methodologies will also contribute to an evidence based medicine paradigm and a better understanding of people behavior and reactions.

On the other hand it is possible to retrieve information form taxonomies and reasoning ontologies and transform this structured text into common speech.

The speech can be sent to each device speaker and listened by the user. It will be possible to create interactive speeches and to develop online questionnaires.

Other applications can be systems to track healthcare services at the patients' home. These systems will make possible to present voice messages saying what should be done and in an interactive way ask for confirmation from the professional. These voice track systems can also be very useful to assist nurses and all kind of assistants.

References

[1] M. F. Porter. *Snowball: A language for stemming algorithms*. 2001; Available from: http://snowball.tartarus.org/texts/introduction.html .

[2] Russ Albright. *Taming Text with the SVD*. 2004; Available from: ftp://ftp.sas.com/techsup/download/EMiner/TamingTextwiththeSVD.pdf.

[3] D. Thakker, T. Osman, and P. Lakin, *GATE JAPE Grammar Tutorial*. 2009.

[4] T. R. Gruber. *What is an Ontology?* Knowledge System AI Laboratory 1992; Available from: http://www-ksl.stanford.edu/kst/what-is-an-ontology.html.

[5] A. Kiryakov, D. Ognyanov, and D. Manov. *OWLIM – a Pragmatic Semantic Repository for OWL*. Available from: http://dip.semanticweb.org/documents/Kiryakov-OWLIM-a-Pragmatic-Semantic-Repository-for-OWL.pdf.

Mário Macedo graduated in Computer Science Engineer from The Universidade Nova de Lisboa, Msc in Electronic Commerce by Open University of Lisbon and Phd in Managememt Information Systems. Member of several scientific working groups in Instituto Português da Qualidade e Instituto Dr. Ricardo Jorge. He has worked with many of the leading national and international companies, healthcare organizations and as governments´ advisor. Has also being teacher in some Portuguese Universities and is currently organizing new Post-Graduate and MSc courses.

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 focuse on AAL, smart interfaces, home automation and ICT for people in loss of autonomy. He is the Director of the BSc "Home automation for elderly and disabled people" and the international MSc "Auton'Hom-e [otɔnɔmi]"

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

eHealth & Social Wellbeing

Actigraphy for Measuring Activity Levels to Support the Treatment of People with Depression

S. Estévez-Cruz[1], M. Wolters[2], D. Pérez-Díaz de Cerio[3], C. Burton[4], A. Szentagotai[5], A. Serrano-Blanco[6], The Help4Mood Consortium
[1]i2Cat Foundation, Research & Innovation Centre, Barcelona, Spain, soraya.estevez@i2cat.net
[2]School of Informatics, University of Edinburgh, UK, maria.wolters@ed.ac.uk
[3]Universitat Politècnica de Catalunya, Spain, dperez@tsc.upc.edu
[4]Centre for Population Health Sciences, University of Edinburgh / University of Aberdeen, c.burton@abdn.ac.uk
[5]Babes-Bolyai University, Romania, AuraSzentagotai@psychology.ro
[6]Parc Sanitari Sant Joan de Déu, Spain, aserrano@pssjd.org

Abstract: **Depression affects between 5% and 10% of the population in Western Europe, one of the main causes of disability in the world. Depression affects mood, cognition and behaviour. The Help4Mood platform is intended to support the treatment of patients with depression in home. In this paper, we present the design of the unobtrusive activity monitoring system used in Help4Mood and summarise the results of a first evaluation.**

Introduction

Depression is a significant contributor to the global burden of disease and affects people in all communities across the world [1]. Depression affects mood, cognition and behaviour and diminishes people's ability to cope with the daily challenges of life. Depression also affects movement. The most common effect is a general slowing. This is reflected in both gross motor function (e.g., gait) and fine motor function (e.g., speech, reaction times) [2-3].

Help4Mood is a Personal Health System administered by a Health Care Professional that supports the treatment of people with mild to moderate episodes of major depressive disorder at home.

The platform is structured around patient sessions and focused on monitoring symptoms and engaging the patient in activities based on Cognitive Behavior Therapy. Help4Mood collects cognitive, psychomotor, and motor data through a Virtual Agent interface and the Personal

Monitoring System (PMS). The Decision Support System controls sessions with the Virtual Agent, analyses the data, and generates summary reports for discussion between patient and clinician. [4]

The PMS obtains objective data about activity through sensor devices, which are interconnected by a wireless sensor network (WSN). The WSN has been designed to be unobtrusive, efficient and easy to use.

In this paper, we will focus on the part of the PMS system designed to acquire and communicate objective data about activity and the outcomes of the first evaluation.

Activity Monitoring

The PMS component collects the objective data about activity patterns for three days per week through sensor devices. Activity can be measured through a watch, a waistband clip, a key ring device, or a smartphone. The watch, the waistband clip, and the key ring device are all based on the same sensor infrastructure, the Texas Instruments eZ430-Chronos watch. The sensors use different wireless communication technologies: Bluetooth (phone) and simpliciTI (other sensors).

The system automatically downloads data from different sensors and stores it in a database. No installation at home is needed; the system can be handed out to patients pre-configured.

Normally, data is synchronized automatically, but the data can also be downloaded manually just at the press of a button. Transmission management techniques are used to reduce the energy consumption and to optimize the efficiency of the system. The information provided by the database interface not only includes activity data but also other statistics of use of the Help4Mood system. For a more detailed description of the system employed during these trials see [6].

First Evaluation of the Activity Monitoring System

The activity monitoring system was tested with a total of ten people who had recovered from depression in Catalunya, Scotland and Romania using a case-study design. Each person used the system for a week. One third of the group tested the smartphone plus the key-ring device, another third used the smartphone plus the watch, while the third part used the waistband clip plus the smartphone. Users were given a separate Help4Mood smartphone (HTC Wildfire, Android 2.2) that had all other functionality disabled. In addition to actigraphy data, we also collected diary information and qualitative data.

During the initial evaluation in Romania, problems with the battery lifetime, the ease of use, and the design of the sensors were detected, which

led to loss of data. It is important that the frequency with which each device needs to be charged is minimized. In particular for female users, good design is important, otherwise, the device will attract unwelcome comments. Feedback from users was incorporated into a revised version of the system. Data compression is used to improve the autonomy and battery life of the sensors. This is feasible, as a substantial amount of data (up to 90% for the key-ring device in one case) indicates the absence of activity.

The final version of the system which will be used in all future trials is quite robust. In the final Romanian case study, where the patient used the key-ring device and the smartphone, all connections were successfully completed. The key-ring device needed an average of 14 seconds and the smartphone less than two seconds to complete their transmissions. Similar results were obtained in Catalunya and the UK.

Conclusions

In our formative evaluation, we identified several aspects around the usability of the PMS which have been improved subsequently. The next step will be to evaluate the usability of the PMS in the framework of a scaled-down version of the Help4Mood system, and to correlate actigraphy findings with self-reported mood.

Acknowledgment

This work was funded by the EU grant No. 248765 Help4Mood.

References

[1] World Health Organisation: Depression, a global public health concern: 2012 http://www.who.int/mental_health/management/depression/who_paper_depression_wfmh_2012.pdf

[2] C. Burton, B. McKinstry, A. Szentagotai, A. Serrano-Blanco, C. Pagliari, M. Wolters. “Activity monitoring in patients with depression: A systematic review”, J Affective Disorders 145(1):21-28, 2013

[3] J. S. Buyukdura, S. M. McClintock, P. E. Croarkin. “Psychomotor retardation in depression: Biological underpinnings, measurement and treatment”, Progr Neuro-Psychopharmacol Biol Psych 35(2): 395-409, 2008

[4] D. Perez-Diaz de Cerio, J. L. Valenzuela, S. Ruiz, M. Garcia-Lozano and J. M. Colome: “Help4Mood: A computational distributed system to support the treatment of patients with major depression” COST IC1004, TD(11)01039, Lund (Sweden), 2011

[5] J. Ramos-Castro, H. Mahdavi, D. Pérez-Díaz de Cerio, M. A. García-González, S. Estévez and J. Rosell-Ferrer: Unobtrusive Activity Measurament in Patient with Depression: the Help4Mood Approach, Information and Communication Technologies applied to Mental Health, pp. 31-33, 2012

[6] D. Perez-Diaz de Cerio, S. Ruiz Boque, J. Rosell-Ferrer, J. Ramos-Castro, and J. C. Castro. “A Wireless Sensor Network design for the Help4Mood european project.” In European Wireless, 2012. EW. 18th European Wireless Conference, pp. 1-6. VDE, 2012

Soraya Estévez has a B .Sc. in Computer Science from the Polytechnic University of Catalonia (UPC), a B .Sc in Business Studies from University of Barcelona (UB). She is certified in Health Level 7 (HL7). She is interested in the clinical data standardization and the data interoperability with the Healthcare Systems

An Online Platform as a Tool for Surveys by Patient Associations

C. Lygidakis[1], C. Vögele[2], S. Cambiaso[1], N. Masella[1], M. Melis[3], R. Stara[4]
[1]Lumos!, Corte Galluzzi 8, 40124, Bologna, Italy, lygidakis@gmail.com
[2] Unité de recherche INSIDE, Université du Luxembourg, Luxembourg, Claus.Voegele@uni.lu
[3] Unità di Farmacologia Clinica e Sperimentale, University of Bologna, Bologna, Italy, mauro18c@libero.it
[4] Federazione Diabete Emilia Romagna, Cento, Italy, rita@lamberti.it

Abstract: **Patients are increasingly interested in sharing their experiences and learning about their conditions, their prevention and treatments, and are more frequently turning into advocates. The connectivity and the wide availability of data have been shown to support this development enabling patients to play an active role in healthcare. The "Lumos!" platform is a web-based solution that has been designed to facilitate teams of researchers conducting multicentre studies, especially in countries and contexts with low research capacity. Nevertheless, it can be modified and tailored as a tool for research studies carried out by patient organisations. The aim of this study is to assess the feasibility of an online platform as a tool for anonymous surveys conducted by a patient organisation.**

Methods: A questionnaire is currently being distributed in the Region of Emilia Romagna (Italy) by the Regional Federation of Diabetics with the aim to study the needs of patients that use self-check-up devices. This observational study has been designed online with the use of the "Lumos!" platform, which enables the creation of the questionnaire with adjustable fields and variables, using the expertise of the participants and the creation of reports. Furthermore, a URL and a QR code linking to the questionnaire are being published on Social Networks and websites inviting people to participate in the study. Several data will be retrieved from the logs of the platform, such as the time required to complete a questionnaire by a patient, the number and types of errors, and the percentage of completed items. These variables will be analysed taking into account the demographic characteristics of the patients.

Conclusions: By studying the indicators of the implementation and the characteristics of the participants, it will be possible to optimise

participation rates and achieve higher engagement from the participants in the future. We expect that with the help of the online platform, patient associations will be supported in their quest to conduct surveys and, as a secondary outcome; they will empower their members to play a more active role in healthcare.

Introduction

Patients are increasingly interested in sharing their experiences and learning about their conditions, their prevention and treatments [1, 2]. The Internet-savvy users, the so called e-patients, seek online health information, connect and collaborate with the others and take advantage of this medium not only for decision making and management of their own condition, but also for education and advocacy purposes. In fact, people with a regular healthcare provider and a chronic disease have been shown to consult online rankings and use social networks for health-related activities more often [3].

Although healthcare is often divided into isolated, professionally-centred silos, in which the doctor-patient communication results impaired, in the dawn of the new century, several patient movements have emerged, establishing the foundations of a revolution.

The "Lumos!" platform has been developed to enable teams of researchers, clinicians and other associations that promote health, to create questionnaires, set up multicentric collaborative studies, and facilitate online data collection, the management of samples and the supervision and coordination of the research projects. The inspiration for the creation of the platform stems from observing teams of researchers, working together in difficult contexts, rural and isolated areas, and countries with low research capacity and limited resources. In such demanding settings, there is often a small Electronic Health Record installation base and it is challenging to coordinate and engage researchers, while dealing with different healthcare systems, organizational models and a variety of individual, community and administrative issues.

The platform consists of a server side, where the data and the main application are stored, as well as a client side, on which users interact with the application. Overall, the platform can be easily extended and tailored for special purposes, [4] one of which entails its employment as software for the needs of research studies that are carried out by patient organisations.

The aim of this study is to assess the feasibility of an online platform as a tool for anonymous surveys conducted by a patient organisation.

Methods

The Federation of Diabetics of Emilia Romagna in Italy (Federazione Diabete Emilia Romagna) in cooperation with the Region of Emilia Romagna has launched a project that aims at assessing the needs of patients that use self-check-up devices, with the objective to provide valuable information for the management of the provision of such devices, the allocation of resources and the improvement of the quality of life of diabetic patients. For such a purpose, a questionnaire has been developed and approved by Regional authorities and is distributed to diabetics.

The "Lumos!" platform has been employed for such a project, offering an integrated set of tools, accessible for consumers besides healthcare professionals and enterprises (Fig. 1). The electronic version of the structured questionnaire has been designed with adjustable fields and variables, additional disclaimers have been appended to it (an informed consent was not necessary for this application as the data will be collected anonymously) and parameters such as the number of cohorts have been set.

In support of the public and media campaign, a URL and a QR code linking to the questionnaire have been produced and published on Social Networks and websites encouraging people to participate in the study.

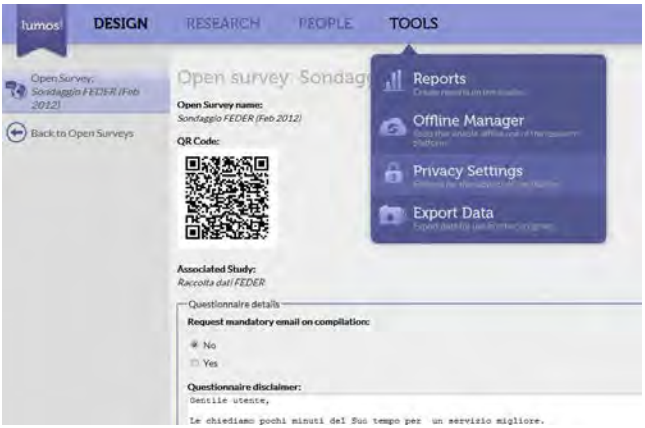


Figure 1. The interface of the "Lumos!" platform

During the implementation, the coordinators of the study have been able to control a set of parameters and quality indicators, such as the number of questionnaires that are compiled by a single computer. At the end of the project they will be able to create reports, run functions, produce 2x2 tables, export the database for further statistical analysis, and transfer the data of the existing cohort for future follow-up projects.

To evaluate the feasibility of such application, the developers of the platform will retrieve the data from the logs and information regarding the behaviour of visitors will be analysed. The variables that will be tracked include the time required to fill in a questionnaire, the percentage of completed items, the number of required fields that were omitted while trying to submit the questionnaire, the number and types of errors, and the website or Social Network from which the visitor entered the survey. Eventually, these data will be cross-analysed in relation with the demographic characteristics of the patients.

Conclusions

Patients with chronic diseases are often remarkably skilled at assembling and assessing health information [5]. The advances in connectivity and the wide availability of data are shifting healthcare towards a more patient-centred model. Problems such as the difficult physical access to remote and rural areas that restrained data collection in the past seem to have been overcome thanks to the technological progress that has facilitated the effectiveness and efficiency of health research in such regions.

The results of this study are expected to lead to an evaluation of the ways of achieving higher engagement from the participants in the future. Furthermore, the implementation of accessibility measures will be studied in order to enable people with a disability or impairment to participate in surveys, and offer everybody equal access and opportunities. All in all, by providing an easy-to-use, accessible and feature-complete platform for surveys, patient associations will be supported in their healthcare-related and awareness-raising campaigns and their members will be encouraged in participating in healthcare more actively.

References

[1] N. L. Atkinson, S. L. Saperstein, and J. Pleis. Using the internet for health-related activities: findings from a national probability sample. J Med Internet Res. 2009;11(1):e4.

[2] M. Ybarra, and M. Suman. Reasons, assessments and actions taken: sex and age differences in uses of Internet health information. Health Educ Res. 2008 Jun;23(3):512-21.

[3] R. Thackeray, T. B. Crookston, and H. J. West. Correlates of Health-Related Social Media Use Among Adults. J Med Internet Res. 2013;15(1):e21.

[4] C. Lygidakis, S. Rigon, S. Cambiaso, et al. A web-based versus paper questionnaire on alcohol and tobacco in adolescents. Telemed J E Health. 2010 Nov;16(9):925-30.

[5] F. Griffiths, J. Cave, F. Boardman, et al. Social networks--the future for health care delivery. Soc Sci Med. 2012 Dec;75(12):2233-41.

Charilaos (Harris) Lygidakis graduated from the Medical School of Bologna and obtained a Master's degree in Alcohol-related Problems and Pathologies from the University of Florence. After completing his Family Medicine / General Practice vocational training, he has focused on primary care research and on e-Health and mobile Health applications. He is the current chair of the Vasco da Gama Movement, the WONCA Europe network for trainees and junior General Practitioners / Family Physicians. Twitter: @lygidakis, http://www.linkedin.com/in/lygidakis

Prof. Claus Vögele graduated in Psychology (Dipl.-Psych., equivalent to MSc) at Landau University in 1983, and was awarded his PhD in Psychology from the University of Hamburg in 1988, and his professorial qualification (Habilitation) from the University of Marburg in 1997. Over the last 25 years he has held academic posts at both German and British Universities before joining the University of Luxembourg in February 2010 as Professor of Clinical & Health Psychology and Head of research group on "Self-regulation & health"

Silvio Cambiaso is an Electronic and IT Engineer (University of Palermo). He worked as a software designer for several IT companies, such as Oracle Corporation, Nortel Networks, and ENI. He is now working as freelance on software configuration management, analysis and development. Linkedin: http://www.linkedin.com/in/scambias

Nicola Masella is a S oftware Engineer, who graduated from the Polytechnic of Bari. He works for an IT consultancy company based in Regio Emilia as software developer. He is particularly interested in developing web-based solutions, focusing on designing user-friendly and efficient applications. http://www.linkedin.com/in/nicolamasella

Mauro Melis has a degree in Pharmacy and works at the Department of Medical and Surgical Science, University of Bologna. He carries out activities related to adverse drug reaction monitoring, pharmacovigilance, as a member of Pharmacovigilance Regional Centre of Emilia Romagna, at an Italian and European level. He conducts research on drugs safety and drug utilization besides participating in the regional center for evaluation and drug information.

Rita Lidia Stara is a mother of three children, two of whom are affected by Type 1 Diabetes Mellitus. She has built upon this personal experience and has focused on improving the quality of life of the diabetic patients and their caregivers by launching and promoting public campaigns to raise awareness of the disease. She is the former president of the AGPC Ferrara, and currently is the chair of Federazione Diabete Emilia Romagna (www.federdiabete.emr.it), which coordinates 21 patient associations in this Region of Italy, and the vice-chair of the Diabete Forum (www.diabeteforum.org), the national association that coordinates more than 70 associations in Italy.

Arrhythmia and Ischemia Detection for a Sportsperson Monitoring System

G. L. de Lima, V. Roesler
Federal University of Rio Grande do Sul, Institute of Informatics, 9500 Bento Gonçalves Av, Porto Alegre, Brazil, gllima@inf.ufrgs.br, roesler@inf.ufrgs.br

Abstract: **This work presents a sportsperson telemonitoring system that uses automatic heart disease detection methods in electrocardiograms allied with mobile and wireless technologies to prevent cardiac complications and make the physical exercise safest.**

The practice of moderate and rigorous physical exercise is recommended to promote the health of the people, but in some cases the practice of rigorous activities can be detrimental to health. The risk of cardiac complications related to physical exercises increases in sedentary individuals and in individuals who exercise regularly. Usually, these complications occurs in individuals with anatomical predisposition to heart disease or hereditary. This work aims to detect cardiac arrhythmias and ischemic heart disease in people who practice moderate or rigorous physical exercises. Its use is recommended in three moments [1]:

1. **Screening athletes and non-athletes prior to their participation in physical activities;**
2. **People monitoring during the physical activity;**
3. **Patient monitoring in cardiovascular rehabilitation programs.**

The procedures can be done remotely through the Internet, without the presence of a cardiologist during the procedure. The system suggest to the participant to stop the activity if the risk of a serious complication is large and allows a remote medical center to take emergency measures if any serious cardiac complications occur. The methods used in the system were evaluated using databases of arrhythmias and ischemia of the MIT/BIH and achieved 99.83% of accuracy to detect arrhythmias and 98.36% of accuracy to detect ischemia.

Introduction and Goals

Despite being recommended to promote health, both moderate and rigorous physical exercise can be detrimental to health mainly causing

cardiac complications. These complications related to physical exercise usually occur in individuals with anatomical or hereditary predisposition to heart diseases. An alarming fact is that the risk of these complications increases in both sedentary individuals and in individuals who exercise regularly.

The cardiovascular complications that this system aims to detect are cardiac arrhythmias and ischemic heart disease. With this, the assisted monitoring system proposed in this paper intends to use methods of automatic detection of heart disease in electrocardiograms to reduce their intercurrence during physical exercises. The system can be used in screening athletes and non-athletes prior to their participation in physical activities, preferentially supported by remote medical diagnosis when the automatic system detects some problem, enabling greater efficiency in the diagnosis of heart diseases.

The system can also be used in the cardiac monitoring of people during physical exercise or be used in rehabilitation programs in cardiovascular rehabilitation providing greater safeness in physical activities. Cardiac complications can be detected by the system, allowing the participant to stop the activity if the risk of a serious complication is large. Besides that, it allows a remote medical center to take emergency measures if any serious cardiac complications occur.

Material and Methods

The electrocardiogram (ECG) records the electrical activity of the heart behavior through precordial and peripheral formed by a pair of skin electrodes with different loads. By analyzing an ECG it is possible to identify changes in rhythm (arrhythmias) and cardiac ischemia. The arrhythmias can be classified as variable rhythm, extra systoles, fast rhythms and blocks [2]. A cardiac ischemia is actually the reduction of the blood supply leading to less blood supply than needed by the body. It precedes a possible infarction and can be identified in ECG by the T-wave inversion, which may vary from one wave flattened or depressed until a reversal deep. However, not every decrease in blood supply to the heart produces a heart infarction.

The system uses methods to detect cardiac arrhythmias and ischemic heart disease during assisted monitoring of sedentary or physically active individuals before or during a physical activity. The method of Varella et. al. [6] is used to detect cardiac arrhythmias and the Lima method is used to detect cardiac ischemia.

To use the solution it is necessary only a portable electrocardiograph for performing electrocardiogram and a mobile device (tablet or smartphone) with the application installed. The program is also responsible for the detection of arrhythmias and ischemia in the received signal, sending alarms and allowing access by remote doctors and health specialists through any computerized device with Internet access.

Results and Discussion

The system validation procedure used ECG records of the MIT/BIH arrhythmias and ischemia databases [3-5]. To verify the behavior of the system, five diagnostic tests were calculated for both arrhythmia and ischemia detection, and the results are presented in Table I: (1) *Sensitivity* is the capability to identify a sick person among all the sick people. (2) *Specificity* is the capability of identify a healthy person among all the healthy people. (3) *Positive predictive value* is the number of truly sick persons in relation to all the people detected as sick. (4) *Negative predictive value* is the number of truly healthy persons in relation to all the people detected as healthy. (5) *Accuracy* is the number of correct predictions considering all studied samples.

Table I. Results for Arrhythmia and Ischemia Detection

	Arrhythmia Detection	**Ischemia Detection**
Sensitivity	99,99 %	98,01 %
Specificity	99,47 %	94,47 %
Positive Predictive Value	99,76 %	96,58 %
Negative Predictive Value	99,97%	96,80 %
Accuracy	99,83 %	96,66 %

The results presented in Table I shows that the measurements for both methods have values at least greater than 94%. Also the minimum value for sensitivity was 98% for the ischemia detection, so in general the system rarely fails to find people with disease.

The results showed that the method for classifying cardiac arrhythmias used is sensitive and specific; it hardly fails to find people with arrhythmias and also rarely consider that a healthy patient is sick. Physical exercise using the system becomes safer because if the system detects an arrhythmia during screening, while performing a physical activity or during the cardiac rehabilitation, the monitored person can stop immediately the physical activity, avoiding further complications.

Considering the classification method used for cardiac ischemia, it was noticed that it did not reach values as high as the method of classification of

cardiac arrhythmias. But its sensitivity was high, which means that the system almost ever finds people with ischemic heart disease. Again, if the system detects episodes of ischemic heart disease, the person may stop the physical activity, avoiding further complications.

Conclusions

Despite the use of these methods for automatic detection of heart disease in the system proposed here, it is worth remembering that the methods themselves are not intended to be the only factor that decides whether a person is qualified or not to practice physical exercises. The system serves as a decision support for physicians and health experts. The information supplied by the methods present in the system is intended only to facilitate medical decision and to ensure greater safeness in physical exercise.

References

[1] P. Deligiannis; A.-S. Deligiannis; E. Kouidi. Trends in e-Health Monitoring Implementation in Sports. Sport- und Präventivmedizin, v. 41, p. 34-37, 2011. ISSN: 1867-1977.

[2] D. Dubin. Rapid interpretation of ECG: a programmed course. 3. ed. Rio de Janeiro: Editora de Publicações Médicas, 1992.

[3] F. Jager et al. Long-term ST database: a reference for the development and evaluation of automated ischaemia detectors and for the study of the dynamics of myocardial ischaemia. Medical & Biological Engineering & Computing, v. 12, p. 172-183, 2003.

[4] G. B. Moody; R. G. Mark. The impact of the MIT-BIH Arrhythmia Database. IEEE Eng in Med and Biol, 2001. 45-50.

[5] A. Taddei et al. The European ST-T Database: standard for evaluating systems for the analysis of ST-T changes in ambulatory electrocardiography. European Heart Journal, v. 13, p. 1164-1172, 1992.

[6] F. A. Varella et al. A method for the automatic classification of ECG beat on mobile phones. Computer-Based Medical Systems (CBMS), 2011 24th International Symposium on. [S.l.]: [s.n.]. June 2011. p. 1-6.

Guilherme Lazzarotto de Lima has a bachelor´s degree in Computer Science in Federal University of Rio Grande do Sul, Brazil. He is the operational manager of the Intelligent Surgical Room. Nowadays he is finishing his master´s degree in Computer Science, with focus on automatic detection algorithms of cardiac ischemia.

Valter Roesler has Bachelor´s degree in Electrical Engineering (1988), Master degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at Federal University of Rio Grande do Sul, Brazil. He coordinates the PRAV laboratory (Projects in Audio and Video) – www.inf.ufrgs.br/prav, with about 30 researchers and projects related to Remote Education and E-Health, in traditional computers and mobile devices.

Improving Mental Health Care in Afghanistan, Badakshan Province through e-Health - Phase 0

S. Khoja[1,2], R. E. Scott[1], H. Durrani[3,4], F. Mohbatali[4], S. Patten[1], M. Palacios[1], W. Yousufzai[5]
[1]University of Calgary, Calgary, Alberta, Canada
[2]COMSATS Institute of Information Technology (CIIT), Islamabad, Pakistan
[3]French Medical Institute for Children, Kabul, Afghanistan
[4]Aga Khan University, Karachi, Pakistan
[5]Aga Khan Health Services, Afghanistan, Kabul, Afghanistan

Abstract: **Despite Afghanistan having a stated goal of improving mental health care, the mental health care system outside of Kabul is weak. To address this gap, a program is being designed that will combine technological (e-Health) and traditional approaches to raise understanding and knowledge of mental health problems at the community level (and among healthcare providers serving those communities) in Badakshan province. A focus will be given to young adults who represent the next generation of community builders. The program will also establish mental health consultation for rural and remote communities, as well as improve the current District Health Information System to monitor the program and ensure consistent access to medical and other necessary supplies.**

Introduction

The history of the past 30 years in Afghanistan is one of prolonged conflict, social unrest, political instability and large scale internal and external migration [1]. The relentless damage caused by conflict has resulted in loss of life, physical destruction, collapsed infrastructure, devastated cities and communities, and broken families. But less well recognized and attended to are other 'invisible' wounds that last for years and cause deep scars on both individuals and society: these are the emotional and mental health wounds caused by conflict.

About 50% of people >15yrs in Afghanistan face some mental health (MH) problem [2]. Prevalence is higher in young adults (18-25yrs), adversely affecting families and reducing productivity in this key age group. The most common issues in young adults are: depression, anxiety, and Post-Traumatic Stress Disorders (PTSDs) [2]; drug abuse is a complication [3].

The Government of Afghanistan's 'Mental Health Strategy 2009-2014' [2] focuses on community based interventions and improving treatment, and mental health needs are on the list of health priorities [4], but the country lacks the capacity and resources to implement desired solutions [5-6].

To address this circumstance, this program will leverage existing health infrastructure (Community Health Workers (CHWs), Community Health Centers (CHCs), and a District Hospital (DH)), clinical networks (provided by Aga Khan Health Services - Afghanistan; AKHS-A), and available communication capabilities (web-based and wireless), to establish a receptive setting (community and health services), and a sustainable and scalable e-health solution for mental health - and for young adults in particular - that initially addresses the most common mental health issues.

Study Plan

This ongoing study (2012-2015) will design, implement, and evaluate a sustainable and scalable e-health supported intervention that develops an *embraced, informed,* and *accessible* mental health care system in one province of Afghanistan.

1. *Embraced*. MH awareness building at each of the community, CHC, and DH levels, using SMS technology and other approaches, and focusing on young adults and the target mental health issues.
   Aim: Reduce stigma and emphasize mental health disorders are treatable.
2. *Informed*. Skills and knowledge development will be achieved through face-to-face and virtual education strategies for CHWs and CHC and DH clinicians. In addition, the existing District-level Health Management Information System (HMIS) will be enhanced.
   Aim: Raise mental health skills, knowledge of healthcare providers, and information available to them.
3. *Accessible*. Service delivery will be enhanced by introducing web-based (CHC to DH) and videoconference-based (DH to Specialist Hospital (Pakistan)) consultation options.
   Aim: Introduce e-health facilitated service delivery for rural and remote communities.

All approaches will adopt only technologically appropriate and culturally sensitive e-health solutions (e-learning, teleconsultation, and e-record tools). The program will be evaluated (formative and summative) to demonstrate 'value' of the solution, allowing an evidence-based business model to be developed.

Several Phases have been planned to achieve these goals:

- Phase 0 (Months 1-6): Preparation, signing MoUs, recruitment and training, procurement;
- Phase I (Months 7-12): Improve awareness in selected communities, and target groups (young adults, healthcare providers, and healthcare managers);
- Phase II (Months 13-18): Improve distribution and supplies of required medications;
- Phase III (Month 19-33): Screening in selected communities; healthcare provider education, and treatment of mental illnesses;
- Phase IV (Last 3 months): Evaluation and dissemination.

Phase 0 (in place now) and phase 1 (imminent), will cover the first year of the project. The following specific steps / actions are in place or planned.

'Phase 0'

Goal: Establish team, logistical, training, and baseline study needs:

i. Study teams operationalized;
ii. Arrange meetings with DOH to engage, inform, and seek formal approval for the study;
iii. Confirm final selection of study sites;
iv. Confirm clear outcomes and indicators;
iv. Develop a 'path to scale' and refine integrated innovation approach for discussion with Grand Challenges Canada (target - Month 6);
v. Develop a draft 'theory of change' map (support and guidance provided by Grand Challenges Canada and experts);
vi. Baseline survey (n = 17 health facilities; 100 health providers; 200 participants from the community), Target completion - Month 6.

'Phase 1'

Goal: To ***Embrace*** mental health issues, train and improve understanding of HCP and CHW around mental health, raise awareness and reduce mental health related stigma.

i. Design and conduct 'town halls', design culturally appropriate information session materials, involve local community and religious leaders;
ii. Recruit and SMS young adults (local language).

Conclusion

This study will, from the outset, be designed, implemented, and evaluated as a 'sustainable *program*' (not a short term funded 'project'), with the support of the Government of Afghanistan. The ultimate outcome will be to reduce the burden of mental health problems in Badakshan Province of

Afghanistan, particularly for young adults. Local capacity building, improved access to information, and use of e-health facilitated care will be enhanced. The study, and its findings, will be an exemplar for future expansion of mental health interventions to other age groups and mental health issues, and within similar settings (difficult rural and remote locations) in Afghanistan and elsewhere.

Acknowledgment

The study is supported by a grant from Grand Challenges Canada. The support of other team members in Canada, Pakistan, and Afghanistan is gratefully acknowledged.

References

[1] G. D. Sayed. Mental Health System in Afghanistan, Burden, Challenges and the Way Forward. Health, Nutrition and Population (HNP) Discussion Paper, South Asia Region; Health, Nutrition and Population Sector, World Bank, Kabul, Afghanistan, August 2011.

[2] National Mental Health Strategy 2009-2014, For a Mentally Healthy Afghanistan Islamic Republic of Afghanistan. Ministry of Public Health, General Directorate of Preventive Medicines, Mental Health & DDR Department, 2009.

[3] United Nations Office on Drugs and Crime (UNODC). Afghanistan drug use survey 2009 [http://www.unodc.org/documents/data-and-analysis/Studies/Afghan-Drug-Survey-2009-Executive-Summary-web.pdf]. Last Accessed on 10 March 2012.

[4] Islamic Republic of Afghanistan. Afghanistan National Development Strategy: Health & Nutrition Sector Strategy 2007/08-2012/13- Volume II

[5] World Health Organization. WHO Mental Health Atlas 2011. http://whqlibdoc.who.int/publications/2011/9799241564359_eng.pdf. Last Accessed on 19 March 2012.

[6] World Health Organization. Mental Health System in Afghanistan. A report of the assessment of the mental health system in Afghanistan using the World Health Organization - Assessment Instrument for Mental Health Systems (WHO-AIMS). Kabul, Afghanistan, 2006.

Perception of eHealth Services by Health Care Professionals (A Case Study of Federal Medical Centre Owerri, Imo State, Nigeria)

U. L. Nnodum [1], A. Ogini [2]
[1]Planning, Research and Statistics, Federal Medical Centre, Owerri, Imo State Nigeria, udokannodum@gmail.com
[2]Telemedicine Unit, Federal Medical Centre, Owerri, Imo State, Nigeria
ugustogini@yahoo.com

Abstract: **Despite the vast research by Nigerians on the use of electronic health services, little is known about its perception and understanding by health care professionals. The degree of acceptance and understanding of eHealth services in health care sector is highly dependent on the perception of eHealth by health care professionals. To evaluate this, a survey was carried out at Federal Medical Centre Owerri, Imo state to substantiate the level of acceptance and understanding of eHealth services.**

Introduction

Federal medical Centre, Owerri, Imo state Nigeria has been rendering health services since 1903 as a m ilitary colonial hospital. It was later changed from General Hospital and to Federal Medical Centre on the 1st of January, 1995.

Patient's attendance since 1995 has increased from 53335 to 490334 in 2012 [1]. eHealth services came into existence in Nigeria late 2005. It was commissioned in 2007. Some Federal Medical Centres and Tertiary hospitals were equipped with telemedicine equipment. The use of electronic tools [2] in delivery health care is rapidly emerging as an international priority in nations at all levels of development.

According to World Health Organization, some components of eHealth are:

1. Electronic medical records: a r eal-time longitudinal electronic record;
2. Tele-health (including telemedicine);
3. mHealth: a medical and public health practice;
4. e-Learning: use of ICTs for learning and innovation form of education, continuing education in information and communication;

5. Standardization and interoperability: interoperability refers to communication between different technologies and software application for efficient, accurate and sound sharing and use of data [3]. eHealth is the single - most important revolution in healthcare since the advent of modern medicine, vaccine or even public health measure like sanitation and clean water [4].

Among these components, only telemedicine was introduced in Federal Medical Centre Owerri Imo state. The introduction of telemedicine as part of electronic health practice brought about the establishment of a prototype unit furnished with telemedicine equipment. Within the first two (2) years of practice, a survey was carried out.

Objective of the Study

1. To know the level of understanding of eHealth;
2. To ascertain the level of acceptance of eHealth;
3. To ascertain the level of perception of eHealth practices;
4. To find out the relevance of eHealth practice in medical curriculum.

Methodology

The methodology adopted for the purpose of this research using a sample from a survey conducted among health care professionals, is the use of descriptive survey research design. Stratified random sampling technique was applied. The sample size of two hundred and fifteen was selected as follows:

Health professionals	**Numbers**
Doctors	55
Pharmacist	52
Nurses	53
Laboratory scientist	23
Medical records	32
Total	215

Result and Discussions

Only two hundred (200) questionnaires were filled and returned. The main instrument used for data was structured questionnaire prepared by the team. Total numbers of returned questionnaire are as follows:

Health professionals	Returned questionnaire	%
Doctors	n =50	25
Pharmacists	n = 50	25
Nurses	n =50	25
Laboratory scientist	n =20	10
Medical records	n =30	15
N	n=200	100

Data collected were tallied and analyzed using descriptive statistics of frequency and percentage.

Research Objective Analysis

Analysis of the research objectives are sought to ascertain the level of perception eHealth by health care professionals.

Result and Findings

Based on the analysis of the responses to the questionnaire, only 26% of

Research objectives	Responses		
	Agreed	Disagreed	Undecided
Objective 1: Level of Understanding of eHealth	52 26%	110 55%	38 19%
Objective 2: Level of Acceptance	25 12.5%	115 57.5%	60 30%
Objective 3: Level of Perception	15 7.5%	140 70%	45 22.5%
Objective 4: eHealth practice in medical curriculum	100 50%	58 29%	42 21%

health care professionals agreed to understanding ehealth,12.5% agreed to accepting it,7.5%perceive it as practicable while 50% were of the view that it should be included in medical curriculum. All the percentages are low, more awareness should be recommended.

Conclusion

The percentage of understanding of eHealth practices by health care professionals is very low .Electronic health is an opportunity for access to quality health care for all in Nigeria but due to the challenges facing the

telecom industry in Nigeria, most health care professional see ehealth as a mirage and believes that it will take a longer time for it to be utilized.

References

[1] History of federal medical centre, owerri. www.fmcow.com
[2] http:www.allvoices.com/contributed news-Kenya.
[3] www.who.int/goe/publications
[4] D. Silber, The case for eHealth (presented at the first high-level conference on eHealth. European institute of public administrators 2003.

Udoka Nnodum

Social Aspects of Telemedicine

T. Eliseeva[1], M. Amcheslavskaya[2], A. Selkov[3],V. Stolyar[1]
[1]Bakoulev Scientific Center for Cardiovascular Surgery of the Russian Academy of Medical Sciences, Moscow, Russia
tamara-eliseeva@rambler.ru
[2]Moscow State Medical and Dental University named after AI Evdokimov, Russia, m_agavelyan@mail.ru
[3]Russian Association for Telemedicine, Moscow, Russia,
ais1710@rambler.ru

Over the past 10 years, Russia has opened more than 620 telemedicine centers (Fig. 1). Modern telemedicine projects are not just as Moscow - Russia's regions, but also different levels of intra-regional projects, such as Regional Hospital - Regional Hospital (Fig. 2). The projects each year are training specialists at telemedicine International School "Modern aspects of telemedicine," in Moscow State Medical and Dental University named after AI Evdokimov established the Department of Telemedicine. The latter improves the quality of telemedicine services and increase the number of telemedicine consultations.

Offering advises to patients at all stages of the diagnostic process and to specialists of federal medical centers; the usage of mobile telemedicine systems in the field and emergency responses, emergency medical assistance to victims, including those in the lesion - this is an incomplete list of socially important areas of telemedicine in health care.

Conducted surveys dedicated to learning the views of various groups on the development of telemedicine are important tools for further development of existence prioretetnye trends in medical practice. Public opinion on issues related to telemedicine technology obtained through public opinion polls confirms social importance of telemedicine.

The obtained results of the study provide a comprehensive description of the sociological needs of the people in the implementation of telemedicine technologies. Telemedicine consultations are extremely popular due to, dissatisfaction with medical care available in the community of patients, and the difficulty in obtaining advice in the Federal Medical Centre, due to the economic and social and domestic reasons.

Critical social issue of telemedicine is not only providing access to high quality medical care to the population, regardless of social status and geographic location, but also the quality of its provision through better

diagnostics. An opportunity to receive advice by specialists, conduct dynamic monitoring without leaving the region. Subsequently, this allows a significant advantage of telemedicine as a tool to prevent disease, reduce morbidity, disability and mortality of inhabitants of Russia, as well as to optimize the financial costs in the health system.

Our 10 yrs. long experience has shown that the local population telemedicine centers provide access to key personnel, while the costs of persons in need of such consultations are much lower than those they should have to travel to the clinic. So last year we conducted more than 1,500 telemedicine consultations (Fig. 3, 4) of different types of patients in 57 regions of the Russian Federation, through telemedicine technologies conducted 15 c ycles training physicians of various specialties, as consultants and lecturers were academicians, corresponding members Russian Academy of Medical Sciences, Professor. In addition to a unique set of stereoscopic imaging stroke surgery (Fig. 5, 6) the opportunity to conduct on-line workshops for doctors, Tele-mentoring from leading surgeons, which significantly increases the quality of care.

The prospect of development is seen through the further expansion of the telemedicine network, the establishment of the management structure of the Ministry of Health of the Russian Federation, to develop a p ackage of normative documents regulating the work of the centers of telemedicine development and implementation of inter-regional information programs with industry bodies, scientific and industrial organizations, commercial firms, businesses and social institutions. It is also important is to promote telemedicine services among the population on the means of mass media, distribution of brochures in hospitals and pharmacy chains.

Fig. 1

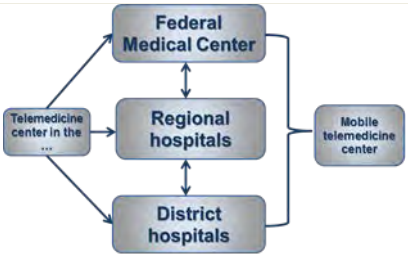


Fig. 2

Fig. 3 telemedicine consultation

Fig. 4 telemedicine council

Fig. 5 surgeon in stereo helmet

Fig. 6 broadcasting stereo image surgical field

Teleconsultation Service to Improve Access to Specialized Care in Physiotherapy: The Experience of the Telehealth Network of Minas Gerais, Brazil

P. P. Geisel, V. R. Neves, J. X. Maia, L. Sousa, M. B. M. Alkmim, A. L. P. Ribeiro, M. S. Marcolino
Telehealth Network of Minas Gerais, Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, telessaude@hc.ufmg.br, Av. Alfredo Balena, 110-Belo Horizonte, CEP 30130-100, Brazil

Abstract: **The main objective of the study was to analyze the teleconsultations in physiotherapy performed by the Telehealth Network of Minas Gerais, Brazil. The teleconsultations performed from January to December 2011 were assessed regarding the requesting professional, type of querie, specialist who answered the teleconsultation and level of assistance. During the study period, 233 teleconsultations in physiotherapy were realized; 75% of them were related to assistance of a particular patient, 23% were educational and 2% were about professional regulation. Regarding the requesting professional, 77% were physiotherapists, 18% were nurses and 3% were physicians. Physiotherapists specialized in trauma and orthopedics (50%), neurology (18%) and pediatrics (12%) answered the majority of teleconsultations. Regarding the type of doubt, 88.4% were about treatment, 3.9% diagnosis and 3.9% orthesis and prothesis. The most frequent level of assistance was ambulatory (96%); home care and hospital represented, respectively, 3 and 1%. Furthermore, it was observed that 13.2% of the municipalities requested teleconsultations in physiotherapy during the study period; 83.8% of them had less than 10,000 inhabitants. In conclusion, most of the teleconsultations in physiotherapy in our service are doubts of physiotherapists related to outpatient care in trauma and orthopedics, of municipalities with less than 10,000 inhabitants.**

Introduction

The access to physiotherapy services in remote cities is really limited in big countries, due to the high concentration of resources and specialized healthcare in the larger cities and non-attractive salaries in the remote ones.

Also, the lack of healthcare professionals can increase the cost for the public health system with unnecessary travels with physiotherapy clinic referrals.

Telehealth is a tool to increase access to expertise in a co st-effective manner, especially for geographic remote areas. Furthermore, the telehealth is an important strategy to provide support to primary care practitioners in small cities by teleconsultation in all fields of health, including physiotherapy.

In a co untry with the proportions of Brazil, where healthcare professionals are unevenly distributed, this scenario becomes much more important. The Telehealth Network of Minas Gerais (TNMG) is a public telehealth service established in 2005. Currently, it provides support to primary care practitioners of 660 of the 853 municipalities in the state of Minas Gerais, Brazil, by performing teleconsultations and tele-electrocardiography. It constitutes an example of successful perennial use of Telemedicine in the Brazilian Public Healthcare System (SUS) [1, 2]. The teleconsultations are in the *offline* or *store-and-forward* mode [3]. The aim of this study was to analyze the teleconsultations in physiotherapy performed by the TNMG.

Methodology

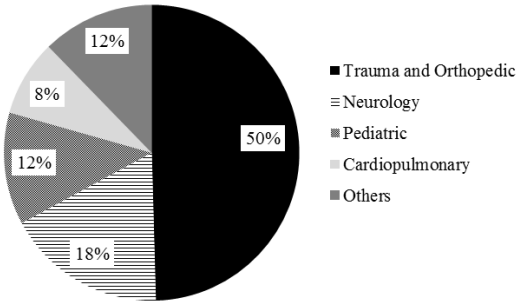
All teleconsultations in physiotherapy performed by the TNMG from January to December 2011 were assessed regarding the requesting professional, type of querie, specialist who answered the teleconsultation and level of assistance. In that period, 607 municipalities were attended by the teleconsultation service. The teleconsultations were analyzed according to the number of inhabitants (lower or higher than 10,000 inhabitants) form the originating municipality.

Results

During the study period, 233 teleconsultations in physiotherapy were performed, 75% of them were related to assistance of a particular patient, 23% were educational and 2% were about professional regulation. Regarding the requesting professional, 77% were physiotherapists, 18% nurses and 3% physicians and 2% other professionals (nutritionist, occupational therapist and physical educator).

Physiotherapists specialized in trauma and orthopedics, neurology and pediatrics answered the majority of teleconsultations (Figure 1).

Figure 1: The graphic represent the percentage of doubts regarding the different yield in physiotherapy



Regarding the type of queries, 86% were about treatment, 4% diagnosis, 4% orthesis and prosthesis and 6% legislation and professional regulation.

The most frequent level of assistance was ambulatory (95%); home care and hospital settings represented, respectively, 3.1 and 0.9%. Of the 607 municipalities which are attended by the service, 80 (13.2%) requested teleconsultations in physiotherapy during the study period; 83.8% of them had less than 10,000 inhabitants.

Discussion

This study illustrates the role of telephysiotherapy in providing support to the primary care practitioners of small and remote municipalities. As expected, the most frequent level of assistance was ambulatory and the majority of municipalities had less than 10,000 inhabitants.

The main focus of TNMG is the primary care in Brazilian public health system (SUS). According to SUS strategies, the access to primary care in remote areas may reduce the waiting time for health service appointments [4]. Additionally, it can decrease the cost regarding unnecessary transport to big cities. The telephysiotherapy is an important tool to improve the access in primary care. Several health professionals (nurses, physician and others) used the service to ask about the different pathologies and treatment. Therefore, teleconsultation in physiotherapy was useful to reduce the wait for physiotherapy treatment and improve to access to SUS.

On the other hand, only 13.2% of the 607 cities attended by the TNMG requested teleconsultations in physiotherapy during the period of study, 83.8% of municipalities which telephysiotherapy had less 10,000 inhabitants. The low utilization rate can be explained to high staff turnover,

lack of training, low adherence to use of teleconsultation and technical limitations.

Conclusion

In conclusion, most of the teleconsultations in physiotherapy in our service are physiotherapists doubts related to outpatient care in trauma and orthopedics, of municipalities with less than 10,000 inhabitants.

References

[1] M. V. Andrade, et al., Cost-benefit of the telecardiology service in the state of Minas Gerais: Minas Telecardio Project. Arq Bras Cardiol, 2011. 97(4): p. 307-16.

[2] A. L. Ribeiro, et al., Implementation of a telecardiology system in the state of Minas Gerais: the Minas Telecardio Project. Arq Bras Cardiol, 2010. 95(1): p. 70-8.

[3] M. B. Alkmim, et al., Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bull World Health Organ, 2012. 90(5): p. 373-8.

[4] C. Jurberg. Flawed but fair: Brazil's health system reaches out to the poor. Bull World Health Organ, 2008. 86(4): p. 248-9.

Patrícia Paulino Geisel - Bachelor' Degree in Physiotherapy from Universidade Federal de Minas Gerais. She is currently respiratory physiotherapist at University Hospital, Universidade Federal de Minas Gerais.

Victor Ribeiro Neves - Bachelor' Degree in Physiotherapy (2004), master (2008) and doctorate (2011) in Physiotherapy from Universidade Federal de São Carlos. He is currently Pos-Doc in Telehealth Center of Minas Gerais, University Hospital, Universidade Federal de Minas Gerais.

Júnia Xavier Maia - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (2001), residency in Internal Medicine (2005) and specialization in Endocrinology and Metabolism (2007). She is currently a teleconsultant at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais.

Lidiane Sousa - Bachelor's Degree in Physiotherapy (1999), master in Rehabilitation Science (2004) and doctorate in Health Science (2008) from the Universidade Federal de Minas Gerais. She is currently a professor at the Centro Universitário Newton Paiva, and clinics coordinator at the Telehealth Center (teleconsultations), University Hospital, Universidade Federal de Minas Gerais.

Maria Beatriz Moreira Alkmim - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1979), residency in Clinical Pathology and specialization course in Hospital Management. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais. She is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry.

Antonio Luiz Pinho Ribeiro - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1988), residency in Internal Medicine (1990) and Cardiology (1992), and doctorate in Medicine from the Universidade Federal de Minas Gerais (2011). He is currently a Full Professor at the Medical School, Universidade Federal de Minas Gerais, and coordinator of the Telehealth Center and the Clinical Hospital, Universidade Federal de Minas Gerais.

Milena Soriano Marcolino - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (2004), residency in Internal Medicine (2007), and doctorate in Internal Medicine from the Universidade Federal de Minas Gerais (2011). She is currently a Professor at the Medical School, Universidade Federal de Minas Gerais and Quality Control Manager at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais.

The Need for a Clearer European Vision for Telehealth

M. J. Fisk
Health Design and Technology Institute, Coventry University
mfisk@cad.coventry.ac.uk
Puma Way, Coventry University Technology Park, Coventry CV1 2TT UK

Abstract: **Publication of the European Commission eHealth Action Plan for 2012 to 2020 provides a focus for telehealth. Its accompanying Staff Working Paper seeks 'a policy debate on how innovation can contribute to rethinking the way in which healthcare is provided, by considering the latest developments in technology, innovative services and the growing impact of new media on the health and well-being systems.' The paper below responds to this call by offering a wider understanding (and definition) of telehealth. It also reports on the European Code of Practice for Telehealth Services (developed within the European Commission funded TeleSCoPE project) in helping to influence the configuration of telehealth services and in supporting a clearer European vision.**

Introduction

There can be few clearer statements than that which affirms the need for 'deep-rooted structural reforms … to ensure the sustainability of [European] health systems while securing access to services for all citizens.' This provides part of the context for the European Commission eHealth Action Plan released at the end of 2012 [1]. In the Action Plan, eHealth is defined as 'ICT tools and services for health' and embraces both telemedicine and ICT for well-being.

Setting aside some uncertainties regarding terminology around telehealth (this is addressed later), it is apposite to note the significance and appropriateness of two of the words within the Commission statement. First is the word 'citizens' rather than 'patients'. It follows that any approach to eHealth must include the broader well-being of people (citizens) and should not solely reflect clinically driven responses to the higher-level needs of some 'patients'. Second is 'access' with its signal that people have choices that they exercise regarding the health services that they might wish to use.

Such wording in the Action Plan responds in large degree to the outcomes of work by the eHealth Task Force that reported in 2012 [2]. This pointed,

amongst other things, to the need for a ‘radical redesign of health’ in a manner that includes integration between health and social care and recognition of people as ‘owners and controllers of their own health data’.

This is the context within which the European Commission funded TeleSCoPE project has operated and now is delivering. The European Code of Practice for Telehealth Services developed within the TeleSCoPE project reflects, therefore, an approach and an ethos for telehealth that supports key aspects of the ‘radical redesign’ sought.

Definitions

The definition adopted within the TeleSCoPE project is such that telehealth is ‘the means by which technologies and related services concerned with health and wellbeing are accessed by or provided at a distance in order to facilitate the empowerment, assessment or the provision of care and/or support for people and/or their carers (at home or in the wider community).’

This definition captures first, the fact that telehealth addresses both health *and* wellbeing. Therefore a role is envisaged where, on the one hand, patients can be monitored and interventions made that improve clinical outcomes; and, on the other hand, people can access services in ways that enable them to manage their own health (garnering the support of clinicians, health or social care practitioners when they see this as appropriate or necessary). There are, therefore, aspects of telehealth that support established health practice and which may focus on institutional settings such as hospitals, clinics and health centres. But, crucially, the definition recognises that there are aspects of telehealth that also address public health and preventative agendas by virtue of (a) responding more flexibly to people’s needs and choices; and (b) encouraging people to adopt and maintain lifestyles that are conducive to better health, build ‘health literacy’ and their capacity for self-management.

It is arguable from the above that telehealth, albeit not defined in the eHealth Action Plan, includes components of both ICT for wellbeing (‘the use of ICT in products, services and processes, in order to directly or indirectly improve the quality of life and wellbeing status of EU citizens’) and telemedicine (‘the provision of healthcare services, through use of ICT’ in situations where ‘the health professional … and the patient are not in the same location)’. It stands to reason, furthermore, that if telehealth is to realise its potential for health *and* wellbeing, then its clinical component can be seen as falling mainly within the subset of eHealth that is, at least in part, recognised as telemedicine. Another part of telehealth might be considered, however, as outside of telemedicine. This perspective is the inverse of that

indicated in the Action Plan which appears to share the perspective of COCIR (the European Coordination Committee of the Radiological, Electro-medical and Healthcare IT Industry) when it refers to 'telemedicine services such as telehealth' [1, 3].

An inverse perspective where telemedicine is a subset of telehealth is considered as more inclusive and, therefore, appropriate for adoption in the European context. That inclusivity takes account of the aim for telehealth services to be accessible to all – regardless of people's age or their level of need for support in relation to the management of their health. This point, of course, links with the Action Plan reference to 'health capital' (health as a component of human capital) whereby people's contribution to society, regardless of age, can be maximised.

Aspects of the Policy Debate

The Action Plan seeks 'a policy debate on how innovation can contribute to rethinking the way in which healthcare is provided, by considering the latest developments in technology, innovative services and the growing impact of new media on (the) health and well-being systems.' Highlighted within the Action Plan is the need to overcome barriers to the adoption of eHealth (and, therefore, telehealth). The barriers relate to such matters as interoperability (of technologies and electronic health records, EHRs), the need for greater legal certainty around service provision, and the need for 'common schemes for conformity testing and accreditation' [1].

Only the last of these particular barriers is covered in this paper by virtue of the introduction given to the European Code of Practice for Telehealth Services (see below). But there is an imperative to overcome a range of barriers to telehealth. In the words of the Action Plan – 'current healthcare models are financially unsustainable' with eHealth carrying a 'promise of more efficient and cost effective care [that] is critical to the survival of the system of healthcare in Europe' [1].

With regard to the areas where service innovations are taking place, a pointer in the Action Plan is to the United Kingdom in view of its 'Whole System Demonstrator' trials that sought to provide evidence of telehealth's efficacy. Some findings from these trials are now being reported and can be considered as at least reasonably robust – in view of the number of people recruited, the manner of their selection and assignment to intervention and control groups, and the twelve month period over which the particular study (noted here) took place. But there is an important caveat (recognised by the researchers) because of uncertainty around the extent to which people did not agree to be part of the trials and the subsequent 20% drop-out rate from them [4]. In all, over 1500 people were involved, with over 800 were

assigned to the telehealth group. But the report is not comfortable reading for those eager to endorse the merits of telehealth.

Two findings from the trials are uppermost. First, it is affirmed that 'the trial of … home based telehealth for patients with chronic obstructive pulmonary disease, diabetes or heart failure found no main effect of telehealth on generic health related quality of life, anxiety or depressive symptoms over 12 months.' And, second, the study noted that 'the similarity of the patient reported outcomes across trial arms suggests that concerns about the potentially deleterious effect of telehealth are unfounded for most patients.' In setting both of these findings with in a wider research context (an extensive trawl of the literature was undertaken) the researchers point to their findings as 'strongly' suggesting that there is 'no net benefit from telehealth; therefore it should not be used as a tool to improve health related quality of life or psychological outcomes' [4].

Taking a Different Perspective

At first glance, these findings from the WSD trials might appear to 'pull the rug' from under key aspects of the Commission's eHealth strategy. But this is only be the case if telehealth is seen narrowly as a tool for helping to support traditional service frameworks aimed at delivering specific clinical outcomes for people with chronic conditions. In any case, as is pointed out by the researchers, 'robust evidence to inform policy decisions is lacking' or is at least ambivalent – a view echoed by the Commission itself [4, 1]. The definition of telehealth adopted for the WSD study is, furthermore, limited in pointing to 'system' rather than service. Telehealth, they affirm 'enables the remote exchange of data between a patient and healthcare professionals to facilitate diagnosis, monitoring and management of long-term conditions' and 'affords the opportunity for earlier intervention which may reduce the frequency with which expensive hospital based care is required.'

Hence the WSD study reported here has limitations by virtue of it and the studies reviewed being focused only on the monitoring of vital-signs. Other telehealth services that would fall within a wider definition of telehealth were not part of the study, nor part of the trial. The conclusion of the researchers that telehealth 'should not be used as a tool to improve health related quality of life or psychological outcomes' is therefore open to challenge. Also questionable is their seeming view that the finding of 'no deleterious effect' is further justification for the rejection of telehealth since this ignores the fact that suitably configured telehealth services can be considered an ethically more appropriate way to provide health services.

The words are important here. The potential changes that could come from a different (and wider) perspective on telehealth mean that, if such

alternative approaches are nurtured and supported, we will be less concerned with the *delivery* of services and will be more concerned with *offering* services for people to access and use. This approach to telehealth accords with an ethical perspective concerned with promoting people's autonomy and choices – a matter that has been recognised within the TeleSCoPE project as fundamental for any code of practice. It accords, furthermore, with many objectives (endorsed by the European Commission) regarding citizenship and inclusion [5].

Such a new approach to telehealth service provision presupposes that as we move forward there will be growing cohorts of people who are increasingly aware of, and take more responsibility for, their own health. In other words they are or will be increasingly 'health literate'. The context is one where health literacy requires our greater attention – with this being a key recommendation of the eHealth Task Force and properly highlighted in the Commission's Action Plan [1, 2].

The European Code of Practice for Telehealth Services

Supporting the changes in approaches to telehealth (and in promoting telehealth in accordance with a definition that embraces health *and* wellbeing) is the European Code of Practice for Telehealth Services. The Code, a beta version of which was released at the Medetel Conference in Luxembourg in April 2013, is seen as helping to give greater clarity to a European vision for telehealth.

The Code, it must be noted, only touches lightly on clinical or technical matters. But it makes clear that clinical inputs are important and that links with clinicians will often be essential. The key point is that, with a wider remit for telehealth there are roles for both clinicians and other health and social care staff in relation to people's health *and* wellbeing. With regard to technical matters, these often relate to signalling protocols and e.g. conventions for exchanging EHR data; and are, therefore, outside the remit of the Code with its focus on telehealth *services*. There are, however, important aspects of the technology such as its usability, configurability and interoperability – all of which are touched on in the Code.

Also dealt with in the Code are matters regarding the safeguarding and usage of personal (including health) data. These will, of course, affect the way that people exercise their choices in accessing and using services. Conversely they will impact on the way that services (and technologies) can be flexible in response to people's choices (and in their use).

More broadly, the way in which the Code gives 'greater clarity' to a European vision relates firstly to the perspective taken. This includes a strong affirmation regarding the needs and choices of 'people' as well as

'patients'; and recognises the public and preventative as well as clinical health agendas. The definition of telehealth adopted by the TeleSCoPE project pertains.

Secondly the Code offers a structured approach by which different kinds of telehealth services can self-assess or be assessed by an independent external body in order to determine the extent of their compliance. The range of telehealth services in question includes those that use installed and mobile technologies (including video-links) to e.g. monitor and track people with dementia; prompt people in relation to their medication or therapies; help in the monitoring of people's vital-signs; or guide people by means of health or motivational coaching

The merits of the Code will be judged by the extent of its adoption in European member states. It offers, however, a vision for telehealth that can help to refine elements of the Commission's eHealth Action Plan and support a direction that clearly affirms the extent to which telehealth can deliver real and widespread benefits in terms of health *and* wellbeing.

References

[1] European Commission "eHealth Action Plan 2012-2020 – Innovative Healthcare for the 21st Century" Staff Working Document SWD 413 Final, Brussels 2012.

[2] European Union "eHealth Task Force Report: Redesigning Health in Europe for 2020" Luxembourg 2012.

[3] European Coordination Committee of the Radiological, Electro-medical and Healthcare IT Industry "COCIR Telemedicine Toolkit", Brussels 2011.

[4] M. Cartwright et al., "Effect of Telehealth on Quality of Life and Psychological Outcomes over 12 months (Whole System Demonstrator Telehealth Questionnaire Study): Nested Study of Patient Reported Outcomes in a Pragmatic, Cluster Randomised Controlled Trial" BMJ 2013; 346:1653.

[5] M. J. Fisk and D. Rudel, "Telehealth and Service Delivery in the Home: Care, Support and the Importance of User Autonomy" in George C, Duquenoy P. and Whitehouse D. (Eds.) eHealth – Legal, Ethical and Governance Challenges. Springer Verlag 2012 pp. 211-226.

Malcolm Fisk is CoDirector of the Age Research Centre at Coventry University and leads the European Commission funded TeleSCoPE project that is developing a European Code of Practice for Telehealth Services. He is a member of the Quality Services Advisory Committee of the National Institute for Clinical Excellence (UK) and an Advisor to the Welsh Government in respect of tackling poverty among older people.

The Social Worker in TMC

M. Amcheslavskaya[1], T. Eliseeva[2], A. Selkov[3], V. Stolyar[2]
[1]Scientific Clinical Center OAO «RZD» nkctelemed@mail.ru
[2]Bakoulev Scientific Center for Cardiovascular Surgery of the Russian Academy of Medical Sciences, tamara-eliseeva@rambler.ru
[3]Russian Association for Telemedicine, ais1710@rambler.ru

Abstract: **Telemedicine, makes high-quality medical assistance be available for patients from the most remote areas of Russia, a country that stretches for thousand kilometers. It improves health care quality, prevents medical errors, reduces health care costs, and decreases paper work. Telemedicine provides the best available postgraduate education for physicians from far distant regions. It becomes possible only in cases of well-organized Telemedical Centers. We consider the social worker to be the important member of TMC team.**

Introduction

The National Russian Program "The Health" aims to provide the population the best available healthcare. Telemedicine eliminating distance as a barrier to healthcare turns to be of great importance in solution of this problem. Whether the patient lives in Siberia or Far East Telemedicine becomes an invaluable tool in healthcare. The specialist can diagnose and recommend treatment immediately.

Optimal organization of TMC turns to be of great importance and provides its effective work. We present our 5-years' experience of distant consultations of patients with neurosurgical pathology that were performed in Burdenko Neurosurgical Institute TMC. During this period more than 500 patients suffering predominantly brain tumors, vascular diseases and brain trauma were consulted by leading professionals of Burdenko Neurosurgical Institute. 400 lectures for doctors from far distant regions of Russia (Siberia, Far East) were held. The lectures were predominantly devoted to latest achievements in different fields of neurosurgery.

The TMC team includes different specialists: program managers, medical director, administrative clinical coordinator, access specialist. We consider the social worker to be the important member of TMC team.

The main functions of social worker in our TMC include:

1. Organization of consultation between a patient and health professional (doctor) providing medical data. It includes acquiring medical data and pre-

senting this data to medical specialist at convenient time. Fig. 1," The second step – is organization of online conference between specialists that in many occasions includes remote examination of the patient. The last step is preparation and sending of documents with medical recommendations (in all cases) and additionally preparation of documents for hospitalization (in cases of surgical treatment in Burdenko Institute). Table 1. The social worker communicates online with the patient and the answers all his questions related to the admission to the hospital.

Table 1. Results of remote TMC consultations. TMC of Burdenco Neurosurgical Institute

Total number of TMC consultations 445	
Brain tumors 207(100%)	Brain trauma, vascular malformations 237 (100%)
Treatment in local Hospitals 84 (40%)	Treatment in local Hospitals 82 (34%)
Hospitalisaion in Burdenco Neurosurgical Institute 123 (60%)	Hospitalisaion in Burdenco Neurosurgical Institute 155 (66%)

2. Organization of medical education for health professionals in remote locations. It includes update of information on WEB site concerning different scientific meetings, seminars and lectures as well as organization and conducting of remote educational courses, lectures, workshops and conferences.

Fig. 2," The social worker conducts a survey on the quality of lectures on the basis of the opinions of the students.

Fig. 1: Distant education. Scientific Videoconference for 5 remote medical centers.

Fig. 2: TMC consultation of a patient with brain trauma.

The UK NIHR Health Technology Co-operative (HTC) in Mental Health and Neurodevelopmental Disorders – 'MindTech'

J. A. Crowe[1], C. Hollis[2], R. Morriss[2], M.F. Valstar[3], L. Bai[3], D. Daley[2], P. Blanchfield[3]
[1]Faculty of Engineering, University of Nottingham, john.crowe@nottingham.ac.uk, Nottingham, UK
[2] Institute of Mental Health, University of Nottingham, UK
[3] Computer Science, University of Nottingham, UK

Abstract: **As part of its strategy of embracing technological innovation the UK's National Institute for Health Research (NIHR) has recently funded eight Health Technology Co-operatives (HTC). Here we discuss the background to the HTC in Mental Health and Neurodevelopmental Disorders, 'MindTech', and how we aim to facilitate the translation and adoption of technologies from academics and industry into clinical practice.**

Introduction

The role of the NIHR HTCs is to devise technology-based solutions that will improve patients' quality of life and the effectiveness of the healthcare services that support them. The HTCs target areas of high unmet need where relatively little technological innovation has occurred, and are designed to facilitate collaboration between industry, academics, clinicians and patient groups.

The development of new technology is needed particularly in the area of mental health since currently much of the diagnosis and assessment within the mental health field is subjective; as recognised by the recent establishment of the NIMH's Research Domain Criteria project in the USA [1]. The application of e & m-health technologies have the potential to transform mental healthcare by increasing patient's involvement in their care, monitoring and outcomes and enhancing interactions with both real and virtual clinicians.

MindTech - The Mental Health & Neurodevelopmental Disorders HTC

MindTech is a joint venture between the Nottinghamshire Healthcare NHS Trust and the University of Nottingham's Institute of Mental Health

involving mental health clinicians and clinical scientists, computer scientists, engineers, health service researchers, service users and carers, and experts in Health Technology Assessment. Within this partnership there will be a collective identification of unmet needs followed by the development of solutions that will then be implemented and tested.

Clinical expertise embedded within the HTC includes attention deficit hyperactivity disorder (ADHD) [2], autism spectrum disorder (ASD) [3], Tourette Syndrome (TS) [4], early-onset psychosis [5], bipolar disorder and depression [6]. Technical knowhow is provided by the HTC members who have previously worked on various aspects of monitoring patients with mental health problems such as Bipolar Disorder [7], Tourette's syndrome [8], the use of serious gaming in the diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) [9], and facial recognition to determine affective state [10]. We also have experience of user centred design [11] and early stage health economics.

Industrial Collaboration

Central to the HTC's activity, and upon which its success will be dependent, is collaboration with commercial partners who will ultimately be responsible for the provision of the new technologies. Founding partners include QbTech Ltd. who provide a camera based method for the objective assessment of ADHD [12]; the providers of BuddyApp, "a digital tool to support therapy services" [13]; Buzz3D who provide eye tracking and gaze systems [14]; and RedEmbedded [15] with their managed visual care services.

We aim to add to this list and invite any companies with products either targeting this field or which could be adapted to do so to contact us. In addition we are available to discuss concept stage ideas on which we would aim to offer advice from a user's perspective.

Future Plans

Alongside our core HTC function we also intend to pursue our own research centred upon the capture and evaluation of bio-behavioural signatures that can be used to evaluate an individual's mental wellbeing. This may include: their everyday interaction with technology (since such activities are nowadays logged routinely); facial and audio analysis; further explorations of the application of eye and gaze tracking, and serious gaming (for both diagnosis and treatment).

Summary

The new Mental Health and Neurodevelopmental Disorders HTC 'MindTech' is collaboration between various academic disciplines and industry whose remit is to work together to provide technological solutions in an area that has been relatively overlooked. We welcome enquiries from those who would like to discuss how MindTech may facilitate the translation and adoption of their own products.

Acknowledgment

JAC acknowledges support of this work through the MATCH programme (EPSRC Grant GR/S29874/01), although the views expressed are entirely his own. All authors acknowledge the UK's National Institute for Health Research (NIHR) for their funding of the 'Mental health and neurodevelopmental disorders' Health Technology Co-operative (HTC).

References

[1] http://www.nimh.nih.gov/research-funding/rdoc/index.shtml (Accessed 24.01.13)
[2] E. B. Liddle, C. Hollis, M. J. Batty et al. Task-related default mode network modulation and inhibitory control in ADHD: effects of motivation and methylphenidate. J Child Psychol Psychiatry. **52**, 761-771, 2011
[3] P. Kochhar, M. J. Batty, E. B. Liddle, M. J. Groom, G. Screif, P. F. Liddle, C. P. Hollis. Autistic Spectrum Disorder traits in children with Attention Deficit Hyperactivity Disorder. Child: Care, Health and Development, **37**, 103-110, 2011
[4] S. R. Jackson, A. Parkinson, J. Jung, S. E. Ryan, P. S. Morgan, C. Hollis, G. M. Jackson, Compensatory Neural Reorganisation in Tourette Syndrome. Current Biology, **21:** 580-585, 2011
[5] T. Kendall, C. Hollis, M. Stafford, C. Taylor: on behalf of NICE Guideline Development Group. Recognition and management of psychosis and schizophrenia in children and young people: summary of NICE guidance, BMJ, 2013;346:f150 [doi: 10.1136/bmj.f150]
[6] R. Morriss, M. Yang, A. Chopra, R. Bentall, E. Paykel, J. Scott. Differential effects of depression and mania symptoms on social adjustment: prospective study in bipolar disorder. Bipolar Disord., **15**, 80-91, 2013
[7] P. A. Prociow, J. A. Crowe, Towards personalised ambient monitoring of mental health via mobile technologies, Technology & Health Care, **18**, 275-384, 2010
[8] V. H. Nguyen, L. Bai, Cosine Similarity Metric Learning for Face Verification, Lecture Notes in Computer Science, **6493**, 709-720, 2011
[9] J. Carr, P. Blanchfield. Engaging the Un-Engageable. *In:* Handbook of Research on Improving Learning and Motivation through Educational Games: Multidisciplinary Approaches, Ed. P. Felicia 633-657, 2011
[10] M. F. Valstar, M. Pantic. Fully Automatic Recognition of the Temporal Phases of Facial Actions, IEEE Transactions on Systems, Man, and Cybernetics-B, **42**, 28-43, 2012
[11] J. L. Martin, D. J. Clark, S. P. Morgan, J. A. Crowe, E. Murphy. A user-centred approach to requirements elicitation in medical device development: A case study from an industry perspective, Applied Ergonomics, **43**, 184-190, 2012
[12] http://www.qbtech.se/ (Accessed 28.01.13)
[13] https://www.buddyapp.co.uk/ (Accessed 28.01.13)
[14] http://www.buzz3d.com/3d_eye_tracking_index.html (Accessed 28.01.13)
[15] http://www.redembedded.com/systems/ (Accessed 28.02.13)

John Crowe is Professor of Biomedical Engineering in the Faculty of Engineering at the University of Nottingham, UK. His research is centred upon the development of novel instrumentation for monitoring physiological function, often using optical techniques, and with many of the devices constructed for use in neonatology. Recently he has begun work on the monitoring of people with mental health problems.

Treatment for Mobbing Victims by Telepsychiatric Services

M. Stojakovic[1,2], B. Stojakovic [3], S. Vukadinovic[2]
[1] Department Of Psychiatry, School Of Medicine, University Of Banjaluka, Banjaluka, Bosnia Herzegovina; misos@blic.net
[2] Clinic For Psychiatry, Clinical Center, Banjaluka, Bosnia Herzegovina;
[3] Medical Health Unit:Intermedic, Banjaluka, Bosnia-Herzegovina

Abstract: **Objective: *Mobbing* in the context of human beings means bullying of an individual by a group in any context, such as a family, school, workplace, neighborhood, or community. *Telepsychiatry,* as a branch of telemedicine, may be defined as the delivery of psychiatric treatment remotely, using live two-way video-teleconferencing equipment. In this paper, we showed the experience, application and effect of various treatment models, including consultation for mobbing victims by telepsychiatric services. Methods: Sample data included 100 examinees, in the age of 18-65 years. They have been treated in Center for telepsychiatry in virtual psychiatry ambulance for various psychiatric syndromes, all having the same denominator-mobbing, as ethiopathogenetic factor. A control group of 62 subjects of mobbing victims who were not treated. In the research, the following instruments were used: Questionnaire of socio-demographical, Telepsychiatric interview (with teleconsultation), Beck's scale for self-esteem of depression, Hamilton's scale for depression (HAM-D) and Hamilton's scale for anxiety (HAM-A). Results: Upon evaluation, it was identified that major proportion of examinees shows: Mental health and psychiatric dignosis 62 (62%) and other Diferent somatic diagnosis 35 (35%) and only 3 (3%) without any diagnosis. *From 62 (62%) Mental health and psychiatric diagnosis 46 (74,2%) is with symptoms of depression (p<0,05).* With treatment by telepsychiatry with teleconsultation 62 (62%) patients with psychiatric diagnosis after mobbing, result is 55 (88,7%) reduces consequences to mental health. Among subjects in the control group, there were 62 patients with mobbing who were not treated. A control group of 62 subjects does not reduces consequences of mental health more than 30%. (N=18). Conclusions: With consultation for mobbing victims by telepsychiatric services result is significantly reduces consequences to mental health**

for mobbing victims. These facts are best confirmed efects by treatments during this research. Analysis of results of research according to socio-demographical characteristics, time interval of mobbing exposure, used measurement instruments, diagnostic catagories and applied therapy measures, confirms the need for further research and treatment of mobbing victims.

Introduction

Mobbing in the context of human beings means bullying of an individual by a group in any context, such as a family, school, workplace, neighbourhood, or community [1].

Services for telepsychiatry (TS) and e-mental health services primarily involve videoconferencing over high speed (broadband) networks to enable natural interactions between patients and providers. The term "telepsychiatry" refers to the use of telecommunication technologies with the aim of providing psychiatric services from a d istance. [2, 3] Telepsychiatry connects patients and mental health professionals, permitting effective diagnosis, treatment, education, transfer of medical data and other activities related to mental health care. 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. Upgrading the diagnostic abilities, which include telepsychiatric service, resulting in better quality of care. Telepsychiatric consultations are provided in various out patient offices such as primary care physician offices, pediatrician offices, and mental health clinics. These services are typically scheduled on a r egular basis and include psychiatric evaluations and medication management. Telepsychiatry has a variety of sub-specialties based on different applications of service delivery. For example, *forensic telepsychiatry* is when an inmate is connected to a remote psychiatrist or nurse practitioner for psychiatric evaluations, medication consultations, suicide watch, required pre-parole evaluations and more. Forensic telepsychiatry significantly cuts down correctional facilities costs because inmates no longer need to be escorted and transported to distant off site appointments and psychiatric interventions. Common application is its use for patients in rural or under served areas. In period of 2008-2012 there were a lot of number of grassroot programs for telepsychiatry, created in the many countries to address such problems. [3-6]

Methods

Total sample data is 162 examinees, in the age of 18-65 years. 100 of tham have been treated in Center for telepsychiatry in virtual psychiatry

ambulance for various psychiatric syndromes, all having the same denominator-mobbing, as ethiopathogenetic factor. A control group of 62 subjects who were not treated.

In the research, the following instruments were used: Questionnaire of socio-demographical, Telepsychiatric interview (with teleconsultation), Beck's scale for self-esteem of depression, Hamilton's scale for depression (HAM-D) and Hamilton's scale for anxiety (HAM-A).

Statistical and Data Analyses

For statistical processing we used programs and methods by SPSS-10, GraphPad INstat-3.05 and PASW-18 statistics for Microsoft Windows.

Results

Among 186 subjects a sample of 100 adults aged 18–65 years then completed all questionnaires administered by services for telepsychiatry for this research, all having the same denominator-mobbing, as ethiopathogenetic factor. The mean age of the respondents was 33.2 (SD = 6.4) years, education 10,2±2,2 years, married 58 %, male 84 %.

Upon evaluation, it was identified that major proportion of examinees shows: Mental health and psychiatric dignosis 62 (62 %), And other Diferent somatic diagnosis 35 (35%), And only 3 (3 %) without any diagnosis. *From 62 (62%) Mental health and psychiatric diagnosis 46 (74,2%) is with symptoms of depression (p<0,05).* With treatment by telepsychiatry with teleconsultation 62 (62%) patients with psychiatric diagnosis after mobbing, result is 55 (88,7%) reduces consequences to mental health.

Among subjects in the control group, there were 62 patients with mobbing who were not treated. A control group of 62 subjects does not reduces consequences of mental health more than 30%. (N=18).

Discussion

This paper reports data from a validation study of the treatment of mobbing victims in Serbian and Bosnian population by telepsychiatric services.

The findings from the Beck's scale for self-esteem of depression, Hamilton's scale for depression (HAM-D) and Hamilton's scale for anxiety (HAM-A) showed that the Serbian and Bosnian respondents with treatment by telepsychiatry with teleconsultation 62 (62%) patients with psychiatric diagnosis after mobbing, result is 55 (88,7%) reduces consequences to mental health. Hamilton's scale for depression (HAM-D) showed statistical significance $P<0.05$ in Comparison for depression after mobbing.

Conclusion

With treatment by telepsychiatry result is significantly reduces consequences to mental health for mobbing victims. These facts are best confirmed by measurement instruments used during this research. Analysis of results of research according to socio-demographical characteristics, time interval of mobbing exposure, used measurement instruments, diagnostic catagories and applied therapy measures, confirms the need for further research and treatment of mobbing victims.

References

[1] N. Selman, M. Stojakovic, S. Selman, Mobbing and depression, 1st International Congress Era of new economy and new jobs - Stress and Mobbing , Split, Croatia.

[2] D. M. Hilty, S. L. Marks et all. Clinical and educational telepsychiatry applications: A review. Canadian Journal of Psychiatry, 49, 12-23.. 2004

[3] M. Stojakovic. Telepsychiatric service –indicator for mobbing, 1st International Congress Era of new economy and new jobs - Stress and Mobbing , Split, Croatia.

[4] D. P. Goldberg, B. Blackwell: Psychiatric illness in general practice. A detailed study using a new method of case identification. BMJ 1970, 1:439-443.

[5] M. Stojakovic, B. Stojakovic, Examination and follow-up war related posttraumatic stress disorder (PTSD) and prolonged posttraumatic stress syndrome (PTSS) by Telepsychiatry service, European Psychiatry Volume 24, numéro S1,page 1269 (2009), Doi 10.1016/S0924-9338(09)71502-0

[6] B. Graetz. Multidimensional properties of the General Health Questionnaire. Soc Psychiatry Psychiatr Epidemiol 1991, 26:132-138.

Prof Dr. 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., 1992-1997 - residency in psychiatry, Institute for mental health, Belgrade University of Belgrade, Yugoslavia. Exchange educational program in Japan 1996. (XI-XII) (O kinawa, Ryukyu University) (Department of Mental Health, Psychiatry, Faculty of Medicine, Department of Clinical Psychology) Medical faculty, University of Belgrade, specialization in forensic psychiatry. Affiliations: 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). 2006. Prof. in Department of Psychiatry, Faculty of Medicine, University B. Luka. 2011. Prof. in Department of Law medicine, Law Faculty, University B. Luka.

User Profiles of a Smartphone Application to Support Drug Adherence - Experiences from the iNephro Project

S. Becker[1,2], A. Kribben[2], S. Meister[3], C. J. Diamantidis[4], A. Mitchell[1,2]
[1]Department of Nephrology, Marienhospital Herne, University Hospital, Ruhr-University Bochum, Germany
[2] Department of Nephrology, stefan.becker@uk-essen.de, andreas.kribben@uni-due.de, anna.mitchell@uni-due.de
University Hospital Essen, Hufelandstrasse 55
45122 Essen, Germany,
[3]Fraunhofer-Institut für Software- und Systemtechnik ISST, sven.meister@isst.fraunhofer.de
Emil-Figge-Straße 91, 44227 Dortmund, Germany
[4]Division of Nephrology, cdiamantidis@medicine.umaryland.edu
University of Maryland Medical Systems, 22 S. Greene Street, Room N3W143, Baltimore, MD 21201, U.S.A.

Introduction

One of the key problems in the drug therapy of patients with chronic renal failure is drug adherence. In 2010 the initiative iNephro was launched (www.inephro.de). A "context sensitive" software to support regular and correct drug intake was developed for a smartphone platform (iOS). The present study investigates, whether and how such an application is deployed by smartphone users.

Methods

Together with cooperating partners the mobile application “medication plan” was developed. Users are able to keep and alter a list of their regular medication. A memory function supports regular intake. The application can be downloaded free of charge from the iTunes App Store. After individual consent of users from 21.10.2010 to 04.02.2012 2,042,338 actions were recorded and analyzed from the downloaded applications. In 2,279 cases, demographic data were collected with a questionnaire.

Results

Overall the application was used by 11,688 smartphone users, in 3,406/11,688 (29.1%) cases at least once a week for at least 28 days.

3,209/11,688 (29.5%) used the application at least 84 da ys. 1,554/2,279 (68.2%) of users surveyed were male, the stated age of all users was between 6-87 years (mean 44). 1,697/2,279 individuals (74.5%) declared to be suffering from cardio-vascular disease, 292/2,279 (12.8%) had a previous history of transplantation and 161/2279 (7.1%) suffered from diabetes mellitus. 1,568/2,279 (68.8%) of users were on <6 different medications, 201/2,279 (8.8%) 6 – 10 and 26/2,279 (1.1%) on more than 10.

Conclusion

A smartphone application that supports drug adherence is already regularly used by chronically ill users with a wide range of diseases over a longer period of time.

For the future one may assume that health-related mobile computing applications will increasingly play a r ole for elderly and chronically-ill users. Already a large proportion of patients with 2 or more diseases hold a cell phone [1]. In Germany more than 32% of smartphone users are older than 45 years, with an increasing trend. The young users already holding smartphones today may encounter chronic disease in the foreseeable future [2]. However, we must caveat that so far most of the hardware and also the commercially successful applications are addressed primarily towards young and healthy users. Experiences from an “Ambient Assisted Living Project”, which is dedicated to the needs of an older group of users, report that the acceptance of 7-inch tablet PC is very high [3]. Such devices are not widely established in the market yet. A decrease of associated costs may be essential for an increased acceptance of mobile computing in the future. Surely "mobile health" will not replace the doctor-patient relationship, but is very likely to enable more effective and efficient treatment and accelerate e-health strategies.

Acknowledgment

The authors thank the German Society of Nephrology for support of the initiative.

References

[1] S. Fox, K. Purcell. Chronic Disease and the Internet. Pew Internet & American Life Project. 2010;http://pewinternet.org/Reports/2010/Chronic-Disease.aspx.

[2] S. Bundesamt. Mobile Internetnutzung über das Handy 2010 stark gestiegen. 2011;https://http://www.destatis.de/DE/PresseService/Presse/Pressemitteilungen/2011/02/PD11_060_63931.html. visited November 8, 2012.

[3] M. Wojciechowski, H. Ristok, M. Brandes, B. Lange, B. Baumgarten. Architecture of the Daily Care Journal' for the support of health care networks. 2011; in: Wichert, R.; Eberhardt, B.; Verband der Elektrotechnik, Elektronik, Informationstechnik -VDE-; Bundesministerium für Bildung und Forschung -BMBF-, Deutschland: Ambient Assisted

Living. 4. AAL-Kongress 2011 : Berlin, Germany, January 25-26, 2011, Berlin: Springer, 2011 (Advanced technologies and societal change 1).

Dr. Stefan Becker is a Nephrologist and Diabetologist. He is a consultant at the Department of Nephrology, Marienhospital-Herne, University Hospital of the Ruhr – University Bochum, Germany, and Head of the iNephro-Initiative, University Hospital Essen, Germany.

eHealth for Low Resource Settings and Developing Countries

e-Health for Training Aboriginal Healthcare Workers

K. Schill [1], R.E. Scott [2]
[1]University of Calgary, Calgary, Alberta, Canada, kschill@ucalgary.ca
[2]Department of Community Health Sciences and Family Medicine & Office of Global e-Health Strategy, University of Calgary, Calgary, Alberta, Canada, rescott@ucalgary.ca

Abstract: **The Aboriginal population in Canada (First Nation, Inuit, and Métis) has significantly worse health outcomes than the non-Aboriginal population. This difference is the result of oppression and marginalization resulting in unequal access to, for example, health resources, adequate housing, and education, particularly if on reserve. Compounding this is the discord between the traditional biomedical model and Aboriginal values (more holistic) and circumstance (more rural, even remote).**

The difference in health outcomes relative to non-Aboriginal populations is also in part attributed to the lack of appropriate medical services available in rural and remote communities.

Lack of Health Human Resources in these communities has been identified as a contributing factor. Application of e-health tools could facilitate *in-situ* training of Aboriginal health care workers raising their self-worth, improving quality of life, and ensuring culturally appropriate health services for the local population. The goal of this study is to assess the potential use of e-Health (e-learning and telemedicine) to address the current health needs of Aboriginal healthcare workers.

Introduction

Current research in Canada strongly suggests a desire to provide training to First Nation peoples as, for example, Medical Office Assistants, Telehealth Coordinators, IT Support Specialists [1]. Earlier research demonstrated this for Early Childhood education [2]. However, ironically the same research shows First Nations are reluctant to leave their community, whether it be for healthcare or training [1]. In relation to training, this can be for a number of reasons, including: cost, social isolation (while away training), cultural difficulties (in 'the city'), and transportation difficulties. This alone suggests the value of virtual training.

We wished to examine the literature to determine if sufficient evidence exists for closer examination of virtual, 'in situ' distance training and learning for Aboriginal healthcare workers.

Methods

We carried out a literature search using the following electronic databases: CINAHL, ERIC, and ProQuest, plus searching on Google. Twenty-eight papers were selected for full review, based on description of some element related to the use of distance training of remotely located Aboriginal healthcare workers. As evidenced by a thesis [3], and available papers (including from Canada [4, 5]), this issue is not new. However, although some success and many lessons learnt have been achieved, there was no evidence of sustained programs.

Discussion

Canadian First Nations populations living on a reserve are at a considerable disadvantage when compared with non-aboriginal populations, with one reason being poor recruitment and retention of healthcare providers in rural and remote locations [6]. Innovative approaches have been implemented to address this [7]. Evidence suggests that healthcare providers trained in rural locations are more likely to practice there. For example, a study of Aboriginal nurses showed that after training about 40% practiced in their home communities, and that as a group they are committed to working in rural and remote locations [8]. If adequate training could be provided *in situ*, perhaps greater numbers would live and practice in those communities.

Examples

The literature shows use of distance learning (some blended learning) has been successfully applied to nurses [4], social workers [5], and radiology technicians [9], with application to Continuing Professional Education [10], but also for degree programs [11-12]. Even use of more modern tools and approaches has been attempted, including YouTube [13] and podcasting [14], and leveraging expanding telehealth networks [15-16].

Challenges

Distributed through these papers were several practical challenges and principles. In order for any form of virtual training or e-learning to occur, there must be adequate bandwidth and reliability of connectivity to access the service. Across Canada various efforts are underway to ensure connectivity of essentially all rural and remote communities, which once achieved will open opportunity not just for education, but healthcare, entertainment, social interaction, and business. Care must be exercised in terms of the content, ensuring cultural sensitivity and relevance of the

content, and to avoid inadvertent intercultural miscommunication [17]. Adequate mentoring must be available also, since whilst beneficial in many ways, in situ training requires much more commitment of the student.

Other Considerations

Beyond the education and training itself, other important issues were identified that must be considered, and include accreditation, credentialing, and certification. *Accreditation* is an administrative process that ensures a basic level of quality for the education given by training institutions (either an institution or a specific training program can be accredited). *Credentialing* is the process of identifying qualifications required to do a particular job (typically curricula are built around such guidance). *Certification* is the administrative process by which a training institution attests to an individual having successfully completed an educational course. All three have important implications for employment, and for inter-jurisdictional practice. In Canada there is no national body or process, meaning for any job training accreditation and credentialing will have to occur within each province and territory, and certification within each training institution.

Conclusion

This study is providing the opportunity to examine if there are technological and educational alternatives to involve the aboriginal community in aboriginal healthcare, particular through *in situ* training for rural and remote healthcare workers. The literature search indicates tools are available, but few have been systematically or sustainably applied for such training purposes. The next component of the study, Key Informant Interviews, will assess if there is interest in these e-learning and e-training opportunities. Combining the data sets may ultimately enable the Aboriginal community to take an active role in reforming the Canadian healthcare system to better address their needs.

References

[1] R. E. Scott (personal communication). 2013.

[2] R .E. Scott, M. Palacios. Utilisation of e-Health for Early Childhood Educators in First Nations Communities: Leveraging Telehealth Networks and e-Learning for Remote Education. NT Consulting, November 2010.

[3] S. Doshier. An evaluation of a reservation-based baccalaureate nursing program. Northern Arizona University. May 2003.

[4] Anon. Innovative Partnership Delivers Practical Nursing Program Directly To First Nation. The Aboriginal Nurse. January 2008, p13.

[5] S. Hick. Connecting aboriginal learners in remote communities: An online social work course. Journal of technology in human services. 2002;20(3-4):267-281.

[6] M. Mendelson. Improving Education on Reserves: A First Nations Education Authority Act. Ottawa Caledon Institute of Social Policy. Available at: http://www.caledoninst.org/Publications/PDF/684ENG.pdf. Accessed January, 2013.
[7] J. T. Rourke. Building the new northern Ontario rural medical school. Australian Journal of Rural Health. 2002;10(2):112-116.
[8] J. C. Kulig, N. Stewart, D. Morgan, M. E. Andrews, M. MacLeod, R. Pitblado. Aboriginal nurses: Insights from a national study. Canadian Nurse. 2008;102(4):16-20.
[9] J. Johnston. Effectiveness of Online Instruction in the Radiologic Sciences. Radiologic Technology. 2008;79(6):497-506.
[10] A. Z. Doorenbos, A. Kundu, L. H. Eaton, G. Demiris, E. A. Haozous, C. Towle, & D. Buchwald. Enhancing Access to Cancer Education for Rural Healthcare Providers via Telehealth. Journal of Cancer Education. 2011;26(4):682-686.
[11] K. Rao and C. Giuli. Reaching REMOTE Learners: Successes and Challenges for Students in an Online Graduate Degree Program in the Pacific Islands. Int Rev Res Open and Distance Learning. 2010;11(1):141-155.
[12] R. L. Stotzer. Serving Rural Communities with Distance Education Degree Programs. Journal of Technology in Human Services. 2012;30(2):109-117.
[13] A. Clifton & C. Mann. Can YouTube enhance student nurse learning? Nurse Education Today. 2011;31:311–313.
[14] S. Greenfield. Podcasting: A New Tool for Student Retention? Journal of Nursing Education. 2011;50(2):112-114.
[15] C. Towle and D. Buchwald. Enhancing Access to Cancer Education for Rural Healthcare Providers via Telehealth. J Canc Educ. 2011;26:682–686.
[16] J. M. Galloway. Pathways Into Health: health professions education for American Indian and Alaska Natives utilizing distance learning, interprofessional education, and cultural integration. Journal of Interprofessional Care. 2007; 21(S2): 3–4.
[17] C. K. Russell, D. M. Gregory, W. D. Care, and D. Hultin. Recognizing and Avoiding Intercultural Miscommunication in Distance Education: A Study of the Experiences of Canadian Faculty and Aboriginal Nursing Students. Journal of Professional Nursing. 2007;23(6): 351-361.

Integration Model Applied to Healthcare Services

L. J. R. López[1], Y. P. Vanegas[1]
[1]Nueva Granada Military University, Telemedicine Research Group - TIGUM, leonardo.ramirez@unimilitar.edu.co
Cra. 11 No. 101-80, Bogotá, Colombia

Abstract: **This case study describes an initiative undertaken by the Universidad Militar Nueva Granada (Bogotá, Colombia), in its role as an articulating agency, to create a model enabling the integration of healthcare services in a multidisciplinary, cooperative and open manner inside the Armed Forces of Colombia. In addition to acting as an articulating axis for the different services furnished by each institution, the integration model helps guide the interoperability and reutilization of such services. While carrying out this work, some generic integration models were analyzed in order to adapt them to the methods, solutions and experiences of a country waging an internal war. The first applications of the proposed model are illustrated using Electronics Clinical Records, Tele-consultation and Tele-education, to name but a few.**

Introduction

Background

The Colombian Armed Forces (FF.MM, Spanish Acronym) consist of the Army, the Navy and the Air Force. Each one of these institutions provides telemedicine services to their members. In this context, the Universidad Militar Nueva Granada (UMNG) plays the role of intermediary agency amongst them and concerning these and new healthcare services through the creation of a Telehealth Center in Cajica (Cundinamarca). This Center operates based on an integration model providing our Armed Forces with a multidisciplinary, cooperative and open environment characterized by scientific, academic and research convergence serving the healthcare sector.

The proposed model considers integration as a continuous process. It does NOT mean that everything is included in the same package or that it can compensate for the lack of resources. The integration requires the involvement of all the bodies in the Armed Forces combining preventive and corrective measures. It offers a wide range of services in just one place and efficiently usage of the resources available. The model provides for different integration levels.

Architecture Design

Due to the need of improving health services, the UMNG introduces a Telehealth Center based on a Service-Oriented Architecture (SOA), which allows for the development of flexible and interoperable services which guarantee an efficient performance on a user-friendly platform. This platform separates the interface from the internal representation of information through a Model–View–Controller. SOA further enables to adjust users' needs according to services, where each layer of the development process is independent [1].

Three-layer Development Methodology (MVC)

The interface shall allow for a dynamic interaction amongst users' requests, information being handled and its storage at the moment of establishing a process. For this purpose, a MVC model is implemented under the Clinical Document Architecture (CDA) standard. The Controller is responsible for handling user's requests initiating negotiation between the Model and the View. Figure 1 shows a user who generates several roles at the moment of interacting with the interface thus raising requests that are controlled by the Web Service connecting their services to the server. These requests are directed to the database where the required information is stored and handled [1].

Figure 1. MVC Model

SOA Architecture

The architecture integrates the HL7 standard in profile definition itself as well as the XML codification handling and data integration about the processes involving the information manager for version collection and control. The Clinical Context Management Specification (CCOW) makes part of the business "core" activities.

Integration Model Design

At the User Level

Eight actors are defined within the model: healthcare professionals, patients, teachers, researchers, students, assistants, developers and managers.

At the Data Level

Integration at the data level is accomplished through the Electronic Clinical Records which defines the following. **Definition:** Computer-based tool designed for storage, handling, collection and disclosure of medical information about patients (assessments, clinical progress, specific health condition, among others.) It consists of specific documents or images. **Domains:** *Assistance*: any medical records; *Teacher*: Sources of information for learning; *Research*: Important data source for analysis and study preparation; *Management*: Administrative with support for medical service billing and administrative management; *Legal*: Certificate of conduct and service. **Functionalities:** Healthcare information management, result processing, medical order handling, decision-making support systems, electronic communication systems and connectivity, support to patients, administrative processes, public health reporting systems, medical report issuance. **Benefits:** Accessibility and availability, multiple data visualization, communication among professionals, communication with patients, information entry, access to knowledge databases, improvement in the quality of information [2].

At the Service Level

As a first step the business processes are identified. Processes are broken down in detail, the requirements are met and the process flow is coordinated. The second step takes place by applications where functionalities within the applications are initially identified and then implemented and published in the services thus eliminating functionality redundancy [3-4].

Results

Three services are integrated as a result of the model:

Telehealth: Initial consultation deals with primary care so the physician needs to have access to the information of the patient. Regarding operative procedures, the user first has access (authentication) and uses the chat, email, contact or communication with the assistant. Moreover, the patient can make a consultation with the physician (they can in turn make further consultation using chat and/or email).

Tele-education: Service integration is provided by the Moodle platforms. Service requirements are videoconference, including forums and discussions, consultation material and updates.

Electronic Clinical Records: The Ministry of Health is responsible for "regulating the collection, transfer and disclosure of the information in the subsystem where the members of the system compulsorily converge."

Through Resolution 3374 of 2000, the Ministry of Health establishes the basic details that health service providers must issue. The HCE interface is shown in Figure 2.

Figure 2. HCE Interfaces

Beneficiaries

All the members of the Armed Forces and rural populations surrounding medical clinics.

Conclusions

The integration model implemented in the Telehealth Center implies a dynamic updating process aimed at consolidating all the services developed by each one of the institutions belonging to the Armed Forces.

The integration model for Telehealth services seeks to enhance the resources in such a manner that benefits provided to users are increased by minimizing costs paid by hospital facilities.

There are few instances in Colombia for healthcare service integration models that could match those found in European countries.

References

[1] E. Guillén, J. Ubaque, LJR López, et al. Telemedicine Network Application with SOA Architecture: A Case Study, Proc ICIMT'12, San Francisco, USA, pp 51-55, 2012.

[2] Corpus Sanchez, An Integrated Health System Review in PEI, 2008.

[3] E. Guillen, LJR López, EP Estupiñan. Security analysis for medical information management in telemedicine, Ciencia e Ingeniería Neogranadina, vol. 21-2, pp 5-9, Bogotá, 2011.

[4] L. V. Dyk, J. Fortuin and C. Schutte. A Maturity Model for Telemedicine, IARIA, pp 78-84, Spain, 2012.

Leonardo Juan Ramírez López - Chief of Division Technology Development and Innovation at the Nueva Granada Military University, Bogota - Colombia. Ph.D. 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) since 2010. IEEE member of EMBS Society since 2000. Associate Professor and leader of Telemedicine Group TIGUM-UMNG.

Yenny Paola Vanegas García - Telecommunications engineer from the Universidad Militar Nueva Granada, 2013. Research Assistant telemedicine research group of Nueva Granada Military University - TIGUM-, Bogota, Colombia. Primarily in the development of interactive applications for telemedicine. Electronics and Telecommunications Technologist at Catholic University in Bogota Colombia, 2008.

Pilot Telehealth Project Brazil-Angola: Success Factors and Perspective

M. Gaspar[1], M.B. Akmim[2], R.M. Figueira[3], A.E.S. Africano[1], B. Silva[1], H. Morais[1], L.R. Cunha[2], F.P. Rubió[4], M.O. Rocha[4]
[1]Health Services, Angolan Armed Forces, gasparchi61@yahoo.com.br
[2]University Hospital, Federal University of Minas Gerais, Brazil
beatriz@hc.ufmg.br
[3]Engineering School, Federal University of Minas Gerais, Brazil
renatominelli@ufmg.br
[4]Faculty of Medicine, Federal University of Minas Gerais, Brazil
franrubio@hotmail.com

Abstract: **The integration of two important initiatives at Federal University of Minas Gerais, the PROANGOLA Project, developed in association with the Angolan Armed Forces, and the University Hospital Telehealth Service, were the base for development of the Telehealth Pilot Project Brazil Angola. Its objective was to motivate and to demonstrate the feasibility of telehealth to improve health condition of population. To reach this objective the strategy used was to promote integrated activities between Brazilian and Angolan teams involving practical use of telehealth. As consequence a formal solicitation to implement a telehealth network in Angola was made by the Angolan Armed Forces to the University Hospital Telehealth Service.**

Introduction

Angola, one of the PALOPs (African Countries of Portuguese Official Language) participating countries, remained a Portuguese colony until the independence in 1975. The civil war was a constant from 1961 to 2002, initially against Portuguese colonial rule and after 1975 as a result of the civil war between major political parties. In April 2002, the signing of the Peace Agreement ended the war in the country. According to World Health Organization (WHO), Angola has 19,082,000 inhabitants, life expectancy of 51 years (men) and 53 (women) and probability of dying before five years old of 158 per thousand children born alive [1]. Similar to other African countries, Angola lacks skilled health labor. According to WHO ePORTUGUÊSe platform, designed to establish a network of health information on the eight Portuguese-speaking countries, many African

countries have more doctors and nurses working abroad than in their homeland [2]. A study by Clemens and Pettersson [3] shows significant exodus of African health professionals to developed countries, due to civil wars, political instability or economic stagnation. Consequently, it is necessary to promote initiatives not only to improve health service delivery but also to retain health professionals. Among them, the possibility of holding a graduate degree or to follow a continuing education program can contribute positively to the decision to remain in the country.

With these objectives in mind, in 2005 was established an Agenda for Health Cooperation between the Federal University of Minas Gerais and the Angolan Armed Forces through the so-called PROANGOLA Project [4], supported and funded by the Ministry of Health of Brazil and the Angolan government, expecting to promote restructuration of health services, human resource qualification and research.

On the other side, telehealth in Brazil and particularly in the state of Minas Gerais, reached a maturity level to be considered as a public policy by the government. Today it is incorporated into the Primary Care public health system through activities of telediagnosis and teleconsulting. The Teleassistance Network of Minas Gerais, coordinated by the Federal University Hospital of Minas Gerais (HC/UFMG), serves more than 600 municipalities in the state and held since 2006 more than 1 million electrocardiograms and 50,000 teleconsultings [5].

As result of the integration of these two initiatives, in 2011 the National Counsel of Technological and Scientific Development (CNPq) approved the Telehealth Pilot Project Brazil-Angola with the objective to promote telehealth use at the Angolan Armed Forces (FAA) health subsystem from HC/UFMG Telehealth Service experience.

Methodology

During the first year of the project, visits, meetings and presentations on telehealth promoted by PROANGOLA was used to raise awareness of senior officials and professionals from the Direction of Health Services of the General Staff of the Angolan Armed Forces to use telehealth. In 2012, the first technical mission was held in Luanda with the aim of implementing a videoconferencing system and training local staff. Tests were conducted successfully between the Army Clinic in Luanda, Angola and UFMG University Hospital in Belo Horizonte, Brazil. The second technical mission, hold in November/2012 in Huambo, had the purpose of direct awareness of managers and health professionals in the telehealth theme through practical demonstration of telecardiology in the Screening Activities for Hypertension and Diabetes, promoted by Angolan Army in

14/11/2012. The screening consisted in epidemiological work in Hypertension and Diabetes hold at five service points in Huambo to the civilian population and army personal. It included a specific questionnaire and various clinical tests, including an EKG made through telecardiology. (Fig.1) To meet the challenge of performing electrocardiograms at distance in parks and streets of Huambo and considering that the whole process had to be carried out by Angolan professionals, it was necessary to train in 24 hours cardiologists, nurses and computer technicians in the telecardiology system and to test various types of Internet connection (Fig.2). The screening results were presented during the II Forum of Chronic Diseases, scientific event held in the next day with the presence of the Angolan Armed Forces Chief of Staff. The third mission took place in December/2012 aiming to set-up a videoconferencing room for the Army Clinic in Luanda, including appropriated training to local staff. At the inauguration was held videoconference with Brazil, with the participation of senior officials of the FAA. The session went technically to perfection with high quality image and sound.

Results and Discussion

The Telehealth Pilot Project Brazil Angola accomplished his goal of raising awareness among Angolan senior managers and health professionals in relation to telehealth benefits and potential. The use of telecardiology in a real situation demonstrated to be an effective strategy.

The main results from the Angolan side were awareness and motivation of senior managers, health and IT professionals regarding the potential of using telehealth and demonstrating the ease of use at all stages of the process.

Fig 1. Service Station of Screening for Chronic Diseases in Huambo

One important result to the Brazilian team was the opportunity to have direct contact with the population, the health system and its professionals in order not only to have a real evaluation of the difficulties to implement a

telehealth system in adverse conditions, but also to confirm the enormous benefits of this technology.

The effective qualification of clinical and technical teams in telecardiology system in a short time, proved by the results obtained, proved the interactivity and simplicity of the system developed at the UFMG University Hospital. Internet connection tests enabled the local knowledge of technical difficulties and to choose the best option.

Over 1,396 citizens attended the screening and were performed 80 electrocardiograms, transmitted to the Regional Hospital and analyzed by local cardiologists. The results were expressed as the percentage of normal and abnormal examinations and pathologies found: 4% were discarded because of interferences, 67% were normal and 29% abnormal. Among the abnormalities, 36% were ventricular repolarization, 14% atrioventricular block and 11% left ventricular hypertrophy.

During the inauguration of the videoconference room, the presence of the Brazilian team, in person and at distance, was an important factor to successfully close the stage of practical demonstration of the technology and awareness in telehealth.

After all these steps, the final result was the negotiation and plans to implement a telehealth service for the health subsystem of the Angolan Armed Forces by UFMG University Hospital team.

Fig.2. Training nurses and computer technicians in telecardiology in Regional Military Hospital in Huambo

Conclusion

To attend real local needs and process/technology acceptance by users have been quoted as some of success factors in telehealth projects [5, 6]. The strategy adopted by Telehealth Pilot Project Brazil-Angola enabled to overcome these barriers by integration and practical work by the technical and clinics teams together. The main perspective is to successfully deploy a Telehealth Network in Angola with focus on teleassistance and tele-education to collaborate on the improvement of population health.

Acknowledgment

We thank the National Counsel of Technological and Scientific Development, Ministry of Health of Brazil and the Angolan Armed Forces for funding and supporting this initiative.

References

[1] Global Health Observatory/WHO, 2009. Statistics of Angola. Available in http://www.who.int/countries/ago/en/index.html.

[2] Rede ePORTUGUESe/OMS. África perde seus profissionais de saúde. Available in http://eportuguese.blogspot.com/2008/01/frica-perde-seus-profissionais-de-sade.html, 2008. Accessed in January 23th 2013. (in Portuguese)

[3] M. A. Clemens, G. Pettersson. "New data on African health professionals abroad," Hum Resour Health, vol.6:1, 2008. Available in http://www.human-resources-health.com/content/6/1/1.

[4] Projeto Pro Angola - Cooperação com Angola na área da saúde. Available in http://www.medicina.ufmg.br/mps/pesquisa.html.

[5] M. B. Alkmim et al. Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bull World Health Organ. 2012 May 1;90(5):373-8.

[6] M. B. Alkmim, A. L. P. Ribeiro, G. G. R. Carvalho, M. Pena, R. M. Figueira, M. L. B. Carvalho. Success Factors and Difficulties for Implementation of Telehealth System for Remote Villages: Minas Telecardio Project Case in Brazil. Journal of eHealth Technology and Application. 2007 Sep;5(3):197-202

Maria Beatriz Moreira Alkimim - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (UFMG, 1979), residency in Clinical Pathology, specialization course in Hospital Management and Master Degree in Health Science. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, UFMG, with more than 800 sites. Received several awards, particularly the Incentive Award in Science and Technology for Brazilian Public Health System in 2010 with the best Master Dissertation.

Lemuel Rodrigues Cunha - Graduated in Information Systems, MBA in Software Engineering and IT Governance. Coordinator in the Clinical Hospital of Federal University of Minas Gerais. Experience in Computer Science with emphasis in Computer Systems operating in the area of health and telehealth

Renato Minelli Figueira - 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 Massachussetts Institute of Technology (1983) and a MBA in Finance by UFMG (1994). Professor at the Metallurgical and Matherial Engineering Department at UFMG. Collaborates since 2007 with the University Hospital of UFMG at its Telehealth Center working on economical aspects of telehealth.

Humberto Manuel Severim De Morais - Degree in Medicine (1986), graduate in Cardiology (1996). Head of Department of Cardiology of Principal Military Hospital/Institute Superior (1999-2011), Angola. Sub director for the medical field of Principal Military Hospital/Institute Superior (2011 - to date). Author and coauthor of 60 oral communications and posters at national and international conferences, author and coauthor of 51 articles in national and international journals. Areas of interest: Heart Failure, Echocardiography, Real-time three-dimensional echocardiography, cardiovascular imaging, adult congenital heart disease, cardiovascular disease in Africa and Telemedicine.

Francisco Panadés Rubió - Graduated in Medicine in 1976 at Federal University of Minas Gerais (UFMG). Medical Residency in Radiology (1977-1978). Assistant Professor of Social Medicine FM / UFMG. Experience: Health Management; Family Medicine and Community; management and Pharmaceutical Laboratory of Public Health; Technological Development of drugs and herbal medicines; Medical Psychology, International Cooperation in healthcare (Cuba and Angola).

Sustainable 24/7 Rural Healthcare with Eco Conservation

D. Lavanian
Elect HL7 & HCit Consultant, ceo@hcitconsultant.com
No:4, 14 Exclusive, Pallod farms, Baner road, Pune 411045 Maharashtra, India

Abstract: **Provision of healthcare to the rural population in India continues to face multiple challenges. Use of Information technologies like Telemedicine and Telehealth has addressed only part of the problem. This paper puts forward an eco-friendly plan to provide low-cost, 24/7, preventive and primary healthcare in the rural environs using Tele-touch©. This primary care plan would examine, investigate, diagnose, provide medication and follow-up rural patients for 1 to 3 days at an average cost of around US$ 1.10 per patient.**

Introduction

India is the 2nd most populous country in the world with a population of 1.2 billion [1]. Of this, the rural population stands at 0.863 billion [2] (2012), which works out to 71.9% of the total population. A study has quoted that "About 60 per cent of India's rural population lives on less than Rs 35(US$ 0.64) a day" [3]. Though governmental healthcare support is available in rural areas, the rural population tends to travel to and visit private hospitals in towns nearby, because of lack of facilities in governmental health centers. WRT the government, Sub Centres (SC) are the first contact point between health workers and the village community. (National norms of population coverage: 5000 in plain area and 3000 in hilly / tribal area). The first level of contact with a medical officer occurs at a PHC (Primary Health Center). There are, as of date around 23,887 PHCs [4] to cover 0.863 billion which translates approximately to a doctor : Patient ratio of 1: 36,128. Incidentally, India's official doctor : Patient ratio is approximately 1:2000 [6]. To make things worse, many of these centers are defunct to the extent that the Supreme court had to bring up this point to the notice of the government. "*In a strong indictment of the country's rural healthcare infrastructure, the Supreme Court on Wednesday said that primary health centres (PHCs), conceived as the pillar of the system providing medical care in the countryside, had become totally defunct.*

"*In rural areas, there are no doctors. They (PHCs) are functioning only on paper. There is no facility at PHCs. Hospitals function without any doctor*," *a bench comprising Chief Justice K G Balakrishnan and Justices Ashok Bhan and P Sathasivam, said."*[5]

Innovative solutions like Telemedicine, telehealth, mobile vans and periodic camps have been and are being deployed, but fall short of providing effective around-the-clock (24/7) care. These innovations either provide face to face, health care sporadically, or provide remote advice and support, on a fixed timetable. What is desirable is an out of the box solution that could provide an acceptable quality of preventive and primary care, around the clock, to villages and small hamlets free of cost or at very low rates. The solution would also need to work without cabled power. Further, it would need to be accountable and auditable for the quality of care provided. A business plan, to run this project on private entrepreneurship, would be nice to have, as it could help replicate the solution all over India.

The Program

Essentially, complex plans and technologies are irrelevant from a patient's point of view. All he wants is quick access to reliable medicare, at times of need and to be provided trustworthy advice and medications towards a cure. Nothing else matters to him.

We therefore, spent around two years working on various aspects to put together a plan named 'Telemed-Touch©', that is based on patients needs, keeping in view local constraints and sensibilities. We now present to the reader, salient points of an innovative pilot that would prove on the ground, the capabilities of Telemed-Touch©.

Salient points:

1. The project would be run across around 100 villages covering a total population of approximately 250,000;
2. It would cover preventive and primary care and referrals for secondary and tertiary care;
3. It would provide for examination, triage, provisional diagnosis, care instructions, clinical advice, medications and follow up of patients;
4. Each Medicare center (MCC) would be accessible 24 hours a day;
5. Clinical data would be collated and available in near-real-time for analysis;
6. The above data would be used, in future phases, for geographical disease forecast and clinical decision support;
7. The MCC would also support the government during natural disasters and for broadcast of instructions;
8. The center would run on solar power and create jobs locally;

9. Healthcare IT applications would use subsets of internationally accepted vocabularies and standards and be HL7 compliant, to ensure interoperability;
10. The program would be cost-conscious and could run either on governmental support, or as a commercial, for-profit model.

Program Details

Telemed-Touch© is a unique program that is a symbiosis of the healthcare person's caring touch and cutting edge healthcare technology. It is a new paradigm that utilizes force multiplier strategies to create a hybrid healthcare model to ensure:

- 24/7 availability of quality healthcare;
- End-to-end ownership with accountability and
- Aa judicious mix of revenue generators to ensure excitement for private equity and partners.

How it works: Men/ women would be carefully selected from each village, trained and placed on duty to provide support to patients visiting them at any time. We call them DEvTAs (Doctor validated and trained assistants). They would be provided with the RMedpacs©, a package that would contain low cost diagnostic instruments, training documentation, IT devices, solar power generator(s) and medication. DEvTAs would be trained to enquire for symptoms, test for clinical signs like icterus, pallor,

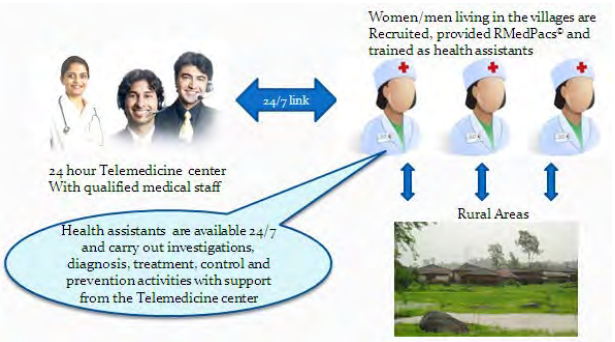


Fig. 1: Telemed-Touch©

abdominal tenderness, dehydration, etc and measure respiratory rate, pulse BP, etc.

The mode of communications would be a low cost camera mobile phone/tablet which would run on 2G connectivity. App(s) placed in the device would permit transfer of the patient complaints, vitals and clinical data to a central telemedicine advisory center. Each patient would be given

an Unique ID and the DEvTA would be paid an incentive for each patient seen.

A telemedicine call center would be set up at a central city, with requisite triage, EMR, and related applications. This center would be manned 24/7 by call takers, nurses and clinicians. DEvTAs would call up this center and interact with the patient on behalf of the medical staff. He would essentially be the eyes, ears and hands of the remote medical staff. Based on these findings and interactions, the patient would be triaged (fig.1) followed by provision of advice and care. The patient would, where relevant, be given 1 to 3 days of medication (oral bioactive generics) (as per need) and asked to return for a review. On review, if the patient is found to have recovered, the case would be closed. In case the patient requires care in a hospital, he would be advised so and given medication to support him during transit. The patient would be charged, for the complete cycle of care (not exceeding 3 days) a rate averaging Rs 60 (US$ 1.10) per episode.

Expected Results and Present Status

The pilot is expected to run for 2 years during which mid course changes could be made, if found necessary, for improving the program. Based on the results the proposal is to expand to 500 then 5,000 villages over 5 years by which time the program would become self sustaining and profitable. Detailed plans and commercials for the pilot are ready, awaiting funds from any national or international donor agency.

References

[1] http://populationcommission.nic.in/facts1.htm

[2]http://indiawater.gov.in/imisreports/Reports/BasicInformation/rpt_RWS_RuralPopulation_S.aspx?Rep=0&RP=Y

[3] http://timesofindia.indiatimes.com/business/india-business/60-per-cent-of-Indias-rural-population-lives-on-less-than-Rs-35-a-day/articleshow/12981727.cms

[4] http://www.data.gov.in/access-point-download-count?url=http://www.data.gov.in/system%2Ffiles%2FNumber_Of_SCs_PHCs_CHCs_During_Five_Year_Plans-1.xls&nid=4665

[5] http://articles.timesofindia.indiatimes.com/2008-10-02/india/27941854_1_phcs-rural-healthcare-health-ministry

[6] http://pib.nic.in/newsite/PrintRelease.aspx?relid=77859

Dr Lavanian Dorairaj MBBS, MD (AM), is a HL7 certified clinician with 30 years of expertise in Healthcare and Healthcare Informatics. He presently heads HCit Consultant (www.hcitconsultant.com), an entity that provides consultancy, training, and implementation in Healthcare IT. He is the Chair-Elect HL7-India and Joint Secretary, Indian Association for Medical Informatics (IAMI).

He has led projects involving various Healthcare IT companies, from across the globe, to put together complex healthcare IT projects using 'best of breeds' solutions, drawing on the individual skill-sets of these companies. He has, in the past, served in the Indian Air Force as the Deputy Director, Medical Services, and has held the position of Vice President at the Apollo Telemedicine Networking Foundation, Apollo Healthstreet, Axsys Healthtech and Bilcare Research.

The Medical ICT Utilization for Perinatal Telemedicine in Remote Areas

Y. Ogata[1], K. Hara[2]
[1]Mitla Co., yhuko@mitla.co.jp
Hayashi 2217-15-406, Takamatsu, Kagawa, 761-0301, Japan
[2] Kagawa University Setouchi-region Research Center,
hara@med.kagawa-u.ac.jp
Hayashi 2217-16-2C, Takamatsu, Kagawa, 761-0301, Japan

Abstract: **As the shortage of obstetricians becomes a serious problem, we have been introducing the perinatal telemedicine system to areas which no longer have doctors. The system ensures the health of pregnant women and a safe delivery by enabling midwives in rural areas and medical specialists far away to share the same patient data during her perinatal period. The system consists of a perinatal electronic medical record, a Mobile CTG Monitor, and a TV conference system, with which doctors, midwives, and patients can communicate by sharing the patient's data. Lately in Iwate Prefecture, the system has become a unified system of perinatal care evolving into "Ihatov", a mechanism where the entire province, municipalities, and hospitals within the prefecture come together to protect the pregnant women. We have been able to solve similar problems nationwide and in Thailand. Our goal is to practically implement our system not only in Japan but in other countries as well.**

Introduction

Today in Japan, we are facing the following problems:

- Decreasing birthrate and aging population;
- Inter-regional discrepancy;
- Decreasing number of obstetricians and gynecologists.

Shortage of doctors is a serious problem in some of the regions of Japan, like Tono city of Iwate prefecture. To provide better perinatal health care, we need a regional medical liaison utilizing IT, such as telemedicine. Kagawa's initiative in regional medical liaison has caught the attention of not only other prefectures in Japan but other countries as well. Tono City is one of the successful cases in which we implemented our model. We have

introduced the electronic medical records for the perinatal care to other regions of Japan as well as overseas.

Background and Issues

The medical IT system being triggered by Kagawa prefecture is the project of the perinatal electronic medical records network in 1998. Recently, Kagawa prefecture is known for K-mix which is a remote diagnostic imaging system. Mitla has developed a perinatal electronic medical record named Hello Baby Program. Meanwhile, the number of obstetricians and gynecologists has deceased in years between 1984 and 2006. This has caused many problems to some of the regions of Japan, especially in Tono city. There are no obstetricians in Tono city, Iwate Prefecture. Pregnant women need a prenatal checkup once a month or more frequently. To meet the need for this checkup, a medical center called Net Yurikago was built in 2007 [2]. At this facility, pregnant women can receive regular checkups provided by midwives. If a patient has any worries or concerns she can talk to a doctor via the internet

Telemedicine System Configuration

There are 2 servers used at the data center. The hospital and midwives center are equipped with a PC and a cell phone. At the maternity center, a Mobile CTG Monitor ("CTG") is also used [1]. Mitla monitors the system daily so that no problems occur. A picture of the CTG is shown below (Fig.1). As shown in the picture, the monitor is small, very light, and user-friendly. The data taken using the CTG is sent to the doctor's cell phone and computer. The graphs show the baby's heart rate and the mother's contractions in the display. The doctor can access the patient's monitored data through the Hello Baby program (Fig.2). The midwife in the maternity center sees the pregnant woman and inputs checkup data in to the Hello Baby program. Doctors can monitor the patient's data during the whole perinatal period of 10 months.

Fig.1 Mobile CTG Monitor

Fig.2 Typical Display of Hello

Baby Program

How to Operate the Telemedicine System

The patient uses the CTG system at home. The system gathers data of the baby's heart rate and the mother's contractions and sends it to the midwives, which is then sent to the hospital where the doctors can see the gathered data [3]. This system is very convenient because both the midwife and the doctor can share the data. The doctor can see all the data at a touch of a button. This also caught the eyes of doctors in the United States and the New York Times wrote an article on this.

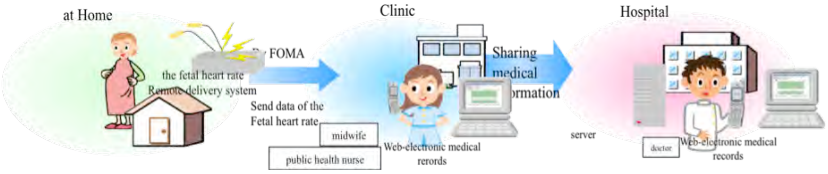


Fig.3 Network of Perinatal Telemedicine

Application and Development

Babies who use this system will have their lives monitored to the end of their lives. In addition, Tono city staff members believe that it is important to measure and confirm health data for all of its citizens. This can be accomplished if the system is used for a child. The mother inputs her child's data once a week into the MCH Handbook system until the child graduates high school.

Ihatov

Japan consists of 47 prefectures, and in Iwate Prefecture, there are 35 municipalities in total. Iwate represents a typical population with 1.31 million people, 11 central hospitals, and 10 000 pregnant women per year. With Ihatov, pregnant women can see their health data at any hospital within Iwate, thus they are able to receive good regional care. After the Great East Japan Earthquake, it was found out that among the three prefectures hit by the earthquake, Iwate had the lowest number of anxious pregnant women and was noted as a reliable prefecture. Ihatov has developed as a network for doctors and midwives to share data, connecting municipalities and homes, and strengthening the relationship between hospitals and municipalities.

Phisanulok, Thai

In 2011, in collaboration with Telephone Organization of Thailand, Naresuan University (Thailand), and Basic Human Needs Association, we launched a Thai-Japan collaborative pilot project which was granted by APT for its ICT Development Program funding. In May 2012, as part of this project, we provided two CTGs to be used at two rural hospitals. The local IT team in Phitsanulok developed a Health Information System which can be accessed by the doctors of each hospital. In case a doctor at either Charttrakarn or Ban-Klang needs to consult a doctor at Buddhchinaraj Hospital, what they have to do is just access the Health Information System and discuss over net-conference. For patients who need close monitoring, we can register an email of the doctor at Buddhchinaraj Hospital so that every time the patient gets measured 130 kilometers away, the doctor will know the results and how the patient is doing in real time.

Summary

The data gathered using the perinatal telemedicine system would be utilized for the health management of pregnant residents. The need for a network linking hospitals, clinics, maternity center, and homes is expected to increase more and more. There is also a great need for data integration technology to develop perinatal care. IT technology and smart phones are expected to evolve more in the future to meet such needs.

Acknowledgment

We would express our thanks to Dr. Toshihiro Ogasawara, Hospital Director of Ohfunato Prefectural Hospital in Iwate Prefecture and Tono city staff.

References

[1] Kazuhiro Hara. “CTGs at home and the CTG transmission system,” Shusanki Igaku, 39(4), pp. 423-430, 2009 (in Japanese), published.

[2] Toshihiro Ogasawara. “Perinatal Telemedicine System can save the collapsed regional medical care – Our project in Iwate,” Gekkan Shiniryo, 35(6), pp. 173-176, 2008 (in Japanese), published.

[3] Kazuhiro Hara, Hideto Yokoi, Toshihiro Ogasawara, Makoto Suzuki, Masao Nakabayashi. “Reconstructing the Perinatal Care System, Applying IT to Perinatal Care,” Sanfujinka no Jissai, 58(6), pp. 897-909, 2009 (in Japanese), published.

	Yhuko Ogata.Yuko Ogata studied in Doctor's course of Department of Nuclear Engineering, Graduate School of Engineering, at Kyoto University. In 2002, she established Medical IT Laboratory Co. ("MITLA"), and became the CEO. Since FY2006, the company has participated in various projects implemented by METI, Ministry of Internal Affairs and Communications, Ministry of Health, Labour and Welfare, and local governments. She has been active as a special zone committee member of "Planning for Relieved Town by Utilizing K-MIX since 2011.
	Professor Hara. Dr. Hara graduated from The University of Tokyo Medical School in 1970 majoring in obstetrics and gynecology. He developed the fetal monitor and ultrasound diagnostic equipment, and then clinically applied them. In 2000 he worked as a professor in the Medical Information Department at the Kagawa Medical University Hospital, in 2003, a Medical Informatics Professor at Kagawa Medical Hospital and in 2009 an Emeritus Professor at Kagawa University. Also he is the President of Japanese Telemedicine and Telecare Association, a specially appointed professor at Kagawa University, and a professor at Tokushima Bunri University Department of Clinical Science.

eHealth in Emergency Care

An Android-Enabled Mobile Framework for Accessing Holistic Emergency Medical Services on the Cloud

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 an Emergency Medical Services (EMS) system in a cloud environment that is accessible by Android- enabled mobile devices. The proposed EMS system focuses on providing ubiquitous access to integrated patient information (both health and social) stored and exchanged during an EMS workflow execution to authorized EMS actors, through familiar environments such as Google's Android.**

Introduction

Emergency medical services are concerned with the provision of pre-hospital and in-hospital emergency care and their operations typically involve a wide range of interdependent and distributed activities, performed by cooperating individuals (administrative, paramedical, nursing and medical) who differ on levels of background, skill, knowledge and status. A holistic approach to emergency care requires coupling among multiple health and social care organizations (e.g. EMS agencies, hospitals, non-governmental organizations, social care institutions) and blending emergency and social care activities to address all aspects of patient care needs. Conceptually, these activities can be interconnected to form socially-enhanced emergency healthcare processes within and between the participating organizations (i.e. ambulance agencies and hospitals), thus comprising a virtual holistic emergency healthcare enterprise [1, 2].

The development of an EMS system as a cloud computing application which interfaces with a PHR and can be accessed by almost any device enables immediate access to critical health and social care information concerning an emergency case either by authorized ambulance center personnel on site of incident and during patient transfer to a hospital or by emergency department personnel to ensure that the treatment provided is the safest and most effective choice for the patient [2-4].

Moreover, the utilization of standard workflow technology such as Business Process Execution Language (BPEL) in the context of Service Oriented Architecture provides an appropriate technological infrastructure for defining and automating EMS processes that span organizational boundaries so that to create and empower collaboration and coordination among the participating organizations. Thus, through process automation and the use of web services in the context of a mobile cloud application, ambulance service and hospital emergency departments can automate their operations by making information available where and when needed and by providing an infrastructure for the integration of pre-hospital and in-hospital emergency healthcare. The prototype implementation of this approach, namely NefeliEMS, is accessible by either a web portal, namely NefeliPortal, or an Android client application, NefeliMobile, depending on the device used.

Motivating Scenario

In an EMS process where the ambulance service and a hospital emergency department are involved, the following user roles are identified:

Ambulance communication operators - Ambulance communication operators are located in the ambulance center premises and use an EMS application to write into a PHR system emergency case data which is provided by either the patient or another person and to pass this data to ambulance personnel.

Ambulance service physician - Ambulance service physicians are usually located in the ambulance center premises and use an EMS application to read from and write into a PHR system relevant health/social care data of their current patients so that to give appropriate medical instructions to ambulance paramedics, regarding en route treatment, that are also recorded.

Ambulance paramedics - Ambulance paramedics use an EMS application, via a smart handheld device, to read authorized portions of health/social care data from a PHR system and write data regarding the paramedic activities performed on the patient at the site of incident and en route.

Emergency department physician - Emergency department physicians use an EMS application to read from and write into a PHR system relevant health/social care data of their current patients.

Emergency department nurse - Emergency department nurses use an EMS application to read authorized portions of patient data from a PHR system, to write a nursing assessment of patient's condition (triage) and to write data of the nursing activities performed on the patient.

System Architecture

Figure 1 shows a high-level architectural view of the prototype NefeliEMS cloud computing environment which adheres to the hybrid cloud deployment model [5]. In particular, the NefeliEMS hybrid cloud is a composition of the community and the public cloud which together constitute unique entities that are bound together by Hyper Text Transfer Protocol Secure (HTTPS).

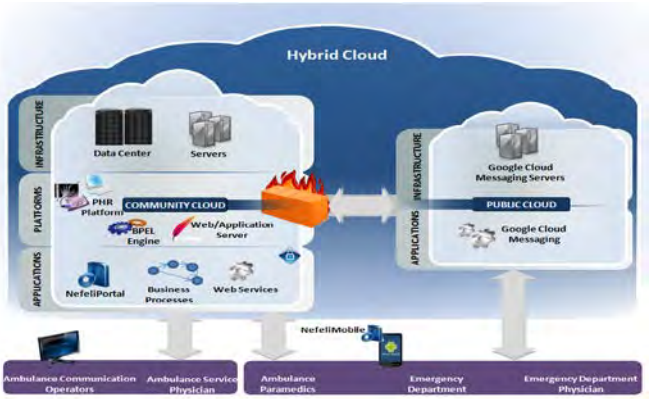


Figure 1. High-Level System Architecture

The community cloud operates behind a firewall and delivers a number of services (platforms and software) to organizationally disparate and geographically dispersed healthcare providers. In broad terms, the platforms and applications delivered as services over the Internet and the hardware and systems software in the data centers that provide those services in the context of the community cloud are the following: 1) *NefeliEMS Infrastructure:* With regard to the infrastructure, NefeliEMS utilizes a cloud data center. It is essentially an off-site cloud storage system comprising a number of servers (storage servers and a master control server) where both PHR and emergency medical data are being stored, 2) *NefeliEMS Platform:* The platforms which are delivered as services in the context of NefeliEMS cloud computing environment are used for the development, deployment and hosting of the several components comprising it. In particular: a) BPEL Engine: All BPEL-based processes involved in emergency case management are deployed on the BPEL engine, which handles their execution, b) PHR Platform: The PHR platform is provided to authorize users on demand. Its architecture is based on the fundamental assumptions that the complete pa-

tient records are centrally stored and that each patient retains authority over access to any portion of his/her record and c) Web/Application Server: It provides, among others, the hosting environment to the web-based Graphic User Interface (GUIs) of the PHR Platform, the BPEL Engine hosting the EMS processes pertaining to emergency case management, and the web services developed in the context of the NefeliEMS, and 3) *NefeliEMS Software:* In the context of NefeliEMS, a number of processes have been defined which pertain to emergency case management and span organizational boundaries. EMS BPEL processes can be accessed by authorized personnel of the ambulance service and the emergency department. Users who are authorized to access the whole or parts of an EMS process for a patient are also authorized to access certain portions of the PHR of this patient. To this end, relevant web services have been developed, the PHR web services.

Conclusions

This paper presents a PHR-based EMS in a cloud computing environment and places special focus on an Android application, namely NefeliMobile, which provides mobile access to the proposed EMS. The information delivery model incorporated in NefeliMobile adheres to the push messaging model and thus time-critical data which must receive immediate attention are provided to ambulance center personnel and emergency department physicians in a way that enables them to devote more time on practicing medicine while alleviating problems related to the use of their mobile devices (e.g. low bandwidth, limited battery life).

References

[1] M. Poulymenopoulou, F. Malamateniou, and G. Vassilacopoulos: 'E-EPR: A workflow-based electronic emergency patient record to support holistic care management', Personal and Ubiquitous Computing, pp.1-10, November 25, 2012.

[2] M. Poulymenopoulou, F. Malamateniou, and G. Vassilacopoulos, "Emergency healthcare process automation using mobile computing and cloud services," Journal of Medical Systems, vol. 36, pp. 3233–3241, 2012.

[3] A. Rosenthal, P. Mork, M. H. Li, J. Stanford, D. Koester, and P. Reynolds, "Cloud computing: A new business paradigm for biomedical information sharing," Journal of Biomedical Informatics, vol. 43, no. 2, pp. 342 – 353, 2010.

[4] C. Doukas, T. Pliakas, and I. Maglogiannis, "Mobile healthcare information management utilizing Cloud Computing and Android OS," in Engineering in Medicine and Biology Society (EMBC), 2010 Annual International Conference of the IEEE, 2010, pp. 1037–1040.

[5] R. Buyya, C. S. Yeo, S. Venugopal, J. Broberg, and I. Brandic, "Cloud computing and emerging it platforms: Vision, hype, and reality for delivering computing as the 5th utility," Future Gener. Comput. Syst., vol. 25, no. 6, pp. 599–616, Jun. 2009.

Ms Vassiliki Koufi received her B.Sc. in Informatics from the University of Piraeus, her M.Sc. in Data Communication Systems from Brunel University, UK. and her Ph.D in the Department of Digital Systems at the University of Piraeus. Currently, she is a postdoctoral researcher in the Department of Digital Systems at the University of Piraeus. 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 Associate 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.

Prof. 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.

Determination of the Relevant First Aiders within a Volunteer Notification System

J. Elsner, M.-T. Schneiders, D. Schilberg, S. Jeschke
Institute of Information Management in Mechanical Engineering of RWTH Aachen University, Dennewartstraße 27, 52068 Aachen, Germany
{jesko.elsner; marie.schneiders; daniel.schilberg; sabina.jeschke}
@ima-zlw-ifu.rwth-aachen.de

Abstract: **During a Sudden Cardiac Arrest (SCA), an untreated time interval of only a few minutes usually means the victims' death. While professional emergency medical services (EMS) are working on shortening the time needed for arriving on scene, there are parameters that limit potential performance increases regarding this topic; e.g. current traffic, the travel distance and the delay between an incoming emergency call and the march out of the professional helpers. Given this premise, it is necessary to find alternative ways for providing immediate first aid treatment to victims suffering SCA. One approach is the implementation of a Volunteer Notification System (VNS) – integrating laypersons and medically trained volunteers into the EMS, by notifying those potential helpers who are, at the time of incident, close to the scene. Whereas the term "close" is suitable for describing the general concept of a VNS, a social valuable system implementation requires an algorithm that analyses and determines which volunteers are to be alarmed. False or unnecessary notifications might have a negative effect on the user acceptance or system performance, whereas not alarming potential helpers who are actually close enough can greatly decrease the system's value. While the actual distance is an important parameter to be considered, it does not necessarily determine the time of arrival at the scene. Due to possible obstacles, the beeline calculation obviously does not offer a suitable background for estimating the traveling time; but even considering up-to-date roadmap material in order to calculate the shortest way does not provide sufficient information without some assumptions. Thus, the type of movement, the physical performance of a volunteer and the traffic situation directly influence those calculations. Furthermore, limiting the relevant decision parameters to merely distance seems inadequate and secondary criteria apply; e.g. medical expertise, knowledge of the area or general engagement. In addition to giving a brief overview to**

the "EMuRgency" project, this paper will introduce the main criteria for determining the relevant volunteers within an ongoing emergency scenario.

Introduction

The Sudden Cardiac Arrest (SCA) is a medical condition that demands immediate treatment of the victims. Only a few minutes without treatment usually mean the victims' death; Jan Bahr states that an untreated time interval of only three minutes is most likely enough for victims of SCA to suffer permanent brain damage, whereas Karin Grassl describes within her dissertation that the chances of survival after five minutes without treatment are practically zero [1, 3]. Even in highly developed regions, e.g. Bavaria in Germany, emergency medical services (EMS) need in average about seven minutes to arrive on scene [2]; as a possible solution for this problem, the research project "EMuRgency" is implementing a volunteer notification system in order to gap the untreated time interval by involving laypersons and medically trained volunteers into the chain of action of an ongoing emergency [4]. The general idea is to notify and guide those potential helpers, who are at the time of the incoming emergency call, close enough to the case of incident to provide Cardiopulmonary Resuscitation (CPR) to the victim and therefor gap the time until the professional EMS arrive on scene. The different parameters and the decision process, determining which volunteers are to be alarmed, are introduced within this paper.

Methodology

The actual decision process is influenced by different criteria and a variety of available data on each potential volunteer; this data is either statically available or dynamically collected within the system and then taken into consideration, using the criteria, in order to create a set of results. The following three categories represent the different types of data available within a volunteer notification system.

The first category of data is requested during the actual registration of a new volunteer; the medical competence level, the contact data and personal details like the birthdate are some examples. This data represents a static layer of information; the content of this information is unlikely to change and potential changes are generally not requested by the system but instead triggered by the volunteer – e.g. supplying new certificates of medical training or changing the address.

The second category of data is characterized by dynamic data and actively collected by the system. The actual location of a volunteer, represented by a combination of latitude, longitude and altitude, or an available acceleration index on a mobile client, are some examples for frequently changing data that is frequently published to the system.

The third category is represented by data that is generated by the system itself; while the process of generating and the underlying system logic is not yet fully defined, the general approach is to process the data from category one and two by using methods and concepts of artificial intelligence (AI) or data mining in order to create new datasets. The creation of abstracted behavior patterns or route approximations based on available historical location values of an individual volunteer, are two examples.

As shown in Fig. 1, the three identified types of data are building the input base for the actual decision system, whereas the final output will be the list of volunteers to be considered. With the input data identified and the result specification defined, the actual decision process is going to be discussed now.

Decision System

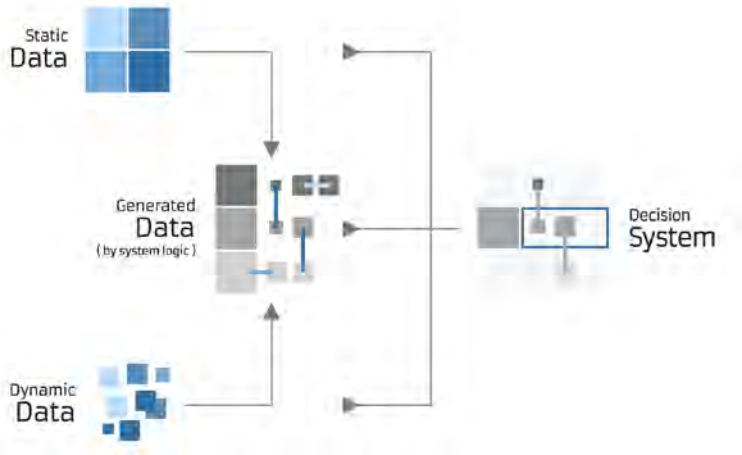


Figure 1: Types of data within a VNS

The term decision implies the choice between different options, which have to fulfill specific criteria in order to be considered. With different

types of data available, a decision has to evaluate the relative importance of each of them [5]; this evaluation must not be constant but instead occur frequently, adjusting over time, depending on some kind of measurement for the quality of past decisions. Whereas the basic data (static and/or dynamic) will result in a first set of possible volunteers within the decision process, an additional set of volunteers will be selected when processing the generated data and invoking the implemented system AI. Without discussing in detail the requirements of mathematical decision optimization and artificial learning, an AI based approach on volunteer determination will therefor provide an enriched set of possible helpers. The exact composition of the final list is again matter of logic and must not be predetermined, meaning that the decision system will adjust the ratio of assumed candidates and those, determined by "facts", over time, depending on the mathematical quality of the systems' past decisions.

Conclusion and Outlook

In order to determine the relevant volunteers in an ongoing emergency, a variety of data needs to be considered. This data can be clustered into different categories, depending on its more static or dynamic nature. Available data is furthermore processed by system logic in order to generate new data and enable history based assumptions and different concepts of AI. Whereas this paper has introduced the main concept and idea of an AI driven decision system for determining the relevant volunteers within a VNS, the actual development and implementation is part of the current research focus within the "EMuRgency" project and will be addresses in future publications.

Acknowledgment

This paper is based on work done within the INTERREG IVa project EMuRgency (www.emurgency.eu). The project is partially financed through the European Regional Development Fund (ERDF) and co-financed by several regions of the Meuse-Rhine Euroregion and partners of the EMuRgency consortium.

References

[1] J. Bahr. Lay resuscitation in the German rescue system. Some basic information, In: Notfall Rett.Med, Volume 10, Number 3, pp 197-200, doi:10.1007/s10049-007-0910-y, 2007

[2] Studie des Instituts für Notfallmedizin und Medizinmanagement (INM) - Klinikum der Universität München, Untersuchung zum Notarztdienst und arztbegleitenden Patiententransport in Bayern, April 2010

[3] K. Grassl. Herzdruckmassage im Rahmen der Laienreanimation: Einsatz eines audiovisuellen Echtzeit-Rückmeldesystems, Dissertation, LMU München: Faculty of Medicine, 2009
[4] J. Elsner et al. An Introduction to a Transnational Volunteer Notification System Providing Cardiopulmonary Resuscitation for Victims Suffering a Sudden Cardiac Arrest, In: Proceedings of eTELEMED 2013, Nice, France, (in press)
[5] M. Hutter. Universal Artificial Intelligence - Sequential Decisions based on Algorithmic Probability, Springer, 2005.

Mr. Elsner studied Computer Science at the California State University Fullerton and afterwards Business Informatics at the University of Paderborn. He worked in the field of complex IT-systems before becoming a scientific researcher and PHD student at the Institute of Information Management in Mechanical Engineering (IMA) of RWTH Aachen University. Mr. Elsner acts as system developer in the research project TemRas and is technical leader of the euregio project EMuRgency.

Four Existing Emergency Medical Dispatch Centres Working as one Virtual Emergency Operation Centre (VEOC)

O. Eielsen[1], B. Nordboe[2]
[1]The Regional Centre of Medical Research and Development
Stavanger University Hospital, eiol@sus.no
Box 1800, 4068 Stavanger, Norway
[2]Regional Medical Dispatch Centre, Stavanger University Hospital,
nobr@sus.no, Box 8100, 4068 Stavanger, Norway

Abstract: **The terrorist attacks on 22 July 2011 in Norway demonstrated that the capacity of the Medical Emergency Dispatch system was insufficient. A new project called: "Four existing EMCCs working as one Virtual Emergency Operation Center (VEOC)" will increase the capacity of the medical dispatch system by using modern ICT. Project: Study the factors necessary to establish a single virtual EMCC in the western region of Norway incorporating the four existing EMCCs. The vision for the EOC in Stavanger, Haugesund, Bergen and Foerde are four Centers working as one.**

Introduction

Norway is one of the three Scandinavian countries in the Northern part of Europe. Mainland Norway covers 385,000 square kilometers [1], but because of all the famous fjords and mountains, and with a small population of 4.9 million, the population density is as low as 14 per km2. Norway is therefore one of the least populated countries in Europe.

Health Care Services is run by the Government through four Regional Health Authorities (Hospitals and Specialist Care) and the Local Municipalities (Primary Health Care) [2].

The official goal for the Norwegian Health Care system is to give each patient the proper treatment – at the right place and right time, regardless where the patient is located. This is a challenge in a country with sparse settlements and land distances to hospitals. To compensate for this, Norway has a well-developed ground and air ambulance service throughout the country. The services are run as a part of the public health care system. All services are available on a 24H basis. The ambulance service is based on close collaboration with the local primary care physicians and physician manned RW air ambulances.

The Norwegian Medical Dispatch System is a national medical, organizational, and technical system handling all medical emergency calls whether routed directly into one of the 19 large hospital-based dispatch centers. All calls using the national medical emergency telephone number 1-1-3 are automatically routed to the nearest hospital-based dispatch center. This system secures an easy and immediate excess to an advanced and well-equipped EMS-system, and on average and in ordinary situations, each patient receives proper medical treatment of high quality [3].

Norway is situated in a quiet corner of the world, and has been ranked the best country to live in by the United Nations Development Programme (UNDP) several times during the past decade [4]. The country has a low level of crime and had not experienced any incidents of terrorism until 22 July 2011.

Background

On 22 July 2011 a lone political extremist bombed the government center in the capital (Oslo), killing 8 people and wounded approximately 200 people in the nearby streets [5]. The explosion from this bomb turned the quiet and tidy Scandinavian capital into a scene reminiscent of terrorist attacks in Kabul or Baghdad, horrific scenery of wounded and panicking innocent people and blowing out windows of several government buildings. Immediately thereafter, the terrorist headed for an island called Utøya, where a summer camp for young members of the governing Labor Party was in session. When the terrorist arrived at Utøya, there were about 700 youths trapped on the island. He immediately started to search for the people there and killing as he went along, sparing no one. Terrified youths jumped into the water to escape and started to swim in panic, though the island is far from the mainland. After shooting people on the island, he started shooting people in the water. He stopped the shooting when he had killed 69 and wounded 58 innocent young people [5].

During these two horrible terrorist actions, both in the city center and on Utøya Island, hundreds of emergency calls did not get through to emergency dispatch centers (police 112, fire 110, and ambulance/hospital 113). This significantly increased the true feeling of panic and fear among everyone who did not got any answer.

The Norwegian Government gave an independent commission the mandate to review and learn from the terrorist attacks on the Government Complex in Oslo and on Utøya Island on 22 July 2011. In addition to this commission, the Norwegian Ministry of Health commissioned the Directorate of Health to conduct a thorough review of the health sector's response to the terrorist attacks on 22 July 2011.

A most important conclusion in the report from the 22 July 2011 Commission is: “More sophisticated use of ICT has a substantial potential for improving efficiency and quality throughout the full range of the work done by the justice sector, ….This is a key to better emergency preparedness in future” [5].

One of the conclusions in the report from Directorate of Health is that EMCCs must have the capacity to handle all 113 calls for emergency medical assistance independent of the load factor, and further:

“The majority of Norway’s 19 EMCCs do not have the option of relieving each other in response to major incidents or of making use of each other’s expertise and capacity because their EMCCs cannot ‘see’ each other’s dispatch screens.

The EMCCs are at present independent entities with limited options for interoperability in situations where an EMCC is faced with an extraordinary volume of 113 calls.

There are few satisfactory solutions to deal with EMCC downtime or redundancy” [6].

As a consequence of these important conclusions, The Western Norway Regional Health Authority, (WNRHA) has initiated a project with the project title: “Four existing EMCCs working as one” [7].

Project Report

Virtual Emergency Medical Coordination Centre (VMECC)

The WNRHA has overall responsibility for providing services in the provinces of Rogaland, Hordaland, and Sogn og Fjordane. Its role is to ensure that the inhabitants of the region have access to the services they need and are legally entitled to.

The Western Norway Regional Health Authority is also responsible for emergency medical dispatch service in the region. In line with EU requirements, 112 is the emergency telephone number in Norway, routed to the police dispatch centers. In addition, the public has direct access to fire departments by calling 110, to hospitals and other emergency medical services, such as ground and air ambulance services, and the local doctor on call by calling 113.

Within the western region of Norway there are four Emergency Medical Communication Centers (EMCCs), one within each local health trust. The total population in the region is one million. The EMCCs are located at hospitals providing emergency care. The medical emergency calls are handled by health personnel (nurses or authorized ambulance officers).

The current situation: Due to the relatively low density population and normally low numbers of emergency calls, the ordinary each EMCC is staffed by 1-2 nurses and 1-2 ambulance coordinators.

The current services are well aligned in their handling of individual patients. Under normal conditions the capacity balances the workload. But in situations with an extraordinary volume of 113 calls, the workload in the local EMCC has limited capacity and will not have the capacity to answer all 113 calls. In several cases this has proven to be a serious weakness. In addition, at present, the physical loss of an EMCC will lead to calls not being attended to, leading to severe risk to health and life.

For larger events, there is a need for central management of combined resources. This can and will occasionally exceed the capacity of a single center, or also called “stand alone operation center”. A famous example of the limitation of stand-alone solution happened in New York on September 11. The N.Y. City Office of Emergency Management lost its state-of-the-art emergency operations center (EOC) when the World Trade Center 7 collapsed. The EOC which was situated across the street from Tower 7 caught fire and collapsed. As a result, the EOC was unusable just when it was needed the most [8].

The traditional way to increase the capacity for a dispatch center is to establish a robust big regional or national operations center. But in the situation of a physical loss of an EMCC, the result is the loss of service for

Fig 1 Western part of Norway Existing four EMCC

Fig. 2 Four existing EMCC working as one Virtual Emergency Operation Centre (VEOC)

a whole region. Another and potentially significant disadvantage is less local knowledge among the operators serving a big area or a region.

With modern communication technology, telemedicine, internet and advanced data systems, it is now possible to establish a virtual emergency operation center with high handling capacity(VEOC) like a big regional or national physically command center. A VEOC is considered to be more

efficient, safer and more cost-effective compared to a traditional "stand-alone" emergency medical coordination center. Fig. 1 &2.

What is a Virtual EOC?

"A Virtual Emergency Operations Center (VEOC) is an EOC that exists solely or partially in cyberspace. A VEOC provides an electronic EOC via a dedicated computer network or the Internet. It can consist of anywhere from one workstation to thousands of networked computers dispersed throughout the enterprise and around the globe" [9].

A Virtual Emergency Medical Coordination Center (VEMCC) is a concept wherein the local operation centers do share information, make decisions, and deploy resources without the requirement to be physically present in the one big physically command center. Typically, using web-enabled software, a Virtual EOC allows participants to work from their normal workstation in the local EMCC. Emergency plans and reports are available from any location. In fact, all information is maintained in a central database that is available to all the local EMCCs.

The total number of operators will be the capacity of each local center. The VEMCC permits effective direction and control of resources, automates processes and methodologies, assigns and track tasks, and efficiently communicate real-time information. If configured properly, a VEMCC also will protect communication and data with required redundancy, security, and flexibility.

Conclusion

The main purpose of the virtual EMCC is:

- To have the capacity to answer all incoming emergency calls including when faced with an extraordinary volume of 113 calls.
- To effectively pool the resources of all the "member-EMCCs" when handling a big incident like the terrorist attack on 22 July 2011.

References

[1] http://no.wikipedia.org/wiki/Norge
[2] http://www.regjeringen.no/nb/dep/hod.html?id=421
[3] National Centre on Emergency Communication in Health, http://www.kokom.no/hurtigvalg/english.htm
[4] Human Development Reports (HDR) – United Nations Development, http://hdrstats.undp.org/en/countries/profiles/NOR.html
[5] NOU Norges offentlige utredninger 2012: 14, ISBN 978-82-583-1148-2
[6] Learning for better emergency preparedness. The medical response to the terrorist incidents of 22 July 2011; Published by Norwegian Directorate of Health; ISBN 978-82-8081-256-8
[7] Forprosjektrapport, Virtuell AMK Helse Vest, 27. august 2012; The Western Norway Regional Health Authority; http://www.helse-vest.no/english/Sider/side.aspx

[8] Crisis Management Series: Virtual Emergency Operations Centers by Steven C. Davis, Risk Management Mgazine vol 49 issue July 1, 2002
[9] http://www.davislogic.com/VEOC.htm

Olav Eielsen, MD., Director, Regional Centre for Emergency Medical Research and Development,
Stavanger University Hospital, Norway.
Experienced Anesthesiologist and Emergency physician.

Brit Nordboe, RN. Director, Regional Medical Dispatch Centre, Stavanger University Hospital, Coordinator EMD, Regional Centre for Emergency Medical Research and Development.
20 years of experience as a director of EMD-center.
Engaged in local and governmental projects.

Implementation of Neonatal Intensive Unit Care Telemonitoring in Minas Gerais State, Brazil

N. L.C. Silva[1], M. R. Botelho[1], M. G. Milagres[1], S. F. Santos[2], K. Bergmann[2], M. C. B. Melo[2]
[1]State Health Department of Minas Gerais, carvalho.nara@gmail.com; 4001 Rodovia Prefeito Américo Gianetti, Belo Horizonte, Minas Gerais, 31630-901, Brazil
[2]Medical School of the Federal University of Minas, Telehealth Center, mcbmelo@medicina.ufmg.br
190 Avenida Alfredo Balena, Belo Horizonte, 30130-100, Brazil

Abstract: **The Minas Gerais State government is working to create 200 new Neonatal ICUs beds. One of the problems for the deployment of these new services is the lack of trained human resources in regional cities. Telemedicine resources should be used. Objective: Describe the development of a telemedicine service for Neonatal ICU aimed in reduce neonatal mortality and support healthcare professionals in clinical decisions. The project is a partnership between the State Health Department of Minas Gerais and Telehealth Center of Medicine School at Universidade Federal de Minas Gerais. The project aims to promote specific training and technical assistance for health and administrative professionals. Methodology: A system of teleconsultation and videoconferencing was devised involving neonatologists with experience in intensive care in a Centre of Telemonitoring and neonatologists of ICU from regional cities. There is monitoring and discussion of clinical cases. There are sub-specialists to make contact if needed. There is continuous availability on duty, during the 12 h/day care period, of neonatologists and nurses. The data have been stored for future assessment, analysis and studies. Incorporation of new technologies for telemonitoring has been studied. The project coordination has been organizing workshops for the ICU managers. Videoconference and semi-present courses have been organized to offer permanent education for the professionals. Results: Through an organizational process, the Telemonitoring Center has been worked well. Neonatologists and nurses were trained to use the system and they are organizing protocols to help the colleagues to work better in the new ICU that will be in function soon. The professionals of the Telemonitoring Center are identifying what difficulties may occur and videoconference will be**

done for permanent education. Conclusion: The ICU professionals have considered that the project is helpful for giving support in the decision making process. The permanent education has been identified by the coordination.

Introduction

Care provided in intensive care units (ICUs) is notable for its high cost and high rates of morbidity and mortality [1]. Each year, over 5 million patients in the U.S.A. are admitted to ICUs [2]. Despite the importance of intensive care services, relatively little is known about technological and work process interventions to improve the quality and efficiency of care in the ICU [3].

The Minas Gerais State government, in Brazil, is working to create 200 new Neonatal ICU beds. One of the problems for the deployment of these new services is the lack of trained human resources in state's cities. The option of Telemedicine resources should consider giving support for the health professionals that take care of the newborns.

This paper describes the development of a telemedicine service for Neonatal ICU aimed in reducing neonatal mortality and support healthcare professionals in clinical decisions.

Methodology

This project is a partnership between the State Health Department of Minas Gerais and Telehealth Center of the Medical School at the Universidade Federal de Minas Gerais. The project aims to promote specific training and technical assistance for health and administrative professionals. Continuing education for health professionals involved in neonatal care and support care for the resolution of difficult clinical cases that could contribute to reducing neonatal mortality in our State.

Technical visits to neonatal intensive care units were done for project presentation. It was necessary to perform awareness meetings to clarify the doubts and susceptibilities for joining the project. At the same time strategic planning and cost survey was held.

A system of teleconsultation and videoconferencing was devised involving neonatologists, with experience in intensive care at a Center of Telemonitoring, and neonatologists of ICU from regional cities. There is a monitoring and discussion of clinical cases. There are sub-specialists to make contact if needed. There is availability on duty, during the 12 h/day care period, of neonatologists and nurses. The data have been collected for future assessment, analysis, and studies. Incorporation of new technologies

for telemonitoring has been studied. The coordination has been organizing workshops for the ICUs managers. Videoconference and semi-presential courses have been organized to offer permanent education for the professionals involved.

Results

The Telemonitoring Center has been organizing and so far it has been possible to make contact with four Neonatal ICUs. Neonatologists and nurses were trained to use the system and they are organizing clinical protocols to help the colleagues to work better in the new ICUs that will be in function soon. The professionals of the Telemonitoring Center are identifying some difficulties to conduce the cases in specific areas and videoconference will be done for permanent education. Daily, up to about 30 cases have been discussed, since the beginning of the project.

Fig.1 shows the number of teleconsultations performed by neonatologists and nurses in January 2013.

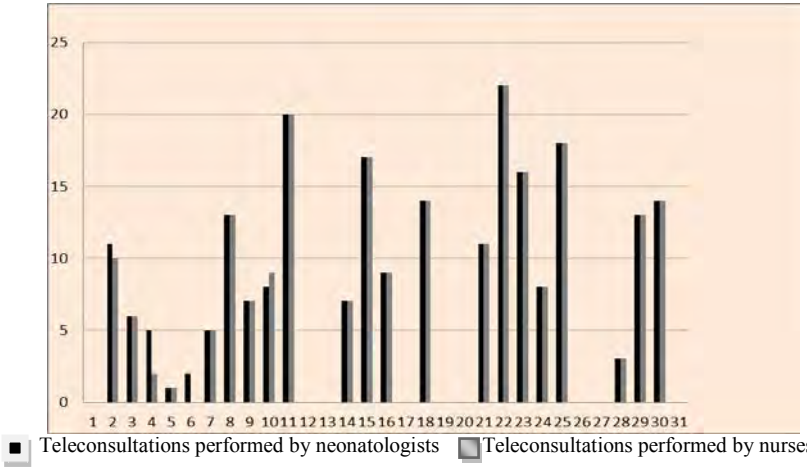


Figure 1 Number of teleconsultations performed by neonatologists and nurses in January 2013

Discussion and Conclusion

The provision of effective telemonitoring of the Neonatal Intensive Unit Care is the major area of interest in this project and a close study on this topic has been done by the professionals involved. One of the technical difficulty found is the use of different health equipments for intensive care units, which hampers interoperability system, thus we chose to use this

early stage teleconsultation and web conferencing system to expedite the start of operation of the Telemonitoring Center.

Nowadays, ICU telemonitoring programs have been expanding despites differences in the revealed evidences in the literature on their effectiveness and cost-effectiveness. Thomas *et al.* [1] studied the association of remote monitoring of ICU patients with mortality, complications, and length of stay in six units and concluded that further use of this technology should proceed in the context of careful monitoring of patient outcomes and costs, since they didn´t find that the project was associated with a reduction in overall hospital mortality. Otherwise, Franzini *et al.* [2] used an observational study with ICU patients cared before and after ICU telemonitoring period in 6 ICUs at 5 hospitals in the Gulf Coast region and concluded that the program is cost effective. Economic outcomes were hospital costs, ICU costs and floor costs, measured for average daily costs, costs per case, and costs per patient. In our project we are planning to study the cost-effectiveness.

Until now it was possible to establish connections with four ICU and put the Telemonitoring Center to work. A team of neonatologists and nurses already has been trained and qualified to work in the teleconsultations and videoconferences. From now on, the State Health Department is planning to incorporate new neonatal ICUs. The new ICUs that will open will have the infrastructure for giving clinical support. In a near future it is expected that the results can be quantified.

The ICU telemedicine approach, trademarked as eICU, by the dominant vendor, offers the promise of a fundamental reengineering of how intensive care is provided, yet it remains largely unstudied [3]. It is necessary to have an open mind about this subject.

Acknowledgment

The authors thank the technical professionals and the neonatologists involved in this project.

References

[1] E. J. Thomas, J. F. Lucke, L. Wueste, L. Weavind and B. Patel. “Association of Telemedicine for Remote Monitoring of Intensive Care Patients with Mortality, Complications, and Length of Stay”. JAMA, December, vol. 302, pp. 2672678, 2009.

[2] L. Franzini, K. R. Sail, E. J. Thomas and L. Wueste. “Costs and cost-effectiveness of a tele-ICU program in six intensive care units in a large healthcare System”. J Crit Care. 2011 June, vol. 26(3), pp. 329–329.

[3] R. A. Berenson, J. M. Grossman and E. A. “Does Telemonitoring of patients-The eICU-Improve Intensive Care?” in Health Affairs, vol.28 (5), pp. w937-947, 2009.

Nara Lúcia Carvalho da Silva – Nurse - Systems' Management in Health Services Specialist. Project Manager for Tele Minas Saúde of the Minas Gerais State Health Department, Brazil.

Maurício Rodrigues Botelho - DVM, Vetenarian. Municipal health secretary. Experience in management of regional health services. Presently, Secretary of Policies and Actions of the Minas Gerais State Health Department, Brazil.

Marcos Milagres - Computer Network Technology Graduate - Support analyst in the Minas Gerais State Government, Brazil.

Kaiser Bergmann - Computer Network Technology Graduate - Extensive experience as a data and metadata administrator, surveying, designing and developing processes for information systems of the Health/Hospital Care. Systems Analyst of the Universidade Federal de Minas Gerais – Brazil

Maria do Carmo Barros de Melo – Pediatrician. M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Member of The Telehealth Center of the Medical School at UFMG, Brazil.

Simone Ferreira dos Santos – Economist - Specialist in Health Economics. Member of The Telehealth Center of the Medical School at Federal University of Minas Gerais, Belo Horizonte, Brazil.

Telehealth in Post Conflict Zones: Six Year Findings from a Cross Border eHealth Program

H. Durrani[1,2], A. Jan[1], N. Mohammadi[1], H. Rasoli[3], N. Saifi[4]
[1]French Medical Institute for Children, Kabul, Afghanistan
[2]Aga Khan University, Karachi, Pakistan
[3]Bamyan Provincial Hospital, Aga Khan Health Services, Afghanistan, Kabul, Afghanistan
[4]Faizabad Hospital Aga Khan Health Services, Afghanistan, Kabul, Afghanistan

Abstract: **The history of the past 30 years in Afghanistan is one of prolonged conflict, social unrest, political instability and large scale internal and external migration. The health system due the armed conflict was hit badly resulting in issues concerning poor access to and quality healthcare to afghan population. It is widely accepted that the use of Information and Communication technology in healthcare (eHealth) services can act as a catalyst for the improving quality of life for people in the rural and remote areas. eHealth in Afghanistan has proved a beacon of hope in providing quality health services to rural population of Afghanistan. Aga Khan Development Network (AKDN) recognizes the role eHealth can play in bringing together different institutions and providers in the Central Asia region, providing coordinated care to the population, ensuring a continuum of care at all levels, and minimizing the barriers of distance and time. This current study reports a model of eHealth activities at the French Medical Institute of Children, (an Aga Khan University managed hospital in Afghanistan) and Aga Khan Health Services Afghanistan managed hospitals in Bamyan and Faizabad, which has successfully completed 6th year of its operation. More than 7850 patients have benefited from this technology, with more than 3800 live teleconsultaions and 4035 store and forward teleconsultations. Through elearning sessions, more than 2300 staff in the rural hospitals of Bamyan, Faizabad and Faizabad has benefited. On average the patients have saved 200 USD and 4-5 days of travel time in Afghanistan. Recently, Khorog Oblast General Hospital in Tajikistan was connected via eHealth to FMIC-Kabul. The study summarizes six years of eHealth services and also gives future role eHealth will play towards an integrated Central Asia eHealth system for AKDN.**

Introduction

The healthcare sectors in post-conflict countries of developing world face similar issues [1]. From Sierra Lione to Mozambique, from Rawanda to Somalia and from Iraq to Afghanistan, all of these countries more or less face the same unstable political system, poor economy, poor baseline health indices, difficult access to healthcare facilities, poor healthcare facility conditions, and lack of trained healthcare providers especially women [2]. Telehealth or Telemedicine uses Information and Communication Technology (ICT) to overcome geographical barriers, and increase access to health care services [3].

Program History

AKDN eHealth program in Afghanistan have successfully completed 6 years of its services. Teleradiology was the first specialty which was started at French Medical Institute for Children, Kabul in the year 2007. CT scans and MRI images were sent to Aga Khan University (AKU) Karachi through a dedicated point to point link [4]. The Telehealth services were extended to Bamyan Provincial Hospital (BPH) (District Bamyan) in 2008, again starting with teleradiology. In 2010 Live teleconsultation and telepathology services were started between FMIC and Bamyan Provisional hospital. eHealth services were extended to Faizabad Hospital (District Badakshan) in March 2011 and in November 2012 it is extended further to Khorog Oblast General Hospital (Tajikistan). At the moment telemedicine services to three spoke hospitals are provided in specialties of radiology, pathology, cardiology, pediatrics, Internal Medicine, General Surgery obstetrics/gynecology, ENT, orthopedics, Pain Management, Dental and dermatology; with Continuing Medical Educations (CMEs) and elearning sessions on capacity building of healthcare providers

Methodology

Survey methodology with exit interviews was used to study the impact of the Telehealth program in Afghanistan. For consultations, both synchronous (live Teleconsultation) and asynchronous (store-and-forward consultation) modes of Telehealth are being used.

Results

AKDN agencies in Afghanistan have successfully completed 6 years of its eHealth program in the region. More than 7850 cases have been seen in this limited period of time through the use of Information and Communication Technology tools. The Teleradiology program between FMIC and Aga Khan University Karachi has exchanged more than 2450 CT

scans MRI, and Mammogram images. This has not only helped the patients get a better opinion but also have helped build capacity of the radiologists at FMIC. The live teleconsultation which started in 2010 have seen more than 3823 cases between FMIC, Bamyan, Faizabad (in Badkshan Province) and Khorog Oblast General Hospital (Tajikistan). The table below gives details of teleconsultation (both live and store and forward) from 2007-2012.

Summary of eHealth consultations							
Specialties	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Teleradiology	**99**	**166**	**365**	**641**	**1031**	**1421**	**3723**
Scans sent (MRI and CT)FMIC-AKU Karachi	*99*	*116*	*266*	*624*	*716*	*635*	
Scans sent (xrays) Bamyan-FMIC		*50*	*99*	*17*	*176*	*491*	
Scans sent (xrays) Faizabad –FMIC					*135*	*295*	
Teleconsultations				**40**	**1206**	**2577**	**3823**
Patients seen (Bamyan-FMIC)				*40*	*1090*	*1750*	
Patients seen (Faziabad - FMIC)					*116*	*820*	
Patient seen (Khorog-FMIC)						*7*	
Telepathology				**9**	**173**	**130**	**312**
TelePathology Cases (Bamyan-FMIC)				*9*	*173*	*93*	
TelePathology cases (Faizabad- FMIC)						*37*	
Grand Total	**99**	**166**	**365**	**690**	**2410**	**4128**	**7858**

Table shows teleconsultaions 2007-2012

Conclusion

AKDN eHealth program has played vital role in the remote area of the region. The survey paints a picture as following:

1) Saving cost and travel

In the exit interviews conducted after the teleconsultations at Bamyan Provincial Hospital, more than 90% of patients claimed that they saved minimum 4 days of travel and around 10,000 Afs (200 USD) due to the Telehealth facility. Patients were very satisfied with the quality of teleconsultations, and were pleased with saving the cost of travelling for next level facility. Travel was avoided to the next level facility which is in Kabul (237 km and around 8-10 hours of unsafe and very tough).

2) Capacity building of health care staff

The eHealth Program has also played a vital role in improving the skills of the healthcare workforce (doctors, nurses and allied health) at FMIC, Faizabad and Bamyan. Different Continuing Medical Educations (CMEs) and eLearning sessions were organized by FMIC and AKU to increase the capacity of staff and healthcare providers, resulting in better care for patients, improving diagnostics, knowledge and quality data transfer. Till end of 2012, around 107 elearning sessions have been organized, benefiting more than 2300 health care providers.

3) Improving gender balance in provision of care

The exit interviews also found the satisfaction rate for both men and women as over 90 percent. Women were not reluctant to discuss their medical issues over video conferencing, which explains the high satisfaction rate. The number of women seeking teleconsultations was at par with the men in the group.

Acknowledgment

Aga Khan Foundation, Geneva, International Development Research Center Canada and Roshan Telecommunications Kabul, Aga Khan Health Services Afghanistan & Tajikistan, Bamyan & Faizabad Provincial Hospitals.

References

[1]. W. Newbrander, R. Yoder, A. B. Debevoise. Rebuilding health systems in post-conflict countries: estimating the costs of basic services. International Journal of Health Planning and Management, 2007, 22:319–336.

[2]. F. Bustreo, E. Genovese, E. Omobono, H. Axelsson, I. Bannon. Improving Child Health in Post-Conflict Countries Can the World Bank Contribute? 2005, Last accessed on 14-7-2012. from http://siteresources.worldbank.org/INTCPR/Resources/ImprovingChildHealthInPost-ConflictCountries.pdf

[3]. World Health Organization, Telemedicine: opportunities and developments in Member States: report on the second global survey on eHealth, Global Observatory for eHealth Series2, 2009.

[4]. K. M. Mirza, Z. Sajjad, M. Yousuf, Z. Usman. Teleradiology between Afghanistan and Pakistan: One Year Expereince, PJR Jan - Mar 2008; 18(1): 22-25.

Telehealth to Provide Support for Healthcare Practitioners in Situations of Floods: A Brazilian Experience

F. R. Pereira[1,2], M. S. Marcolino[1,2], E. V. Santos[1,2], M. B. M. Alkmim[1],
[1]Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, 110, Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil, telessaude@hc.ufmg.br
[2]Medical School, Universidade Federal de Minas Gerais, 190, Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil

Abstract: Telehealth may be used to provide support for public health in situations such as natural disasters, but there is lack of evidence regarding telehealth support in cases of floods. The objective of this study is to report examples of the use of telehealth in situations of floods. All 1826 teleconsultations from December 2011 to January 2012 performed by the Telehealth Network of Minas Gerais, Brazil, were analyzed. Only 3 of them were related to floods, 2 were educational and 1 was for health assistance. These teleconsultations were reported here. Flooding situations are critical moments, when the infrastructure and services of the city are in the worst condition to support the population. The damage in the communication system became a challenge to local health professionals in requesting teleconsultations during the study period. In conclusion, telehealth is useful in flooding situations and as the local infrastructure is affected by the natural disaster, developing strategies such as teleconsultation using telephones or 3G internet connections may be alternatives to increase the use of telehealth in those situations.

Introduction

Natural disasters are any event of nature with catastrophic consequences and great impact on society. Floods are the natural disasters that predominate in Brazil [1] and they have many consequences on the environment, infrastructure, city's services and economy. The environmental impact increases the incidence of certain diseases, generating needs when the network services, infrastructure and resources are less available [2].

Telehealth may be used to provide support for public health in situations such as natural disasters, but there is lack of evidence regarding telehealth support in cases of flooding.

The Telehealth Network of Minas Gerais (TNMG) was founded in 2005 by the State Government of Minas Gerais, Brazil. The aim was to connect specialists in state university hospitals with primary healthcare professionals of 658 municipalities of the state of Minas Gerais. The TNMG supports these healthcare professionals by providing tele-assistance through tele-electrocardiography and teleconsultations, using low-cost equipment [3]. From June 2006 to October 2012, 1 076 086 electrocardiograms and 46 750 teleconsultations were performed [4].

The objective of this study is to report examples of the experience of the TNMG on the use of telehealth in the assistance of healthcare professionals in situations of floods in the cities of Minas Gerais, Brazil.

Methodology

All consecutive teleconsultations performed by the TNMG, from December 2011 to January 2012, were analyzed. This period was chosen because it is the time of greater concentration of rainfall in the state. Teleconsultations were classified as assistencial, if related to the assistance of a particular patient, or educational, if it was a general doubt about a certain issue.

Results

During the study period, 1 826 teleconsultations were analyzed, 29.9% of them were requested by physicians, 61.5% by nurses and the remaining ones by other healthcare professionals. Only 3 of them were related to the floods, 2 were educational and 1 was for health assistance; all of them were requested by physicians.

The teleconsultation for health assistance was about a 47 year-old male, from the city of Belo Vale (86 Km from the capital), who presented with fever, headache, myalgia, dehydration, hyporexia, jaundice and choluria 5 days after contact with water from a flood. He had abnormalities in the liver function, infectious and hematimetrics parameters, but renal function were preserved. He was admitted in the local hospital and antibiotics were prescribed. As the patient had not improved, his physician sent a teleconsultation to the TNMG. The teleconsultant doctor suggested leptospirosis as the main hypothesis, but advised to investigate other infectious diseases and to refer the patient to a hospital with more resources for better supportive treatment.

In the first teleconsultation for educational assistance, requested from Rio Pardo de Minas (670 Km from the capital), it was reported that every year in the season of rains there was a surge of diarrhea cases among a heterogeneous group of citizens. The city's water had been analyzed and was not contaminated. The physicians wanted to create an evaluation commission and asked the teleconsultant from the TNMG for help. The teleconsultant suggested guidelines with models available for investigation.

In the second educational assistance, there was a flood in the city of Rodeiro (281 Km from the capital). The physician had doubts about vaccination and whether there were any medication or laboratory exams that should be done. The teleconsultant from the TNMG answered that the only action that should be done was to keep the tetanus immunization updated and be alert for typical symptoms related to diseases of floods, such as hepatitis and leptospirosis.

Discussion

Telemedicine enables a faster and more appropriate treatment to the patient that cannot be carried over to a specialist [5] that, in most cases, is only available in large cities, usually far from the patient's home. In situations of floods due to heavy rain in Brazil, most of the times there are no conditions of transportation due to the floods themselves or landslides, with the destruction of bridges, streets and roads [6]. Consequently, the communication by internet or telephone with the specialist might be the only option to offer good treatment.

This study showed 3 examples of telehealth usage in situations of floods in Brazil. The only teleconsultation classified as "health assistance" was a case in which, despite the typical clinical presentation of a disease easily linked with flood scenarios – leptospirosis - , there was a need for additional propaedeutics because the patient was not responding to the treatment. The teleconsultation apparently helped guiding the differential diagnoses, but the fact that the city was isolated due to the flood prevented most of those exams from being done.

Due to the mean number of teleconsultations performed by the network per day, it was expected that there would be a higher number of teleconsultations related to the floods during the study period. However, since the electrical services may not work well I these types of situations, there is a limitation in the telemedicine use by those cities. In inland cities of Minas Gerais, the internet connections are commonly made by radio and a storm normally causes a disruption [7]. The possible solution is to perform teleconsultations using telephone or 3G internet connection.

Conclusion

Telehealth is useful in flooding situations. As the local infrastructure is affected by the natural disaster, developing strategies such as teleconsultation using telephones or 3G internet connections may be alternatives to increase the use of telehealth in those situations.

References

[1] A. R. M. Sena, D. F. Cerutti. Guia de preparação e resposta aos desastres associados às inundações para a gestão municipal do Sistema único de Saúde. Ministério da Saúde. 2011, Available at: http://portal.saude.gov.br/portal/arquivos/pdf/guia_para_sms_desastres_julho_2011.pdf (last accessed November 01, 2012)

[2] R. C. Merrell, C. R. Doarn. Disasters-how can telemedicine help? Telemed J E Health, vol.11, pp. 11-12, 2005.

[3] M. B. Alkmim, R. M. Figueira, M. S. Marcolino, C. S. Cardoso, M. Pena de Abreu, et al. Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bull World Health Organ, vol.90, pp. 373-378, 2008.

[4] Centro de Telessaúde – Hospital das Clínicas/ Universidade Federal de Minas Gerais. 2012, Available at: http://www.telessaude.hc.ufmg.br (last accessed November 20, 2012)

[5] D. Balch. Developing a National Inventory of Telehealth Resources for Rapid and Effective Emergency Medical Care: A white paper developed by the American Telemedicine Association Emergency Preparedness and Response Special Interest Group. Telemed J E Health, vol.14, pp. 606-610, 2008.

[6] F. C Machado, X. E. Francioli. Enchentes e saúde pública: uma questão na literatura científica recente das causas, consequências e respostas para prevenção e mitigação. Ciênc. saúde coletiva, vol.17, pp.1601-1616, 2012.

[7] M. B. Cysne, M. S. Marcolino, J. X. Maia, L. R. Cunha, W. M. Carvalho, C. S. Elone et al. The Potential of mHealth Technology Incorporation in Brazil. In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luxembourg, vol.5, pp. 537-542, 2010.

Fabiana Resende Pereira - 6th year's Medical Student of the Universidade Federal de Minas Gerais, Brazil, which was recently ranked among the 10 Best Universities of Latin America by QS World University Rankings®. She has been undertaking research at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, since 2012

Milena Soriano Marcolino - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (2004), residency in Internal Medicine (2007), and doctorate in Internal Medicine from the Universidade Federal de Minas Gerais (2011). She is currently a Professor at the Medical School, Universidade Federal de Minas Gerais and Quality Control Manager at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais

	Emília Valle Santos - 6th year's Medical Student of the Universidade Federal de Minas Gerais, Brazil, which was recently ranked among the 10 Best Universities of Latin America by QS World University Rankings®. She has been undertaking research at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, since 2013.
	Maria Beatriz Moreira Alkimim - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1979), residency in Clinical Pathology and specialization course in Hospital Management. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais. She is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry.

eHealth in Support of Routine Medical Practice

Automatic Triage of Electrocardiograms

R. V. Andreão[1], T. Sarti[2], J. Celestrini[1], M. Q. Schimidt[1]
[1]Federal Institute of Espirito Santo, rodrigova@ifes.edu.br
Av. Vitória, 1729 Jucutuquara, Vitória, ES 29045780 Brasil
[2]Federal University of Espírito Santo, Social Medicine Dep., Av. Marechal Campos, S/N Maruipe, Vitória, ES Brasil, thiagosarti@yahoo.com

Abstract: **This work proposes an automatic triage system based on an automatic classification of the ECG records as normal or abnormal. As a consequence, the records presenting any abnormality are evaluated by the cardiologist in priority reducing the response time after an ECG recording. Our system carries out a multilevel analysis of ECG which is composed of the following steps: ECG features extraction; ECG classification; ECG triage. At the ECG triage step, a predefined set of ECG patterns are then assigned by the medical staff to the abnormal ECG class. Aiming at testing the algorithms, we have done some experiments using standard ECG databases containing abnormal ECGs. Our results in terms of sensitivity and positive predictability are presented for the following ECG patterns: QRS peak detection; premature ventricular contraction beats; ST elevation; QT dispersion; atrial fibrillation. On the sequel of these experiments, we are planning to apply the automatic ECG triage system in a telecardiology service and evaluate its performance in terms of time response.**

Introduction

Telecardiology is a telemedicine modality where the ECG recording is sent through the internet to a cardiology center to be manually analyzed by cardiologists [1]. The ECG report is then sent back to the health professional who requested the service. The response time depends whether the ECG is assigned as an emergency or not. In such situation, the interpretation is prioritized. Otherwise, the ECG is analyzed according to its queue position. According to reference [2], the percentage of ECGs classified as urgent is nearly 14% of total amount of ECGs analyzed. All these urgencies were identified after ECG interpretation by the cardiologist, i.e., the selection and distribution of the ECGs to the cardiologist respect the arrival time of each record, except when the ECG is classified as urgent. As a consequence, normal ECGs delay the response time of abnormal ones.

In order to face this problem, a suitable solution would be an ECG triage system, prioritizing abnormal ECGs. This idea was already successfully implemented in an emergency medical service called Medic, where on-scene ECGs were automatically analyzed aiming at identifying the ST-segment elevation, which suggests a myocardial infarction in progress [3]. An automatic triage system was also proposed in a drug trial, where the response time of 48 hours could be reduced for patients with abnormal ECGs [4]. While the ECG is sent to be interpreted by the cardiologist, the automatic triage can accelerate the evaluation of such ECG according to the severity of the abnormality found.

In such context, this work proposes an automatic triage system based on the automatic classification of the ECG records. Our system carries out a multilevel analysis of ECG which is composed of the following steps: QRS peak detection; ECG waveform segmentation; rule based system for ECG classification. A predefined set of ECG patterns are then assigned as an abnormal ECG by the medical staff. The algorithms implemented were validated through standard ECG databases containing abnormal patterns. Our results in terms of sensitivity and positive predictability are presented for the following ECG patterns: QRS peak detection; premature ventricular contraction beats; ST elevation; QT dispersion; atrial fibrillation.

Telecardiology

Taking advantage on these findings, the Espírito Santo Tele-health Program (http://telessaude.ifes.edu.br) is building a Telecardiology service which carries out an automatic triage of ECG recordings. The Telecardiology service is totally based on the Web, where ECG recorded by a digital electrocardiograph at the health unit is uploaded to the Telecardiology Server. The ECG is then automatically processed by an ECG analysis agent [5-6]. The agent carries out three steps: ECG features extraction; ECG classification; ECG triage. Several

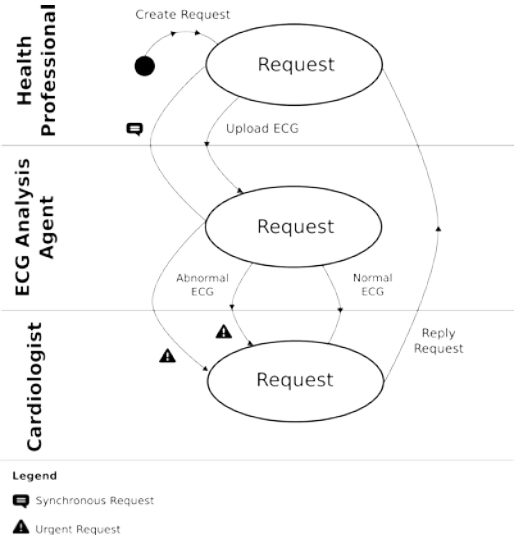


Figure 1. Working flow of the ECG Triage System

features are then extracted from the ECG, as follow: QRS onset and offset and T wave offset; R wave and S wave amplitudes; ST segment amplitude; RR interval; Heart Rate (HR). All these features are applied as input of the ECG classification layer, which produces the following classification results: Atrial Fibrillation; QT dispersion; Bradycardia or tachycardia; Left ventricle hypertrophy; Premature ventricular contraction beats. The ECG triage is performed by a ruled based system which is in turn configured by the medical staff, taking the decision if the ECG is normal or abnormal. Abnormal ECGs are then placed in the first position of the ECG list waiting for interpretation and the cardiologists are notified to perform an urgent evaluation.

Figure 2. Screen of the telecardiology system

Results

The algorithms employed in our ECG Triage System were evaluated on real ECG recording [5-7]. The QRS peak detection algorithm achieved 99.6% and 99.4% of sensitivity and positive predictability respectively on a representative set of ECG records of the MIT Arrythmia Database. The Atrial Fibrillation algorithm based on the RR interval obtained 79.1 % and 92.1% of sensitivity and positive predictability respectively on a test set of six ECG records of the MIT Arrythmia Database. Comparing our QT dispersion algorithm to the manual annotations carried out by cardiologists, we achieved 1.8 ms and 21.7 ms of mean and standard deviation error, which are below the recommendation of the IEC 6001-2-51:2003 (15.0 ms and 28.3 ms respectively). The premature ventricular beat detector achieved 95.1% and 98.4 of sensitivity and positive predictivity respectively on a test set of six ECG records of the MIT Arrythmia Database. Finally, the algorithm for ST-elevation was tested in an ischemia detection problem achieving 86% and 85% of Se and PP respectively on a test set of 48 ECG records of the European ST-T Database.

Discussion and Conclusions

The ECG triage system presented in this article employs algorithms whose performance was very good in terms of sensitivity and positive predictivity. High sensitivity (Se) means that the algorithm is sensible in detecting abnormalities and high positive predictability (PP) means that the algorithm is correct in the majority of cases. There is a trade-off between high Se and high PP which should be defined by the medical staff. In our Telecardiology service, the algorithms will be configured to be sensitive in detecting abnormalities, hence the number of false positives will increase and the PP value will get worse. On the other hand, the PP value for the normal cases will improve enough to reduce the necessity of manual reading of the normal ECGs.

Another advantage of the ECG Triage System is that the ECG recordings will be sent to the cardiologist with a pre-classification result, accelerating his interpretation and report.

Our expectation is that the automatic triage will improve our Telecardiology Service.

In a future work, we will evaluate the performance of our ECG Triage System in terms of response time, abnormality detection, medical staff satisfaction and avoidance of unnecessary patient transportation to the closest public hospital.

References

[1] M. Marcolino, M. B. Alkmim, D. Palhares, A. L. Ribeiro, Prevalence of Normal Electrocardiograms in Primary Care Patients: a Study by a Telemedicine Service in Brazil, In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luexmbourg, Vol. 5, pp. 615-618, 2012.

[2] A. Sparenberg, G. Fetter, A Public Telecardiology Network in Southern Brazil: Results of Phase II (1st Year), in M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luexmbourg, Vol. 5, pp. 598-602, 2012.

[3] J. G. Jollis, Moving Care Forward Prehospital Emergeny Cardiac Systems, Circulation, vol. 122, pp. 1443-1445, 2010.

[4] T. K. Zyweitz, A. Khawaja, R. Petrovic, R. Fischer, J. Reinstaedtler, Increasing Patient Safety in Drug Trials with Computer Based Analysis – a Study with 13.000 Resting ECGs, Computers in Cardiology, vol. 36, pp. 245 248, 2009.

[5] R. V. Andreão, J. G. Pereira Filho, C. Z. Calvi, TeleCardio: Telecardiologia a Serviço de Pacientes Hospitalizados em Domicílio, in Proc. of Congresso Brasileiro de Informática em Saúde, pp. 1267-1272, 2006.

[6] L. S. C. de Oliveira, M. Sarcinelli Filho, R. V. Andreão, Premature Ventricular Beat Classification Using a Dynamic Bayesian Network, in Proc. of 33th Annual IEEE/EMBS Conference, Boston, 2011.

[7] R. V. Andreão, S. M. T. Muller, J. Boudy, B. Dorizzi, T.F. Bastos Filho, M. Sarcinelli Filho, Incremental HMMtraining applied to ECG signal analysis. Computers in Biology and Medicine , vol. 38, pp. 659-667, 2008.

Rodrigo Varejão Andreão was born in Vitória, Espírito Santo, Brazil, in 1975. He received the B.E. degree in electrical engineering from UFES, Brazil, in 1998, the M.Sc. degree in the field of speech recognition from UNICAMP, Brazil, in 2000, and the Ph.D. degree in the field of biomedical engineering from INT (Télécom SudParis) , France, in 2004. He is currently professor at the Federal Institute of Technological Education of Espírito Santo (Ifes). His research interests are in signal processing, biological signal processing, and telemedicine. Dr. Andreão is also a member of Brazilian Society of Biomedical Engineering (SBEB).

Thiago Dias Sarti was born in Vitória, Espírito Santo, Brazil, in 1980. He graduated in medicine from the Santa Casa de Misericordia de Vitória, Brazil, in 2004, and received the M.Sc. degree in the field of Public Health from UFES, Brazil, in 2009. He is currently professor at the Federal University of Espírito Santo (UFES). His research interests are in primary heath care, general practice and telemedicine.

Jordano Ribeiro Celestrini was born in Linhares, Espírito Santo, Brazil, in 1987. He received the degree in systems analysis from Faculdade Católica Salesiana, Brazil, in 2008, and the MBA in project management from Fundação Getúlio Vargas, Brazil, in 2010. He is currently doing his Master Degree in the field of computing in education at UFES, Brazil. He works with system development for Internet and with research projects focusing on telemedicine, telehealth.

Marcelo Queiroz Schimidt was born in Sorocaba, São Paulo, Brazil, in 1968. He received the B.E. degree in administration from FAESA, Brazil, in 1992, the M.Sc. degree in the field of Informatics - Virtual Library from UFES, Brazil, in 2005. He is currently professor at the Federal Institute of Technological Education of Espírito Santo (Ifes). His research interests are Telemedicine, telehealth, distance education, youth and adults education. M.Sc. Schimidt is also a member of Brazilian Society of Health Informatics (SBIS).

Health Care Management with KeepCare

R. Sousa[1], M. Alves[2], G. Gonçalves[3,4]
[1]IncreaseTime, Rua Dr. Afonso Cordeiro, 877 - 204, 4450-007 Matosinhos, Portugal
[2]FreedomGrow, Rua Dr. Afonso Cordeiro, 877 - 203, 4450-007 Matosinhos, Portugal
[3]Inovamais, Rua Dr. Afonso Cordeiro, 567, 4450-007 Matosinhos, Portugal
[4]Department of Informatics Engineering, School of Engineering, Porto University (FEUP), Rua Dr. Roberto Frias s/n, 4200-465 Porto, Portugal

Abstract: **Wireless sensing is part of our lives. Major technological breakthrough on the areas of sensors, integrated circuits, and also on wireless communications, led to the creation of wireless sensor networks (WSNs). Such networks have multiple uses, from monitoring and tracking of people and goods, to the coordination and processing of activities in different contexts, they are used in industry, defence and healthcare application. As part of this use in healthcare applications KeepCare, a solution based on monitoring, tracking and processing of healthcare related information, is presented in this paper. This solution uses a WSN based application to monitor people's health and quality of life through vital signs and activity information received via wireless sensors. This solution monitors users such as elderly, people suffering from chronicle conditions in their home environment, but can as well be used in athletes or other professionals (e.g. first responders) that need to be monitored under hazardous conditions.**

Introduction

Continuously monitoring of vital signs and daily activity information can help to promote better healthcare and better quality of life. Clinical data is obtained by specific equipment, mostly available in hospitals, with several sensors, being necessary to put into practice the concept of proximity to be able to access in real-time to health related information wherever the patient is.

Medical telemetry is not a new concept, but the vast majority of available solutions are not capable to re-organize its different sensing components on a network and to transmit and retransmit data to other sensors or expand it to several devices. In addition, most available products in the market require

the patient to stay in bed and the few ambulatory wireless products are usually too big and heavy.

The application of WSNs to personal health monitoring systems is an emergent area of research. There are many health-related projects and products with wireless sensor network such as for example SmartVest [1], AMON [2] and Wealthy [3].

Smart Vest is developing a Wearable multi-parameter remote physiological monitoring system consisting in a comfortable wear vest with sensors integrated for monitoring physiological parameters, wearable data acquisition and processing hardware and remote monitoring station. The wearable data acquisition system is designed using microcontroller and interfaced with wireless communication and global positioning system (GPS) modules. The physiological signals monitored are electrocardiogram (ECG), photoplethysmogram (PPG), body temperature, blood pressure, galvanic skin response (GSR) and heart rate. The AMON system is a wearable medical monitoring computer which provides complex monitoring, data analysis and communication capabilities in a single wristworn unit. The WEALTHY system is a Wearable Health Care System Based on Knitted Integrated Sensors. The system is based on a textile wearable interface implemented by integrating sensors, electrodes, and connections in fabric form, advanced signal processing techniques, and modern telecommunication systems. Although many other solutions are being developed these are mostly piecewise solutions and seldom integration efforts exist.

KeepCare® is an innovative cloud computing solution, regarding the current social and economical context where remote medical assistance may be one of the most growing segments on the future health care related industry. KeepCare® is a platform that can collect store and process data from multiple sensors that are being used to monitor multiple patients. As opposed to the projects mentioned before, KeepCare is able to integrate sensors from different manufacturers.This platform is also capable to optimise the use of resources (e.g. formal and informal care givers), which is very important when KeepCare® is used in medical clinics, nursing homes or to provide remote health care support solutions. KeepCare® is a WSN based solution implemented with the rapid development environment PlugSense.

The remainder of this paper is organized as follows: Section 2 provides an overview of the rapid development environment, the PlugSense Framework, its functionalities and highlights. Section 3 describes in more detail the KeepCare® solution and, finally, Section 4 presents the main conclusions of the paper.

Rapid Application Development Environment

The PlugSense Framework [4] is a rapid application development environment for WSN based solutions, which allows developers to accomplish their goals with a structured and focused implementation method. Developers are now able to configure devices, extract and import data, manage and personalize interfaces without worrying about the application architecture. In the end, the resulting applications will provide a simple and fast bi-directional monitoring and management solution with high expandability, connectivity and support for most wireless devices in the market.

PlugSense Framework was created to address the issues that make the process of building a WSNs based application complex, time consuming, and costly. Using the structure approach provided by the PlugSense development framework, developers can focus on the application specifications and no longer have to overcome difficulties in its development; applications can be created easier and quicker when compared to the development of a bespoke solution. An application developed using the PlugSense framework is capable of receiving, processing and analysing data from most wireless devices in the market, as well as integrating with management software, communication protocols and specific final solutions.

WSNs based solutions are capable to monitor and control all data received through a web application (PlugSense Application), accessible from anywhere, with some features such as: real-time graphical representation; historic data graphical representation; alert triggering based on custom rules; sending alerts by e-mail and by SMS; management of human resources, entities and groups; real-time representation of data from GPS or other positioning methods on a map; integration with plugins, previously created on Framework Wizard.

There are in the market some similar products, with almost all PlugSense's features and containing support for the three main layers of a WSN application (sensors' layer, data layer and interface layer).

CrossBow has a development kit named MoteWorks, which consists on a platform to develop WSNs, and contains all three main layers - Supports ZigBee Mesh Networks and tinyOS. It allows storing data. On interface layer it is possible to watch the network status, access to management tools and watch all received data [5].

Sentilla has a development kit that is focused on the development and management of Mesh WSNs, working mostly on sensors' layer and data layer. Supports Sentilla and tinyOS. It allows storing data. On interface

layer it is possible to watch the network status, access to management tools and watch all received data [6].

Other tool is Octavex, the most similar to PlugSense Framework. It is focused on three main layers. So as PlugSense Framework, Octavex has a gateway to decode received data from sensors and redirect it to upper layer, the data layer, where there are some methods to receive data, publish it to interface layer and trigger alerts. All this data is presented on the interface layer through a web application. The support to other technologies is limited, but it has some expansion capabilities. It allows storing data and it has alert services on interface and by email. On interface layer it is possible to perform some administration tasks.

There is other tool, similar to PlugSense Framework and Octavex, named Wisense, from SignalGeneriX Ltd, which consists on a platform that can aggregate multiple sensor motes from different types. It also is focused on three main layers and the support to other technologies is limited, because it is used with a set of sensors, but it has some expansion capabilities. It allows storing data and it has alert services on interface and by email or SMS. On interface layer it is possible to perform some administration tasks and watch all received data from sensors [7].

Comparing these products between them and with PlugSense Framework, it can be concluded that PlugSense Framework was the best choice for the implementation of KeepCare® because of its capability to easily integrate external services, as well as its capabilities to receive, store and manage data from virtually any sensor. Other important feature is the capability to send commands to the sensors, which aims to be an important point to KeepCare® because not always is necessary to have sensors sending data.

The KeepCare® Healthcare Solution

KeepCare® is a real-time mobile health monitoring system developed with the elderly and people suffering from chronicle conditions in mind, but can as well be used by athletes or other professionals (e.g. first responders) that need to be monitored under hazardous conditions. With the development of mobile computing and wireless sensor technologies, it was possible to develop integrated application which offers real-time mobile health monitoring. Considering that wireless sensors are an essential factor to create an innovative solution like KeepCare®, the PlugSense Framework was the selected technology to develop the entire application core.

KeepCare® is able to monitor the real-time condition of people through body sensors and automatically alert their caregivers or even an emergency centre. The system is prepared to monitor ECG, body temperature, heart rate, localization, weight, glucose and oximetry. The sensor data is

transmitted to KeepCare® Mobile through Bluetooth® technology that processes data locally and warns the caregivers if the data exceeds the thresholds. Furthermore, the system has an alert button for emergency situations which establishes immediately the communication between patient and caregiver, this function could have a vital role in people lives.

The system has a complementary service which includes medical vigilance. This service allows patients to be followed by doctors. They can view the current and history condition of patients, set remotely the thresholds values for each metric and give health-related advices.

Another feature of KeepCare® is a personal assistant module which includes regular reminders and location tracking. This alarm feature is configurable to remember users to take medicines or other daily routines. The location tracking is used to get a real-time location in order to find users when an emergency is detected as well as a location tracking of, for example, Alzheimer patients.

Depending on the needs, KeepCare® uses different monitoring devices. For example, to monitor ECG, body temperature and heart rate the system uses BioHarness™ BT or Consumer HxM by Zephyr Technology. For localization it uses the GPS signal of smartphone or even SPT10 by Wonde Proud. The system was developed to integrate any kind of wireless sensors easily in order to increse the offer of devices to their clients.

Considering that the system was developed for cloud computing, the requirements to use KeepCare it's only an internet access.

Figure 1. KeepCare® and KeepCare® mobile

Conclusions

The KeepCare® product is WSN based solution for real-time mobile health monitoring of user in the home environment, developed using the PlugSense framework. This solution promotes not only better healthcare,

since it can be used to support formal and informal caregivers, but also promotes self-management, by providing valuable information for the user.

The use of the PlugSense framework in the implementation enable a reduction of 1/3 in the estimated development time; due to its features and structured methodology the development time was reduced and as a consequence the total cost of the project was lower reduced, maintaining the functionalities and quality of the final product.

References

[1] P. S. Pandian, K. Mohanavelu, K. P. Safeer, T. M. Kotresh, D. T. Shakunthala, P. Gopal, V. C. Padaki. Smart Vest: wearable multi-parameter remote physiological monitoring system. Medical engineering & physics, 30(4):466–77, Maio 2008.

[2] U. Anliker, J. A. Ward, P. Lukowicz, G. Troster, F. Dolveck, M. Baer, F. Keita, E. B. Schenker,F. Catarsi, L. Coluccini, A. Belardinelli, D. Shklarski, M. Alon, E. Hirt, R. Schmid, M. Vuskovic. AMON: a wearable multiparameter medical monitoring and alert system , 2004.

[3] R. Paradiso, G. Loriga, N. Taccini. A wearable health care system based on knitted integrated sensors , 2005.

[4] http://www.freedomgrow.pt (last visited January 2013)

[5] http://bullseye.xbow.com:81/Products/productdetails.aspx?sid=154 (last visited November 2012)

[6] http://download.java.net/mobileembedded/developerdays/2009/TS-14-v1.pdf (last visited December 2012)

[7] http://www.ewisense.com/ (last visited January 2013)

Raquel Sousa has a master degree in Network and Information Systems Engineering (University of Porto). She has participated in several research projects in the ICT for Health area, with expertise in telemetry and sensor networks. At IncreaseTime since its creation, Raquel Sousa is a Senior Engineer and Project Manager. She (co)-autored some publications related to e-health.

Marco Alves has the master degree in Informatics and Computing Engineering (University of Porto). Since 2011 he is Development and Support Manager at FreedomGrow, where he is responsible for the development of software solutions based on wireless sensor networks and he is coauthor of some publications presented in renowned WSN conferences.

Gil Gonçalves received the Engineering Degree in 1993 and the M. Sc. degree in Electrical and Computer Engineering in 1996, both from Porto University. He is receiving the Ph.D. in Electrical and Computer Engineering in 2013. Lecturer/researcher at Faculdade de Engenharia da Universidade do Porto since 1998 and researcher at Instituto de Sistemas e Robótica - Porto since 1994. He (co)-authored more than 60 publications in areas related with innovation, ICT, manufacturing, robotics and control.

Organization, Workflow and Technical Issues of School Screening Telediagnostics of Faulty Postures and Scoliosis

B. Glinkowska[1,5], A. Żukowska[2,5], K. Walesiak[3,5], J. Michoński[4], R. Sitnik[4], W. Glinkowski[3,5]
[1]Department of Sports and Physical Education, Medical University of Warsaw, Poland, Żwirki i Wigury 81A, 02-091 Warszawa, Poland
[2]Student's Scientific Club "TeleHealth", Medical University of Warsaw
[3]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Medical University of Warsaw
[4]Institute of Micromechanics and Photonics, Warsaw University of Technology, Warsaw, Poland
[5]Polish Telemedicine Society, Poland

Abstract: **An automated system for telediagnostics of faulty postures and scoliosis was designed and developed. Surface topography, clinically relevant parameters are calculated, based on landmarks detected with a markerless method. The safety of the system is warranted by using the structured light method. Back surface topography helps the clinician detect measure and monitor the deformity, sagittal plane curvatures and sagittal trunk inclination. The results can be stored in a database and accessed remotely. The results can be transferred using the Internet for teleconsultation with a specialist. The software allowing for data analysis and management remains the key element of the presented 3D, telemedicine oriented system.**

Introduction

Medical screening is a strategy used in a population to identify an unrecognized disease in individuals in apparently good health, with pre-symptomatic or unrecognized symptomatic disease [1]. Its main purpose for school children is detection and prevention of diseases and health problems. Screening tests are usually performed by the family physician [2]. School screening tests may utilize Adam's forward bending test and rib hump quantification with a scoliometer. Modern techniques of scoliosis screening utilize non-invasive surface topography methods such as Moire topography.

The aim of this study was to describe the organization, workflow and technical issues of telediagnostics for school screening for faulty postures and scoliosis with an originally developed three-dimensional, computer-aided, measurement based on structured light.

Materials and Methods

A telemedicine automatized system for diagnostics of faulty postures and scoliosis was designed and developed. It consists of a three-dimensional measurement system based on the structured light method and custom-made data analysis software. Examination results are stored in a centralized database to allow remote access via Internet [3]. The structured light method makes the examination safe, using no ionizing radiation. The results of the measurement include the three-dimensional image accessible for viewing, a series of indices connected to scoliosis (POTSI, DAPI, SHS, sATR), sagittal curvature angles and the sagittal balance angle. For the purpose of this project, two mobile units were constructed and delivered to over 60 schools in the Mazovia region, Poland. The measurement systems did not require any complicated calibration on the premises apart from a simple procedure for acquisition of the plumb line. The examination procedure consisted of several steps to be performed by the system operator. Firstly, the group of children or adolescents had to be mustered. Examination of each subject was conducted separately. A stand was used to ensure that the subjects remain within the measurement volume. Once on the stand, the subject was asked to expose the shoulders, neck, waist, and buttocks a few centimeters below the natal cleft towards projector. The stand could also serve as a bra hanger for girls. Patients with long hair were asked to tie the hair to reveal the whole back surface. The investigator entered patient's personal data (e.g. name, date of birth, weight, height) to *3D Orthoscreen* software, asked the patient to stand still in the habitual position and performed the measurement. The measurement device projected a set of patterns onto patient's back surface. During surface topography no palpation examination was performed. The surface scan resulted in a cloud of points enabling further analysis. A well-organized examination schedule is important and allows examining the maximum number of subjects per day. The exam requires to secure the confidence, understanding, and cooperation of the students participating in the screening process because they may be shy and anxious [4]. The whole procedure was explained to subjects in detail before the examination to alleviate anxiety and stress. Adolescent girls could experience discomfort due to the obligation to remove the bra. The time required for the measurement was similar to the standard screening procedure. The study protocol was

approved by Bioethical Committee accordingly to Declaration of Helsinki. All minors' parents or legal guardians signed the informed consent form. All adult subjects signed their informed consents to participate in the study as well.

Results

The examination team has faced several organizational, workflow and technical difficulties to manage over 20,000 three-dimensional exams. The measurement data was stored in a dedicated remote database at the Telediagnostic Centre for assessment. Obtaining informed consents form parents or legal guardians was the principal condition for subjects workflow. Remote access to data via VPN (Virtual Private Network) only by authorized investigators provided safety of the study. The result for individual subject consists of his/her three-dimensional image of the back with calculated indices based on anatomical landmarks. These measures are included in the report generated for an individual exam or in a spreadsheet for the cohort studies [5, 6]. The average efficiency of the three-dimensional measurement system achieved by the examination team was approximately 100 subjects per day. The software allowing for data analysis and management remained a key element of the presented 3D, telemedicine oriented system.

Discussion

Surface topography methods are sufficient for scoliosis screening [7] and can be used for monitoring of treatment results [8]. School screening only for scoliosis remains controversial, however Adobor et al. [9] have found that lack of school screening programs results in increased number of surgical treatment of scoliosis [10]. Ueno et al. have postulated that primarily it is "necessary to review and optimize the target groups" to increase effectiveness of early scoliosis detection [11]. According to Fong et al. [12] Adam's forward bending test and angle trunk rotation are the most common techniques used for school screening for scoliosis. Other used methods were Moiré topography and low-dose roentgenography. Those methods require that examination is carried out by medical professional (e.g. orthopaedist, nurse, physical therapist or other) [13]. Traditional scoliosis screening utilizing Adam's forward bending test and rib hump quantification with a scoliometer usually require palpation examination, which may increase the level of anxiety and stress in patients. The three-dimensional telediagnostic measurement system allows to access patient's three-dimensional measurement data remotely for further analysis

and monitoring. The presented methodology for 3D structured light posture assessment may improve efficacy and effectiveness of screening, including cost effectiveness. The efficiency of the system may rely on several technical issues including the Internet connection, however organizational, ethical and workflow issues require consideration. Relatively fast Internet connection allows achieving reasonably short time for the posture assessments. We expect that further and more advanced automation of the examination in the near future shall speed up the procedure.

Acknowledgment

This study was supported by the project NR13-0020-04/2008 funded by the National Center for Research and Development with public money for science.

References

[1] J. Van Cleave, K. A. Kuhlthau, S. Bloom, P. W. Newacheck, A. A. Nozzolillo, C. J. Homer, et al. Interventions to improve screening and follow-up in primary care: a systematic review of the evidence. Acad Pediatr 2012;12:269-82.

[2] M. Riley, A. B. Locke, E. P. Skye. Health maintenance in school-aged children: Part I. History, physical examination, screening, and immunizations. Am Fam Physician 2011;83:683-8.

[3] J. Michonski, W. Glinkowski, M. Witkowski, R. Sitnik. Automatic recognition of surface landmarks of anatomical structures of back and posture. J Biomed Opt 2012;17:056015.

[4] P. G. Korovessis. Observations made during school screening for scoliosis in Greece. Spine (Phila Pa 1976) 1998;23:1924.

[5] W. Glinkowski, J. Michonski, B. Glinkowska, A. Zukowska, R. Sitnik, A. Gorecki. Telediagnostic 3D school screening of back curvatures and posture using structured light method - pilot study. Stud Health Technol Inform 2012;176:291-4.

[6] A. Żukowska, J. Michoński, R. Sitnik, W. Glinkowski. The 3D Posture Telediagnostics: Preliminary Efficiency Study. In M. Jordanova and F. Lievens (Eds.) Med-e-Tel 2012 Electronic Proceedings of The International eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business. Luxembourg: International Society for Telemedicine & eHealth (ISfTeH); 2012. pp. 704-7.

[7] T. Kotwicki. Evaluation of scoliosis today: examination, X-rays and beyond. Disabil Rehabil 2008;30:742-51.

[8] K. Schumann, I. Puschel, A. Maier -Hennes, Weiss HR. Postural changes in patients with scoliosis in different postural positions revealed by surface topography. Stud Health Technol Inform 2008;140:140-3.

[9] R. D. Adobor, S. Rimeslatten, H. Steen, J. I. Brox. School screening and point prevalence of adolescent idiopathic scoliosis in 4000 Norwegian children aged 12 years. Scoliosis 2011;6:23.

[10] R. D. Adobor, R. B. Riise, R. Sorensen, T. J. Kibsgard, H. Steen, J. I. Brox. Scoliosis detection, patient characteristics, referral patterns and treatment in the absence of a screening program in Norway. Scoliosis 2012;7:18.

[11] M. Ueno, M. Takaso, T. Nakazawa, T. Imura, W. Saito, R. Shintani et al. A 5-year epidemiological study on the prevalence rate of idiopathic scoliosis in Tokyo: school screening of more than 250,000 children. J Orthop Sci 2011;16:1-6.
[12] D. Y. Fong et al. A meta-analysis of the clinical effectiveness of school scoliosis screening. Spine (Phila Pa 1976) 2010;35:1061-71.
[13] D. Y. Fong, C. F. Lee, K. M. Cheung et al. A meta-analysis of the clinical effectiveness of school scoliosis screening. Spine (Phila Pa 1976) 2010;35:1061-71.

Bożena Glinkowska M.S. (Physical Education); V-ce Chief of the Department of Sports and Physical Education, Medical University of Warsaw, Poland. Diploma in teaching. Physioprophylaxis and Corrective Exercise Specialist.

Teleconsulting Inserted in a Moodle platform: The Experience of UERJ Nucleus of Brazilian Telehealth Networks Program

R. Santos, W. Santos, M. Santos, M. Rocha, João Neves, A. Monteiro
Rio de Janeiro State University Telehealth Center,
coordenacao@telessaude.uerj.br
Laboratório de Telessaúde, UERJ, Av.Vinte e Oito de Setembro,77.Térreo.Sala 126, Vila Isabel.Rio de Janeiro, Brazil

Abstract: **30,024 health professionals, with graduation or high school levels, are registered at the Moodle platform of UERJ Telehealth Center. All these professionals take part in educational live or recorded events and in distance online courses. Under this background the system of teleconsulting (SIATES) was integrated to Moodle, in order to make easier the access of the users (that now have got a single register and login) to both systems.**

Introduction

30,024 health professionals, with graduation or high school levels, are registered at the Moodle platform [1] of UERJ Telehealth Cente [2]. All these professionals take part in events through teleconference and/or distance online courses. Under this background, in 2010, the system of teleconsulting (SIATES) was integrated to Moodle, in order to make easier the access of the users (that now have got a single register and login) to both systems. The aim of this paper is to demonstrate the influence of the integration of two different systems.

Methodology

Moodle is the acronym for "Modular Object-Oriented Dynamic Learning Environment", e.g., an open software of support to learning in a virtual environment. SIATES is a teleconsulting health system developed by UERJ Telehealth Center staff. It enables health professionals registered at Moodle to send doubts (clinical or general ones) for a second opinion of a specialized multiprofessional staff. At the Moodle page “entrar.php” some parameters took from the page “config.php” were applied, making possible to recover information from the active session of the user. So, when the user, logged in Moodle, accesses SIATES, some of his data, as ID and CPF

(Brazilian acronym for Taxpayer Identification Number) are saved by the system and compared with SIATES data bank. In case the user already exists in SIATES and his data are updated, the system is going to authenticate it automatically and fairly. If the user is not registered in SIATES, the Moodle routine of "entrar.php" automatically makes the register based in the data recovered from Moodle, and then proceeds to the user's authentication.

Results

After the integration [Fig. 1], an expressive increase of 57% in the number of users registered at SIATES [Fig. 2] was verified, in comparison to the former period of integration, which was of 25%; and a dramatic decrease in the quantity of support requests for register or assessment to the systems was also observed.

Figure 1. Integration between Moodle platform and teleconsulting system (SIATES)

Figure 2. Teleconsulting System for Health [SIATES]

Conclusion

Based in the outcomes reached, it is possible to conclude that the integration of the systems acted as a facilitating agent to the user in health, fulfilling, thus, the aim of the present study.

References

[1] UERJ Telehealth Center Collaborative Platform**.** Accessible in http://www.telessauderj.uerj.br/ava/

[2] Rio de Janeiro State University Telehealth Center**.** Accessible in http://www.telessaude.uerj.br/site/

Alexandra Monteiro. MD.PhD. - Associate Professor of Radiology, Medical School of State University of Rio de Janeiro [UERJ].Brazil. Coordinator of Rio de Janeiro State University Telehealth Center. Member of the State of Rio de Janeiro Academy of Medicine. Coordinator of the Brazilian College of Radiology Teleradiology Committee. Coordinator of the Nucleos RJ - Brazilian Telehealth Network Program (Ministry of Health). Member of the Standing Committee for Telemedicine and Telehealth (Ministry of Health). Member of the Advisory Committee of Telemedicine University Network (Ministry of Science technology and Innovation).

Telerehabilitation for Patients Suffering Musculo-Skeletal Disorders – Own Experience Based on Implementation Projects

W. Glinkowski[1,2], K. Krawczak[1, 2], D. Cabaj[1,2], K. Walesiak[1,2]
A. Czyżewska[1,2], 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] Polish Telemedicine Society, Warsaw, Poland

Abstract: **"Telerehabilitation or e-rehabilitation is the delivery of rehabilitation services over telecommunication networks and the Internet." Our first attempts to support patients with remotely mentored rehabilitation were performed in 2004. 3G videoconferencing and MMS services on mobile phones and videoconference application were implemented for telerehabilitation in 2006. The further development of telerehabilitation for orthopaedic patients suffering chronic hip or knee osteoarthritis (OA) occurred within the frame of European ICT PSP CIP Project „CLEAR". Clinical telerehabilitation protocols were implemented for home rehabilitation. The further implementation in the field of the telerehabilitation uses biofeedback sensors to provide efficient and innovative telerehabilitation service in the clinical practice.**

Introduction

"Telerehabilitation or e-rehabilitation is the delivery of rehabilitation services over telecommunication networks and the Internet". Our experience in telerehabilitation rises from first attempts performed in 2004, followed by 3G videoconferencing and MMS services on mobile phones and videoconference application dedicated for telerehabilitation for postoperative management and exercises, until now where we have tested internet based platform allowed implementing telerehabilitation for orthopaedic patients within the frame of European ICT PSP CIP Project „CLEAR". The perspectives for near future rehabilitation consider merging videoconferencing systems with modern, new devices including biofeedback sensors.

Aim of the Study

The aim of that project was to assess possibilities and efficacy of telerehabilitation in home environment for patients suffering chronic diseases i.e. osteoarthritis (OA), pain syndromes, etc.

Projects Description

In 2008 we have designed another telerehabilitation system for treatment postural disorders. In 2012 the research and implementation of telerehabilitation services using motion isokinetic sensors for the treatment of musculoskeletal disorders of civilization. The main orthopaedic rehabilitation task of the CLEAR Project was to implement home therapy protocols for osteoarthritis patients. Osteoarthritis (OA) is among the five most disabling diseases, having a remarkable public health impact due to pain and disability. OA is one of the most common forms of arthritis and affects men and women equally. Patients suffering OA were diagnosed and treated at the facility with use of telemedical platform either before or after Total Joint Replacement (Hip or Knee). The project allowed to design, develop and implement clinical based protocols a telerehabilitation service for home rehabilitation and telecare for self-management and to elaborate the European standard for home telerehabilitation, freely accessible from the Website. The implementation consisted of: defining users requirements, defining patients' needs in relation to the treatment of certain disorders, creating and improving patient - oriented platform for the telerehabilitation, defining telerehabilitation protocols and initiating and introducing telerehabilitation services in Poland. The most important task was to incorporate telerehabilitation services to the already existing therapy standards for patients. The technical services supporting telerehabilitation were outsourced from a local service provider. Patients recruited to participate in the telerehabilitation study were supervised by a qualified team of orthopaedic surgeons and physiotherapists.

The Project CLEAR achievements

Three hundred and seventy two patients suffering osteoarthritis of the hip and knee signed informed consent. In the study group 161 patients were diagnosed and put on a waiting list for the Total Joint Replacement surgery. Fifty six patients were included to the study group after surgery. They received their home exercises programs over the Internet platform Habilis. One hundred and five patients were enrolled to the control group. Patients in the control group did not participate in the exercise program under the supervision via platform and received only standard instructions to perform

exercises at home. One hundred and ninety seven patients completed the exercise program over the Internet. Organizational and technical difficulties were well recognized. Drop-outs from the study resulted from an independent and unforeseen circumstances at the outset, i.e. difficulties of Internet access over the 3G network, lack of adequate computer skills, or independent comorbidities. More than 80% of patients who finalized their individual teletreatment program were satisfied of using the platform and service.

Telerehabilitation with use of Biofeedback Sensors

Several patients mentioned the sensing as the most missing attribute of remotely supervised rehabilitation. The next step of development of telerehabilitation is focused to deliver a remote sensing. A new implementation utilizes biofeedback sensors along with web based videoconferencing to provide efficiently innovative telerehabilitation service in the clinical practice. The system based on the concept of feedback (biofeedback) containing an innovative device with integrated position and speed sensors to assess the function of upper or lower extremities or the trunk. A specialized software allows the remote assessment and monitoring of telerehabilitation program (Meditouch - HandTutor, Arm Tutor, LegTutor, 3D Tutor) (Fig.1). The biofeedback devices can be used for hospital and remotely mentored home care rehabilitation. Wearable motion capture devices and tailored rehabilitation software allow patients to take part in intensive virtual functional task training. Patients are able to practice exercises tailored for their disabilities having their joints or body parts remotely supervised.

Fig.1 Hand biofeedback device (Hand Tutor) The system uses games that allow the patient to practice isolated or inter joint coordination exercises (Fig.2). “Playing” rehabilitation games enable the patient to perform Range of Motion (ROM), speed and accuracy of movement exercises. The therapist can adjust and customize properly selected exercises to the

patient's movement abilities. Therapists can objectively and quantitatively evaluate and report on the patient's treatment progress. The range of rehabilitation protocols is assured by use of four biofeedback devices for upper extremity including hand, lower extremity and also for functional rehabilitation of the trunk. Patients with musculoskeletal disorders as well as neurological problems may benefit from using biofeedback telerehabilitation. Ongoing study expects that biofeedback system can provide additional form of remotely supervised rehabilitation based on active exercises to improve patient's functional abilities, similar to presented by Carmeli at al. [1].

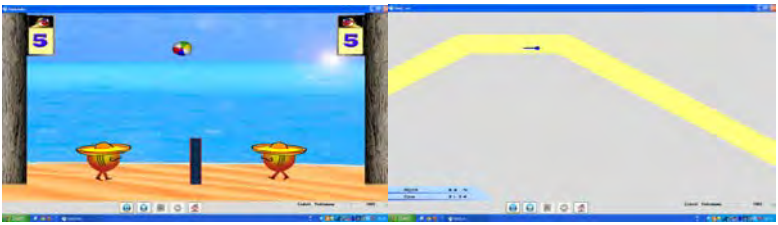


Fig.2 Own screenshots - patient's telerehabilitation game training

Conclusion

The experience gained during the implementation of the telerehabilitation protocols support that remotely supervised rehabilitation can be recognized as complementary to the standard face-to-face therapy. This solution can be recommended for patients who are not able to attend outpatient rehabilitation. The already tested protocol consisting of four weeks of individually tailored, intensive telerehabilitation program has shown its safety and effectiveness for patients suffering musculoskeletal disorders. Additionally, the combination of traditional therapy with the biofeedback system proved to be significantly more effective than traditional therapy alone. The advantages of telerehabilitation rely on patient motivation for daily activity, online remote data access, and cost-effectiveness [2]. Own experience indicates that the currently developed form of ICT supported home rehabilitation may become the leading methodological approach for the implementation of efficient and innovative telerehabilitation service for daily clinical practice. We do expect further improvement of telerehabilitation effectiveness due to merging various technologies into a complex telerehabilitation system like presented merging videoconferencing, gaming for health and biofeedback devices.

Acknowledgment

This study was partially supported by CLEAR project (ICT-PSP-224985) Clinical Leading Environment for the Assessment and validation of Rehabilitation Protocols for home care and by project funded by National Center for Research and Development NR13-0109-10/201.

References

[1] E. Carmeli et al. *HandTutor ™ Enhanced Hand Rehabilitation after Stroke — A Pilot Study*. Physiother. Res. Int. , 2010.

[2] W. Glinkowski et al. *Pre-surgery and Post-surgery Telerehabilitation for Hip and Knee Replacement - Treatment Options Review and Patient's Attitudes towards Telerehabilitation* eChallenges e-2010 Conference Proceedings 2010.

Wojciech Glinkowski MD, PhD. Assistant Professor of Orthopaedics and Traumatology of Locomotor System at the Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto" (for Telediagnostics and Treatment of Disorders and Injuries Musculo Skeletal System). President of Polish Society of Telemedicine and eHealth.

The Bioresonanse Approaches for Telediagnosis and Telecare

I. E. Ivanov[1], V. E. Gueorguiev[1], D. V. Georgieva[2], S. Gerova[3]
[1]Technical University Sofia, iei@tu-sofia.bg, veg@tu-sofia.bg
8 "Kl. Ohridski" blvd., 1000 Sofia, Bulgaria
[2]New Bulgarian University, dvelcheva@nbu.bg
21 "Montevideo" str., Sofia, Bulgaria
[3]Clinicists Specialist, svetlanadavidova@mail.bg
Sofia, Bulgaria

Abstract: **It was experimentally proved that that cellules, tissues and organs have strict bioelectrical characteristics. Changes of cellules can be deciphered only with the newest diagnostic method - energy-informational diagnostic - bioresonanse. This paper aims to present some novel approaches to integrate bioresonanse with telemedicine practice and to present first results of combination of telediagnosis solutions based on bioresonanse diagnostic tools. Additionally will be presented some preliminary work on telecare based on bioresonanse therapy.**

Introduction

Researches, carried in many laboratories and centers has shown, that cellules, tissues and organs are such structures that have strict bioelectrical characteristics. It was experimentally proved, that this characteristics can fast and deeply change during the reign of pathologic processes. But beginning latent deep changes of human organism, changes of cellules can be deciphered only with the newest diagnostic method - energy-informational diagnostic – **bioresonanse diagnostic**. This is one of the latest medical diagnostic developments that allow showing the slightest changes of the human's organism. Such a technology gives possibility to get full information about the health of a patient and to localize any early presentations of diseases, what is impossible when is used any of other present-day diagnostic methods, which can detect only already formed pathologic process.

The paper aims to present some novel approaches to integrate bioresonanse with telemedicine practice and to present first results of combination of telediagnosis solutions based on bioresonanse diagnostic

tools. Additionally will be presented some preliminary work on telecare based on bioresonanse therapy.

Preliminary Research

The group aimed in this work has long experience with telemedicine applications of vital signs acquisition and remote transportation. Together with general signs acquisition like blood pressure, temperature, CO_2, etc. we found new needs for solutions for complex diagnosis in situation when qualified medical personnel is not available. There are at least two ways to go – on-site automated diagnosis and remote diagnosis based on complex data acquisition. The first one is not a target for our research. The second method can be based on many different technical solutions and wide variety of approaches. A number of space and military applications can prove this.

If we talk about precise remote diagnosis based on vital signs and measurements for civil applications we need some stable, proven and not extremely expensive technology supporting physicians in they work. For the last 20 years a brand new direction in computer-based diagnosis was created – Non-Linear Computer Diagnosis. It is based on more than 70 year work in the field of human electromagnetic fields analyses. In general it is based on measurements of generated by the body (all levels of complexity) electrical frequencies and responses on externally generated periodic signals. This work is not oriented to introduce new research in this area but to exploit its results and ready-to-use apparatus.

According to known solutions all machines measuring human electrical signs are contact, e.g. the patient holds electrodes and the apparatus generates some electrical signals and measures body responses. There are differences how many electrodes are used, how and where they are connected to the body and similar details. All this is not relevant to our investigation except one important point – some machines need medical personnel to connect the apparatus to the patient and some other are simpler and the patient can connect himself without external support. Measurements are patient independent. The machine runs preprogrammed sequences of measurements. Depending on how general is this measurement it lengths different time periods. After that results are processed by computer to filter and normalize measured signals and to compare them with patterns from diagnostics library. After all of this results are presented to the doctor for final diagnosis.

Many machines are equipped with sensors to do analyses proposed by d-r Reinhold Voll. This method is based on acupuncture contact points and needs educated doctor. Additionally measurement needs constant pressure

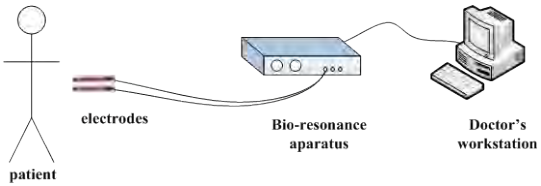
at each contact point what makes it hard to proceed and subjective. So it is not appropriate for telemedicine application.

We did not find anywhere applications of bioresonanse-based diagnosis adapted for remote use. Our investigation targets this extension of available today technologies.

Experimental Work

Basically the possibility to use **bioresonanse diagnostic** and **bioresonanse treatment** for telemedicine applications requires measurements to be independent form any qualified personnel. The best way is when sensor or sensors are worn by the patient and need no support. If this is impossible the patient himself or somebody puts the sensor(s) on the patient's body and starts measurements. Communication to the server and doctor's working place should be patient independent.

All the systems we can access directly are closed computerized equipment without possibilities for customization. This answers requirements for medical devices.



Usual application of bioresonanse environment looks like this one on figure 1. The system has not distributed structure.

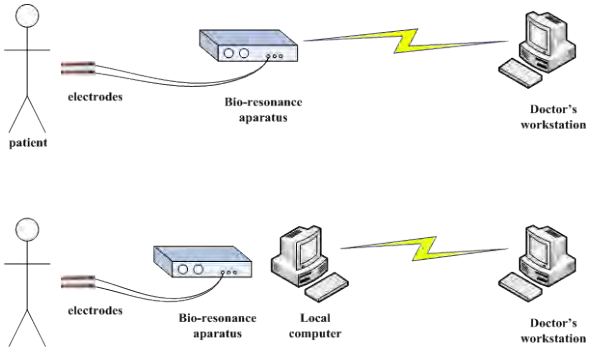
Fig. 1. General structure of bioresonanse environment

All bioresonanse apparata are fully computerized thus they can easily communicate over available networks. Surprisingly this is not available for the most of them. Without changing anything in the manufacturers' software or hardware we implemented the following adaptation for telemedical (remote) applications like one of presented on figure 2 solutions.

The implemented extension is easy to run and gives all possible control over the equipment. It is based on techniques for remote access on a target computer. The main progress here is the invented possibility to connect the doctor and data acquisition equipment which are on some distance.

After general approval that remote diagnosis based on bioresonanse is technically possible we continue our investigation to the possibility to

control remotely curing equipment to implement remote therapy. Exploiting the same technology we found that there are two solutions – real-time remote control and preliminary pattern sending to the therapeutic apparata. Both solution are stable and promise to extend applicability of the



bioresonanse methodology and methods for telediagnosis and telecare.

Fig. 2. Extended for telemedicine bioresonanse environment

Conclusion

In this paper were presented some preliminary result about possibilities to use telemedical approaches for bioresonanse diagnosis and treatment. First results are successful. Fast results can be obtained in the following areas: teleconsultations/telecare for people/groups positioned far from hospitals and no-access to general medical support, teleconsultation for many diseases in general practice, telecare for patients with known diagnoses, rescue applications.

Acknowledgment

This research is partially funded by Bulgarian NSF projects DO 02-113 and D01-1250.

References

[1] http://www.regumed.com/bicom_optima_en/it_bicom_optima_start_fs.html
[2] http://www.sensitiv-imago.ru/
[3] http://www.altimed.net/ru/production/atm-complex.html
[4] http://www.energy-healingarts.com/docs/Non-LinearAnalysis.pdf
[5] http://www.physiospect-diagnostics.com/nls-diagnostics.html.htm

The Experience of Research and Development of Second Opinion in Health: UERJ Nucleus of Brazilian Telehealth Networks Program

M. Santos, R. Santos, W. Santos, M. Rocha, J. Neves, A. Monteiro
Rio de Janeiro State University Telehealth Center, Laboratório de Telessaúde. UERJ, Av.Vinte e Oito de Setembro,77.Térreo.Sala 126, Vila Isabel, Rio de Janeiro, Brazil coordenacao@telessaude.uerj.br

Abstract: **Experiences in the use of teleconsulting represent a strategic change in health practices. The possibility of professionals working with the perspective of support at distance for a second opinion may contribute, effectively, for the improvement of the attendance to population. With such a vision, software dedicated to teleconsulting, named SIATES (System of Support to Teleconsulting in Health), was created. The aim of this study is to present the results of the use of SIATES by Brazilian health professionals**.

Introduction

Experiences in the use of teleconsulting represent a strategic change in health practices. The possibility of professionals working with the perspective of specialized and educational support at distance for a second opinion may contribute, effectively, for the improvement of the attendance to population. With such a vision, a software dedicated to teleconsulting, named SIATES (System of Support to Teleconsulting in Health), was developed by the UERJ Telehealth Center [1] IT team. This aim of this study is to present the results of the use of SIATES [2] by Brazilian health professionals.

Methodology

Web-based system developed in open software, with PHP language and use of PostGree database, a specific software for teleconsulting consisting in sending clinical or general doubts on health by submitting an online form. The access is made through a distance education platform (Moodle), in which recorded seminars, online courses and other materials are available.

Results

Until now, 30,024 health professionals are registered at the platform, 39.84% of whom use SIATES. Concerning the teleconsultings requested, 52% were related to clinical doubts, 16% to education in health, 12% to community approach, 9% to process of work, 6% to familiar approach (Fig 1). Among the users of the system, 36.09% are nurses, 21.56%, physiotherapists, 8.75% are nutritionists, 7.7%, physicians and 2.44%, dentists, including also other careers. The group of physicians and nurses prevails in sending clinical doubts.

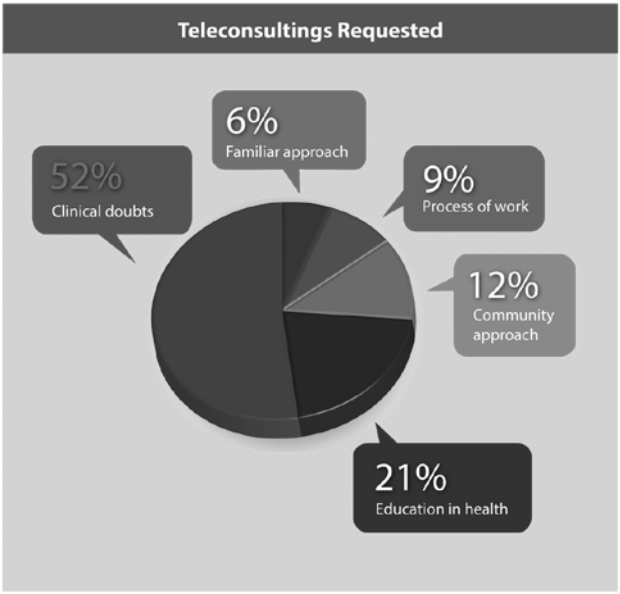


Fig. 1: Teleconsultings requested results

Conclusion

Teleconsulting is breaking paradigms in clinical practice and in health education.

References

[1] Rio de Janeiro State University Telehealth Center**.** Accessible in http://www.telessaude.uerj.br/site/

[2] System of Support to Teleconsulting in Health. Accessible in http://www.telessauderj.uerj.br/ava/

Alexandra Monteiro. MD.PhD. Associate Professor of Radiology, Medical School of State University of Rio de Janeiro [UERJ], Brazil. Coordinator of Rio de Janeiro State University Telehealth Center. Member of the State of Rio de Janeiro Academy of Medicine. Coordinator of the Brazilian College of Radiology Teleradiology Committee. Coordinator of the Nucleus RJ - Brazilian Telehealth Network Program (Ministry of Health). Member of the Standing Committee for Telemedicine and Telehealth (Ministry of Health). Member of the Advisory Committee of Telemedicine University Network (Ministry of Science technology and Innovation).

Towards Applying Cloud Computing Technologies to Support PACS in the Public Hospital Routine

M. C. Oliveira[1,2], L. H. S. Simoes-Almeida[1,2], N. Rossetti[1,2], T. De Morais[2,3] M. Melo[2,3]
[1]Computing Institute, Universidade Federal de Alagoas, Brazil
[2]Lab of Telemedicine and Medical Informatics of the University Hospital (HUPAA), Brazil
[3]Campus Arapiraca, Universidade Federal de Alagoas (UFAL) Av. Lourival Melo Mota, s/n, Tabuleiro do Martins, Maceió, 57072-900, Brazil
oliveiramc@ic.ufal.br

Abstract: **Cloud computing has been gaining ground as a solution IT worldwide. And with medical images is no different. A large volume of these images is generated every day, so it is necessary an environment that to adapt to the demand presented. Moreover, the availability of a mechanism to assist the remote diagnostic becomes a mechanism relevant to improve patient care. In view of this, the present work aims to present a model of ecosystem of virtual machines based in cloud computing, where the machines cooperate to provide an environment of display and storage of medical images by network.**

Introduction

The health centers are directly related to life quality of all citizens. The medical diagnosis based on medical images is one of the most relevant services of this sector. The digital image has revolutionized the medical area and grounded how radiologists and clinical proceed in disease treatment and direct the diagnosis. Due to their widespread use of medical images to support diagnosis, the volume of images ends growing overly. The PACS (Picturing Archiving and Communication System) server arises as a mechanism to manager this entire sum produced by centralizing into a database. Though the use of the PACS server is an approach applied commonly to store images, the server itself has storage restrictions. In clinical routine, this large volume of data should be stored safely and analyzed timely with accuracy. Even the medical images are complex by nature and require a robust computational technique to support medical diagnosis [1, 2].

The Cloud Computing (CC) technology represents the most recent and promising appliance in distributed systems area. It arises as a new paradigm

which pretends to revolutionize the computation, allying the high scalability and performance promises with an environment highly available and customizable. The CC eventually becomes the ideal scenario for the development of a wide variety of application in healthcare [3].

The goal of this project is to develop a CC environment to provide support for visualization of medical images over the network, as well as store medical images in a PACS system.

Methods

In order to perform the initial tests of the project, it was built a small cloud containing two nodes. The first machine we call PACSOnCloud-FrontEnd, with Intel Xeon X3363 processor, 2 gigabytes (GB) of RAM, 1 TB of storage capacity and has virtualization technology. The second machine we call PACSOnCloud-Node01, with Intel Xeon 5120 processor, 3 GB of RAM, 250 GB of storage capacity and has virtualization technology. The cloud was built using the virtual structure manager OpenNebula, version 3.0 and Linux hypervisor KVM. We use the web interface Sunstone, which it is provided jointly with the OpenNebula. It is a web interface to manager the whole environment, from node and virtual machines (VMs) allocation on cloud to total cloud monitoring. Furthermore, it was used the VirtualBox software to create and preconfiguration of VMs. The approach to create an environment followed two allocation mechanisms. One is to store medical images in the cloud and the other to view these images on cloud.

To the proposed environment, the store mechanism chosen was a PACS server. The PACS adopted was the DCM4CHEE. It is a DICOM (Digital Imaging Communications in Medicine) archive server, which has implementation in JAVA language. There are a few factors that explain why they were chosen: is free and open source; compatible with the chosen visualization tools and it has a web interface to management, which makes it easier for remote interaction. Since it is a test environment and the restriction imposed by the hardware, the virtual machine was scaled to 8 persistent gigabytes. The system was performed on the Ubuntu 10.04 operating system.

The software used to the visualization environment was the InVesalius. This is software to diagnosis assistance which allows the creation models in three dimensions of anatomical structures of patients, besides allowing visualization of these models. The InVesalius is a free software and public domain it can be directly acquired from the public software portal, factor that contributes to its choice.

The InVesalius version used was developed on ours laboratory, which has in its composition the ConsultPACS. The ConsultPACS is a query and retrieval tool in a PACS server, which facilitates integration with DCM4CHE installed on another VM. In this way, it is necessary that the ConsultPACS retrieve the medical images desired from the server and store them in a local repository inside the VM, so the InVesalius can rebuild the images and displays them on your viewing environment.

The goal of this allocation is to provide a visualization environment to several clients, so the VM was scaled to 256 megabytes of RAM, single-core processor, network interface and VNC (Virtual Network Computing) enabled. The images from the visualization environment were defined as non-persistent with 6 GB of store capacity.

The ecosystem of allocated VMs on cloud has one central VM, which includes the DCM4CHE server, allowing access from VMs and external entities. It also has a set of machines carrying the visualization environment, in order to attend a larger number of clients. The approach of splitting the VMs carrying the visualization environment from the VMS with PACS server proved quite adequate. With its use it is possible to perform specific modifications to each service without interfering with the other. This makes the environment more flexible and facilitates its management. The VMs can be accessed by external entities, allowing the insertion of new images on server, enabling access to the visualization environment and communicating between themselves, the visualization environment collect the medical images that was visualized on the PACS server and display them in the visualization software.

Results and Discussion

The storage environment, it is possible to insert medical images from any terminal. In that way, the allocated VM on cloud can be supplied by various sources of images, facilitating the cooperation between different organizations and allowing the database sharing with remote institutions that have the necessary privileges to use the service in the private cloud.

Regarding the allocation of the visualization environment showed simultaneously an innovative and a challenge activity. Supplying specific applications inside the network should attempt to several factors as application performance and the interface that is delivered to the user, in order to increase the number of customer as possible. Due to application requirements, this allocation was the most problematic in the overall project.

The image retrieval stored in DCM4CHE is intermediated by the ConsultPACS. The communication between ConsultPACS and the

DCM4CHE happened normally. Then, it is possible to perform queries in the DCM4CHE database through the ConsultPACS. The InVesalius, by working with 3D images, requires more computational resources to work properly. Then, it is necessary resize the VMs. The most viable alternative to resolve this problem is using a visualization environment with web services.

Conclusion

Using CC to solve IT problems has become an interesting alternative and begins to gain more space in several areas of knowledge. The medicine does not exclude from this context. Storing medical images, allowing software to manage hospitals and diagnosis assistance composes the main solutions that the medicine hosts on cloud until then.

This project proposed a scalable environment to medical images base on CC. In summary, the environment was developed in order to contain both visualization environment for medical images and the storage server of these images. In this way, this approach has absorbed a remarkable differential when compared to similar studies. While most studies relating PACS and CC are focused on storage and a few others in the provision of software to assistance diagnosis, the proposed environment unites these two possibilities. This results in an innovator environment in the context of medical images and CC.

Lastly, it is worth to highlight the social contribution of this study. Using the proposed environment will be possible to share medical images between different institutions, besides the availability of the network viewer software. This contributes directly to the quality of the patient diagnosis. The possibility of cooperation between health centers and the possibility of remote diagnosis are aspects that elevate the importance of what was presented.

Acknowledgment

Special thanks to CNPq for the financial support granted to the project.

References

[1] M. C. Oliveira,W. Cirne, and P. M. D. Marques, “Towards applying content-based image retrieval in the clinical routine,” *Future Generation Computer Systems-the International Journal of Grid Computing Theory Methods and Applications,* vol. 23, no. 3, pp. 466–474, 2007.

[2] M. C. Oliveira, P. M. de Azevedo-Marques, and W. da C. CirneFilho, “Grades computacionais na recuperação de imagens médicas baseada em conteúdo,” *Radiologia Brasileira,* vol. 40, pp. 255–261, 2007.

[3] A. Rosenthal, P. Mork, M. H. Li, J. Stanford, D. Koester, and P. Reynolds, “Cloud computing : A new business paradigm for biomedical information sharing,” *Journal of*

Marcelo Costa Oliveira is member of the faculty at Computer Institute of the Federal University of Alagoas, in Brazil. Dr. Oliveira holds a PhD. in Medical Informatics from University of São Paulo (USP), M.Sc degree in Physics Applied to Medicine and B.Sc in Computer Science. Dr. Oliveira heads the Research and the Telehealth Project of the Hospital of the University of Alagoas. His current research interests include BigData Health, Cloud Computing and Medical Image Processing.

Tércio de Morais is professor of Computer Science at Federal University of Alagoas, campus Arapiraca, in Brazil. He received MS degrees in Electrical Engineering from the Federal University of Santa Catarina, Brazil. Currently, he is PhD student at Centre of Informatics (CIn) of the Federal University of Pernambuco, in Brazil. His research interests comprise Middleware, Cloud Computing and Service Science.

Luan Henrique Santos Simões de Almeida is an undergraduate student in Computer Science at Federal University of Alagoas, in Brazil. He is a member in the Research and the Telehealth Project of the Hospital of the University of Alagoas. His research interests comprise Cloud Computing.

Nathalia Rossetti is a graduate in Bachelor of Computer Science at the University of São Paulo (USP). She is a member in the Research and the Telehealth Project of the Hospital of the University of Alagoas. Her current research interests include Cloud Computing and and Medical Image Backup.

Matheus D'Eça Torquato de Melo is professor of Informatics at Federal Institute of Sertão Pernambucano, campus Salgueiro. He receives BS degrees in Computer Science from Federal University of Alagoas, campus Arapiraca, he is MSc Student at Center of Informatics (CIn) of the Federal University of Pernambuco(UFPE), in Brazil. His research interests comprise Cloud Computing and Performance Evaluation of Systems and Analytical Models for Dependability. He is also a member of MoDCS research group at CIn-UFPE.

eHealth: Junior Doctor's Perspective and Future Implications

e-Health: Junior Doctor's Perspective and Future Implications

M. Capizzi[1], T. Laaveri[1,2]
[1]e-Health Working Group, European Junior Doctors,
capizzi.marco@gmail.com, Rue Montoyer 23 1000 Brussels, Belgium
[2]Helsinki University Central Hospital, Department of Medicine;
tinja.laaveri@fimnet.fi

Abstract: **Even if technology is mature and e-health is a technical reality, its diffusion is more a socio-technical and socio-cultural issue: e-Health needs to be accepted and used by stakeholders. Therefore one of the most urgent areas to examine and develop is the usability of the e-Health approach and applications. Junior doctors are naturally considered computer literate and some even computer natives. These generations have met technologies earlier during their learning process and medical studies and they have been already considered an important variable in the development of functional e-health systems. Since we are interested in the opinions of JD's (Junior Doctors) on different e-health aspects we decided to perform a short analysis of literature present online and to propose a first online survey to EJD (European Junior Doctors).**

Introduction

E-Health is a reality with respect to technology. But the first determinants of e-Health diffusion are socio-technical and socio-cultural, namely the level of usage by the principle stakeholders [1]: patients, who own their personal data, health workforce who introduce, use and modify patient data after patient's allowance and health care systems/organizations which need reports from clinical data for business intelligence. The structure of the e-Health system needs to answer to the needs of different stakeholders and to be coherent with the law requirements. So, beyond a harmonic legal framework, one of the most urgent matters to settle is the usability, especially of Electronic Health Records (EHR's), from the clinicians' perspective [2]. From the socio-cultural perspective Junior Doctors are an important variable, given the new socio-cultural experience created by junior workers in other industries [3]. Junior doctors (belonging to Generation Y and younger X generation) are naturally considered computer literate and some even computer natives, so they have a particular insight of

the ICT applications in health, which will slowly replace the ageing healthcare workforce vision. Therefore we are interested in the opinions of junior doctors on different e-health aspects and about the perception of their role in e-Health development.

Materials and Methods

We examined present literature regarding junior doctors and e-health (through Google, Google Scholar and PubMed) and started to investigate junior doctors' opinion with an online survey. The survey included some basic and open questions directed to the national members of EJD (European Junior Doctors www.juniordoctors.eu/main-objectives), the EMO (European Medical Organization) whose objectives are safeguarding Junior Doctors interests in Europe, contributing to the development of Junior Doctors' work and education and play a role of background group for the organizations of Junior Doctors in countries preparing to join the European Union. The survey results will be examined as the survey questions will be answered by delegates.

Results

The research of keywords "Junior Doctors" and "e-Health" shows a potential bias in terminology used to define younger doctors in literature: Junior is a term almost connected with inexperience of doctors in the health area in comparison to senior doctors [4-5]. Instead "generation y" in which the majority of Junior Doctors is included, is a term connected with natural skills regarding IT system utilization. This generation of workers even if technology savvy [6] has very different expectation of technology utilization, technology design and knowledge presentation [7]. Generation Y health workforce members do not highly value reading and listening to lectures [8] and they are accustomed to using technology when they should be studying or are in class [9]. Junior doctors could appreciate IT solutions because these solutions can help them to remember protocols that otherwise should have been only learnt by heart. The socio-cultural understanding of generation Y healthcare workers is essential to guide the design and implementation of ICT solutions for a sustainable healthcare future [10]. But significant changes to the current healthcare organization will be

required in order to unleash the full potential of generation Y workers and ICT implementation.

A study conducted among almost 4000 Finnish physicians showed that doctors under the age of 35 years seem to be less satisfied users of EHR systems than the older generations [2]. This suggests that computer literacy per se doesn't solve the usability problems experienced by physicians and that JDs should be involved more deeply in the developing of e-Health suitable solutions. This first short survey between Junior Doctors representatives aims to investigate the diffusion of e-health in European countries, the Junior Doctors perception of this diffusion and the role they have or they should have in e-Health development. The provisional results of the EJD survey will be discussed in the Med-e-Tel 2013 congress.

Discussion

The words "Junior Doctors" and "Generation Y" partially overlap at the moment with respect to their meaning. Hereafter the evolution of e-health will bring new methods, and interfaces as well as new "generations" will appear. So while the "Generation Y" will age, being composed by senior doctors, and the new generation Z will substitute the Y in the junior doctors category, the term "junior doctors"will continue to have (for natural reasons) a higher level of adaption to novelties brought by information technology. So we recommend the usage of the term "Junior" in studies regarding junior doctors and e-health, in order to allow a direct recognition of the positive connotations "Junior" word seems to have with respect to e-health, proposing Junior Doctors as crucial and critic partners in the paradigm-shift from health to e-health. Presently some of our processes and workflows are based on paper and even when computerized, in most cases we have just transferred papers on computer screens. Sometimes present EHR systems do not support any workflows: paper doesn't work on computer and revisioning workflows/processes has just only begun. In these cases if we try to work the way the EHR's require, we make completely new mistakes that get unnoticed and also our workfows could get significantly slower. Our present position as EJD e-Health working group is that medical schools should include teaching about how electronic healthcare should work in order to boost Junior doctors contribution in the development of e-Health, involving them not only as learners, but as leaders and teachers too. Moreover the aknowledgment of Junior Doctors natural skills should allow their involvement in eHealth implementation teams/working groups with senior doctors (more clinically experienced) helping each other in increasing the system usability through their different skills and skill levels.

Aknowledgment

We thank the EJD e-Health working group for the revision of this work and the national members of the countries represented in EJD for their contribution in the survey.

References

[1] R. L. Wears, M. Berg Comp. techn.andclin.work: still waiting for Godot. JAMA293 (2005), 1261-1263

[2] J. Viitanen, H. Hyppönen, T. Lääveri, J. Vänskä, J. Reponen, I. Winblad: National questionnaire study on clinical ICT systems proofs: physicians suffer from poor usability. Int J Med Inform. 2011 Oct;80(10):708-25

[3] E. Mills, C. Airey, K. C. Yee. Generation Y in healthcare: the need for new socio-technical consideration for future technology design in healthcare. Stud Health Technol Inform. 2007;130:169-79..

[4] L. Rowen, H. Melissa, P. Aoki. Asynchronous remote medical consultation for Ghana. roceedings of the SIGCHI Conference on Human Factors in Computing Systems, Pages 743-752

[5] C. A. Vincent, P. A. Driscoll, R. J. Audley, D. S. Grant. Accuracy of detection of radiographic abnormalities by junior doctors. Arch Emerg Med. 1988 Jun;5(2):101-9

[6] Pew Research Center.Millennials: A Portrait of Generation Next. Washington, DC: Pew Research Center; 2010

[7] K. C. Yee. Bermuda Triangle or three to tango: generation Y, e-health and knowledge management. Stud Health Technol Inform. 2007;129(Pt 2):1184-8

[8] K. Mangold. Educating a new generation: teaching baby boomer faculty about millennial students. Nurse Educ. 2007;32:21–23.

[9] K. T. Pardue, P. Morgan. Millennials considered: a new generation, new approaches, and implications for nursing education. NursEducPerspect. 2008;29:74–79

[10] K. C. Yee, E. Miils, C. Airey. Perfect match? Generation Y as change agents for information communication technology implementation in healthcare. Stud Health Technol Inform. 2008;136:496-501

Marco Capizzi - MD PhD, specialised in Endocrinology, Diabetes and Metabolism
EJD Communications Officer and coordinator of E-health working group
UEMS Endocrinology Section delegate and member of e-learning working group
CPME E-health working group delegate
ISfTeH Junior Doctor's working group coordinator
Engera African People Caring supporter
SID (Italian Society of Diabetology) Regione Lazio website project designer/manager.

Electronic Tools in Continuous Professional Development (eCPD) for Junior and Senior Finnish Physicians

K. Patja, T. Litmanen
Pro Medico, The Association for Medical Continuous Professional Development in Finland, kristiina.patja@promedico.fi
Mäkelänkatu 2, P.O.Box 49, 00501 Helsinki, Finland

Abstract: **In Finland, Continous Professional Development, CPD is voluntary with an ethical and legal obligation for physicians. Taitoni-platform is a personal web tool designed to manage and support physician CPD with both formal and informal learning activities. The tool is accompanied and linked with an interactive national Continuous Medical Education (CME) calendar and with official data of individual qualifications and work-place history hence it forms also an ePortfolio. Platform use and usability was tested at Helsinki Health Centre.**

Introduction

Physicians expertice can be divided to competencies, which consist of specific knowledge, skills and behaviour. In medicine clinical skills form the core competence but other competencies such as economic reasoning or communication are equally important. Society lays trust on physicians to keep their competency up to date, but equally physicians need to demonstrate their trustworthyness. In Finland, the main three medical associations have set national targets for supporting physicians CPD, accordingly by collaborating in building a comprehensive assessment tool for Finnish physicians. Tool can be used in all phases on career from juniors to seniors. The challenge is that assessment and eTools are in a constant strain in between practicality and comprehensiveness. We chose to use broader framework of competencies and focus on usability and individual benefits [1]. Tool is called Taitoni, which means in Finnish “my skills”. Model for functions of the tool was adopted from the Royal College of Physicians and Surgeons of Canada, MAINPORT, [2].

Figure 1. Front page of the Taitoni-tool interface www.taitoni.fi

Physicians can use to Taitoni:

- To document Learning Goals: aim is to support task-oriented learning. Structures goals can vary in interchangeable three phases and have competency labels (CanMEDS);
- To document Learning Events in predefined formative fields (events, self-directed learning etc.) with an option to additive informal notes;
- To seek educational events from CME calendar including national and regional trainings. Events can be directly imported to Taitoni;
- To assess their goals and learning events in graphics or tables;
- To export all data for own purposes (e.g. specialist qualifications).

While documenting learning events, physicians are asked to assess four domains: 1) What did you learn? (formatted sentences) 2) Which CanMEDS-roles the learning event covered? 3) How applicable the learned items were regarding their work with 10-point- Likert-scale from weak to 10 good. 4) Did event meet any of your learning goals?

Pilot Study in Helsinki Health Centre

In this study, there were 80 physicians voluntary using Taitoni-tool for a six-month period and 45 of them inserted learning events. The total number of recorded learning events was 354, average visits per week was 53. Of those who inserted learning events, the mean number of events was 7.9 per user (SD=6.9, range 1-29). Altogether 120 (average 2.9) learning goals were listed. At least one learning goal was inserted by 42 of users (53%.

Physicians set goals in all CanMEDS-roles and recorded also learning events in all roles and there was no major difference in proportions in different roles in goals and events.

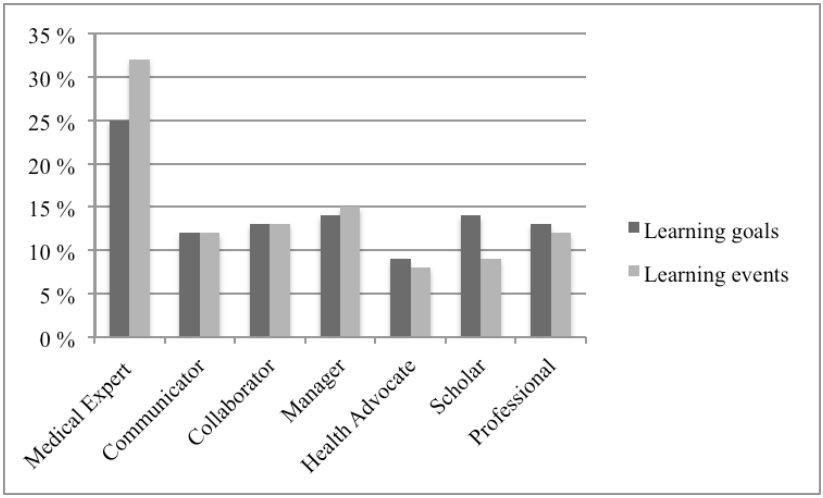


Figure 2. How learning goals and learning events inserted in Taitoni were associated with CanMEDS-roles.

Usability

The usability of Taitoni was developed further using different user-centred design methods. Feedback about use of the tool was requested from the users with a feedback box in Taitoni. Experiences and comments were collected during tutorials at health stations and hospitals. An electronic questionnaire including the 10-item System Usability Scale [3] was used to measure the usability with electronic questionnaire before (response rate 70%) and after study period (response rate 54%). By November 80% of the physicians had visited the site and usability index was 54, when a sufficient aim is to have points over 60 [4]. At the end of study the usability index was 53.

Feedback from volunteer users was active and mainly positive. Structured fields were both criticized and appreciated. Learning goals were experienced as difficult to set. Technical problems arose from older browser versions. Initiatives raised from pilot users were adopted during the pilot, such as the extension of free notes and the development of in-house CME-calendar.

Discussion

This eCPD tool forms an individual portfolio, but data from larger groups could be merged to describe learning needs and activities of a physician population as a whole. Before this pilot, we produced a website for

physicians where they can compare their learning needs and support for learning based on annual physician query [7]. In this pilot, we produced a report with figures of the total group and sub-groups (e.g. hospital vs. primary care), which was presented to the pilot group and the chief physicians at Helsinki Health Centre. In this study, junior doctors found it useful to use Taitoni data in their discussions with their mentors. It also made learning efforts visible at worksite. On a long run Taitoni could improve Organisational competence development, which supports junior doctors also. In future, e CPD tools should provide this type of data not only to physicians, but to other healthcare personnel as well. Learning is an investment to good quality and deserves to be recognised [6].

Acknowledgment

We thank the Helsinki Health Care Centre and physicians in this study.

References

[1] R. M. Epstein, E. M. Hundert. Defining and assessing professional competence. JAMA 2002 Jan 9;287(2):226-235.

[2] The Royal College of Physicians and Surgeons of Canada. The CanMEDS 2005 Physician Competency Framework. Better standards. Better physicians. Better Care. 2005.

[3] A. P. Schwab. Putting cognitive psychology to work: Improving decision-making in the medical encounter. Soc Sci Med 2008 Dec;67(11):1861-1869.

[4] K. Holtzblatt, J. B. Wendell, S. Wood. Rapid contextual design : a how-to guide to key techniques for user-centered design San Francisco: Elsevier; 2005.

[5] K. Overeem, M. J. Faber, O. A. Arah, G. Elwyn et al. Doctor performance assessment in daily practise: does it help doctors or not? A systematic review. Med Educ 2007 Nov;41(11):1039-1049.

[6] K. Patja, T. Litmanen, P. Salokekkilä, A. Hemminki. Developing electronic tools for continuing professional development for Finnish physicians: a usability study in a primary health care setting. Journal of European CME 2012, Vol.1, No 1: 42-47.

[7] T. Litmanen, J. Ruskoaho, J. Vänskä, H. Halila, K. Patja. Does the need for professional competencies change during the physician's career? – A Finnish national survey. Medical Teacher 2012, 33 (5), e275-e280.

ePortfolios in Postgraduate Medical Training – from European Junior Doctors' Perspective

L. I. Lanczi
ePortfolio Working Group, European Junior Doctors
lanczilevente@gmail.com

Abstract: **Assessment and registration of postgraduate medical training activities are mostly paper-based to date around European countries. European Junior Doctors (EJD) aim to evaluate experiences in its member countries and find possibly common solutions for a state-of-the-art electronic assessment tool: ePortfolio. Moreover, an ePortfolio system has more possible applications that focus on self-learning, professionals' progress and can support mobility. EJD designed a survey and organized a workshop recently – the outcomes will be presented in this paper.**

Introduction

Portfolios and logbooks are widely used in medical training on both undergraduate and postgraduate level. European Junior Doctors' aims to have a panoramic view and set up minimal standards around Europe that supports European level goals. Licensing varies among countries and specialties, on the other hand students', trainees' and professionals' mobility has enormously increased [1]. Bridging these gaps a collection of previously performed and assessed skills and knowledge can support recognition and more importantly progress of professionals [2].

Medicine is generally in good situation among recognition of professions that means diplomas and licenses are accepted bilaterally. Assessment and professionals' progress can be followed up using logbooks that in 21st century should be electronic [3]. That is ePortfolio.

EJD's opinion is that documentation and evaluation are essential parts of postgraduate medical training. For that reason there must be sufficient and easy to access web-based applications, that allows junior doctors to proceed in their training without being all time depending on their supervisors to sign papers [4-5]. Parallel to this, evaluation of postgraduate medical training and curricula is essential, preferably on a regular base.

It has been for many years a goal of EJD to assess the logbook or ePortfolio systems and postgraduate training around Europe, thus a survey was performed during last EJD General Assembly October 2012 in Malaga.

Moreover, a multilateral workshop was organized in early 2013 to discuss the topic, representing 8 European countries, junior and senior doctors and medical students.

Survey results, discussion outcomes and some recommendations will be presented in this paper.

Materials and Methods

An on-line questionnaire was created and submitted for EJD representatives during October 2012. 12 questions were asked about the logbook systems and personal opinions on future applications.

Results

13 countries answered: Croatia, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Malta, Portugal, Slovenia and Spain. In most of the countries a logbook is compulsory for trainees during postgraduate medical training. In most of the countries (77%) logbooks are compulsory. In 3 countries (23%) the logbook is electronic. Majority (71%) of countries with paper based logbook states that it would be more useful and beneficial, if the paper-based logbook would change for an electronic one. In some countries there are not any logbooks (e.g. France).

Discussion

It is clearly visible, that portfolios are needed by trainees. The way and method of data collecting and validation, roles are still under discussion. It is important to mention, that there are good examples for ePortfolio systems in Europe and overseas [3-5], that can support an European framework process. European Junior Doctors role can be a facilitator amongst European countries: it can provide platform for discussion, experience and idea exchange, moreover can formulate recommendations for member countries and other European medical associations and decision-makers.

There are still open questions: the way of using systems, Portfolios role during licensing. [6] We should emphasize: portfolios make only the framework. It is not a goal to use portfolios, it makes only visible the elements of training, supports assessment, training and communication amongst trainees, supervisors and peers and provides feed-back for the quality of healthcare system and patients' sake.

References

[1] C. P.van der Vleuten. National, European licensing examinations or none at all? Med Teach. 2009 Mar;31(3):189-91.

[2] F. Rubulotta, A. Gullo, G. Iapichino, A. Pezzi, J. Bion, H. Barret. CoBaTrICE Italian Collaborative. The Competency-Based Training in Intensive Care Medicine in Europe

(CoBaTrICE) Italian collaborative: national results from the Picker survey. Minerva Anestesiol. 2009 Mar;75(3):117-24.
[3] J. R. Frank (Ed.) The CanMEDS 2005 physician competency framework. Better standards. Better physicians. Better care. Ottawa: The Royal College of Physicians and Surgeons of Canada, 2005.
[4] D. Bryson. Learning Journal and Portfolio Tools. Journal of Visual Communication in Medicine, December 2012; Vol. 35; No. 4, pp. 178–180
[5] K. Patja, T. Litmanen, P. Salokekkilä, A. Hemminki. Developing electronic tools for continuing professional development for Finnish physicians: a usability study in a primary health care setting. Journal of European CME 2012, Vol.1, No 1: 42-47.
[6] J. van Tartwijk, E. W. Driessen. Portfolios for assessment and learning: AMEE Guide no. 45. Med Teach. 2009 Sep;31(9):790-801.

Levente Istvan Lanczi has a Medical doctor degree at University of Debrecen (UD), 2010. PhD student (2010-) and educational officer (2012-) at Department of Biomedical Laboratory and Imaging Science at UD.
Vice-president of Student Union 2008-2010. Representative of Hungarian Medical Association of America - Hungary Chapter (2010-). Member of Hungarian Resident Doctors' Association (2009-). Hungarian delegate for European Junior Doctors (EJD) (2011-). EJD ePortfolio working group coordinator (2012-).

Harmonizing Postgraduate Medical Specialist Training In Europe: A European E-Platform Supporting Quality in Mobility

[1, 2]Z. Fras, F. Destrebecq[1], J-B. Rouffet [1]
1UEMS – "Union européenne des médecins spécialistes", Brussels, Belgium
2University Medical Centre Ljubljana, Division of Internal Medicine, Ljubljana, Slovenia

The UEMS - A Long-Standing Tradition in Harmonisation of Medical Training in Europe

Since its creation in 1958, the UEMS ("Union Européenne des Médecins Spécialistes" – European Union of Medical Specialists) promotes patient safety and quality of care through the development of harmonized standards of postgraduate specialist medical training (PGSMT), qualifications and, hence, health care across Europe. The UEMS general ambition has always been to support professionals' and patients' mobility while ensuring the best quality and safety of health care. Important pieces of EU legislation [1] were adopted in order to secure a legal framework that enables EU citizens to benefit from their right to mobility. Nevertheless, these directives have also created a need for professional organizations to develop systems which would complement and sustain these legal provisions.

In line with its Strategy [2] adopted in 2008, the UEMS established the European Council for Accreditation of Medical Specialist Qualifications (ECAMSQ®) with a view to assess the competence of European medical specialists against these high standards. Once fully implemented, this competence-based approach will contribute to achieving a common background for the assessment and certification of medical specialists, based on European Core Curricula. These Curricula were elaborated and adopted by national medical associations, competent authorities, professional and/or scientific societies as well as academics, and are also updated on a regular basis. While doing so, the ECAMSQ® is not intended to supersede the sovereignty of national competent authorities nor create a new layer of bureaucracy but rather to mobilize the existing initiatives and forces in the field of PGSMT in order to ensure grass-root improvements of quality standards in medical education and training. Its founding philosophy is based on competence-based learning and training with periodical

formative (and, possibly, summative) assessments of Knowledge, Skills and Professionalism. In a context of increased cross-border health care, the development of such a model will significantly contribute to guaranteeing that safe and high quality health care is delivered to all European citizens.

In connection with the EU Professional Qualifications Directive (PQD), such a system will also allow for increased comparability of doctors' qualifications, not only in their titles but also in their content. Whilst the PQD is mainly seen as a success, concerns were raised with regard to the accuracy and relevance of training standards in use when comparing the titles of qualifications in a certain number of medical specialties. The UEMS strongly advocated for a revision of the duration of PGSMT in different specialties in order to better reflect the evolution of medical practice and bring the Directive up-to-date with modern standards of medical care. At the same time the UEMS advocated to incorporate into the legislation also the modern educational concepts such as competence-based training and learning outcomes.

The UEMS e-Platform to Support PGSMT: A Robust and Flexible Mechanism to Support Harmonization

Nowadays, the IT technology has become essential to support education and training and engage trainees in their personal development processes. This is why use of an electronic tool to support the implementation of harmonized, high level and transparent competence-based PGSMT was seen as one of the cornerstones to build up a robust structure for widely recognized standards of comparative qualifications' recognition system in Europe.

In this regard, the UEMS is currently working on the development of a European e-platform, which will support the actual training process as well as the accreditation of medical specialists' qualifications in general. The platform is planned to embrace three different areas of PGMST assessments, namely the modules for: Knowledge; Skills; and Professionalism. The aim is to ensure that the PGMST undertaken in any of the EU and EEA Member States is recorded via the e-portfolio and assessed against the European Training Requirements developed by the UEMS Specialist Sections and European Boards. This way, wherever a trainee is trained, he/she will be able to provide high quality of care by demonstrating that he/she fulfills these European Training Requirements. These standards are also to be complemented by specific requirements, such as those established in the trainee's host Member State.

Eventually, the e-portfolio will engage the learner and the trainer into a formative process of documenting and assessing the improvement of performance at all stages of the PGMST.

The starting phase: Knowledge-based online examinations. In order to initiate a real life test of this concept, the UEMS has launched a pilot project with a view to monitor the feasibility of pan-European knowledge-based examinations supported by an e-platform. The aim was to evaluate the knowledge of trainees in different countries according to defined European Standards in different specialities. In 2011, three pilot specialities (Anaesthesiology, Cardiology and Intensive Care Medicine) took part in the starting phase of this pilot project running under the ECAMSQ®. Three online examinations were then organized, involving in total nearly 300 medical trainees from multiple centres over 15 different countries and different time zones (GMT, CET, APT) and supported by the same IT platform. This experience proved to be successful and paved the way to the next phases of implementation of a European e-platform for PGMST.

Lessons learnt from the starting phase. The key findings from these pilot tests were the following:

- IT technologies are available and ready to be used and implemented in the medical education world but have to be shaped by doctors and for doctors;
- The e-platform can be used irrespective of the location of the user at any time, either separately or simultaneously;
- The success of any IT solution depends on the involvement of all interested parties from the conception to the implementation phase;
- Strong management support is needed in each country. A network of local referees is key to ensure successful implementation of the examination;
- The quality and security of on-line examination is not different from a regular examination: using an e-platform does not prevent high quality assessment;
- Data protection and ownership of data must be addressed;
- Language remains an issue.

Next Steps

Based on this first experience, the UEMS organised further online knowledge-based examinations in other medical specialities (e.g. Emergency Medicine, Angiology). The UEMS also explored various other already existing e-platforms across Europe, mainly those enclosing the e-portfolios, with a view to design and develop a European framework for

harmonized competence-based PGSMT sustained by the technology. There is sound evidence that, if properly implemented, e-portfolios are effective and practical in a number of ways including increasing personal responsibility for learning and supporting professional development. Electronic versions are better at encouraging reflection and users voluntarily spend longer on them. The UEMS will now work on elaborating Terms of Reference for European e-platforms with an aim to provide recommendations to IT providers on the needs and expectations of European medical specialists. It will also work on further elaboration of a common standard and improvement in its individual European Curricula for Medical Specialities to ensure that they are harmonised and implementable within any e-platforms or e-portfolios.

Conclusions

The establishment of a comprehensive mechanism of evaluation and accreditation of competence-based PGMST at the European level will only be possible if resulting from a stepwise approach and if its IT enabler is developed and implemented in parallel. Research highlights the importance of feedback, relevance and assessment in engaging users and encouraging the educational/training processes which the online environment can exploit. The use of an e-portfolio and e-supported assessment of various competences needs to be embedded firmly into the curriculum and embraced by educators and users alike.

References

[1] Directive 2005/36/EC of the European Parliament and of the Council on the recognition of professional qualifications (Official Journal L255 of 30 September 2005 – page 22); and Directive 2011/24/EU of the European Parliament and of the Council on the application of patients' rights in cross-border healthcare (Official Journal L88 of 4 April 2011 – page 45)

[2] UEMS, "UEMS Strategy 2008" (UEMS 2008/05) adopted by the UEMS Council Brussels on 19th April 2008, unpublished. http://www.uems.net/fileadmin/user_upload/uems_documents/old_website_documents_admin/984.pdf

F. Destrebecq - UEMS – "Union européenne des médecins spécialistes", Brussels, Belgium

Modern Methods and Materials in the Undergraduate Education of Medical Imaging – How to Implement in Postgraduate Medical Training?

L. I. Lanczi, M. Nagy, M. Beres, A. Jakab, E. Berenyi
lanczilevente@gmail.com
University of Debrecen, Department of Biomedical Laboratory and Imaging Science, 4032 Debrecen, Nagyerdei krt. 98, Hungary

Abstract: **Modern methods and tools are inevitable in medical education – both undergraduate and postgraduate level. Our department has experience with eLearning tools and other state-of-the-art educational equipment, designed for radiographer BSc and medical students. Setting new achievements and meeting the expectations we want to extend our educational duties for postgraduate training of healthcare professionals, including physicians, radiologists and non-doctor professionals. Our way for this transition is presented in this paper.**

Introduction

Studying has been a human demand for hundreds of years, however education has to face several challenges in any time of the history. Moreover, it is a facilitator of new initiatives and scientific research. Education is not only a collection of theoretical knowledge and practical skills, but it is a special connection among masters, students and peers. In ancient times accessibility of education was very limited, since Gutenberg it has been made theoretically accessible for everyone, but only IT revolution made it practically accessible for anyone, anytime, anywhere. It is important to find the most appropriate formula for modern education methods, first of all in eLearning [1, 2].

Radiology is an appropriate field to test eLearning both undergraduate and postgraduate level [3, 4]. Our aim is to apply for postgraduate medical imaging training the below presented tools and educators' experience applied during undergraduate education.

Materials and Methods

There have been individual initiatives for implementing eLearning tools into medical education before the late 2000's at University of Debrecen, Hungary. It was a great success to introduce a system-wide eLearning project in 2010, focusing on non-doctor medical education (imaging and laboratory analyst, public health workers, etc.). A Moodle platform was customized for coordinating courses. Moodle courses are supplemented by electronic lecture notes, electronic books, wikis, glossaries, test banks, special lessons and of course live lectures, seminars and practices. Around 2500 users have attended more than 120 courses so far.

Figure 1. Front page of eLearning server at University of Debrecen

Besides Moodle other internet-based tools, such IMAIOS eAnatomy for macroscopic, radiographic and cross-sectional anatomy education, or web-based radiology case report repositories (such Radiopaedeia or Auntminnie) are used. Interactivity and self-learning can be enhanced by an own educational eRad PACS, that was introduced in 2012.

Electronic tools support theoretical education and some basic skills, but laboratory equipment, simulation tools and moreover, teaching methods have a great importance, too. For example Terranova earth field MRI system with its accessibility and low costs greatly supports MRI education. [5] Or a simulation puppet for X-ray or CT scans supports not only education, but can reduce students' and educators' radiation exposure.

Discussion

Modern methods and tools are not only opportunities, but needs from trainees in education. Radiology is a field of medicine where electronic solutions are accessible for professional use that means educators are familiar with such systems and easier to present pilots in this field.

There are several examples worldwide using similar tools in undergraduate and postgraduate training [2-4, 6]. We have to mention, that everywhere should be the most fitted methods and tools introduced. eLearning is not an omnipotent tool [7], but its advantages should be used for postgraduate medical training.

References

[1] C. Pintz, L. Posey. Preparing students for graduate study: An eLearning approach. Nurse Educ Today. 2012 Dec 19.

[2] S. Lillis, V. Gibbons, R. Lawrenson. The experience of final year medical students undertaking a general practice run with a distance education component. Rural Remote Health. 2010 Jan-Mar;10(1):1268.

[3] A. M. Monteiro, D. G. Corrêa, A. A. Santos et al. Telemedicine and pediatric radiology: a new environment for training, learning, and interactive discussions. Telemed J E Health. 2011 Dec;17(10):753-6.

[4] G. Sparacia, F. Cannizzaro, D. D'Alessandro, M. D'Alessandro, G. Caruso, R. Lagalla. Initial experiences in radiology e-learning. Radiographics. 2007 Mar-Apr;27(2):573-81.

[5] P. T. Callaghan, A. Coy, R. Dykstra, C. D. Eccles, M. E. Halse, M. W. Hunter, O. R. Mercier, J. N. Robinson. New Zealand Developments in Earth's Field NMR. Appl. Magn. Reson. (2007) 32, 63-74

[6] J. C. Núñez, R. Cerezo, A. Bernardo, P. Rosário, A. Valle, E. Fernández, N. Suárez. Implementation of training programs in self-regulated learning strategies in Moodle format: results of a experience in higher education. Psicothema. 2011 Apr;23(2):274-81.

[7] M. C. Mazzoleni, C. Maugeri, C. Rognoni, A. Cantoni, M. Imbriani. Is it worth investing in online continuous education for healthcare staff? Stud Health Technol Inform. 2012;180:939-43.

Levente Istvan Lanczi has a Medical doctor degree at University of Debrecen (UD), 2010. PhD student (2010-) and educational officer (2012-) at Department of Biomedical Laboratory and Imaging Science at UD.
Vice-president of Student Union 2008-2010. Representative of Hungarian Medical Association of America - Hungary Chapter (2010-). Member of Hungarian Resident Doctors' Association (2009-). Hungarian delegate for European Junior Doctors (EJD) (2011-). EJD ePortfolio working group coordinator (2012-).

eLearning

E-Learning Asynchronous Activities: Access and Interest Profile in Teledentistry

M. M. P Rendeiro, A. M. Monteiro, P. R. V. Dias
UERJ / Brazilian Telehealth Networks, Av. Vinte e oito de setembro, 77, térreo, sala126. Vila Isabel – RJ, Brazil
mmrendeiro@yahoo.com; monteiroamv@gmail.com;
volpatouerj@gmail.com

Abstract: **In 2007, The Brazilian Ministry of Health established The Brazilian Telehealth Program aiming at developing actions of support towards health assistance and, mainly towards permanent education of health care providers. The Program has been structured in the form of a chain of partner institutions named Brazilian Telehealth Network, within the establishment of Telehealth University Centers, Telehealth Points and Telehealth Advanced Points at the Service Units. In order to fulfill such demands, we have organized and deployed some synchronous learning actions in 2011 - monthly seminars, two-hour interactive sessions on points of interest for the professionals involved with Primary Health Care, physicians and public health. These seminars are recorded and they can be accessed afterwards. The aim of this research is not only to evaluate the participation of Dentists in the asynchronous activity, but also to get to know their profile of interest. A retrospective study was undertaken, using available information on Moodle Platform, organized on an Excel spreadsheet and analysed according to the percentage frequency. In 2011, there were 726 accesses, 41% in the afternoon shift and 44% in the night shift. In 2012, there were 2,149 accesses in order to watch the recorded seminars, involving a total increase of 296%. 38% were registered during the afternoon shift, while 58% were registered during the night shift, respectively. In relation to the professional interests concerning the topics, 70% of the accesses were towards the topics on Public Health, while 30% were related to clinical issues. Based on these outcomes, we may conclude that the learning activities are not only essential, but also very well accepted, taking into consideration the increase in the participation rate. In relation to the time of access, it was observed that they are primarily in the afternoon, the time when the Health Units are at off-peak hours and also at night, when it can be accessed from home. When it comes to the profile of interest, the topics related to Public**

Health were the most accessed ones, which show interest and the necessity of enhance knowledge.

Introduction

In 2007, The Brazilian Ministry of Health established The Brazilian Telehealth Program aiming at developing actions of support towards health assistance and, mainly, towards permanent education of health care providers. The Program has been structured in the form of a chain of partner institutions named Brazilian Telehealth Network, within the establishment of Telehealth University Centers, Telehealth Points and Telehealth Advanced Points at the Service Units. In order to fulfill such demands, we have organized and deployed some synchronous learning actions in 2011 - monthly seminars, two-hour interactive sessions on points of interest for the professionals involved with Primary Health Care, physicians and public health. For those activities, we have invited renowned professionals of remarkable knowledge. These seminars are recorded and they can be accessed afterwards.

Brazilian Policy for Continuing Education in Health, established in 2004 by the directive GM 198 of 13/02/2004, come up with the proposal of qualifying health attention through the creation of new manners of capacitation, recognizing the work as a privileged space for pedagogical practices of formation and development for health workers. This proposal demands, however, the breaking of paradigms, e.g. computer literacy for health professionals, digital inclusion programmes for the Basic Units of Health, and being aware to understanding that learning at work is also working. This is rather difficult when considering the repressed demand that causes the increasing of mouth disorders in Brazilian people, although there have been recent improvement and reduction of mouth diseases.

Collaborative learning at work is still not a practice. Even when there is applied time to the credit hours of health professionals for pedagogical activities, they do not have their right accepted. For this reason, their participation in synchronous activities is restricted to the opportunities that fit their work schedule or restricted to the Manager permission. It enhances the importance of making those opportunities of learning available to asynchronous access at Moodle platform.

Methodology

This paper intended to evaluate the participation of Dentist-Surgeons in asynchronous activities, and knowing their points of interest. A retrospective study was made using available information from Moodle

platform. That data was organized in Excel and analyzed in relation to the frequency percentage.

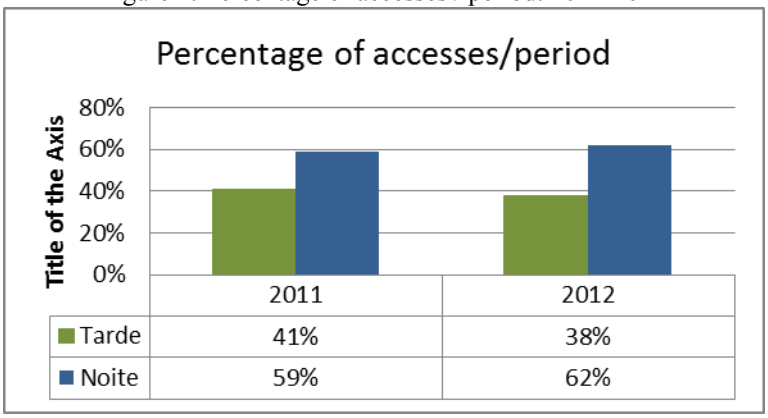
Results

In 2011, 726 accesses were made, 41% in the afternoon period and 44% in the evening. In 2012, 2,149 accesses happened for attending the recorded seminars, what sums up an important increasing of 296% (Table 1). 38% of them were made in the afternoon, and 58% in the evening (Figure 1). About the points of interest of the professionals, concerning the issues presented, 70% of the accesses were for themes related to Public Health, while 30% to clinical matters.

Table 1: Evolution of the Total of Accesses /period: 2011 and 2012

Total ofAccesses/Year		Afternoon		Evening	
2011	726	41%	297,66	59%	428,34
2012	2149	38%	816,62	62%	1332,38

Figure 1: Percentage of accesses / period: 2011-2012



Conclusion

According to these outcomes, it is possible to conclude that pedagogical activities are important and welcome, considering the increasing participation of health professionals. In relation to the periods of accesses, it was verified that they happen mainly in the afternoon, when Health Units have small movement, and in the evening, when professionals may access at

home. Concerning the points of interest, those themes related to Public Health were the most required, what characterizes the interest and the need to extend knowledge.

References

[1] Brasil, Ministério da Saúde. Portaria nº35 de 4 de janeiro de 2007. Disponível: www.ufrgs.br/telessauders/arquivos%20pdf/portaria%20MS%2035_04_01_07.pdf. Acessado em 10 de agosto de 2007.

[2] F. C. Campos, A. E. Haddad, C. L. Wen, M. B. M. Alkmim. Telessaúde em apoio à atenção primária à saúde no Brasil. Em: Santos AF, Souza C, Alves HJ, Santos SF, organizadores. Telessaúde - um instrumento de suporte assistencial e educação permanente. Belo Horizonte: UFMG; 2006. Pp. 59-74.

[3] Brasil. Ministério da Saúde. Secretaria de Gestão do Trabalho e da Educação na Saúde. Departamento deGestão da Educação em Saúde.Política Nacional de Educação Permanente em Saúde / Ministério da Saúde, Secretaria de Gestão doTrabalho e da Educação na Saúde, Departamento de Gestão da Educação em Saúde. – Brasília: Ministérioda Saúde, 2009.64 p. – (Série B. Textos Básicos de Saúde) (Série Pactos pela Saúde 2006; v. 9)

Rendeiro, Márcia Maria Pereira, PhD - Graduated at DENTISTRY (1986), Master of Dentistry (Social Dentistry) Federal Fluminense University (1999) and Doctorate in Public Health from the National School of Public Health (2011). Has experience in Management in Public Health, acting on the following topics: program assessment and health services, public health policies and Telemedicine and Telehealth. She is currently Executive Coordinator of the Open University of SUS / MS / UERJ; Brazil Telehealth Program Consultant / MS, Center UERJ and Telemedicine Project Manager of Rio SMSDC, the Municipality of Rio de Janeiro.

Evaluation of the Content of Teleconsultations Conducted by the Telehealth Nucleus of the Medical School of the Federal University of Minas Gerais, Brazil

M. A. S. Dias, A. F. Santos, R. C. Oliveira, G. C. Penna, S. F. Santos, C. Souza
Medical School of the Federal University of Minas, Telehealth Nucleous, nutel@medicina.ufmg.br; nutel@medicina.ufmg.br
190 Avenida Alfredo Balena, Belo Horizonte, 30130-100, Brazil

Abstract: **The National Program of Telehealth in Brazil is increasing actuation. There are a lot of municipalities that need a support for the health care since there are not healths professional's disponible to work in country cities. Objective: This paper aims to describe the initial evaluation of the content of teleconsultation and their degree resolubility. Methods: For the study we selected 2,300 teleconsultations requested by family health nurses, doctors and dentists, and their answers during the period of January 01, 2010 to October 31, 2012. A sample proportional to the number of teleconsultation by specialty has been selected for analysis. Data is being entered and consolidated into Excel spreadsheet and will be analyzed through a descriptive study. Results: Until now it is possible to point out that 37% of the analyzed sample of teleconsultations were requested by physicians, nurses by 46% and 3% of dentists, 13% did not disclose their profession and 1% for other categories (physical therapists, managers, nurse technicians). The most widely discussed subjects are still being compiled, as well as evaluating the content of the questions and answers. Conclusions: The analysis of the evaluation of the content of teleconsultations is very important. A program of continuing education can be developed to meet the demands of health professionals in order to qualify the care provided for the patients.**

Introduction

The purpose of Brazil Telehealth Networks Project is to better the health care attention delivered to the users of the National Health System, by performing teleconsultation by experts of the Telehealth Nucleus of the

Medical School who help family health team professionals of local health departments of municipalities of the state of Minas Gerais, Brazil.

It is important to evaluate the content of the questions of family health professionals and the experts responses, identifying aspects of training and care, the quality and completeness of questions and answers, the chance of their replication as formative second opinion, their clinical aspects and insertion of the questions and answers within the healthcare model of the Brazilian National Health System and the resolubility degree of this tool.

This paper aims to describe the initial evaluation of the content of teleconsultation and their degree resolubility to contribute for the qualification of the training of health professionals and qualification of health care, respecting the current health care model in Brazil and creating new models of the telehealth related teleconsultation.

Methods

For the study we selected 2,300 teleconsultations requested by family health nurses, doctors and dentists, and their answers during the period of January 01, 2010 to October 31, 2012. From this universe it was calculated a sample proportional to the number of teleconsultation by specialty. Three hundred and ninety three records were examined by four physicians and public health professionals. It was constituted a roadmap for analysis with information on questions and answers with clinical and training aspects, and resolubility analysis. Calibration was done to verify the agreement between the evaluators and analysis of the tool. Data is being entered and consolidated into Excel spreadsheet and will be analyzed through a descriptive study.

Results

The study is currently under development and is expected to be concluded results by February 2013. Until now it is possible to point out that 37% of the analyzed sample of teleconsultations were requested by physicians, nurses by 46% and 3% of dentists, 13% did not disclose their profession and 1% for other categories (physical therapists, managers, nurse technicians). The most widely discussed subjects are still being compiled, as well as evaluating the content of the questions and answers. The perception so far is that it is necessary to make a more thoughtful discussion about the flow of requests. The answer to teleconsultations time has been reduced over time due to the interventions made by the team of Telehealth Center.

Discussion

Considering the assistance aspects for municipalities, the possibility of health professionals discussing clinical cases with specialists increases the effectiveness and adds quality to the primary care [1]. The University can also have benefits from the integration with primary care provider, and so it can identify gaps and improve its teaching/learning activities. The implemented project between the university and service structured itself so that the two would be present and integrated when contributing to the discussions of the topics. This presupposes a continuous dialogue between the health department coordinators who organize assistance activities and university professors. In Brazil, this process would coincide with the problems of structuring of family health programs (*Programa de Saúde da Família* – PSF in Portuguese) in the country, where the initiatives for training of specific skills in primary health care are still precarious [2]. Since the education process happens at the health unit, it implies in efforts optimization and resources rationalization, once professionals do not have to move from his/her workplace [3].

Conclusions

The analysis of the evaluation of the content of teleconsultation is very important for designing the real necessity of capacity of the health professionals. A program of continuing education can be developed to meet the demands of health professionals in order to qualify the care provided for the patients.

References

[1] C. W. Callahan, F. Malone, D. Estroff, D. A. Person. Effectiveness of an internet-based store-and-forward telemedicine system for pediatric subespecialty consultation. Arch Pediatr Adolesc Med, vol. 159,pp.389-393, 2005.

[2] A. F. Santos, S. C. Haddad, H. J. Alves, R. M. Torres, C. Souza, M. C. B. Melo. Evaluating the experience of training trough videoconferences in primary care. J Telem eHealth, vol. 17, pp. 722-726, 2011.

[3] M. P. Gagnon, A. Cloutier, J. P. .Fortin. Quebec population and telehealth: a survey on knowledge and perceptions. Telehealth J E Health. vol. 10(1), pp. 3-12, 2004.

Maria Angélica de Salles Dias – Medical Health Officer - Master in Public Health. Member of the Telehealth Nucleous of Medical School of the Federal University of Minas Gerais, Brazil

Alaneir de Fátima dos Santos – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG)), Brazil. Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Roseli da Costa Oliveira - Medical Health Officer - Master in Public Health Member of the Telehealth Nucleous of Medical School of the Federal University of Minas Gerais, Brazil.

Gustavo Cancela Penna – Medical Doctor. Sspecialist and Master in endocrinology. Member of the Telehealth Nucleous of Medical School of the Federal University of Minas Gerais, Brazil

Simone Ferreira dos Santos – Economist, Specialist in Health Economics. Subcoordinator of the Telehealth Center of Medicine School at Federal University of Minas Gerais, Belo Horizonte, Brazil.

Claudio de Souza – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Abdominal Surgeon. Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Evaluation of the Virtual Course in Telehealth for Latin American Countries

A. F. Santos, J. Nogueira, M. C. B. Melo, R. M.Torres, C. Souza, H. J. Alves
Medical School of the Federal University of Minas, Telehealth Center, nutel@medicina.ufmg.br; nutel@medicina.ufmg.br
Avenida Alfredo Balena, 190, Belo Horizonte, 30130-100, MG, Brazil

Abstract: Introduction: In the current global context of restructuring of health systems it is essential the development of sectorial evaluative tools. Thus the evaluation of the Virtual Course in Telehealth for Latin American countries is of fundamental importance as a factor for its improvement, as well as to other practices in telehealth. Objective: Evaluate the online course in telehealth having as reference some quality parameters listed in the data collection instrument used in the research. Methods: It will be used as a research tool data collected by means of a questionnaire available on the platform to the participants of the online course. Some of the quality parameters listed in the questionnaire is: available content, teaching methodology, forum participation, project development, experiences exchange. Results: The results of this research are not yet completed; it still is in the data collection phase and final evaluation.

Introduction

In the current global context of restructuring of health systems it is essential the development of sectorial evaluative tools. The project "Telehealth Public Policy in Latin America/ TPP-LA", financed by the Inter-American Development Bank (IDB), as proposed under the Initiative for the Promotion of Regional Public Goods has the general objective of generating a set of consensual regional protocols on public policies on goods and services, and to develop a model of training and certification of health managers that shall be accepted by all countries of Latin America and so aimed at training leaders in the telehealth field. In this regard it has been developed an international distance course in telehealth, which aimed to train leaders of the Ministries of Health and major Latin American universities in the process of incorporation of telehealth resources in the areas of healthcare and education. We seek to evaluate the course, through

the established parameters, and suggest the continuation and/or modification of actions and activities developed.

Methods

The participating Latin American and Caribbean countries were: Argentina, Bolivia, Brazil, Chile Colombia, Costa Rica, Ecuador, El Salvador, Guatemala, Guyana, Mexico, Panama, Peru, Suriname, Uruguay and Venezuela.

The course has been using 3D modeling, animations effects and videos. The Moodle platform was used for the course. The official language was Spanish.

The evaluation of the procedures used in the course, through the e-questionnaire, has the ability to analyze the results and identify them through the responses provided in comparison with the objectives established for the course. The tool used to assess the course, *e*-questionnaire, professional data and intellectual training of the participants, and the positive and negative aspects of the course, providing the following evaluative values of choice: excellent, good, fair, poor and very poor.

Results

For the course evaluation the following quality parameters have been used: content offered, teaching methodology, use of the course forum, information technology employed, project proposals, exchange of experiences and achievements. Considering that the data collection and final assessment has not been completed, the results of evaluation are not completed yet and analysis are planned to be finalized by March. Until now the positive aspects were identified as the quality of the mentoring, interesting thematic, quality of classes and quality of teachers. The negative aspect was the course requirement of a lot of dedication and time. Some of the participants considered that the thematic of the course fair. The evaluation of the Virtual Course in Telehealth is essential to improve the development and maintenance of the methodological quality applied to the course.

Discussions

Information and communication technologies have great potential to address some of the challenges faced by both developed and developing countries in providing accessible, cost effective, high-quality health care services [1]. Attempts to institutionalize the field of telehealth in multilateral organisms are increasing progressively. It began with the structuring of telehealth seminars in the scope of the SELA - *Sistema Económico Latinoamericano y del Caribe*, in 2009 [2]. By addressing LA's

current dilemma regarding ICT, ECLAC (*Comisión Económica para América Latina – CEPAL, in Spanish*) shows that it is not a matter of deciding whether or not to incorporate these tools, but rather finding the best options and developing strategies for making their potential come true in a cost-effective manner. It is important to improve the quality of care, optimize processes and reduce costs requiring integration of ICT to health policies [3]. This course is the first initiative to train health professionals and managers who already work or have potential to increase the activities of telehealth in LA. The evaluation of the outcome of the course is essential for future considerations.

Conclusions

The evaluation of a virtual course of telehealth by way of *e*-questionnaire as a tool of control, improvement, maintenance and development of the course for Latin American countries goes through the systematic evaluation of learning and communication resources in telehealth. Based on this analysis we have concluded that the course is improving the knowledge and contributed to the improvement of telehealth activities in Latin America. In general, this course has been well evaluated by the participants.

References

[1] World Health Organization. Telemedicine - Opportunities and developments in Member States. Report on the second global survey on eHealth Global Observatory for eHealth series 2009. v. 2.

[2] Sela. Conclusiones y recomendaciones. *II Seminario regional de salud-e y telemedicina en América y el Caribe: Prácticas de innovación y estándares*. http://www.sela.org/attach/258/default/Di_No_28-IF_II_SR_Salud-e_y_Telemedicina_en_ALC.pdf (last acessed 21-02-2013)

[3] Fernandez A. El programa @lis en Cepal: contribuciones al desarrollo de la salud eletronica en la region. *Latin Am J Telehealth* 2010; 2 (2): 252-261.

Alaneir de Fátima dos Santos – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG), Brazil. Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Janaina Nogueira - Course of Technology in Environmental Sanitation. Federal Institute of Science, Education and Technology Sergipe,Brazil. Supervisory “Project Protocols Regional Public Policy” in the School of Medicine Federal University of Minas Gerais, Brazil.

Maria do Carmo Barros de Melo – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG), Brazil. Sub-Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Claudio de Souza – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Abdominal Surgeon. Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Rosália Moraes Torres – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Cardiologist. Subcoordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Humberto José Alves – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Sub-Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

Evidence Based Medicine in HIV/AIDS and Reproductive Health Research: Piloting Two Distance Learning Courses in Low-Resource Settings

M. Zolfo[1], B. Ingelbeen[1], R. Aryeetey[2], A. K. Cuzin-Kihl[3], C. Kiyan[1]
J. Khanna[3], V. Maojo4, L. Lynen[1] and AFRICA BUILD WP6 group
[1]Institute of Tropical Medicine, mzolfo@itg.be; bingelbeen@itg.be; ckiyan@itg.be; llynen@itg.be
Nationalestraat 155, Antwerp, 2000, Belgium
[2]University of Ghana School of Public Health, raryeetey@ug.edu.gh, Box LG 13, Legon, Accra, Ghana
[3]WHO Department of Reproductive Health and Research
World Health Organization, cuzina@who.int; khannaj@who.int, Avenue Appia 20, CH-1211 Geneva 27, Switzerland
[4]Biomedical Informatics Group, Facultad de Informática, vmaojo@infomed.dia.fi.upm.es; Universidad Politécnica de Madrid, Campus de Montegancedo s/n, Madrid, 28660, Spain

Abstract: **AFRICA BUILD is a project, developed under the 7th European Framework Programme (FP7), in order to support the development of centers of excellence in health care, education and health research in African countries, thanks to Information Technology. The Institute of Tropical Medicine in Antwerp is in charge of developing a specific training program in HIV/AIDS and Reproductive Health research in collaboration with the World Health Organization Department of Reproductive Health and Research (RHR), to be delivered via eLearning. We hereby describe the state of the art of these courses.**

Introduction

Over the past decade there has been a growing demand for Evidence-Based Medicine (EBM) in clinical care and research. Not only is there more evidence available in health care, but also more opportunities for this evidence to be used in effective interventions and to link it to research questions. The practice of EBM signifies the integration of individual clinical expertise with the best available external clinical evidence from systematic research [1, 2].

The benefits of evidence based practice are many-fold: knowledge of latest clinical evidence empowers healthcare workers to make informed decisions regarding optimal care, and empowers health facilities' workers to demand relevant resources. In addition, the use of EBM enables those working with (in) health facilities and programs in identifying gaps in research and in developing systematic strategies to address these gaps.

AFRICA BUILD (AB) is a Coordination Action to support the development of centers of excellence in health care, education and health research in African countries, using Information Technology. This project, developed under the 7th European Framework Programme (Grant Agreement no. 266474), consists of seven Work Packages (WPs). The Institute of Tropical Medicine in Antwerp is leading WP6 which is tasked with developing a specific training program in HIV/AIDS and Reproductive Health research in collaboration with the World Health Organization Department of Reproductive Health and Research (WHO/RHR), to be delivered via eLearning.

Fig. 1: AFRICA BUILD Portal

The aim of this program is to enhance research and education in the above mentioned fields, via novel approaches and to identify research needs, emanating from the field. This pilot experience, which will be run both in English-speaking (Ghana), and French-speaking (Mali and Cameroon) partner institutions and produce targeted courses for strengthening research methodology and policy.

Study materials will be available for the courses' participants through the AFRICA BUILD Portal and modules' content will be delivered via live webcasts (Fig. 1).

State of the Art

The state of the art of the project, which has been recently rolled out, allowed a full revision of the format, content, and references of the different topics and the allocation of subject-matter experts for both the Reproductive Health and the HIV/AIDS research courses.

A specific focus, due to the limited lifespan of the project (which is only 36 months), is the planned assessment of the immediate or direct effects of the program, such as:

(i) How much the program was used; how many people were reached and graduated; the extent to which program objectives were met; and changes in skills, knowledge, or attitudes;

(ii) The graduation rates and learner achievement (course grades or standardized test scores);

(iii) The overall effectiveness of distance education programs (e.g. student satisfaction ratings, completion rates, and staff turnover).

The analysis of these two pilots could provide the basis for extending new courses at the different postgraduate and PhD programmes that are currently offered or planned by the African partners.

Conclusions

Through the courses described above, the students will learn and apply the steps of EBM, from the definition of a specific clinical research question and the design of a search strategy till the interpretation of the evidence and the application of the latter to practice, linking the detected gaps to possible research topics within the fields of HIV/AIDS care and Reproductive Health.

Moreover, the students will be engaged in virtual communities of researchers who can continue to develop research ideas, exchange information and knowledge regarding new tools and evidence, as well after the short lifespan of the project.

Acknowledgment

This project is developed under the 7th European Framework Programme, Grant Agreement no. 266474. We thank all the collaborators of WP6.

References

[1] A. K. Akobeng, Principles of evidence based medicine, Arch Dis Child, Aug; 90(8), 837-40, 2005.

[2] G. H. Guyatt, A. D. Oxman, R. Kunz, G. E. Vist, Y. Falck-Ytter, H. J. Schünemann, GRADE Working Group, Rating quality of evidence and strength of recommendations: What is "quality of evidence" and why is it important to clinicians?, BMJ, May 3;336(7651), 995-8, 2008.

Impact on Learning and Medical Practice of an Online Community of Practice for Rural Physicians in A Developing Country

G. F. R. Restrepo
Medellin General Hospital, Colombia & Telehealth unit (e-health), Simulation Center, Faculty of Medicine, University of Antioquia, Medellín, Colombia, guillermorodmd@gmail.com

Abstract: **The present study's main purpose was to create the conditions for building a virtual community of practice for practitioners in Colombia's rural communities, as an alternative to formal continuous education in medicine. This allows them to create learning spaces to enrich their knowledge and expertise for solving problems in their professional everyday practice. Often, rural physicians have to work under great limitations of human and technical resources in developing countries. In most cases, they have little access to continuous medical education activities and do not have access to senior colleagues with whom to share their cases in order to treat their patients properly. Health communities of practice are becoming more popular as an option to promote and foster learning among health professionals. Most experiences in relation to communities of practice in this field have been conducted in countries with high levels of social and economic development. One of the most important findings of this study is that virtual communities of practice can be a suitable alternative to develop continuous medical education activities for physicians in rural areas. The participation of physicians in the community of practice showed remarkable evidence of improved learning and a strengthening of the capacity to respond. This enabled rural physicians to positively impact their medical practice, which is one of the fundamental objectives of any continuous medical education activity.**

The usage of an accessible low-complex and low-cost mobile phone platform allowed physicians in rural places to simultaneously (in real time) and collaboratively share and resolve their cases supported by an expert in orthopedics and traumatology (the coordinator of the community of practice and study author). This situation allowed the team to have a significant impact on their medical practice, which, in turn, benefitted the target rural populations.

Introduction

Communities of practice founded on the social learning theory concepts, developed by Etiennne Wenger et al [2], have gained importance worldwide as a new approach to developing continuous medical education activities, thus taking advantage of the significant benefits of collaborative learning [1].

This study aimed to build a virtual community of physicians in rural places which are geographically detached from major urban centers. Therefore the study acted as an alternative method of continuous medical education, which primarily used Information Communication Technology (ICT) as its communicative tool.

The community was developed on the *BlackBerry* platform, where community members could share, and collaboratively solve, their real and complex orthopedics and clinical trauma cases with the support of an orthopedic surgeon (author of the study and community of practice coordinator), who helped them to form learning spaces to create new knowledge and improve their expertise.

The present study aimed not just to have an expert responding to teleconsultations, but to use those real clinical cases as learning opportunities. These new learning opportunities would allow rural physicians to collaboratively learn to improve their operational capacity and thus directly and positively impacts their medical work.

Materials and Methods

This study was conducted with a qualitative methodology, using a "case study", based on Rowley, J.'s concepts [3], taken from his article "Using Case Studies in Research". The participants were a group of physicians, who graduated from the Faculty of Medicine at the University of Antioquia in Medellin, Colombia. The community activities were developed by using as "digital habitat" the Blackberry mobile platform.

Figure 1 shows the geographical location of Colombia in Latin America (left) and the location of each physician in Colombia's rural populations (right)

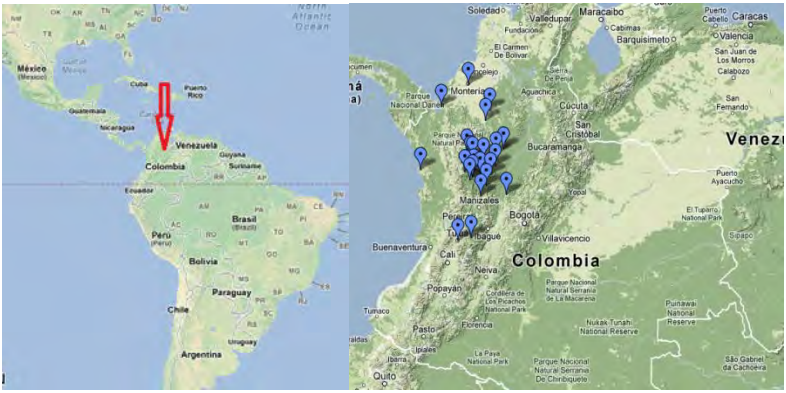


Figure 1. Location of Colombia in Latin America (left) and location of the various physicians in Colombia's rural populations (right)

The study assessed elements or factors that facilitated or hindered the design, implementation and development of a virtual community of practice on medical work for physicians in rural settlements. The research also assessed the learning achieved and its impact on a medical work environment where technical, financial and human resources are limited.

The information was obtained through data collection instruments such as transcripts of conversations that were carried out via the BlackBerry wireless platform, the researcher's personal blog and surveys and interviews with community members (the triangulation principal).

Results and Discussion

The following elements were considered as evidence of learning (based on the fact that the project was an activity that aimed to create learning spaces for continuous medical education):

- The construction of clinical cases and their resolution were evidence of an adequate development of clinical judgment that enabled the physicians to make appropriate decisions;
- The progressive difficulty of the clinical cases that were discussed in the community was considered as indirect forms of evidence of increased learning.

Figure 2 shows the positive development of the quality and difficulty of the case studies discussed in the community in a sample of two physicians. (Physicians were chosen based on their higher level of participation in the community).

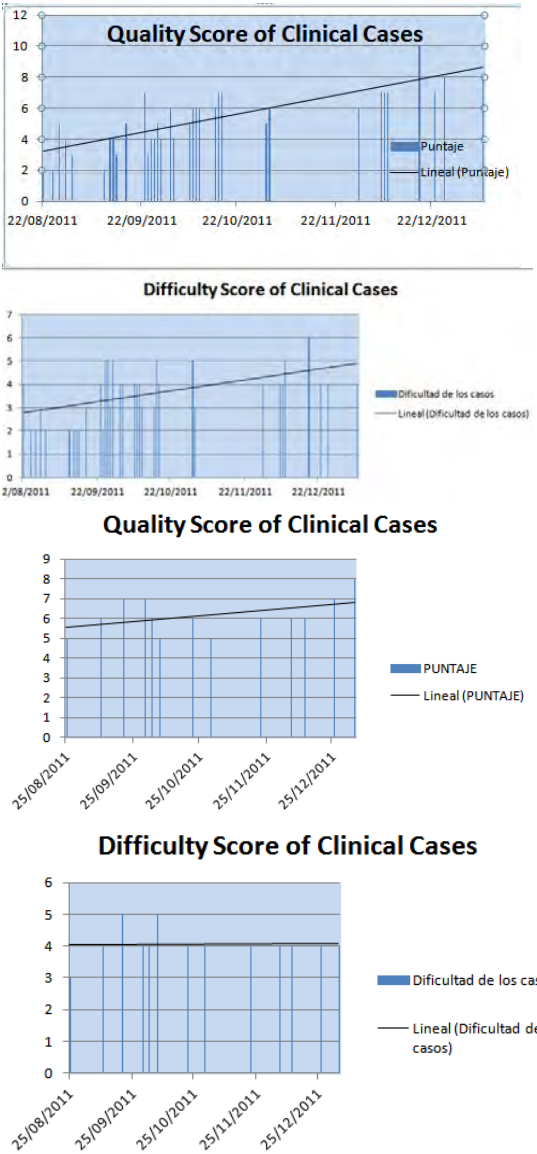


Figure 2. Scores obtained by physicians M1 and M2 regarding quality and difficulty of the clinical cases discussed in the community of practice

A significant impact on medical practice was found based on more than 200 cases collaboratively treated by members of the community and the author of the study. These cases were treated in a better way than if they had not been discussed in the community, and served, at the same time, as learning spaces to improve the responsiveness of the physicians.

Conclusions

This study clearly shows that virtual communities of practice can be an alternative in developing continuous medical education activities for physicians in rural

settlements. This is especially important as these rural communities have little access to technical and specialized human resources, which is an everyday reality in all developing countries with significant limitations in their access to health systems. The study demonstrated that physicians can improve their response capacity and their medical practice by making advantage of actual clinical cases as learning spaces.

The significant impact that can be achieved by using highly penetrative, accessible, simple and low-cost technological equipment was evident throughout the study. The ICT's significantly reduced geographical barriers and helped physicians in different settlements to share and collaboratively treat their cases.

Acknowledgement

Special thanks to Luz Adriana Osorio, my mentor and director of my thesis project who patiently guided me during the development of this research.

References

[1] G. Ranmuthugala, J. Plumb. Cunningham, F, Georgiou, A, Westbrook, I, Braithwaite, J (2010). Communities of Practice in the Health Sector a systematic review of the peer-reviewed literature. Published for the Centre for Clinical Governance Research Australian Institute of Health Innovation. Downloaded on November 05/2012 from http://www.aihi.unsw.edu.au/sites/aihi.cms.med.unsw.edu.au/files/aihi/resources/CoP_monograph.pdf

[2] E. Wenger, R. McDermott, W. Snyder. Cultivating Communities of Practice. Harvard Business School Press. 2002.

[3] J. Rowley, Using Case Studies in Research, Management Research News, Volume 25, Number 1, 2002.

Guillermo Fernando Rodriguez Restrepo is a physician and surgeon graduated from the Faculty of Medicine of the Pontifical Xavierian University in Bogotá, Colombia, in 1995. Orthopedist and traumatologist of the Nueva Granada Military University in Bogotá, Colombia, in 2002. Master of Education with emphasis on use of new ICT's, Universidad de los Andes, Bogotá, Colombia, 2013. Professor of medicine and orthopedic surgery, member of the telehealth group (e-Health), part of the Simulation Center, Faculty of Medicine, University of Antioquia. Medellin, Colombia. Researcher in communities of practice and social networks in the health area.

Increasing Telehealth Knowledge in U.S. Veterans through Video Education

J. Nelson
Indiana State University, jhouchen@indstate.edu
Landsbaum Center for Health Education, 1433 N. 6 ½ Street Office #208,
Terre Haute, IN, United States of America

Introduction

As Telehealth technologies and modalities of care are expanding, education on the subject of Telehealth is often times nonexistent. Although health care providers within the United States Veterans Health Administration (VHA) have been highly educated on the topic of Telehealth and the services Telehealth can provide to patients, many times patients are not formally educated on the topic of what Telehealth can do for their health care experiences or even the existence of Telehealth services. This gap in knowledge about Telehealth technology among patients leaves room for increased anxiety and a lack of patient buy-in relative to Telehealth services, which can lead to a decrease in utilization of Telehealth services.

An extensive literature review was conducted focusing on solutions to rising health care demands of rural Veterans including evidence to suggest that Telehealth technologies offered a low cost alternative [1-3]. Additional literature revealed that although Telehealth technology is currently utilized by the VHA, education about the technology was not offered to Veterans. Supporting evidence in several studies revealed that education delivered in the form of video media was significantly more effective for increasing knowledge and the retention of knowledge in a variety of health care settings [4-5]. This evidence-based practice project sought to increase U.S Veteran knowledge of Telehealth services through video education in order to enhance utilization and participation of Telehealth technologies.

Methods

A newly created patient education video on Telehealth was created focusing on improving specific patient outcomes including increasing patient knowledge regarding Telehealth services offered by the VHA and to educate Veterans about the safety and security of using Telehealth technology. An eight minute video was created utilizing VHA staff and

guidelines from the Office of Telehealth Services. The video was produced by VHA staff and was developed using key components of the Rocky Mountain Training Center, Boston Store and Forward Center, and Sunshine Training Center operational documents [6]. The information contained in the video was scripted to be equivalent to a 6th grade reading level in accordance to VHA guidelines and regulations for educational materials.

Two groups of Veteran populations were utilized in this EBP change project. Group 1 consisted of Veterans newly enrolled to the VHA system participating in new patient orientation. Group 2 consisted of Veterans participating in group nutrition classes utilizing Clinical Video Telehealth (CVT) at the facility. The two groups were utilized to compare new patients and existing patient populations to determine if the educational video impacted their knowledge or willingness to participate in Telehealth programs. The purpose for including a group of veterans who were already using CVT was to compare and contrast the differences in knowledge both pre and post video intervention between Veterans with prior exposure to Teleheatlth services and those who had no exposure to Telehealth services.

In order to measure outcome performance, a self-developed pre and post survey was created to capture baseline data as well as data collected post intervention. The pre and post survey was developed in compliance with VHA regulations and guidelines by the project coordinator as no other tool was applicable or in existence for this project change. In order to confirm the appropriateness of the tool, the project coordinator worked in conjunction with other Telehealth staff in addition to VHA quality managers and the head of nursing education to create a survey specific to this project. Facility Telehealth Coordinators from various VHA sites within the surrounding region were utilized as expert reviewers to confirm the appropriateness of all content and ensure all key components of video outcomes were present within the survey tool.

The survey, titled for Veterans attending new patient orientation, was applicable to Veterans also participating in other health care areas including those participating Veterans in group 2. The survey was used pre and post video intervention for both group 1 and group 2 Veterans. The survey included seven questions, six of which included a five-point Likert scale to measure responses including; 1) strongly disagree, 2) disagree, 3) neither disagree nor agree, 4) agree, and 5) strongly agree. An additional question was provided on the survey to capture Veteran feedback to obtain qualitative data regarding the intervention.

Results

The following five intended outcomes were measured and analyzed in addition to compassion among both groups including: 1) Increase in patient knowledge of Clinical Video Telehealth, 2) Increase in knowledge of Store and Forward Telehealth, 3) Increase in knowledge of Home Telehealth, 4) Increase in overall willingness to participate in Telehealth services and benefits of Telehealth participation and 5) Increase in knowledge regarding the safety and security of Telehealth technology.

A total of 193 Veterans participated in this EBP change project. Over the course of a five week implementation period, the video was shown a total of five times to both groups of Veterans on separate days. Veterans in group 1 were shown the educational video of Telehealth services on Fridays with an average weekly participation of 24 Veterans. Group 2 Veterans were shown the educational video each week on Tuesdays with an average participation of 13 individuals.

Group 1

The pre and post-test survey was administered to 131 out of 143 Veterans within a five week timeframe resulting in a 92% participation rate for group 1. Ten Veterans opted not to participate for reasons unknown to the project coordinator. Two participants were excluded as their surveys had missing data making the overall total number n=129. Utilizing Microsoft Office Excel, a score for each question and an overall group 1 pre and post-test mean score was calculated. The overall group 1 pre-test mean score was 2.12 and the overall group 1 post-test mean score was 4.26 which reflects a mean increase of 2.14 (see Figure 1.0). Overall group 1 mean scores for each individual question were calculated revealing a >50% increase in 5 of the 6 questions, between pre and post survey mean scores.

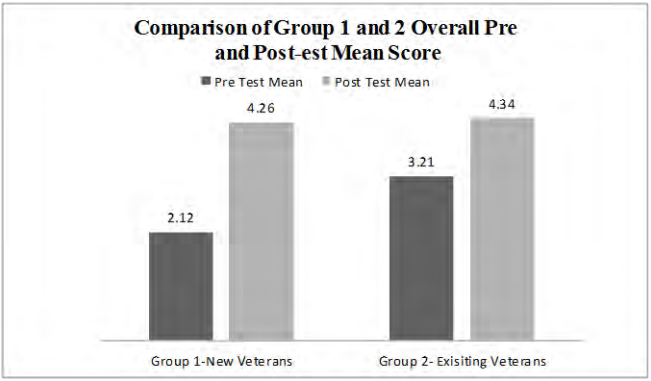


Figure 1.0 Comparison of Group 1 and Group 2 Overall Pre and Post-Test Mean Score

Group 2

The pre and post-test survey was administered to 62 out of 87 Veterans participating in Clinical Video Telehealth nutrition classes resulting in a 71% participation rate. Twenty five Veterans chose not to participate. Although the project coordinator did not receive feedback from all of the Veterans who opted out of project, some Veterans made reference to time constraints and conflicts with other appointments. Another rationale for lack of Veteran participation could be contributed to a room change where Veterans were asked to move down the hall where audio visual equipment was available. Final sample size resulted in n= 62. Utilizing Microsoft Office Excel, a mean score for each question and for the overall group 2 pre and post-test was calculated using the same formula as conducted with Group 1 participants. The overall mean score for group 2 pre-test was 3.21 and the overall mean score for group 2 post-test was 4.34 which revealed a mean increase of 1.13 (see Figure 1.0). Individual question scores were calculated revealing a $\geq$ 26% increase in each question between pre and post survey scores.

Summary

This EBP change project focused on the integration of a Telehealth educational video within two groups of Veteran populations. The results revealed using a video educational tool increased Veteran's knowledge of Telehealth services. Telehealth technology is redefining how the world of health care delivers care. Telehealth is changing what was convenient for the health care provider to what is convenient for the Veteran by bringing care closer to rural Veterans and providing much needed services to a population with huge health care disparities. In order for Telehealth technology to work, it must work for the individual it was meant to help and the health care professionals who provide care via the technology. Telehealth education through the use of technology is one small way to engage Veterans in this much needed modality of care with the VHA.

Acknowledgment

"J. Nelson would like to thank Indiana State University and colleagues throughout VHA VISN 11 Telehealth programs for continued support and dedication to increasing patient access to care through education and Telehealth technologies."

References

[1] A. Gattoni and K. E. Tenzek. "The practice: An analysis of the factors influencing the training of health care participants through innovative technology," Communication Education, vol 59, pp. 263-273, 2010.

[2] M. Gysels and I. Higginson. “Interactive technologies and videotapes for patient education in cancer care: Systematic review and meta-analysis of randomized trials,” Support Care Cancer, vol 15(1), pp. 7-20, 2006.
[3] A. Darkins and M. Cary. Telemedicine and Telehealth. New York, NY: Spring Publishing, 2000, pp. 45-57.
[4] C. Isarankura-Na-Ayudhya, C. Nantasenamat, P. Dansethakul, P. Saetum, S. Laosrivijit and V. Prachayasittikul. “Solving the barriers to diabetes education through the use of multimedia,” Nursing and Health Sciences, vol 12, pp. 58–66, 2010.
[5] A. Hill, S. McPhail, T. Hoffmann, K. Hill, D. Oliver, C. Beer et al. “A randomized trial comparing digital video disc with written delivery of falls prevention education for older patients in hospital,” Journal of American Geriatrics Society, vol 57(8), pp. 1458- 1463, 2009.
[6] Office of Telehealth Services. “What is care coordination services?” U.S. Department of Veterans Affairs. Washington D.C. Retrieved from http://www.carecoordination.va.gov/, 2011.

Dr. Jessica Nelson is an Assistant Professor at Indiana State University where her research interests include telemedicine technologies, rural disparities among a variety of patient populations as well as interventions to increase access to care in rural America. Prior to her professorship at Indiana State University, Dr. Nelson coordinated Telehealth services for thousands of Veterans in her role as a clinical program manager within in the Department of Veterans Affairs in Ann Arbor, Michigan.

Learning Objects, Professional Competencies for Health Professional and eLearning: Main Elements for Developing a Taxonomy

L. B. Brasil, M. C. Skelton-Macedo, C. L. Wen, F. E. Campos, A. E. Haddad
Open University of the National Health System, linabrasil@unasus.gov.br; linabarreto@gmail.com
Av. L3 Norte, Campus Universitário Darcy Ribeiro, Gleba A, SC 04 - room 201, ZIP CODE 70910-900, Brazil

Abstract: **The Open University of the Unified Health System – UNA SUS (www.unasus.gov.br) was developed by the Brazilian Ministry of Health, in partnership with 18 public universities, as well as state and municipal health services, in order to provide capacity building and education for health professionals working at Unified Health System (SUS), which has approximately 2.5 million health workers. One of its main components is the production of interoperable and reusable learning objects (LOs) according to the needs identified by the professionals at work, those who deal with healthcare, as well as management matters. The LOs are published in an archive that is open to the public and free of charge (http://ares.unasus.gov.br/acervo/). One strategic issue for expanding, and at the same time maintaining quality of what is financed by public funds, is establishing standards, and for this purpose we plan to develop a taxonomy capable of describing pedagogical, technological and professionals competencies and skills that are expected to be developed by a determined LO, in order for it to be interoperable and reusable.**

Introduction

UNA-SUS was inaugurated on June 18th, 2008 by the Ministry of Health, with the aim to:

a) Propose actions to meet the needs of capacity building and continuing education of SUS's workers;
b) Lead and guide the provision of courses and capacity building programs aimed at SUS's workers;
c) Prospect, foster and support the development and dissemination of information and communication mediums and technologies that allow the expanding of the scale and scope of educational activities;

d) Contribute to the reduction of inequalities between the different regions of the country, by making equal the provision of capacity building and continuing education and
e) Contribute to the education/service integration in the area of health care.

UNA-SUS fosters the expansion of an integration network between the education system and SUS, which operates through the exchange of experiences, the partaking of educational materials, the cooperation for development, and the implementation of new health educational technologies that support action learning and ensure the quality of the graduates of the courses it offers.

In this way, it is possible to provide to every health worker learning opportunities, such as self-learning materials, short and update courses, professional development courses, specialization studies and even professional master´s. Using the strategy of distance learning allows healthcare professionals to learn according to their needs, in their time and in the place that is most convenient to them.

Justification

In distance learning, the development of educational resources, when compared to educational institutions with on-site presence, requires more rigorous planning, a clear definition of the educational objectives, a more effective communication and the application of educational assessment processes with more exhaustive documentation. This raises the initial costs needed to ensure investments in technology and in the capacity building of coordination teams, professors and faculty tutors, instructional and graphic designers, evaluators, and technical support.

The strategy adopted by UNA-SUS to reduce these costs and increase the production capacity of educational resources by the public universities that make up its network was to set up standards for the learning objects, such as reusability and interoperability, whilst maintaining focus on the professional learning needs of workers (education/service integration), thereby allowing greater effectiveness of the educational programs and the creation of an open, public, and free archive with resources especially geared towards health care. The production of these LOs requires speed without quality loss, in order to produce the required amount necessary to meet the huge demand for capacity building. On the one hand, there is no tradition of production of educational resources for distance learning courses on the web, with the standards of reusability, interoperability and the education/service integration in the 18 - a growing number - Higher Learning Institutions that make up the UNA-SUS Network. On the other

hand, the Ministry of Health, public manager and financier of UNA-SUS, needs reliable criteria and indicators to monitor the execution of these actions by the Higher Learning Institutions.

There will be an analysis and systematization of the studies regarding the key desirable characteristics with the intention that UNA-SUS's LOs become effective in their educational purposes and reusable, such as: professional competencies and skills, distance learning competencies versus instructional design of LOs, i.e.: research on the professional competencies and skills, and on the educational resources in data warehouse, research on the reusability and interoperability; research on the alignment between the instructional design and the learning object; research on the competencies and skills of the distance learning teams. This research will use as reference the dentists who work in the government program Saúde da Família (Family Health), for which there are already well established professional competencies and skills. Based on this analysis, taxonomy of the skills involved in the construction of digital learning objects for dental health workers will be proposed according to the guidelines suggested by UNA-SUS.

Taxonomy under Construction

In Information Science, taxonomy is a system used to classify and facilitate the access to information. Its goals are to represent concepts through terms; improve communication between specialists and others; offer ways to control diversification, and provide a map of the knowledge process. It is, therefore, a controlled vocabulary of a particular field of knowledge and a tool that allows one to allocate, retrieve, and communicate information within a system.

The structuring of taxonomy demands the organization of concepts in processes that include categorization and classification of concepts, definition of the relationships between these concepts and the usage of the terminology used in the concepts, and the relations of the structure. In table I, which follows, some key features/utilities of this taxonomy under construction are presented.

The proposition is to describe and list the pedagogical and technological characteristics and the typical competencies and skills involved in capacity building in dentistry, which will help to print onto the LOs developed the qualities of reusability, interoperability, and the alignment of educational activities with the needs of the health care professional/service for which it was developed for.

Table I- Uses, Applications and Purposes of Taxonomy

Uses Applica-tions and Purposes	Assis-tance in organi-zing information	Streamlines communication Assists in the organization and sharing of knowledge Assists users in specific and more suitable terms for the production of LOs Assigns responsibilities of evaluation, organization, elimination and archiving Facilitates the search in archives Facilitates the access to information Methodology of organization, retrieval, representation and availability Allows reusability of information Provides immediate access to information Enables data aggregation Allows one to allocate, retrieve and communicate information within a system Enables better interpretation of information Allows the user to name and share information Enables better integration of information Used to locate relevant information
	Information Management	Map of area that will serve as a guide for knowledge processes Important part of knowledge management Pillar of Information and Knowledge Management High-level rules to organize and classify information and knowledge

Source: Elementos Constitutivos do Conceito de Autonomia, Aganette. E. Alvarenga. L. E Souza. R. R. (2010)

References

[1] A. D. Wiley, Connecting learning objects to instructional design theory: A definition, a metaphor, and a taxonomy, The Edumetrics Institute, Logan, UT, 2010.

[2] B. Blackburn Taxonomy design types. AIIM E-doc Magazine, Maryland, USA. v.20, n.3, p.14-16, maio/jun. 2006.

[3] B. S. Bloom et al. (Eds.). Taxionomia de objetivos educacionais. Porto Alegre: Globo, 1972. V.1.

[4] Competências profissionais para egressos e temas abordados nos Cursos de Especialização em Saúde da Família da UnA-SUS, MIMEO, DAB/MS, Brazil, 2010

[5] D. L. Silva, R. R. Souza and M. B. Almeida Comparação de metodologias para construção de ontologias e vocabulários controlados. Anais do Seminário de pesquisa em ontologia no Brasil, Niterói, 2008, Niterói.
[6] M. C. C. Baranauskas, H. V. Rocha, M. C. Martins and J. V. V. d'Abreu Uma taxonomia para ambientes de aprendizado baseados no computador, artigo do livro *O computador na sociedade do conhecimento*, Campinas, SP, 1999.
[7] R. R. Relvão Estudo Sobre a Utilização e Interoperabilidade entre Conteúdos de Aprendizagem com Diferentes Granularidades, Master thesis, Universidade do Minho, Minho, 2006.
[8] J. C. C. Terra et al. Taxonomia: elemento fundamental para a gestão do conhecimento. 2005. Disponível em : http://www.terraforum.com.br Acesso em: 30 dez. 2013.

Lina Sandra Barreto Brasil - PhD student of the Orthodontics and Pediatric Dentistry Department at the Faculty of Dentistry, University of Sao Paulo, Brazil. Consultant for distance education of Open University of the Unified Health System – UNA SUS from Ministry of Health, retired Professor at the University of Brasilia

The e-Learning Platform Developed by Clinique Bohler

O. Christian, B. Atanasova
christian.oberle@ffe.lu; bistra.atanasova@cbk.lu
Clinique Privée Dr E. Bohler SA, Fondation François-Elisabeth, G. D. of Luxembourg

Presentation of Clinique Bohler Kirchberg (CBK)

- Clinique Bohler, a private hospital with 68 beds, is the leading women's clinic in Luxembourg for the past 55 years within its two distinct activity sectors: maternity (2,650 births/year) and gynaecology (4.000 suregeries/year).
- Since 2003, Clinique Bohler is ranked #1 in Luxembourg by EFQM (European Foundation for Quality Management) and measured in 2011 a patient satisfaction rate 2011 of 86.3% and a patient recommendation rateof 95%.
- Clinique Bohler is owned by Fondation François.-Elisabeth and is part of the Kirchberg Hospital Centre that counts 1,250 employees, 160 physicians, 413 inpatient beds, 16,000 surgeries/year

CBK e-Learning PlatformContext and description

Health education and coaching represents 75% of the support given to birthing mothers during their stay. Their important need for information, advice and support before and after treatment convinced Clinique Bohler to invest in the development of an e-Learning platform in order to:

1. Establish early contact with the patient base;
2. Develop communication channels and innovative training;
3. Be accessible to current customers whatever their geographic distance to the Clinic;
4. Provide consistent information and quality education before, throughout and after the patient's journey and stay;
5. Anticipate patient questions, needs and concerns;

The e-Learning platform developed by Clinique Bohler is:

- A unique platform for preventive health and health education of women and support for future parents through new multimedia technologies,
- Providing a variety of learning tools (educational videos, quizz, ….) in gynaecology and obstetrics,

- And life interactive sessions via internet ssupported by nursing staff at the institution offering the opportunity to patients to participate form home or during hospitalisation to the online workshops.

Evolution of the CBK e-Learning Platform

To cover the multilingual and multicultural context of Luxembourg, we have the following expectations:

- High quality standard withal contents developed and controlled by medical professionals, the multimedia tools developed and the pedagogical tools developed by specialize professionals;
- Multi-language learning platform and interactive live sessions given by native speaking professionals;
- Large coverage of all important issues in obstetrics and gyneacology adapted to a large number of cultural backgrounds.

Fig. 1. E-Learning Platform

We will meet these expectations with the help of key partnerships:

- The Clinique Bohler covers the French and Luxemburg regions and has a partnership with Henallux for the development of pedagogical tools;
- The German region will be covered by our partner Frauenklinik Dr Geisenhofer (Munich);
- The Portuguese region will be covered with an University Hospital from Coimbra;

- A next partnership will cover the needs of English speaking patients;
- The leverage opportunities of the e-Learning concept make the tool interesting for developing countries. As project of social responsibility, we currently make our first experiences in this field in cooperation with the Fondation Raoul Follereau with a Mali project.

Fig. 2 Interactive live-session

Video on interactive live session is available at http://www.cbk-learning.lu/video/seance-live_1Mbps.mp4

	O. Christian. Born on 13th of February 1964 in Luxembourg. Chief Executive Officer, Clinique Privée du Dr E. Bohler S.A. Financial and Administrative Director of the Private Foundation "Fondation François-Elisabeth" (FFE) and its private hospitals Hôpital Kirchberg (HK) and Clinique Sainte-Marie (CSM). Member of the Board of Directors Fédération des Hôpitaux Luxembourgeois (FHL), the representative organization of all Luxembourg hospitals. President of LUXTIH, GIE created for mutualized IT projects in the Hospital Sector.
	Bistra Atanasova. Born on 4th of October 1983 in Varna, Bulgaria. Masters Degree in Communication and Marketing, Pantheon-Assas, Sorbonne Universities, Paris. Person in charge of communication, Centre Hospitalier du Kirchberg of projects management, development of the websites of the Fondation François-Elisabeth, development of cbk-learning partnerships.

The Experience of the Implementation of a Telehealth Resource Management Course in Brazil

A. F. Santos[1], R. M. Torres[1], M. A. M. Silva[1], M. C. B. Melo[1], N. Rievrs[2], R. Oliveira[1], H. J. Alves[1]
[1]Medical School of the Federal University of Minas, Telehealth Nucleous, mcbmelo@medicina.ufmg.br
Avenida Alfredo Balena, 190, Belo Horizonte, 30130-100, Minas Gerais, Brazil
[2] Department of Health, Belo Horizonte City, Minas Gerais State, Avenida Afonso Pena, 1212,Belo Horizonte, 30130-003, Minas Gerais, Brazil
neuslene@pbh.gov.br

Abstract: **Introduction: Brazil is a rich field for use of ICT applied to health related activities. Currently, the country is incorporating the telehealth resources on its National Health System. In recent years, 63 technical-scientific clusters were implemented throughout all Brazilian states, covering 16,836 Family Health Teams and 3,256 municipalities. For the success of actions implemented, it is essential the training of coordinator staff in each cluster. Objective: To develop a Telehealth Resource Management Course for the training of telehealth team coordinators. This course is part of the process of strengthening primary care and telehealth in the country and aims to train leaders of the scientific-technical clusters and managers of the Brazilian NHS, at the state and local levels, in the process of incorporation of telehealth resources for both healthcare and education. Methods: The course was developed in a partnership between the Department of Primary Care of the Health Ministry of Brazil and the Health Technology Center of the Medical School of the UFMG. It was applied online in the second half of 2012 and is near completion and evaluation of the results achieved. Its structure is modular, with a total of 76 hours, applied over a three months period. The content was formulated by teachers of different Brazilian universities expressing the great accumulation of knowledge and experience existing in the country in relation to telehealth. Three hundred and three students, of all Brazilian states, signed up for the course. Results - The results concerning the effectiveness and quality of this course will be obtained through the verification of grades achieved by students and analysis of data in the course evaluation questionnaire.**

Introduction

Brazil is a rich field for use of ICT applied to health related activities. Currently, the country is moving towards the institutionalization of telehealth actions through incorporation of telehealth resources on its National Health System. In recent years, 63 technical-scientific clusters were implemented throughout all Brazilian states, covering 16,836 Family Health Teams and 3,256 municipalities.

For the success of actions implemented, it is essential the training of coordinator staff in each cluster. E-learning is an effective strategy to address the major barriers to continuing education faced by professionals in the public sector, including budget constraints, schedules, learning opportunities at work, poor access to information and lack of training opportunities on the public [1].

This paper aims to describe a development of the "Telehealth Resource Management Course" for the training of telehealth team coordinators. This course is part of the process of strengthening primary care and telehealth in the country and aims to train leaders of the scientific-technical clusters and managers of the Brazilian NHS, at the state and local levels, in the process of incorporation of telehealth resources for both healthcare and education.

Methods

The course was developed in a partnership between the Department of Primary Care of the Health Ministry of Brazil and the Health Technology Center of the Medical School of the UFMG. It was applied online in the second half of 2012 and is near completion and evaluation of the results achieved. Its structure is modular, with a total of 76 hours, applied over a three months period. The content was formulated by teachers of different Brazilian universities expressing the great accumulation of knowledge and experience existing in the country on telehealth. Animation, 3D modeling, and videos were used in the production of the classes. The tutoring system allowed wide monitoring and assistance to students. Module I provided an overview of telehealth; in Module II the focus was on project management; and in Module III experiences of telehealth in Brazil were presented and discussed. Three hundred and three students, of all Brazilian states, signed up for the course.

A data collection instrument was applied online and students who complete the course filled the questionnaire. The following data were systematized and analyzed.

Results

The program content of the course in Telehealth Resource Management featured 21 classes, corresponding to 76 hours, divided into three modules: 1) Development of the actions of telehealth: a general approach; 2) Design and implementation of projects; and 3) Structuring telehealth activities in scientific-technical clusters. The course had the participation of 13 tutors who conducted the monitoring of students enrolled.

The effort of the Ministry of Health of Brazil was to provide a training process in telehealth for persons who will be responsible for deploying the next 64 telehealth scientific-technical centers in Brazil. These centers will provide coverage to more than 3,000 Brazilian municipalities and more than 13,000 family health teams. Each cluster indicated, for this training, five professionals who have demonstrated coordinator profiles.

The first group enrolled 343 professionals. From this total, 327 students attended the course effectively, 241 (73%) finished basic training in telehealth and 189 (58%) finished the training in telehealth. The loss of 4.7% of students in this phase and 27% who have not completed basic training, and 42% who have not completed training in telehealth occurred even after the adoption of a set of measures designed to prevent those losses, such as contacts with the students by phone and email, and also contact with regional and national telehealth coordinators of the Ministry of Health and State Health Departments to help in sensitizing those professionals.

The instrument used to evaluate the course – a questionnaire - comprised of both open and close questions and it was answered for all of 172 students who completed the course. The demographic data analysis showed that female participants were two times more that male participants. With regard to age, it was observed that 50% are between 26 and 45 years of age, and 16% between 46 and 55 years of age. It was also observed that the group of students was sufficiently qualified: most students had a university degree (75%), and 59% had postgraduate studies. This occurred because the course was directed to an audience that had profile to coordinate the activities of public technical-scientific telehealth centers in Brazil.

One goal of the training was to provide subsidies for the implementation of a center that could be responsible for the telehealth activities a significant number of municipalities. The result shown is that 56% of students felt that the course is 100% suitable for the deployment of the nuclei, 33% of students felt that the course is between 80 to 99% appropriate in this regard. That is, the great majority of the students evaluated the course as

contributing to the actual process of implementation of the new centers of national telehealth project in Brazil.

Discussion

The results indicated that an important part of students did not fully finish the course. These results did not differ from the Brazilian experience in relation to distance education. Overall analysis of the results obtained in Brazil regarding the difficulties with e-learning shows several positive aspects. According to Nunes [2], the main problem would be the discontinuity of the projects, the public administrative lack of memory and cultural and political difficulties in adopting more rigorous scientific methodologies and evaluation of programs and projects. Knebel, on review of more than 100 articles on e-learning in the healthcare area, found that the greatest benefit was the convenience and accessibility of training for those who do not live near training centers and traditional universities [3]. Highlighted the opportunity for training and updating without disrupting health care benefits, without losing pay, or negatively impact your family life. Like Knebel, other authors also emphasize the advantages of e-learning, with the expansion of access to education and reducing costs, two of the most mentioned.

Analyzing the results of the course, it could be observed that these aspects were very present in the structure of the course. Brazil, as a country with a very large population and continental size, has exponentially increased process of training using distance courses. For the present course, there were students from all 26 Brazilian states, municipalities usually far from states capitals. The choice of e-learning in structuring the course took into account several aspects. The students from the northern region of Brazil and the Amazon region presented low adhesion due to connectivity issues. Despite the problems identified, it was also observed that the course, the student assessment, is fulfilling an important role in the deployment process of the National Telehealth Program in Brazil.

Conclusion

This course was the first initiative to train managers for telehealth in our country. The results, assessed through a questionnaire, were very positive and will contribute to the strengthening of government initiatives in this area.

References

[1] World Health Organization. Department of Essential Health Technologies. Information technology in support of health care. Genebra, [s.d.]. www.who.int/entity/eht/en/InformationTech.pdf [accessed 15 November 2012]
[2] I. B. Nunes. Noções de educação a distancia. Revista Educação a Distância, n.4/5, pp. 7-25, 1994.
[3] E. Knebel. The use and effect of distance education in healthcare: What do we know? Quality Assurance Project Issue Paper 2(2), 2001. http://www.qaproject.org/pubs/PDFs/distlrnissue.pdf [accessed 10 February 2013].

	Alaneir de Fátima dos Santos – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG)), Brazil. Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.
	Rosália Morais Torres – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG)), Brazil. Sub-Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.
	Maria Aparecida Miranda da Silva - Psychologist on the faculty of medicine at the Federal University of Minas Gerais (UFMG), Brazil. Member of the Telehealth Center of Medicine School at UFMG.
	Maria do Carmo Barros de Melo – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG), Brazil. Sub-Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.
	Neuslene Rievrs - Graduated in History from the Letters and Science School of Caratinga and specialist of Basic Health Management. Manager of Information Technology in Health of the Municipal Health Department of Belo Horizonte, Minas Gerais, Brazil.
	Roseli da Costa Oliveira - Graduated in Medicine by the Federal University of Para , Brazil. Residency in Preventive and Social Medicine, by the Federal University of Minas Gerais, Brazil, Master in Public Health from the University of Campinas - UNICAMP, specialist in Hospital Management from the School of Health of Minas Gerais. Member of the Telehealth Center of Medicine School at UFMG.
	Humberto José Alves – M.D., PhD. Full professor of medicine at Federal University of Minas Gerais (UFMG). Sub-Coordinator of the Telehealth Center of Medicine School at UFMG, Brazil.

The impact of Using the Social Web for Pedagogical Actions in UERJ Telehealth: UERJ Nucleus of Brazilian Telehealth Networks Program

M. Rocha, M. Santos, J. Neves, R. Santos, R. Pablo, A. Monteiro
Rio de Janeiro State University Telehealth Center Laboratório de Telessaúde, UERJ Av.Vinte e Oito de Setembro,77, Térreo Sala 126, Vila Isabel, Rio de Janeiro, Brasil
coordenacao@telessaude.uerj.br

Abstract: **The Social web is a new environment of communication, information and learning, which embraces many tools, in order to support and promote social interaction. Those online means of interaction – including Facebook, Twitter and other sites – are the basis for the main part of the pedagogical activities that happens in Telehealth Center of Rio de Janeiro State University. This work intends to presenting the impact of the social web as a support for the disclosure and maintenance of Telehealth, in a country with so large dimensions such Brazil.**

Introduction

The Social web is a new environment of communication, information and learning, which embraces many tools, in order to support and promote social interaction. Those online means of interaction – including Facebook, Twitter and other sites – are the basis for the main part of the pedagogical activities that happens in Telehealth Center of Rio de Janeiro State University [1]. This work intends to presenting the impact of the social web as a support for the disclosure and maintenance of Telehealth, in a country with so large dimensions such Brazil.

Methodology

Twitter and Facebook profiles with specific contents, and a general gateway were created for the research. From November 2011 to November 2012 a quantitative and qualitative analysis was made with the use of specific tools. For evaluating Twitter, the TweetDeck was used – it enables measuring the level of satisfaction with the publications and also the level of interaction, and still makes possible to observe what the users are telling concerning the posts. In Facebook and in the gateway, Google Analytics

was the tool used for measuring the analysis and number of visits. During this evaluation period, the aim was to share the weekly schedule of activities such as live events and/or online courses.

Results

In Twitter [2], the most significant posts which showed more interaction and reactions of the users were the ones related to online distance courses provided monthly by UERJ Telehealth Center, and also to the weekly virtual seminars [Fig 1]. The way as Twitter users use filters and "retweet" data for other social groups in the net has got a relevant and important role for UERJ Telehealth Center and its wok.

Fig. 1. UERJ Telehealth Center's Twitter

UERJ Telehealth Center's profile in Facebook [Fig 2] has got a total weekly number of 892 visualizations of the contents related to the page. The viral effect, e.g., the number of people who created something using its contents was 52.98%. The number of comments made concerning UERJ Telehealth posts, detailed by gender and country of origin, is: 86.3% female audience; 13.3% male audience. About the age of the users who made comments, 39.3% were women (25-34 years old) and 7%, men (either). Among the countries present at UERJ Telehealth Center Fan Page [3], there are Brazil, Portugal, Canada, Bolivia, South Africa, Argentina, Peru, Mexico, Italy, Turkey, U.S.A., Australia, UK, Costa Rica, Saudi Arabia,

Fig. 2: UERJ fan page

and Spain. This same kind of information is also available at UERJ Telehealth Center's gateway. However, what makes us use this tool is the approach established in Facebook, which is much more interactive, and brings together UERJ Telehealth 5,097 "friends".

Conclusion

UERJ Telehealth Center at social web is an excellent tool for promoting its activities and integrating health staffs and professionals. Social web proved to be efficient in the quick disclosure of its site, making easier the access to its contents.

References

[1] Rio de Janeiro State University Telehealth Center**.** Accessible in http://www.telessaude.uerj.br/site/

[2] Rio de Janeiro State University Telehealth Center Twitter. Accessible in https://twitter.com/telessaudeuerj

[3] Rio de Janeiro State University Telehealth Center fan page. Accessible in http://www.facebook.com/telessauderj

Alexandra Monteiro. MD.PhD. Associate Professor of Radiology, Medical School of State University of Rio de Janeiro [UERJ], Brazil. Coordinator of Rio de Janeiro State University Telehealth Center. Member of the State of Rio de Janeiro Academy of Medicine. Coordinator of the Brazilian College of Radiology Teleradiology Committee. Coordinator of the Nucleus RJ - Brazilian Telehealth Network Program (Ministry of Health). Member of the Standing Committee for Telemedicine and Telehealth (Ministry of Health). Member of the Advisory Committee of Telemedicine University Network (Ministry of Science technology and Innovation).

The Teledentistry Center of the Dental School of the University of São Paulo: Better Education for a Better Health in Times of ICT

M. C. Skelton-Macedo[1], J. H. Antoniazzi[1], C. L. Wen[2], C. G. Abdala[1]
A. E. Haddad[1]
[1]School of Dentistry, University of Sao Paulo, 2227 Prof. Lineu Prestes Street - Cidade Universitária 05508-000 São Paulo Brazil, marycskelton@gmail.com; jhantoni@usp.br
[2]São Paulo Center, University of Sao Paulo, Brazil chaolung@terra.com.br; camillaabdala@hotmail.com; aehaddad@gmail.com

History

The Teledentistry Center of the Dental School (NTO-FOUSP) [1] (Figs 1 and 2) of the University of São Paulo was created as part of the Telehealth Center of the State of São Paulo [2] that is linked to the Brazilian Telehealth Program of the Ministry of Health [3,4,5] (www.teleodonto.fo.usp.br).

It started in August 2007 with two initial projects: a studio to produce interviews and web classes and another one for real time web transmissions from auditorium.

The discipline of Telehealth and Teledentistry for the undergraduate course began in 2008. In 2010 it started for the graduate students. In the same year NTO-FOUSP certified two doctors in Teledentistry and hired an IT professional. It has also presented to the Ministry of Health and PAHO a project to produce contents and create the Brazilian Teledentistry Network [7]. After that, the NTO-FOUSP took part in a project coordinated by the Telemedicine Discipline from the Faculty of Medicine, in a national initiative from the Ministry of Health, and approved by the Research Agency of the Ministry of Education – CAPES. The project aim is to develop interactive educational technologies to improve education of health professionals. In 2011 the Brazilian Teledentistry Network started its activities and hired the first Brazilian associate professor (senior lecturer) in Teledentistry [8]. In the same year a course on Distance Learning in Health and a Bioethical Course to Latin America was produced in two languages: Portuguese and Spanish. Other disciplines began developing educational material to be offered in the web.

2012 was the year of another great project in partnership with the Nursing School to evaluate the human resources in health. NTO-FOUSP was invited

to participate in Technical Boards: Repositories Developing, Open Access Project in the University of São Paulo, Copyright Issues, Metadata, a new Multiconference system, a new video collaboration environment in health, among others. NTO-FOUSP hired another IT professional. Today there are 3 professors and 2 IT professionals in the center. Two of these professors were invited to become members of the editorial board of the Telehealth Brazilian Journal [9].

2013 will be a promising year: it was created a Special Interest Group (SIG) in the University Network of Telemedicine10 involving 3 major public education institutions (USP, UFGRS, UERJ) and one State Health

Fig. 1: – Brazilian Teledentistry Center website at www.teleodonto.fo.usp.br/nucleo

Fig. 2: – Brazilian Teledentistry Center fanpage at www.facebook.com/pages/Teleodontologia-Fousp

Secretary (Mato Grosso do Sul). More institutions had been added since January 2013.

NTO-FOUSP was invited to create an Interest Group in the Brazilian Society of Health Informatics.

NTO-FOUSP has great challenges ahead: it is a new science and much research is needed to develop and involve partners because of the great dimensions of our country.

Supporting Professors

The NTO-FOUSP first objective was to offer support to the professors for a better use of ICT in the teaching and learning processes. It should also offer teleconsultations and the Second Formative Opinion to dentists and other health professionals working at the Unified Health System (SUS) [11, 12].

Teledentistry started to be used by many Departments at the Dental School with the support of the NTO-FOUSP. Learning objects and e-learning courses have been developed, such as atraumatic restorative treatment, dental surgery, prosthesis, endodontics and bioethics.

Researches and published articles certify the positive results in the teaching and learning processes. A multiprofessional e-learning course on maternal and infant care was developed in partnership with the Discipline of Telemedicine in the Medical School of the University of São Paulo and the Federal University of Maranhão [13].

The NTO-FOUSP has been working with the Moodle LMS for the management of e-learning courses and collaborative work. It has already benefited 1026 students and 319 professors at FOUSP.

A Discipline to Teach

The discipline of Teledentistry was established in the undergraduate and graduate courses. The School hired a Teledentistry Professor, the first one in the country, especially to develop this discipline and the preparation of didactic material.

The general objective of this discipline is to graduate skilled professionals who will be able to apply ICT on their general activities and improve their experience in telehealth/teledentistry. In the graduate courses, the aim is to produce educational material, build and manage distance learning courses, produce answers to teleconsultations, investigate the aspects related to dental education, health education and educational technologies. In the undergraduate course the discipline involves subjects, such as telehealth/teledentistry, distant education of the population, synchronic and

asynchronous communication, production and distribution of campaign contents and scientific initiation.

Brazilian Teledentistry Network

In partnership with the Brazilian Association for Dental Education6, the NTO-FOUSP has been working on the creation of the Brazilian Teledentistry Network [7], involving education and research institutions, as well as health services, helping professionals to deliver a more effective primary health care [14]. The general aim of the project is to implement a center in each Public Dental School. This will be linked to a specific network where all the actors can publicize their expertise, educational production, courses, etc. Formative Second Opinions can integrate a library for common use and the network has a Collaboration Space to work on collaborative projects. These possibilities will increase the volume and quality of productions, allowing a spectacular environment of collaboration, development and implementation.

Brazil's educational sector is considering the Open Access movement [15] and a bill was presented for the State of São Paulo: all the educational material should be publicized in the Open Access. By means of the Integrated Libraries Service (SIBi USP) [16], NTO-FOUSP is building a repository for the School and the University. Another project is to build a Digital Media Institute to concentrate professionals and professors in order to produce quality educational material.

There are many challenges, such as the quality of the Brazilian Internet (broad band); poor connectivity in rural areas and in the North and Northeast regions and digital illiteracy at college (professors and students). On the other hand, there are interesting initiatives, such as a portal of public software [17] that unifies all software developed in the country for public use, participation of all the Dental Schools in the Brazilian Teledentistry Network and an increased interest in ICT application by the dentist, the professor and all the students.

References

[1] Teledentistry Center at University of São Paulo, available at www.teleodonto.fo.usp.br acessed on February 2013.

[2] Telehealth Center of the State of São Paulo, available at www.telessaudesp.org.br, acessed on February 2013.

[3] Brazilian Telehealth Program, available at www.telessaudebrasil.org.br acessed on February 2013.

[4] A. E. Haddad. Brazilian Experience in Telehealth Brazil Program." In: Gold Book 50º Congresso Científico do HUPE. eBook. Tecnologia em Educação e Saúde. 2012. Available at www.telessaude.uerj.br/goldbook/artigos, accessed on February 2013.

[5] A. E. Haddad, M. C. Skelton-Macedo, E. D. Fo. Castro, C. V. Abdala, R. M. P. Andrade, F. E. Campos. Formative Second Opinion: Qualifying Primary Health Care in Brazil. Global Telemed eHealth Updates: knowledge Resources. 2010;3:546-50.
[6] Brazilian Association for Dental Education, available at www.abeno.org.br acessed on February 2013.
[7] Brazilian Teledentistry Network, available at www.fo.usp.br/?page_id=6169 acessed on February 2013.
[8] A. E. Haddad. A Odontologia na Política de Formação dos Profissionais de Saúde, o papel da Teleodontologia como ferramenta do processo de ensino-aprendizagem e a criação do Núcleo de Teleodontologia da FOUSP. Tese de Livre-Docência. Faculdade de Odontologia da USP. 2011. 198p.
[9] Telehealth Brazilian Journal, available at www.telessaude.uerj.br/jornal acessed on February 2013.
[10] Brazilian Universitary Network for Telemedicine, available at www.rute.rnp.br acessed on February 2013.
[11] S. Kleinert, R. Horton. Brazil: towards sustainability and equity in health. Lancet, vol. 377(9779), p.1721-2 May, 2011.
[12] C. G. Victora, M. L. Barreto, M. C. Leal, C. A. Monteiro et al. "Health conditions and health-policy innovations in Brazil: the way forward." Lancet v. 377(9782), p.2042-53 June 2011.
[13] E. Harzheim, V. J. P. Dias, R. R. Witt, T. Silveira, J. H. G. Kolling, P. Fontanive et al. Telenursing in Primary Health Care: Report of Experience in Southern Brazil. Stud Health Technol Informatics vol.146, p.202-6. 2009.
[14] N. Almeida-Filho. Higher education and health care in Brazil. Lancet v. 377(9781), p.1898-900. June 2011.
[15] Open Access at University of São Paulo, available at www.acessoaberto.usp.br accessed on February 2013.
[16] Integrated Libraries Service (SIBi USP), available at www.usp.br/sibi accessed on February 2013.
[17] Portal do Software Público Brasileiro, available at www.softwarepublico.gov.br accessed on February 2013.

Mary Caroline - Teledentistry Professor at University of São Paulo School of Dentistry, Endodontics MSc and PhD.

Training Course for Experts of Telemedical Network in Russia (conclusions)

A. Selkov, V. Stolyar, E. Selkova
Russian Association for Telemedicine ais1710@rambler.ru
135, Rublevskoye Highway, Moscow 121552

Introduction

Over the past years there has been a significant increase in the number of telemedical training and consulting centers all over Russia. In 2011-2012 the Russian Health Ministry was able to multiply videoconference equipment fourfold. In 2009 in Russia there were only 887 units of such equipment, today this number exceeds 4 thousand. This has given more possibilities for telemedical consultations, as well as real-time interactions by means of videoconferencing [7].

The experts of the Russian Association for Telemedicine quite a long time ago identified need to train a group of highly qualified technical consultants whose field of expertise is to remotely provide assistance to local telemedical centers in organizing and conducting telemedical events.

Our past experience (since 2000 to the present) in training personnel for regional telemedical centers (RTC) at the "International School of Telemedicine", as well as further support to our graduates to establish new telemedical centers, shows that employees of regional telemedical centers seek advice from the Russian Association for Telemedicine on a wide range of technical and organizational issues that inevitably arise while they get used to working with innovative equipment and technologies. [1, 2].

At the same time highly experienced consultants of regional telemedical centers at times face problems caused by growth in the market of videoconference equipment and, consequently, an increasing range of products purchased for new telemedical centers.

Assistance in solving such kind of problems should be also in the competence of qualified professional consultants.

We came to conclusion that a new category of experts should learn from the accumulated experience of the Russian Association for Telemedicine so that they can work with existing videoconference systems. At the same time they should as constantly improve their knowledge in this field.

Task Assignment

Having analyzed problems faced by regional telemedical centers while providing proper teleconsultations and telelectures, the experts of the Russian Association for Telemedicine set down a number of basic requirements for professional consultants:

- Work experience in organizing various telemedical events in leading diagnostic telemedical regional centers of Russia with high occupancy throughout the year;
- Thorough understanding of the field, knowledge of specific features of videoconference equipment made by different manufacturers;
- Experience in organizing videoconferences using different equipment; ability to synchronize the equipment during videoconference in the "multipoint" mode;
- Maintaining videoconference equipment in operating condition long-term (up to 12 hours), with multiple breaks during conferences (as well as link disconnects), as well as connecting and disconnecting additional participants;
- Experience in testing communication channels and ability to integrate signals of different standards using required equipment;
- Cooperation with foreign technicians in testing communication channels and equipment while preparing cross-border videoconferences (usually communication is done in English).

Additional though not a secondary requirement to qualifications of professional consultants was experience in remote interaction with consulted regional telemedical centers [3, 4].

For Russia consultants' visits to regional telemedical centers is and expensive and time-demanding practice, that fails to provide prompt assistance, especially in emergency situations.

We believe that professional consultants should employ all means of communication - phone, email, ICQ, videoconferencing.

Since in many cases initial assistance is needed for adjusting videoconference equipment, cooperation with consultants starts with a telephone call or an electronic inquiry.

Thus, 2009-2010 we established a goal to prepare professional telemedical consultants, whose qualifications meet the abovementioned requirements and started to work towards it.

Achieving the Goal

Long-standing practice of training highly qualified telemedical experts has many examples of staff loss in hospitals due to higher salaries in other industries.

Therefore, we could not ignore this problem starting this training course.

As an “insurance” against staff turnover we chose financial incentives and provided our students with opportunities to have additional income during initial and advanced training course. Our experience demonstrates that initial training by itself can’t be enough to maintain high qualifications. Continuity of education plays a key role in providing impeccable videoconferencing. However, busy schedule of telelectures and teleconsultations makes it hard to allocate time for comprehensive training. At the same time telemedical centers must ensure the best technical support for telelectures of the best Russian doctors.

Thus, we based the training course on technical and organizational capacities of the Russian Association for Telemedicine in regard with conducting contractual arrangements in adjacent areas, as well as providing support for governmental events.

Our partnership agreements always specify possibility to train experts during video conferences, provided that such training does not affect the event.

A great example of a comprehensive intensive training could be the execution of a 2010 government contract on technical support and maintenance of videoconference equipment for continuous sessions of jury that was selecting investment projects by means of remote dialogue

Fig.1: View of conference rooms from Moscow studio.

During the said videoconferences our experts had a chance to work with the most of regional video conferencing centers and learn to use all types of videoconference equipment that exists in the country. The jury sessions lasted from five to twelve hours with the scheduled breaks, when connection between the cities was stopped, and then restored again. Good commutation provided audiovisual dialogue between all participants of the jury (mostly from three to five points). Jurors got images of studios of participating cities on screen as well as presentation slides of companies applying for state funding. (Fig. 1, 2)

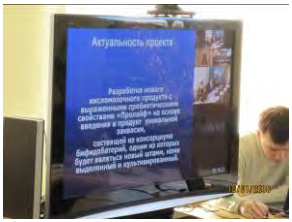


Fig.2: Slides of an applicant for state funding.

Participation in the project enabled our experts to gain invaluable experience in providing continuous long-term videoconferencing, while

inevitable channel interferences taught them to cooperate in order to find the right solution. At the end the customers highly appreciated the work of the experts of the Russian Association of Telemedicine, stating that the proposed technology ensured independence of the jury members' opinions and absence of complaints from competitors.

Later, concluding contracts for videoconference services in Russia, we gave priorities to healthcare organizations, such as pharmaceutical companies, as well as international conferences that usually involve full range of videoconference equipment demonstrating achievements of science and technology.

In order to teach professional consultants to cooperate with foreign technicians the Russian Association for Telemedicene participates in tenders aimed to provide technical and videoconference support for intergovernmental negotiations at various levels [5, 6].

Over the years our experts have fruitfully cooperated with foreign counterparts while providing videoconferences with the EU countries and Vietnam. (Fig. 3).

Fig.3: Meeting of the Russian (small screen) and Vietnamese delegations.

Our training course also includes study of the latest video conferencing equipment. In order to do it we sign testing agreements with manufactures of equipment that allow testing new products in the industry.

Manufacturers well know that the experts of the Russian Association for Telemedicine – both technical and medical staff - thoroughly analyze possibilities of new technologies and are glad to give advice on its upgrade according to practical requirements of the medicine, that help to increases their competitiveness on the market. At the same time, our expert consultants have a great opportunity to keep up with new equipment and follow global trends of telemedicine.

Conclusion

We believe that we have achieved the goal to establish a pilot group of professional consultants for the telemedicine network of the Russian Federation.

We also completed the task to provide initial and advanced training for the group members that is in line with the set goal.

Additional income helped to avoid staff turnover among the expert group – only one expert, who had decided to entirely change his career, left the group.

However, we still refer to this project as experimental. Today we cannot guarantee required continuity of the educational process, as contracts on training depend on demand for videoconference services, which is subject to seasonal fluctuations as well as the emerging competition for a potential client. And, due to the legal restrictions, our association is at a disadvantaged position comparing to potential competitors.

References

[1] A. Selkov, E. Selkova, O. Atkov, V. Stolyar, N. Chueva. Nine-years expirience in telemedicine for rural & remote districts of Russia: from teleconsultations to e-diagnostic centeres and development of the health delivery system. – Med-e-Tel 2006 Proceedings – The International Trade Event and Conference for eHealth, Telemedicine and Health ICT. / Editors: Malina Jordanova, Frank Lievens / April 5-7. 2006 Luxembourg, G. D. of Luxembourg: Published by Luxexpo, 2006, pp. 353-357, ISSN 1819-186X.

[2] A. Sel`kov, V. Stolyar, O. Atkov, E. Sel`kova, N. Chueva. Tecnologias Inovadoras de Telemedicina na Rússia: Des Anos de Experiência Única. – Telessaúde: um instrumento de suporte assistencial e educacao permanente / Alaneir de Fátima dos Santos. [et al.], Organizadores. - Belo Horizonte: Editora UFMG, 2006. 502 p.: il. ISBN 85 - 7041 - 582 – 6, p.p. 443 -451.

[3] V. Stolyar, O. Atkov, A. Selkov, E. Selkova, N. Chueva. From telemedicine consulting to e-clinics of small towns and villages // Ukrainian Journal of Telemedicine and Medical Telematics. – 2007. – Vol.5., №3. – P.252-257. ISSN 1728-936X

[4] A. Selkov, V. Stolyar, O. Atkov and E. Selkova. Experience in Professional Training for Users of Innovative Equipment. Proceedings of The IADIS International Conference on International Higher Education (IHE 2011), Organized by International Association for Development of the Information Society (IADIS) and East China Normal University (ECNU), Shanghai, China 8 – 10 December, 2011/ Edited by Heling Huai, Piet Kommers, Ji-ping Zhang and Pedro Isaías. – Shanghai: IADIS-ECNU, 2011. – pp. 109-112, ISBN: 978-972-8939-56-4.

[5] A. I. Sel`kov, V. L. Stolyar, O. U. Atkov, E. A. Sel`kova, N. V. Chueva. Telemedicine Experience to Serve E-Clinics in rural & remote districts of Russia // Journal of eHealth Application and Technology. Published by Tokai University, Japan. – September 2007. Volume 5, Number 3. pp. 213-216. ISSN: 1881-4581.

[6] A. Selkov, V. Stolyar, O. Atkov, E. Selkova, N. Chueva. Telenurse – The Main Person in Medical Station of Small Village in the Near Future. - Med-e-Tel 2009. Electronic Proceedings: The International Educational eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business. / Editors Malina Jordanova, Frank Lievens, April 1 - 3, 2009. Published by Luxexpo, 2009. ISSN 1818 – 9334. pp. 416-417.

[7] http://www.rosminzdrav.ru/health/it/29

	Professor Andrey I. Selkov was born in Permski Region, USSR in 1948. He received a Ph.D in information science from the Moscow Higher Technical University in 1988 and DBA (USA) in 2002. Head of Management, Marketing and IT Department, professor at the Moscow Institute of International Business, Moscow, Russia. President of the Russian Telemedicine Association. The author (coauthor) more than 100 books and articles on different aspects of a telemedicine
	Valery L. Stolayr wass born in Gorky City, USSR in 1952. He received a Ph.D in biology from the A. N. Bakulev Cardiovascular Surgery Research Center of the Russian Academy of Medical Sciences (Moscow). Head of Telemedicine Laboratory at the A. N. Bakulev Cardiovascular Surgery Research Center of the Russian Academy of Medical Sciences (Moscow). Executive Secretary of the Russian Telemedicine Association. The author (coauthor) more than 100 books and articles on different aspects of a telemedicine
	Elena A. Selkova wass born in Moscow, USSR. She received a degree in Politology from the Moscow State University (2000) and Diploma Manager of International Business from the Moscow Institute of International Business (1999). Associate professor at the Moscow Institute of International Business, Moscow, Russia. Deputy Delegate, The Moscow City Duma (Regional Parliament). Consultant of the Russian Telemedicine Association. The author (coauthor) more than 40 books and articles on different aspects of a telemedicine

Global eHealth Strategy

Change Management – From Conception to Achieve Integration?

C Saunders[1], R. E. Scott[2]
[1]Haskayne School of Business, University of Calgary, Calgary, Alberta, Canada, chad.saunders@haskayne.ucalgary.ca
[2]Department of Community Health Sciences and Family Medicine & Office of Global e-Health Strategy, University of Calgary, Calgary, Alberta, Canada, rescott@ucalgary.ca

Introduction

A number of recent reports and toolkits regarding e-health [1] strategy have been published. Change management is typically presented as a discrete activity occurring after or concurrently with implementation. We critically evaluate the role of change management within these e-health frameworks, and conclude that there is a need for change management throughout the entire e-Health initiative – from conception to integration.

The most recent guidance regarding e-health comes from the World Health Organization (WHO) and International Telecommunications Union (ITU) [2]. Although termed the 'WHO/ITU National eHealth Strategy Toolkit', it is less about strategy and more about the process of introducing e-health to a country. Change management is mentioned only twice in the entire 223 page document, being identified as an example of desirable expertise in the leadership of the 'management and operation' component, and as an example of the type of resource required during the delivery of the action plan.

The document also speaks of 'strategic e-health architecture'. This is a worrisome term, since for many organizations, especially those in healthcare, strategic thinking can be quite a different mindset from the current approach. Furthermore, we are just beginning to resolve that 'strategy' is an important and discrete entity by itself, and that development of clear and evidence-based strategy comes before, indeed guides, development of the required 'architecture' [3-4]. While it is still too early to evaluate the impact of this toolkit on practice, we offer that a key aspect missing from the literature in general (and specifically from this toolkit) is a complementary approach to deal with the type, level, and consistency of change management needed to deliver and capture the full value from using this and similar tools [4-5].

Change Management Metaphors

An underlying premise for e-Health initiatives, especially those of large scope covering regional or national mandates, is that there are benefits to understanding the healthcare system holistically, then determining how to change it, while attempting to determine where resistance will occur. However, there is also the possibility that planning change, especially at that scale, is not possible at all. To help determine where on this spectrum we might position ourselves we critically assess the underlying metaphors, and allow them to guide conceptualization of organizations. This insight is then used as the basis for reflection on whether these assumptions will hold for particular initiatives at this point in time and whether those assumptions will also change over time.

To achieve this, we draw upon Gareth Morgan's [6] work on metaphors and adapt an approach based upon Cameron & Green [7] to highlight four metaphors (of the original eight) that are particularly relevant for understanding how organizations work in the context of the changes associated with e-Health initiatives. The four metaphors are viewing organizations as: machine, political system, organism, or as flux and transformation.

Organizations as machine. Under this metaphor, organizations are structured and well defined and we understand clearly how the various components are connected [7]. Central to this is the division of labor and management by objectives, who in turn decide when and how change is needed and simply work to manage the shifts in the organization, including any resistance. Managers simply 'pull the levers' that collectively lead to the required changes. This approach potentially works well in highly stable environments and for incremental changes, but can lead to disastrous results if implemented fully within more dynamic contexts and for more radical or disruptive change.

Organizations as political system. This metaphor highlights the roles that power, competing interests, and conflict play in organizations. Individuals vary in the levels of power they have in various situations and need to build support for their position as they establish a new coalition and navigate the political map [7]. The challenge with this approach is that since it requires winners and losers (i.e., zero sum game) it can foster a political war zone with 'behind the scenes' negotiating that ultimately leads to a poisoned work environment.

Organizations as organism. This metaphor purports the need for alignment between the organization and the environment in which it

operates. Organizations are collections of inter-related subsystems with changes arising only in response to changes in the external environment [7]. A key assumption is that there is no optimal design or way to manage the organization, however responses to changes in the environment can be managed in the sense that they can be designed and worked towards. The challenge with this approach is that it does not recognize the possibility for the organization to influence the environment in which it operates.

Organizations as flux and transformation. This metaphor suggests that order naturally emerges out of chaos through self-organizing mechanisms and that change cannot be fully managed [7]. The role of management is to create the conditions for change, while embracing tensions and conflicts. This metaphor can be troubling for management since their role seems diminished – it does not lend itself to an agenda or action plan. Instead change is emergent.

Viewed through these metaphors, we can see that documents such as the WHO/ITU National eHealth Strategy Toolkit evidence a strong 'machine' metaphor. This perspective is driven by a project management approach, assuming that one phase of the work leads into the next, and that all this can be 'managed' and any change is unproblematic. The Toolkit does recognize the cyclical nature of aspects of this (e.g., see Figure 12) but fails to recognize the potential for feedback among phases highlighted by the 'organism' metaphor. Similarly, using the 'political system' metaphor, political aspects are recognized as being key, with political stakeholders needing to be engaged and on board, but no guidance from a change management perspective is provided on how to actually do that. Nor is there explicit recognition of how political agendas (and not just those of politicians) can undermine all aspects of this. Finally, the 'flux and transformation' view argues that many of the aspects we normally think of managing are really beyond our control and influence, and the role of management is very different in this view. Each of these metaphors can be seen to have direct association with elements of the Toolkit, but are unrecognized and unsupported.

Discussion

A challenge arises from the perspective of the argument presented above. On the one hand we need to recognize that strategic thinking can require a significant shift in an organization to begin with, while on the other hand recognize that not all organizations necessarily benefit from such strategic thinking. However, for those that can benefit from strategic thinking in this

manner, the required changes must be considered over time and the role of management critically evaluated throughout the e-Health initiative.

This has significant implications for e-health theory and practice. If we prescribe to an approach like that presented in the WHO/ITU 'National eHealth Strategy Toolkit' then we need to be cognizant of the underlying theoretical assumptions around the perspectives on change management that are either explicitly supported or implicitly inherited from the guidelines.

Conclusion

By viewing organizations more broadly, and applying accepted change management metaphors, we can use these lenses to: (a) Identify assumptions explicitly or implicitly guiding extant guidelines, frameworks, and toolkits; (b) Identify areas where certain key assumptions might be overlooked (e.g., political) and need inclusion; and (c) Highlight the possibility that change management is needed throughout these various phases and different metaphors might be more suitable over time and across stage of introduction.

If e-health is to be allowed to revolutionize health and healthcare, we must first provide the opportunity for it to do so. We can begin by thinking about the process by which e-health delivers health services in a profoundly different manner. The goal of our research is to seek alternate insight regarding the best evidence of the sequence of steps needed to ensure successful implementation and integration of e-health into health systems, and how these steps can best be successfully introduced using change management practices – at all stages of the process. It is unlikely any single model or metaphor will offer all the needed answers, but clarity around the sequence of steps and application of different change management metaphors at each step is arising.

References

[1] World Health Organization. Definition of e-Health. http://www.who.int/topics/ehealth/en/

[2] World Health Organization and International Telecommunication Union. National eHealth Strategy Toolkit. WHO Press, 2012

[3] K. E. Pearlson & C. S. Saunders. (2013) Managing & Using Information Systems – A Strategic Approach 5th Ed. Wiley

[4] R. E. Scott & M. Mars. Principles and Framework for e-Health Strategy Development. Unpublished, 2013.

[5] T. Jones. Developing an e-Health Strategy: A Commonwealth Workbook of Methodologies, Content and Models. Commonwealth Secretariat, 2011.

[6] G. Morgan. Images of Organization: The Executive Edition, abridged, Berrett-Koehler, San Francisco, CA, 1986.

[7] E. Cameron & M. Green. Making Sense of Change Management, 3ed. Kogan Page, 2012.

Economics of e-Health: Measuring the Long-term Effect of Telecare

Y. Akematsu[1], S. Nitta[2], K. Morita[3], M. Tsuji[4]
[1]Osaka University, Graduate School of Economics, y.akematsu@sky.plala.or.jp, 1-7 Machikaneyama, Toyonaka 560-0043, Japan
[2]Division of Health and Welfare, Nishi-aizu Town kenkou@town.nishiaizu.jp, 3261 Nozawa, Nishi-aizu, Fukushima 969-4406, Japan
[3]Business and Office Promotion Division, NTT East Japan, ken.morita@east.ntt.co.jp, 1-9-1 Kounan, Minato-ku, Tokyo 108-8019, Japan
[4]Masatsugu Tsuji, Graduate School of Applied Informatics, University of Hyogo, 7-1-28, Minatojima-Minami-cho, Chuo-ku, Kobe 650-0047, Japan

Abstract: **This paper examined the long-term effects of the use of telecare (e-Health) on the residents of Nishi-aizu Town, Fukushima, Japan, between 2002 and 2010. We compared medical expenditure and days of treatment between 90 telecare users (treatment group) and 118 non-users (control group). Using rigorous statistical methods, including system generalized method of moments (GMM), this paper demonstrates that telecare users require fewer days of treatment and lower medical expenditure than non-users with respect to the chronic diseases of stroke, hypertension, heart failure, and diabetes.**

Introduction

To cope with the serious healthcare situation in Japan, local governments have begun implementing telecare or e-Health, which allow the local government to remotely monitor the health of elderly residents at home by transmitting health-related data, such as blood pressure, blood oxygen level, and ECG, to medical institutions via telecommunications networks. Telecare is thus expected to improve users' health, as our previous studies [1-4] demonstrated. The present study was conducted in Nishi-aizu, a town located in Fukushima Prefecture, Japan, and we demonstrate that telecare use reduces not only medical expenditure but also days of treatment. System generalized method of moments (GMM) is used to statistically assess the causal relationship that telecare use actually reduces medical expenditure

and days of treatment. This relationship is not "seemingly correlated" [3, 5, 6].

We conducted our field research in March 2012 to obtain two basic data for statistical analysis such as receipt data which included individuals who were included in our previous studies of the period 2002 to 2006; therefore, data for 90 telecare users and 118 non-users for the period 2002 to 2010 were used in this study.

Materials and Methods

Sample Selection

The receipts for each month are kept at the Nishi-aizu town office, and include a range of information. In the current study, the following data was used: (i) name of patient, (ii) birth date, (iii) regular outpatient treatment or hospitalized patient treatment, (iv) name(s) of major disease(s), (v) date of initial treatment, (vi) number of days of treatment needed, and (vii) "point" of medical treatment (one point is equivalent to JPY 10).

We next collected receipt data for the years 2002 to 2010. To ensure that the patients included in the previous studies were also included in the current study, we first checked whether they responded to the questionnaire survey (in case of death, etc.); about half of the respondents had not responded, which resulted in a lack of samples. We therefore selected 565 new respondents from among the telecare users. The questionnaire used in this study was the same as that used in our previous studies. The questionnaire asks about characteristics such as sex, age, and the individuals' use of the telecare system, which is data not included in the receipt data. Non-users were selected by stratified sampling from the list of subscribers to the National Health Insurance, which amounted to 1035 non-users. The respondents are 91 users and 118 non-users were included in the study.

Summary of Mail Survey

The percentage of sex of users and non-users is shown in Table 2. The percentage of males (59.1%) is higher than that of female (40.9%). The average ages of the two groups are similar, but they are naturally higher than in the previous research, since the last survey was five years ago. As for the number of patients with these four diseases that were treated within the study period, hypertension was the most common of these four diseases, followed by heart disease. Users that had used the telecare system for more than 10 years accounted for 25.6% of the total number of users, which is the largest percentage, and this makes examining the long-term effect of the

system possible. More than half of the respondents reported that they used the telecare system at least once a week. This high frequency of use is possibly due to the town office's effort to hold public meetings for users to teach them how to use the system, as already mentioned.

Results

Model for Estimation

In the estimation, the dependent variables were (1) days of treatment of outpatients, all diseases, (2) medical expenditure for outpatients, all diseases, (3) days of treatment of outpatients, chronic diseases, and (4) medical expenditure for outpatients, chronic diseases. The explanatory variables were telecare use (if users, 1; otherwise, 0), age, income, and the presence of any of the four main chronic diseases such as heart disease, hypertension, diabetes, and stroke (if treated, 1; otherwise, 0). In addition, other factors were added as instrumental variables such as dummy variables for sex or year dummies.

Estimation Results, Chronic Diseases

The estimation results on both days of treatment and medical expenditure of all diseases, may contain biases due to serial correlation, and therefore the result may not be creditable. On the other hand, Table 1 and 2 are results for patients with related to chronic diseases.

Table 1 result (1): Days of treatment (outpatients, chronic diseases)

	Coefficient	S. D.	t value	p value	
Telecare use	-4.223	1.957	-2.16	0.031	**
Age	0.053	0.012	4.50	0.000	***
Income	0.002	0.004	0.47	0.637	
Heart diseases	1.761	3.873	0.45	0.649	
Hypertension	9.061	1.111	8.16	0.000	***
Diabetes	3.370	2.471	1.36	0.173	
Strokes	-3.856	4.621	-0.83	0.404	
Number of observation			1820		
Arellano-Bond test for AR(2) (p value)			0.415		
Hansen test for overidentifying (p value)			0.231		

Note: *** and **indicate levels of significance of 1%, 5%, and 10%, respectively.

The coefficients for telecare use were negatively significant for both days of treatment (p<0.05) and medical expenditure (p<0.05). Age was again positively significant for both outcomes (p<0.01). In contrast to the previous estimation, only hypertension was positively significant for days of treatment (p<0.01) and medical expenditure (p<0.01). This means that hypertension is a main contributing factor for days of treatment and medical

expenditure. The coefficients indicate that telecare use reduces days of treatment for chronic diseases by 4.2 days per user per year, and medical expenditure for chronic diseases by JPY 64,944 per user per year.

Table 2. Result (2): Medical expenditure (outpatients, chronic diseases)

	Coefficient	S. D.	t value	p value	
Telecare use	-6494.41	3215.58	-2.02	0.043	**
Age	70.83	19.37	3.66	0.000	***
Income	-3.11	8.25	-0.38	0.707	
Heart diseases	6885.39	4903.83	1.40	0.160	
Hypertension	9714.75	1466.91	6.62	0.000	***
Diabetes	5606.42	4452.80	1.26	0.208	
Strokes	-6857.28	6447.90	-1.06	0.288	
Number of observation			1820		
Arellano-Bond test for AR(2) (p value)			0.165		
Hansen test for overidentifying (p value)			0.692		

Note: *** and **indicate levels of significance of 1%, 5%, and 10%, respectively.

Conclusions

In this study, we analyzed the long-term effects of telecare use, and found that it reduces days of treatment and medical expenditure for patients with chronic diseases by 4.2 days and JPY 64,944 per user per year, (respectively [1, 2, 3]). The results obtained in the current study are larger than those reported previously, which means that telecare use produces both long-term and short-term effects. Therefore, the longer patients use telecare, the larger the reductions in days of treatment and medical expenditure.

References

[1] Y. Akematsu, M. Tsuji. “An empirical analysis of the reduction in medical expenditures by e-health users,” Journal of Telemedicine and Telecare, vol. 15, pp. 109-111, 2009.

[2] Y. Akematsu, M. Tsuji. “Measuring the effect of telecare on medical expenditures without bias using the Propensity Score Matching Method,” Telemedicine and e-Health, vol. 18, pp. 743-747, 2012.

[3] K. Minetaki, Y. Akematsu, M. Tsuji. “Effect of e-health on medical expenditures of lifestyle-related diseases by using system GMM,” Telemedicine and e-Health, vol. 17, pp. 591-595, 2011.

[4] Y. Akematsu, M. Tsuji. “An empirical approach to estimating the effect of e-health on medical expenditure,” Journal of Telemedicine and Telecare, vol. 16, pp. 169-171, 2010.

[5] F. Wang. “The role of cost in telemedicine valuation,” Telemedicine and e-Health, vol. 15, pp. 949-955, 2009.

[6] Y. Akematsu, M. Tsuji. “Relation between telecare implementation and number of treatment days in a Japanese town,” Journal of Telemedicine and Telecare, in press. K. Elissa, “Title of paper if known,” unpublished.

ePORTUGUESe – The Power of a Language Network

R. Ungerer
ePORTUGUESe Programme, World Health Organization, 20, Avenue Appia – CH 1211 Geneva 27 – Switzerland, ungererr@who.int

Abstract: **The ePORTUGUÊSe network is a platform developed by the World Health Organization (WHO) to promote initiatives and the use of ICT tools to improve access to health information in Portuguese speaking countries. Portuguese is the sixth most spoken language in the world with almost 300 million people living in eight countries (Angola, Brazil, Cape Verde, Guinea Bissau, Mozambique, Portugal, Sao Tome & Principe and Timor Leste) throughout four continents and four WHO Regional Offices [1]. Considering that Portuguese is also the third most spoken language in the western hemisphere after Spanish and English and the most spoken language in the south, this platform supports Portuguese-speaking countries to improve their access to a wealth of knowledge and evidence-based health information contributing to the development and capacity building of human resources for health (HRH) [2]. Its main purpose is to generate an ongoing alliance of institutions and health professionals to disseminate, distribute and circulate information and use this knowledge to improve health care delivery and enhance health systems, ultimately to improve their Millennium Development Goals (MDG) targets.**

Background

There are five Portuguese-speaking countries in Africa and four are among the least developed in the world according to the UNDP Human Development Index (table 1) [3]

Very high (1 a 47)	High (48 a 94)	Medium (95 a 141)	Low (142 a 187)
41 - Portugal	84 - Brazil	133 – Cape Verde	144 – Sao Tome & Principe 147 – Timor Leste 148 – Angola 176 – Guinea Bissau 184 – Mozambique

These countries together with Timor Leste in South East Asia struggle with low literacy, high infant and maternal mortality, low life expectance, intermittent electricity, low connectivity, lack of internet access, shortage of health information in their own language, and therefore in much need of external aid and assistance. Some of them also face political difficulties that contribute to their decelerated development.

Today, we live in an information society and information barely reaches developing countries and when it reaches them it is shared in languages not accessible to local people. The right information can save lives and language is the most important way to communicate, interact and disseminate information; it is an authentic expression of a culture, tradition and identity of a community, and the **ePORTUGUÊSe Network** came to fulfill a long term demand of health professionals in the Portuguese-speaking developing countries who have continually expressed their need for improved access to health information and knowledge in their own language [4].

For the past seven years, the **ePORTUGUÊSe** has been able to contribute to strengthening South-South Collaboration and the development of:

a) National Virtual Health Library (VHL) in all eight countries that was created and adapted according to local conditions [5].

To build each National VHL, local health and information professionals were trained by the Latin American and Caribbean Centre on Health Sciences Information (BIREME/PAHO/WHO) located in Brazil. The involvement of Ministries of Health has been essential to encourage local sustainability and continuity of the VHL. These health professionals are focal points and they contribute by helping the network to better understand the needs of each individual country.

This VHL model enables countries to have their own technical and scientific portal with local directory of health events, health sites, health legislation and a wealth of peer reviewed health information that can be accessed for free by anyone with an internet connection. It has been used in Latin America for more than 15 years with an interface in English, Spanish and Portuguese.

b) The **ePORTUGUÊSe** also supports a **Collaborative Space**. A "knowledge base" portal to share news, documents, press releases, that are being built with the help of members from all the eight Portuguese-speaking countries. This collaborative space was a request from the Directors of Human Resources for Health in Portuguese-speaking African Countries (PALOP) considering the difficulty in sharing documents with their low connectivity and through emails [6].

c) The **ePORTUGUESe BLOG** is a space that publishes general information related to all countries to help disseminate local culture, such as typical dresses, food, books, films, and makes it possible for each country to understand their differences and similarities and supports the fight against isolation. Access to the Blog from 2007 to 2012 can be seen at Figure 1 [7].

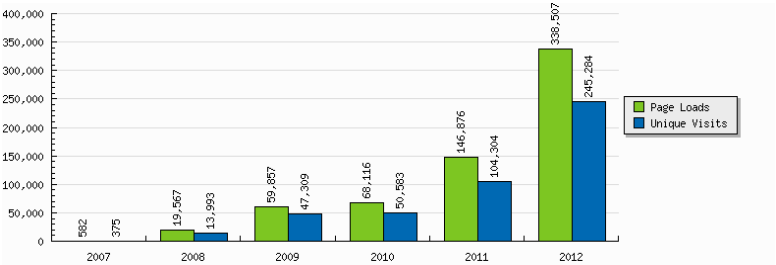


Figure 1

d) **The ePORTUGUÊSe Network** moderates a **Discussion group** called **HIFA-pt** (health Information for all in Portuguese) based on a Global Campaign (HIFA2015) that supports discussions and exchange of experiences to delivery health information to as many people as possible by 2015. Its purpose is to ensure that health professionals from all Portuguese-speaking countries will have access to the information they need to improve their work. Today there are more almost 2000 members from all eight Portuguese-speaking countries [8].

e) In many rural areas, information and communication technologies are scarce and sometimes inexistent. To provide updated health information to those community health workers, the ePORTUGUÊSe has developed a Portuguese language version of the **Blue trunk Library (BTL).** These compact libraries contain basic public health and medical information developed in partnership with the Ministry of Health of Brazil and the Portuguese Health Directorate that donates the selected materials to be sent to countries according to their requests. From 2006 to 2012, 214 BTL have been dispatched to Africa and Timor Leste, and they continue to be in high demand [9].

Respected as an umbrella of activities to improve capacity building of health professionals from the Portuguese-speaking countries, the **ePORTUGUESe** network has now been recognized as a platform that strengthens the South-South collaboration among a group of countries that share the same language and can actively contribute to programmes such as: International Health regulations (IHR), Health Action in Crises (HAC),

Special Programme for Research and Training in Tropical Diseases (TDR), Evidence informed Policy Network (EVIPNet), Patient and Vaccine Safety, Violence and Injury Prevention.

For the future, the ePORTUGUESe Programme is planning to offer and facilitate eLearning opportunities in collaboration with several stakeholders to provide equal learning opportunities for University students from different geographic locations.

References

[1] The Ethnologue: languages of the world – (http://www.ethnologue.com)

[2] R. L. S. Ungerer. ePORTUGUÊSe: Uma rede de informação e uma nova ferramenta da OMS para os países de língua portuguesa. Hospital do Futuro nº 15, julho de 2012 (www.hospitaldofuturo.com)

[3] UNDP – (http://www.undp.org)

[4] World Health Organzation. ePORTUGUESe Programme (http://www.who.int/eportuguese/en)

[5] ePORTUGUESe Virtual Health Library. (http://www.bvs.eportuguese.org).

[6] Collaborative Space (http://cspace.eportuguese.org).

[7] ePORTUGUESe Blog - (http://eportuguese.blogspot.com).

[8] HIFA-pt discussion group (http://www.who.int/eportuguese/hifa/pt)

[9] Blue Trunk Library – (http://www.who.int/eportuguese/bluetrunk/pt)

Regina Ungerer is a medical doctor with a MsC in mother and child health from the Oswaldo Cruz Foundation in Rio de Janeiro. She has been working in the field of Public Health and health promotion for more than 20 years and she specialized in Global Health Diplomacy. In 2005 she joined the World Health Organization to coordinate the ePORTUGUÊSe network, a platform to strengthen collaboration among Portuguese-speaking countries in the areas of health information and capacity building of Human Resources for Health.

From a Research Project to a Regular Telehealth Service: Redefining Objectives and Strategies

R. M. Figueira [1], L.R.Cunha [2], D. S. Neves [2] M. B. M. Alkmim [2]
[1]School of Engineering, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, renatominelli@ufmg.br
[2]Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, Belo Horizonte, Brazil, beatriz@hc.ufmg.br

Abstract: **The Teleassistance Network of Minas Gerais was created in 2005 from a research project to evaluate the cost-effectiveness of telecardiology use in remote and poor areas. In 2009 it became a regular telehealth service providing assistance to primary care health professionals in more than 600 municipalities. During this period, objective and strategy changes related to technology and clinical and organizational processes have to be restated in order to guarantee its sustainability.**

Introduction

From June 2006 until December 2012 the Teleassistance Network of Minas Gerais (TNMG), Brazil, held more than 1.1 million electrocardiograms and 50,000 teleconsulting, covering about 49% of the population of the State of Minas Gerais [1]. Behind these numbers are important objective and strategic changes to follow the transformation of a research project on a regular telehealth service.

The initial steps of telehealth at the University Hospital of Federal University of Minas Gerais happened in 2001, developing a telehealth model for primary care and searching for funders. In 2004 clinical activities (teleconsultations) to support the Family Health Program teams in the capital of the state of Minas Gerais, Belo Horizonte started as a pilot project in 14 sites [2]. In 2005, a larger scale project, involving 82 municipalities in the state and funded by the State Health Department and the research government agencies FAPEMIG and FINEP, was approved with focus on cardiology [3-5]. To develop this project, a partnership between five public universities in the state was established, creating the Telehealth Network of Minas Gerais. Along the past years, the project expanded and in 2009 it became a regular telehealth service, presently with 820 sites and covering 660 municipalities (December 2012). Along this period the main activities were developed to support health professionals in public primary care

through offline teleconsultations and telecardiology. The aim of this paper is to describe the objective and strategy changes related to the transformation of a research project into a telehealth service.

Objectives and Strategies

During the past seven years, the TNMG passed through two main periods: initially as research project, with public funds, and since 2009 as a regular telehealth service. During these two periods the objectives and consequently the strategies to reach them have changed substantially, as it will be showed below.

Objective and Strategies as a Research Project

When the initial project was conceived, the main objective was related to the fact that cardiovascular diseases were the most important cause of death in the state. Consequently, it was necessary to evaluate the cost-effectiveness of telecardiology use in remote and poor areas of the state. For this project 82 municipalities with less than 10,000 inhabitants and low HDI, covered by the Family Health Program and located far from health reference centers were chosen. At that time, the use of telehealth was very unknown, not only for the researchers involved in the project, but mainly by the health professionals located in these remote areas. To reach the objective of the project, a telecardiology model applied to these circumstances was developed and proved to be cost-effective [4]. Afterwards it was adopted the strategy to diffuse the use of the technology among the health professionals in the public primary care in order to reduce cost and to help reaching the Brazilian constitutional principles of health equity and universality. Funding from different government agencies, but mainly by the State Health Department and Federal Ministry of Health, were made available. Total funds applied were about 8 Million US$.

It is important to notice that the main objective at this initial period was to make telehealth and its benefits for health professionals and patients well known.

Objective and Strategies as a Telehealth Service

Based on the results obtained previously, the State Health Department decided to adopt telehealth as one of its strategies. To transform this strategy in reality, in 2009 it approved the continuity of the project changing the objective: telehealth should be incorporated as a routine process in the primary care, improving its use in order *also* to help to reduce public health cost. From this moment the TNMG started to be considered as a telehealth service provider. That was a milestone for telehealth evolution in Brazil because until then all initiatives were considered as exploratory projects.

Although the conceptual change occurred in 2009, the process of funding changed gradually. Even after be considered as a service provider, the TNMG received public funds until June 2012. In July 2012 a contract was signed by the State Health Department and TNMG establishing the conditions and remuneration for the service.

After this contract, considering that all expenses have to be paid by the service provided to the municipalities, a complete restatement of objective and strategies had to be done.

Telehealth Project versus Telehealth Service: Restatement of Objectives and Strategies

As stated previously, as a research project the objective was to transform telehealth from a "scientific fiction" to routine use of technology for health professionals and patients. Later, the objective changed to increase its use in a sustainable way. The change of objective had impacts on the technology and clinical and organizational process strategies.

Technology

(i) Improvements on the telecardiology software to reduce procedures during exam analysis in order to increase productivity (to reduce time expended per exam);

(ii) Improvements on the teleconsultation system in order to make easier the interaction between local health professionals and specialists, increasing number of teleconsultations;

(iii) Implementation of software to automatize the analysis of normal EKG.

Clinical Processes

(i) Better selection of gatekeeper teleconsultation professionals to increase their resolution capability and to improve response quality;

(ii) Assessment of users satisfaction;

(iii) Auditing EKG results and teleconsultation responses to increase reliability.

Organizational Processes

(i) Management based on financial KPIs (key process indicators);

(ii) Intensive monitoring of the service use to detect reductions of EKG/teleconsultation;

(iii) Prioritizing corrective actions based on financial losses.

Conclusion

Since telehealth is a new approach to health care, sustainability is a common concern in all initiatives. Cost-effectiveness demonstration is the first step on a telehealth project evolution towards a regular service provider. The experience of the Telehealth Network of Minas Gerais in this evolution showed that deep changes in the management of technology, clinical and organizational processes are necessary to increase the possibilities of survival. It is necessary to be constantly able to rethink objectives and strategies.

References

[1] M. B. Alkmim et al. Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bull World Health Organ. 2012 May 1;90(5):373-8.

[2] A. F. Santos et al. BHTelehealth: a public telehealth model. In Brazil in Advances in International Telemedicine and eHealth Around the World. 2006 Vol. 1, 2006, MediPage, Poland.

[3] M.B. Alkmim et al. The Implementation Experience of a Telehealth Center in a Brazilian University Hospital. In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. Luxexpo, Luxembourg, 2008;1:359-364.

[4] A. L. Ribeiro et al. Implementation of telecardiology system in the State of Minas Gerais: The Minas Telecardio Project. Arq Bras Cardiol 2010; 95(1):70-78.

[5] 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. 2007;5 (3):197-202.

Maria Beatriz Moreira Alkimim - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (UFMG, 1979), residency in Clinical Pathology, specialization course in Hospital Management and Master Degree in Health Science. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, UFMG, with more than 800 sites. Received several awards in telehealth, particularly Incentive Award in Science and Technology for the Brazilian Public Health System in 2010 with the best Master Dissertation.

Lemuel Rodrigues Cunha - Graduated in Information Systems, MBA in Software Engineering and IT Governance. Coordinator in the Clinical Hospital of Federal University of Minas Gerais. Experience in Computer Science with emphasis in Computer Systems operating in the area of health and telehealth.

Renato Minelli Figueira - 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 Massachussetts Institute of Technology (1983) and a MBA in Finance by UFMG (1994). Professor at the Metallurgical and Material Engineering Department at UFMG. Collaborates since 2007 with the University Hospital of UFMG at its Telehealth Center working on economical aspects of telehealth.

Gender Ratio in Engineering Disciplines: Why Are There Differences?

L. Lhotska[1,2], V. Radisavljevic Djordjevic[2]
[1]Czech Society for Biomedical Engineering and Medical Informatics
lhotska@fel.cvut.cz
[2] Czech Technical University in Prague, Department of Cybernetics
Technicka 2, 166 27 Prague 6, Czech Republic

Abstract: **In last decades there were many discussions about status of women in technology and engineering. Ratio of male and female university students corresponds to gender ratio in population. However when we look at individual study fields there are great differences. In the paper we try to show the situation in the Czech Republic considering number of university students and gender ratio in the country. We also point out what might be the reasons for lower number of women studying engineering disciplines.**

Introduction

In last decades the effort to increase the number of women applying for studies at technical universities, and consequently for a job in the field of technology, can be seen in European countries. However, the advance in the decreasing of gender disbalance is very weak and the amount of female students in technical fields is still quite small. Reasons for this are for sure historical patterns and society prejudices that maintain and encourage gender discrimination.

Nowadays, various organizations both on global/European and local level present role models – women who overcome gender stereotypes and become successful in the area of engineering. These organizations, as for example IEEE Women in Engineering, Women's Engineering Society (http://www.wes.org.uk) or Zkus IT (http://www.zkusit.cz) and Zeny a veda (http://www.zenyaveda.cz) in the Czech Republic are dedicated to promoting and supporting women in engineering, as well as inspiring young women to achieve their potential as engineers, scientists and technical experts.

The aim of the paper is to present briefly current situation and gender disbalance at universities in the Czech Republic, but also an example of good practice. Also, female engineering students' motivation to enroll a specific Master program – Biomedical Engineering (BMI) – was explored.

Social and Educational Stereotypes

The fact that there is a low percentage of women in the field of technology, engineering and science in the Czech Republic can be explained based on the results of two studies conducted by Public Opinion Research Centre and Ministry of Work and Social Affairs in 2006 and 2007. According to [1], Czech society is conservative considering the dividing the male and female roles in the society. Also, employment of a woman in any field of engineering is considered nontraditional [2]. This clearly points out to social stereotypes in this country, considering only the close connection of men and technology to be natural.

We can observe these stereotypes already at the primary school. There is still prevailing belief that boys are more gifted for mathematics, and physics, and girls for humanities (languages, literature, art). However, it was shown in several studies performed with pre-school children that the natural talent for any of these disciplines is almost equally distributed in the population independently on sex. When children start school education, we can see in many cases that boys and girls are treated differently in different courses according to the type of the course. Definitely there is a bias: boys have plus points in mathematics, physics and similar courses even before starting examinations; on the other hand girls have plus points in languages, history, etc. Unfortunately this attitude may be found at secondary schools, too. However, we have to say that not all teachers are biased. Both authors were lucky during their studies that they met excellent teachers that treated the pupils and students equally, independently on sex.

But in general as a consequence, we can observe disbalance in numbers of male and female students at specialized secondary schools, e.g. nursing, economy versus electrical or mechanical technology. And this disbalance continues at universities.

Current Situation in the Czech Republic

Engineering Faculties in General

This section provides a brief overview of gender balance among applicants, students and graduates at universities in the Czech Republic. In addition, gender disbalance among students at engineering faculties is given. The data provided in this paper refer to persons with Czech citizenship, and they were obtained from the Czech Statistical Office (http://www.czso.cz), Institute for Information on Education, which is run by the Ministry of Education, Youth and Sports of the Czech Republic (http://www.uiv.cz), and Eurostat (http://ec.europa.eu/eurostat). We performed more detailed analysis 2 years ago in [3].

The total number of university students at all 73 universities and colleges (both public and private) in the Czech Republic has been slightly increasing during the last decade. Since 2010 the total number is almost constant – 392 thousand of students, out of which 219 thousand are females. In Bachelor and Master Study the gender structure is almost the same: 46 – 49 per cent males and 51 – 54 per cent females. Certain shift is observable in PhD study; there are only 42 – 44 per cent females.

Completely different situation is observed at engineering faculties at all educational levels. Technical sciences are studied more by men: overall percentage of women is about 11 per cent (from the whole number of females studying at universities) and slowly decreasing, while this percentage in male population is around 40 per cent (from total number of male students). In natural sciences the numbers are 9.5 per cent males versus 5.8 per cent females. In medical, pharmaceutical and veterinary studies there are 7 per cent males and almost 13 per cent females. In law and management there are 26 per cent males and 31 per cent females. And finally in humanities and arts there are 21 per cent males and 42 per cent females. These ratios confirm the observation from the primary and secondary schools.

Faculty of Electrical Engineering, Czech Technical University in Prague

At this moment the Faculty of Electrical Engineering (FEE), Czech Technical University in Prague, has 24 active master programs with almost 4000 enrolled students both in full- and part-time form of study. It is worth mentioning that at 7 of these programs there are no female students at all. At other 6 programs there is one female student. The highest percentage of female students is at Biomedical Engineering program. Thus this master program presents an example of good practice. When we look closer on curricula in individual study programs we can see that biomedical engineering has the highest degree of interdisciplinarity, combining pure engineering with life sciences. This fact is one of the reasons why female students enroll in biomedical engineering. There might be another aspect, which we have not yet tackled, namely personalities in the individual fields. At FEE in biomedical engineering there are good examples in male/female composition of academic staff in comparison to other fields having only male members of academic staff. In biomedical engineering we have successful female researchers, PhD students and graduates. Thus the students have positive practical examples they can follow.

Conclusion

This paper presents briefly overall gender situation in higher education in the Czech Republic, with focus on gender disbalance among students at engineering faculties and possible reasons, why females are not so interested in engineering. Also, special attention was focused on Biomedical Engineering Master Program at Faculty of Electrical Engineering, Czech Technical University in Prague, its gender ratio, and female students' motivation to enroll this particular program. We have also discussed with students the issue of selecting a particular study program and possibility to attract more students, in particular females, to engineering. One of the conclusions that can be derived according to obtained answers is that approach of addressing students as early as in secondary school and introducing engineering to them brings good results in practice.

Another issue we have discussed has tackled the perception of women in engineering. Regarding the prejudices about women in engineering, students are aware of their existence, but they personally are not making the discrimination. This is a very positive conclusion bringing hope that the situation in engineering fields generally will change, finally resulting in gender balance. However, we still have the so-called vertical segregation in employment. When it comes to comparison of positions in the companies or institutions, males are more frequently on hierarchically higher positions. Less than 10 per cent of the top positions and about 20 per cent of high managerial positions are occupied by females. Detailed analysis of this situation and the reasons is beyond the scope of this paper. Hopefully with the changing attitudes of the young generation, we will see positive changes in this issue in the near future.

Acknowledgment

This work has been supported by the EACEA EU Project SALEIE and the research program No. MSM 6840770012 of the Czech Technical University in Prague (sponsored by the Ministry of Education, Youth and Sports of the Czech Republic).

References

[1] Roles of men and women. Online: http://www.cvvm.cas.cz/upl/zpravy/100732s_ov71206.pdf (in Czech).

[2] Women in IT. Online: http://www.zkusit.cz/zeny-v-it.pdf (in Czech) .

[3] V. Djordjevic, L. Lhotska, and V. Gerla. Gender Ratio in Biomedical Engineering. In Proceedings of the 22nd EAEEIE Annual Conference, Maribor: University of Maribor, p. 56-61, 2011

Lenka Lhotska holds MSc. and Ph.D. in Cybernetics. She is the representative of the Czech Society of Biomedical Engineering and Medical Informatics in the ISfTeH and IFMBE Council. Currently she is head of the Biomedical Signal and Data Processing group (BioDat) at the Department of Cybernetics, Faculty of Electrical Engineering of the Czech Technical University in Prague. Her research interests are in artificial intelligence methods and their applications in medicine; interoperability and standardization.

Vladana Radisavljevic Djordjevic holds MSc. in Telecommunication Engineering. Since 2008 she has been a research fellow in the Biomedical Data and Signal Processing group of the Gerstner Laboratory, Department of Cybernetics, Faculty of Electrical Engineering, Czech Technical University in Prague. Her research interests cover advanced processing and analysis of biomedical signals, feature extraction and selection, with special focus on electroencephalography.

New Skills and Knowledge Requirements for Telehealth Staff: A United Kingdom Perspective

M. J. Fisk
Health Design and Technology Institute, Coventry University,
mfisk@cad.coventry.ac.uk
Puma Way, Coventry University Technology Park, Coventry CV1 2TT UK

Abstract: **The widening array of technologies associated with telehealth services means that new types and higher levels of understanding are needed by both their management and operational staff. Supporting these understandings are 'skills and knowledge sets', the nature of which has been explored by Coventry University on behalf of Skills for Care and Development (an employer-led organisation concerned for the skills of social care staff in the UK). These sets will, following further development and refinement, guide the training and education of social care workers in relation to telehealth service provision. This paper explains the context for the skills and knowledge sets and points to the areas in which these are necessary.**

Introduction

The widening array of technologies associated with telehealth services means that new types and higher levels of understanding are needed by management and operational staff (referred to here as social care staff). Those understandings can only be attained through training, education and experience. It follows that there is a requirement for new 'skills and knowledge sets' that can help to equip social care staff in relation to the services. These respond to more than just demographic change.

The European and UK Contexts

Before examining the nature of the new skills and knowledge sets it is necessary to set out the context for telehealth services. Reference has been made to demographic change. With demographic change come needs associated with growing numbers of people who live with challenges that can relate to their illness, physical, sensory or cognitive impairments. It is acknowledged that the fact of demographic change affects the way in which telehealth services will, in the future, be provided; but demographic change must not be seen as driving expansionist beliefs (in the public, private or

third sectors) associated with some kind of inevitable need for services to grow to meet the same.

Indeed, the assumption that demographic change will inevitably place greater pressure on health and social care services is open to challenge. Its potential truth lies in a future Europe within which traditional and often top-down services are maintained more or less in their current form. But there are alternative paths for support and care services where service users (and carers), instead on being recipients of top-down care, are supported in self-management and in their maintenance of lifestyles that are conducive to their own health and well-being. This is an agenda for people of all ages. But it offers an escape from some more traditional service frameworks that may have promoted dependency rather than independency.

Telehealth technologies and services, suitably configured, can help in the finding of 'alternative paths' and have, to some extent, been pointed to as a key means by which radical transformations can be achieved. Taking a key place in this is the European Commission's eHealth Action Plan which sets a course founded on 'health capital'. It states that 'without better tailored and more effective health and social care services, Europe's social and health models will be seriously jeopardised' [1]. The wider availability of telehealth services is seen as part of these 'more effective' health services and systems by virtue of fitting within a new vision where eHealth can help unlock 'innovation, enhance patient / citizen-centric care and citizen empowerment; and encourage organisational change.'

The European perspective sets the context. And, largely because of developments in Scotland, the UK is seen as a telehealth pioneer. Of note in the National Telehealth and Telecare Delivery Plan for Scotland, there is a clear objective to have a healthcare system with 'integrated health and social care, a focus on prevention, anticipation and supported self management' with people (service users) 'empowered ... to be the lead partner in managing their care and support' [2]. Importantly, the Scottish Government recognises the need and is supporting the development of relevant training and education courses for social care staff. Their skills agency, the Scottish Social Services Council, plays a key part in this and is working closely with the other UK agencies that come under the Skills for Care and Development 'umbrella'.

Skills and Knowledge Sets for Social Care Staff

The question arises as to the implications of telehealth service development for the skills of social care staff. Before responding to this question it is necessary to recognise that telehealth services are concerned with more than vital-signs monitoring. Telehealth is a wide field that

includes lifestyles and behaviours as much as vital signs. It also includes telecare. This much has been made clear in the work of the European Commission funded TeleSCoPE project which has developed a European Code of Practice for Telehealth Services (see www.telehealthcode.eu). The Code affirms 'telehealth as the means by which technologies and related services concerned with people's health and wellness are accessed by or provided at a distance' (www.telehealthcode.eu).

The pointer, therefore, is to telehealth services that are concerned both with (a) health and well-being – and therefore lifestyles and health behaviours; and (b) facilitating access by people to use in ways that suit them – as much as providing to or for people in accordance with needs that may be assessed by health or social care staff. Telehealth services considered in this way are, therefore, very important to the path for healthcare services signalled above – wherein people are encouraged to take more responsibility for their own health and, crucially, are empowered in the sense of being afforded more choice and being able to retain greater autonomy. The ethical case for this has been made elsewhere [3]. It is in this context that the new skills and knowledge sets are considered.

The new skills and knowledge sets for social care staff that have initially been recognised as needing to cover:

- Basic IT and technical skills (digital literacy);
- Ethical conduct and handling personal information;
- Knowledge of the technologies available;
- Assessment skills;
- Safe installation, maintenance and disposal; and the
- Operation of telehealth services.

The need for some of these was identified in previous work which examined workforce needs in relation to assistive technologies more generally – notably by Skills for Care and Development, the skills agency in England [4-6]. But arguably insufficient attention was given in such work to the need for new 'understandings' and attitudes of social care staff if telehealth services, appropriately configured, truly are to play a key role in changing the way that health services are provided. Hence within the skills and knowledge sets, attention is being given to ethical considerations and how these play out in relation to such matters as data handling and confidentiality. Issues pertaining to the importance of data was, it can be noted, highlighted in the eHealth Task Force report that has strongly influenced the European eHealth Action Plan [7].

More straightforward within the skills and knowledge sets is the need for digital literacy. This carries especial importance in view of telehealth services being increasingly available via smart mobile devices. Alongside

this skills and knowledge set is the need for basic knowledge about the range of technologies and services – albeit allowing for the fact that there will remain areas that are the 'preserve' of some specialist social care and health professionals. Finally there are, of course, requirements for social care staff around day to day operational skills and their knowledge of telehealth services.

Current work is exploring each of these skills and knowledge sets in some detail, along with the range and nature of training and education resources that will help to fill gaps in current provision within the UK. It will lay further foundations for the path of telehealth services and help to shape the attitudes of a social care workforce in ways that will support the real empowerment of telehealth service users (and carers).

Acknowledgment

Skills for Care and Development in the UK funded this work as part of its role to support social care workers. Their guidance for the work has been much appreciated.

References

[1] European Commission "eHealth Action Plan 2012-2020 – Innovative Healthcare for the 21st Century" Staff Working Document SWD 413 Final, Brussels 2012.

[2] Scottish Government "A National Telehealth and Telecare Delivery Plan for Scotland to 2015: Driving Improvement, Integration and Innovation", Edinburgh 2012

[3] M. J. Fisk and D. Rudel. Telehealth and Service Delivery in the Home: Care, Support and the Importance of User Autonomy, In George C, Duquenoy P and Whitehouse D (Eds.) eHealth – Legal, Ethical and Governance Challenges. Springer Verlag 2012 pp211-226

[4] K. Down and A. Stead "Assistive Technology: Workforce Development" Foundation for Assistive Technology, London 2007.

[5] L. Burtney and D. Buddery "Assisting Employers with the Workforce Implications of Assistive Technology: Desk-based Research" Skills for Care and Development, Leeds 2012.

[6] L. Tarpey and S. Hollingworth "The Impact of New Technology upon the Social Care, Children and Young People's Workforces" Report for Skills for Care and Development, Hasca Ltd. 2010.

[7] European Union "eHealth Task Force Report: Redesigning Health in Europe for 2020" Luxembourg 2012.

Malcolm Fisk is CoDirector of the Age Research Centre at Coventry University and leads the European Commission funded TeleSCoPE project that is developing a European Code of Practice for Telehealth Services. He is a member of the Quality Services Advisory Committee of the National Institute for Clinical Excellence (UK) and an Advisor to the Welsh Government in respect of tackling poverty among older people.

The Digital Divide: Still a Reality?

M. Mars
Department of TeleHealth, University of KwaZulu-Natal mars@ukzn.ac.za
Pvt Bag 7, Congella, Durban 4013, South Africa

Abstract: **There is a perception that the digital divide is no longer an issue in eHealth, but what is the reality? This study examines the current status of the digital divide in the developing World and sub-Saharan Africa in particular. Methods: Data on mobile phone penetration, fixed phone line access, proportion of households with Internet access, Internet use, fixed and mobile broadband access, population age distribution, and poverty indices were reviewed. Results: The gap between the developed and developing World has widened over the past 10 years for all metrics. With approximately 40% of the developing World living on less than US$ 1/day, purchasing power parity, it is unlikely that the situation will improve. Conclusion: Poverty is driving the digital divide and may lead to a growing health gap as eHealth and mHealth solutions remain out of reach of the poor who are most in need of better access to and quality of healthcare**.

Introduction

The digital divide is a term coined in the mid 1990's [1]. It refers to the gap between those who have access to and the ability to use information and communication technologies and those who do not. There are many reasons for such a divide, including poverty, education, literacy, age, gender, culture, exposure to ICTs, geographic location, infrastructure, connectivity, bandwidth and telecommunication costs. The digital divide occurs not only between developed and developing countries but also within countries.

The digital divide has been seen as an obstacle to implementation of eHealth in the developing world and in rural areas of the developed world. While much was said about the digital divide, expectations were that as infrastructure and connectivity improved, additional bandwidth became available, technology and communication costs came down, and mobile phone use increased, the divide would narrow. These have all occurred to varying degrees in much of the developing World.

But what is the state of the digital divide in the developing World? For those involved in implementing telemedicine and other eHealth services in sub-Saharan Africa many problems remain. The aim of this study was to

review available literature to determine whether the divide is narrowing as predicted and whether sub-Saharan Africa is following the same trend.

Methods

Searches of PubMed, Cinahl and Scopus electronic databases were undertaken using the search term "digital divide". This returned 195 papers which were reviewed. Specific Google searches were made for relevant documents from the World Health Organization, the World Bank, the International Telecommunication Union (ITU), and the Organization for Economic Co-operation and Development.

Data were gathered for several standard metrics reported annually for the developed and developing World by the ITU [2, 3]. These include the percentage of households with Internet access, individuals using the Internet per 100 inhabitants, fixed (wired) broadband access per 100 inhabitants, mobile cellular subscriptions per 100 inhabitants and active mobile-broadband subscriptions per 100 inhabitants. Separate data were gathered for sub-Saharan Africa where available [3, 4, 5].

All metrics report in terms of number per 100 inhabitants or households. To express changes in the digital divide over time, data from 2001 to 2011 were examined. The difference between the percentages for the developed and the developing World at the first reporting date, were taken as the baseline measure of the divide. These were compared with the difference in 2006 and 2011 to establish possible trends [3]. Similarly differences between the percentages for the developing World and sub-Saharan Africa were calculated to determine if sub-Saharan Africa is following the same trends as the developing World in general.

Data on poverty and population distributions were obtained from the United Nations [6] and the WHO [4].

Results

In 2010, the median age in more developed countries was 39.7yr, in less developed countries 28.2yr and in least developed countries 19.7yr. In sub-Saharan Africa it was 18.6yr [6]. In low income countries, 48.8% of people live on less than US$1 per day, purchasing power parity, and in lower middle income countries 30.2% [4].

Data for the metrics Internet penetration, fixed broadband subscriptions, mobile cellular subscriptions and mobile broadband subscriptions were available from 2001, for households with Internet access from 2002 and mobile broadband subscriptions from 2007. The differences in percentage of households or individuals in the developed World and the developing World for the metrics gathered are shown in table 1.

Table I. The current percentage penetration for the various metrics in the developing World (Curr.) and the differences (ΔD) in percentage penetration of various metrics over time in the developed and developing World and between the developing World and sub-Saharan Africa (ΔS).

	Curr	**ΔD**			**ΔS**		
	2011	**2002**	**2006**	**2011**			
Households with Internet access	9.8	30.4	37.2	49.8			
		2001	**2006**	**2011**	**2001**	**2006**	**2011**
Internet users	24.4	26.5	44.1	45.8	1.7	5.3	14.2
Fixed broadband subscription	4.9	2.0	13.7	20.1	0.2	1.4	4.0
Mobile cellular subscription	77.8	39.2	62.7	44.5	3.4	10.7	16.4
			2007	**2011**			
Mobile broadband subscription	8.0		17.7	43.3			

For all metrics, the differences between the developed and developing World increased over the period reported. Using households with Internet access as an example, in 2002 in the developed World there were 30.4 households more per 100 households that had access to Internet than in the developing World. By 2011 this had increased to 49.8 households more per 100 households. While the gap for Internet users has increased over 10 years the rate of uptake of Internet by users appears to be similar in both groups over the past 5 years. The difference in mobile cellular subscriptions has increased over 10 years but shows an improvement in the developing World over the last 5 years. For sub-Saharan Africa, there is a growing gap between it and the rest of the developing World.

In the developing World, only 24.4% of individuals were Internet users in 2011, which is still less than that of the developed World in 2001 (29.4%). Similarly, the developing World had not by 2011, achieved the percentage of households with Internet access of the developed World in 2001 (35.0%). Fixed broadband and mobile cellular subscriptions in the developing World are currently at figures achieved in the developed World 8 and 6 years ago respectively.

Discussion

The adoption of technology follows an S shaped curve, slowing as it nears saturation. In some instances the developed World is approaching this. It would be expected then that the developing World would start to catch up and close the gap. There are media reports of large percentage increases in ICT adoption, especially mobile phone use in the developing World. While correct they merely reflect an increase off a small starting base. In none of the metrics measured has the digital divide narrowed over the past 10 years.

This raises the question as to whether the divide will ever be narrowed. Theoretically it should, but in practice this is unlikely as technology continues to evolve. The advent of mobile broadband is an example. The developing World currently lags 5-10 years behind the developed World for most metrics. With new technology, new metrics will evolve that will continue to reflect the differences between the haves and the have nots.

Poverty remains a major reason for the divide. People living on less than US$1 per day, purchasing power parity, will in all likelihood continue to not have Internet in their home or a mobile broadband subscription. Food and shelter are their priorities. With half its population in sub-Saharan Africa being children and teenagers, governments have to function off a small tax base and are ever dependent on donor funding and international loans to develop and maintain infrastructure. This is reflected by sub-Saharan Africa lagging further behind the rest of the developing World.

The widening of the divide over time may also indicate that the developing World too is nearing saturation in ICT use measured by these metrics, as the limited number of people with the capacity to purchase and use ICTs, do so.

eHealth activities in the developing World should be guided by a realistic understanding of the digital divide, its implications and the factors that drive it.

References

[1] V. E. Eubanks "Trapped in the digital divide: the distributive paradigm in community informatics," The Journal of Community Informatics, vol. 3, pp. 1-12, 2007

[2] International Telecommunications Union."Measuring the information society 2012," Geneva, ITU, Geneva, 2012

[3] International Telecommunications Union."ICT Data and Statisitics," 2013

[4] World Health Organization."World Health Statistics 2012," 1-175, 2012

[5] Minwatts Marketing Group."Internet usage statistics for Africa," http://www internetworldstats com/stats1 htm, 2013

[6] D.o.E.a.S.A. United Nations."World population prospects, the 2010 revision," http://esa un org/wpp/unpp/panel_population htm, 2012

The EMPOWER Project - Facilitating Self-Management of Diabetes Patients by Intelligent, Knowledge-Based Pathways

H. Schmuhl[1], H. Demski[1], I. Lamprinos[2], A. Dogac[3], M. Plößnig[4], C. Hildebrand[1]
[1]Helmholtz Zentrum München, IBMI medis Working Group, hans-holger.schmuhl@helmholtz-muenchen.de
Ingolstädter Landstraße 1, 85764 Neuherberg, Germany
[2]Intracom Telecom, Telco Software Department, Athens, Greece
[3]Software Research, Development and Consultation Ltd., Ankara, Turkey
[4]Salzburg Research Forschungsgesellschaft, Knowledge and Media Technologies, Salzburg, Austria

Abstract: **A modular patient empowerment framework is described that will facilitate self-management for diabetes type 1 and 2 patients and promote collaboration with health care professionals. Pilot applications will be deployed in Germany and Turkey, connecting to existing EMRs, EHRs and PHRs. Technical and semantic interoperability is provided by the utilization of common standards.**

Overview

Within the EMPOWER project [1] a modular and standard-based patient empowerment framework is being developed which will facilitate the self-management [2, 3] for diabetes type 1 and 2 patients.

Research and development efforts focus on knowledge-based self-management pathways for diabetes patients. These are realized through the combined use of the following services:

The monitoring of vital, physical and mental parameters as well as physical and lifestyle activities: Parameters can be recorded within EMPOWER's Personal Health Record (PHR) [4] and by integrating external data sources like Electronic Medical Records (EMR) [5], Electronic Health Records (EHR) [5], PHRs and Personal Health Applications (PHA) for example in form of mobile Apps.

The identification and selection of patient-specific recommendations: Taking into account the monitored health parameters of a specific patient, relevant recommendation candidates are generated based on expert

knowledge such as diabetes guidelines. They are then provided for selection and revision by the health professional.

The definition of goals and corresponding actions to accomplish given recommendations and to support of the patients' self-dependent execution of these actions in order to facilitate behavioural changes often necessary for patients with chronic diseases: The patient can define goals and plan specific actions in her/his individual action plan to fulfil the recommendations and hence, the treatment requirements.

Trends and feedback mechanism to visualise and evaluate the progress: By means of intuitive and self-explanatory data visualization, motivating reminders and reward mechanisms, patients will be empowered to achieve their personalized goals.

The provision of training and information material comprehensible to laypersons in order to offer the patient up-to-date and individualized background information specific to her/his diabetes type and overall health state.

Seamless, consistent and standard-based integration of relevant data originating from existing systems like EMRs of participating health care institutions, regional or national EHRs, PHRs and PHAs.

The EMPOWER core services will be implemented in two pilot deployments - on a national level in Turkey in cooperation with the Turkish Ministry of Health [6] and in the region of Ingolstadt, Germany in cooperation with the Network of Practices GOIN [7] - to ensure the generalizability and applicability of the project's overall outcome.

Although both pilots share common goals, they are substantially different regarding the overall technical setup of integrated data sources and the country specific characteristics. This means that not only different languages but also specific treatment guidelines, legal requirements and expert knowledge need to be supported.

Methods

An extensive state of the art analysis has been conducted; requirements engineering activities have been carried out to come up with a detailed specification and design concept. Details and issues have been clarified within the scope of experts' discussions involving consortium's partners and domain specialists like doctors and nutritionists.

Results

Data originating from health care institutions are integrated using country specific approaches. Within the German pilot no regional or national EHRs have been established yet in which aggregated health data could be accessed

directly. As a result the EMRs of the participating health care institutions must be interfaced one by one. In contrast, in the Turkish pilot a nation-wide EHR is available that serves aggregated data from treating health care institutions. Data provided by the patients will be integrated using the same approach in both pilots. Patients may own a PHR of an external provider and/or decide to use EMPOWER's PHR. Furthermore, they may start to use or may already be using a PHA (Web- or Mobile App-based) to record and monitor personal health data. Additionally biometrical measurements are - if applicable - imported directly from connected medical devices like blood glucose meters or via PHAs that are already paired with the device. On the technical interoperability level data exchange within both pilots will be based on IHE profiles as defined in the IT Infrastructure Technical Framework [8] and the Patient Care Coordination Technical Framework [8]. On the semantic interoperability level – in order to process EMR and EHR data safely and consistently [9, 10] - ISO 13606 [11] and openEHR [12] information models will be utilized.

The EMPOWER system has been drafted on basis of a modular, service-oriented architecture to offer a maximum of flexibility and extensibility. Beside services providing the core EMPOWER functionalities, additional services are integrated to ensure seamless integration of heterogeneous data sources and end-user delivery of EMPOWER services to multiple platforms like smartphone, tablets and desktop computers. Diabetes guidelines issued by professional societies or administrations will be computerized by the utilization of clinical guideline definition languages and thus can be easily adjusted to national guidelines and scenarios. Comprehensive requirements arise in the fields of identity and data management in respect to the identification schema. In Turkey, a country-wide unique patient identifier was established whereas in Germany it has been introduced only recently in form of the "Gesundheitskarte" [13] that is currently being issued to the wider public. Moreover country-specific legal regulations and the different pilot setups require comprehensive, convenient and adjustable security and privacy services for the management of patients' consent, access control and overall system auditing capabilities.

Discussion

Implementation works such as early prototyping and component integration have recently started and aim to verify adequacy and practicability of the proposed concept.

By the innovative and interdisciplinary combination of latest methodical and technological advancements, EMPOWER breaks new ground in the

field of patient-centered, data- and knowledge-based medical decision support systems.

Acknowledgement

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement No 288209, EMPOWER Project.

References

[1] Empower Project Homepage. Available from: http://www.empower-fp7.eu, last visited 24.10.2012.

[2] L. Alpay, P. van der Boog, A. Dumaij. An Empowerment-Based Approach to Developing Innovative E-Health Tools for Self-Management. Health informatics journal. 2011 Dec;17(4):247-55. PubMed PMID: 22193825.

[3] A. Tsalatsanis, E. Gil-Herrera, A. Yalcin, B. Djulbegovic, L. Barnes. Designing Patient-Centric Applications for Chronic Disease Management. Conference proceedings: Annual International Conference of the IEEE Engineering in Medicine and Biology Society IEEE Engineering in Medicine and Biology Society Conference. 2011; 2011:3146-9. PubMed PMID: 22255007.

[4] Committee HPHRS. Himss Personal Health Records Definition and Position Statement. Available from: http://www.himss.org/content/files/phrdefinition071707.pdf, last visited 24.10.2012.

[5] HIMSS Analytics. Electronic Medical Records Vs. Electronic Health Records: Yes, There Is a Difference. Available from: http://www.himss.org/content/files/WP_EMR_EHR.pdf, last visited 24.10.2012.

[6] Turkish Ministry of Health. Available from: http://www.saglik.gov.tr/EN/, last visited 24.10.2012.

[7] Go in Integrationsmanagement- Und Beteiligungs-Gmbh Im Gesundheitswesen. Available from: http://www.goin.info/, last visited 24.10.2012.

[8] IHE Technical Frameworks. Available from: http://www.ihe.net/technical_framework/, last visited 24.10.2012.

[9] H. Demski, C. Hildebrand, A. Brass, S. Jedamzik, R. Engelbrecht. Improvement of Cross-Sector Communication in the Integrated Health Environment. Studies in health technology and informatics. 2010;155:95-100. PubMed PMID: 20543315.

[10] V. Stroetman, P. Lewalle, A. Rector, J. Rodrigues, K. Stroetman, G. Surjan, B. Ustun, M. Virtanen, P. Zanstra. Semantic Interoperability for Better Health and Safer Healthcare2009 29.10.2012 29.10.2012]. Available from: http://ec.europa.eu/information_society/activities/health/docs/publications/2009/2009semantic-health-report.pdf .

[11] En 13606 Association. Available from: http://www.en13606.org, last visited 24.10.2012.

[12] OpenEHR Foundation. Available from: http://www.openehr.org/, last visited 24.10.2012.

[13] Bundesministerium für Gesundheit. Elektronische Gesundheitskarte. Available from: http://www.bmg.bund.de/krankenversicherung/elektronische-gesundheitskarte.html, last visited 24.10.2012.

Holger Schmuhl studied information technology and medical informatics at the Technical University of Munich, the Tampere University of Technology and the University of Leipzig. He holds a diploma in computer science with specialization on clinical information management of the University of Leipzig. His working experience include 4.5 years as project manager, system integrator and application development manager at GE Healthcare and 2 years as research assistant at the Center for Information Technology and Medical Engineering of the Heidelberg University Hospital. Since August 2012 he is working as researcher at the Helmholtz Zentrum München - German Research Center for Environmental Health at the Laboratory for Medical Information Systems. His research activities focus on inter-institutional personal and electronic health records, system integration/interoperability and free/libre and open source software. He is founder and coordinator of Medfloss.org and freelance consultant and developer. He is vice-chairman of the IMIA Open Source working group, member of the EFMI LIFOSS working group, the German Association for Medical Informatics, Biometry and Epidemiology (GMDS) and the Free Software Foundation.

The Virtual Organization in Telemedicine: Problems and Solutions

I. H. Monrad Aas
Vestfold Hospital Trust, monrad.aas@siv.no
PO Box 2267, 3103, Tönsberg, Norway

Abstract: **When personnel from different organizations work with telemedicine, they form virtual organizations. Network organization, centralization, decentralization and collaboration measures are important for telemedicine virtual organization. For organizations planning telemedicine, work with organization should be done.**

Introduction

Telemedicine means working by virtual organizations or virtual teams. The word virtual is of Latin origin and means thought or potential, but not in fact. Virtual organizations are 'almost organizations' [1, 2]. It is not right to conclude that when telemedicine is practiced only now and then, it is not a virtual organization. Little attention has been given to the telemedicine virtual organization. In two Norwegian telemedicine projects, organizational problems were identified and solutions to the problems designed. The more than 40 publications show numerous organizational consequences and numerous types of organizational consequences [2]. More than 25 studies from several countries confirm and corroborate the findings [3], for example [4, 5].

Aims: To show the fundamental role organizational problems have for the telemedicine virtual organization and how they can be solved.

The Organizational Problems in Telemedicine

That an ordinary organization is found behind bricks and a telemedicine virtual organization is found 'behind' clicks on a computer does not mean that a well functioning virtual organization is established without doing work with the organization itself. When telemedicine is to become an ordinary activity, focus on the organizational problems is necessary. In the telemedicine community, this has not been fully understood.

In the Norwegian studies, a similarity in organizational problems was demonstrated across organizations and even across very different applications, like teleconsultations and teleradiology [2]! Studies from other countries confirm and corroborate the Norwegian findings [3].

The Telemedicine Virtual Organization for Several Providers

How to organize telemedicine for the providers in an area or for the providers of a health care corporation is a problem. The solution is network organization and centralization/ decentralization.

Network organization

Network organization is not a new term, but well known from private industry, outside of the health service. Telecommunications can be an infrastructure around which single health care providers are distributed. Such network organization means a formation of alliances between organizations with purposes like: new distribution of hospital functions, increased flexibility in what single providers can do by competence complementation and improved access to care [1, 2]. Production done with the aid of new technology must then be integrated in (and interact with) a health service where most of the production is done with ordinary work processes.

Centralization and Decentralization

Centralization and decentralization are important terms for all organizing. Centralization and decentralization are opposite trends on the same scale. Decentralization means 'away from the centre' and centralization 'towards the centre'. New technology makes the questions of centralization or decentralization relevant.

The teleradiology case: The production process in radiology has two elements, i.e. capturing of images and interpretation of images. Centralization can be defined as performing all, or parts, of the radiology image interpretation at fewer organizational units than before digitalization of radiology and teleradiology. An example is that a region centralizes image interpretation for one type of radiology to a larger radiology department. Decentralization can be defined as performing all, or parts, of the radiology image interpretation at more organizational units than before digitalization of radiology and teleradiology.

For radiology, we have a number of types of centralization. In the literature, a cross-table has been used to ease the overview [2]. Centralization types are put in two main categories: geographic centralization (with three subcategories) and centralization according to function (with seven subcategories). The subcategories of geographic centralization can be combined with the subcategories of centralization according to function, and the cross-table has 21 (7x3) theoretically possible combinations [2].

Teleradiology represents a possibility for building up centralized specialized competence. For sites, with few radiologists, having top competence in all areas of radiology is difficult. With teleradiology, existing specialized competence can be exploited better, more specialized competence can be developed and qualified second opinion can be obtained more easily. The result may well be improved quality of image interpretations [2, 6]. Also, images from several sites can be stored in one common computer. Such archives can be used for pathology comparisons, to follow a patient's history of disease, for learning and teaching purposes. The archives can play a role for quality [1]. With teleradiology, rethinking of the distribution of work tasks, for larger regions or in larger enterprises, is possible. Reconsidering the organization of 24 hours duties in-between hospitals, of a larger area or larger enterprise, can include who should take care of the duties (for example, centralization of 24 hour duties to one hospital) and specialization of duties (for example all neuroradiolgy taken care of by one hospital in a larger area).

For decentralization, we find fewer types than for centralization. Decentralization is considered less relevant for radiology than centralization. Decentralization to a higher number of organizational units could drain small departments for radiologists. Fragmentation of care requires coordination [2, 7]. Decentralization may still imply advantages like, capturing of radiology images in new locations. This can mean earlier diagnosis, earlier good quality care and the advantage of a shorter travel.

Extension of the Teleradiology Virtual Organization Concept

When it comes to the organization of telemedicine in geographic areas or in larger corporations, the radiology case is a useful model. Analysis of future organization of telemedicine can be based on network organization, centralization, and decentralization.

Telemedicine Collaboration

Obtaining the benefits of telemedicine is dependent on implementing the right collaboration measures [2, 8, 9]. Collaboration measures can be defined as actions important for good telemedicine collaboration. When telemedicine is planned to be a routine activity, rather than a just a project run by champions, implementation of measures of collaboration is required [2]. Research has identified collaboration measures for telemedicine [2, 8, 9]. Teleradiology and teleconsultations are pretty different forms of telemedicine, but we find obvious similarities (and differences) in measures for improved collaboration. Three measures for improved collaboration are the same both in teleradiology and remote consultations: make someone

responsible and distribute tasks, organize face-to- face meetings (knowing each other plays a positive role), telemedicine should be organized so participants get more experience with telemedicine (the collaboration works better when the volume is larger) [2].

Other Factors

Organizational self-interest is important and an obvious motivator for telemedicine participation. Management at different levels should involve itself in the inter-organizational collaboration. Managers close to the telemedicine activity may fear of loss of power and control when employees work externally to own organization. It can be necessary to perform a conscious selection of individuals and organizational partners. From research, organizational consequences of telemedicine internally in participating organizations are known to be very common [2, 10].

Conclusions

There are problems with virtual organizations. None of the problems with virtual organization and telemedicine collaboration are large enough to prevent effective collaboration.

References

[1] I. H. M. Aas. Improving patient safety with telemedicine. Exploring organizational factors. In: Moumtzoglou A, Kastania A (Eds.): E-Health Technologies and Improving Patient safety: Exploring Organizational Factors. Hershey, IGI Global, (pp 56-70) 2013.

[2] I. H. M. Aas. The organizational challenge for health care from telemedicine and e-health. Oslo, The Work Research Institute, 2007 (155 pages). http://www.afi.no/stream_file.asp?iEntityId=2088

[3] I. H. M. Aas. Organisational consequences of telemedicine. Generalization of findings from Norwegian studies. Proceedings of eHealth and TeleMed 2011: Raising the standard – improving care, cutting costs. London, 2011.

[4] C. May, R. Harrison, T. Finch, A. MacFarlane, F. Mair, P. Wallace. Understanding the normalization of telemedicine services through qualitative evaluation. J Am Med Informatics Association, Vol. 10, pp. 596-604, 2003.

[5] D. Nicolini. The work to make telemedicine work: A social and articulate view. Social Science & Medicine, Vol. 62, pp. 2754-67, 2006.

[6] I. H. M. Aas. Organizational centralization in radiology. Journal of Telemedicine and Telecare, Vol. 12, pp. 27-32, 2006.

[7] I. H. M. Aas. Organizational decentralization in radiology. Journal of Telemedicine and Telecare, Vol. 12 (Suppl. 1), pp. 1-3, 2006.

[8] I. H. M. Aas. Telemedical work and co-operation, Journal of Telemedicine and Telecare, Vol. 7, pp. 212-218, 2001.

[9] I. H. M. Aas. Organizational cooperation in teleradiology. Journal of Telemedicine and Telecare, Vol. 11, pp. 45-50, 2005.

[10] I. H. M. Aas. A qualitative study of the organizational consequences of telemedicine. Journal of Telemedicine and Telecare, Vol. 7, pp. 18-26, 2001.

I. H. Monrad Aas is a PhD (1983) from the University of Oslo with full professor competence (from 1994). Authored more than 120 publications, invited speaker to international conferences in Europe, Australia, USA and the Middle East, mentor for more than 250 research works, leading international courses at high level for health personnel and international courses for researchers, opponent at doctoral dissertations, evaluated research institutions in other countries.

Value Analysis to Outline the Future of Robotics in Healthcare - PRAMAD Project

A. Schiltz[1], I. Gafton[1], L. Liauzu[1], J. Braive[2], M. Pino[3], G. Legouverneur[3], M. Boulay[3], V. Dupourque[4], J. Caquas[5], M. Chetouani[6], C. Sapt[7], P. Caton[8] D. Vaufreydaz[9]

[1]Orange Labs Centre, 28 Chemin du vieux chêne, 38243 Meylan, France
[2]Orange Healthcare, 6 Place d'Alleray, 75015 Paris, France
[3]Hôpital BROCA, AP-HP, 54 Rue Pascal, 75013 Paris, France
[4]ROBOSOFT, Technopole d'Izarbel, 64210 Bidart, France
[5]ROBOSOFT-PGES, 4bis, Chemin des Prés - 38240 Meylan, France
[6]ISIR, Boîte courrier 173, 4 Place Jussieu, 75252 Paris, France
[7]WIZARBOX, 1 Rue de la Cristallerie, 92310 Sevres, France
[8]COVEA TECH, 11, Place 5 Martyrs Lycée Buffon, 75014 Paris, France
[9]INRIA - Inovallée – 655, Av. de l'Europe, 38334 Montbonnot, France

Abstract: **Assistive robots for people with loss of autonomy represent a market with high potential for growth in the coming years. These robots aim firstly to meet the needs of dependent elderly people and secondly to "reinforce" the homecare service ecosystem in order to improve its effectiveness. In addition, retirement homes and care facilities are not always affordable contributing to increase the levels of stress and burden in informal caregivers. Under these circumstances, robot assistance for homecare could represent a pertinent solution for individuals who have some functional limitations but who are not dependent on medical care.**

Introduction

This study was conducted within the framework of the PRAMAD project (Robot Platform for Ambient Assisted Living), which is supported by the French national 'competitiveness cluster' for digital content and services 'Cap-Digital', whose robotics community is addressing the subject of Robotics and Smart Objects.

The purpose of the PRAMAD project is to propose an economically-viable concept for an assistive robot intended for persons with impaired autonomy with the main objective of improving homecare efficiency.

PRAMAD is a collaborative project associating ROBOSOFT manufacturer, BROCA Hospital (APHP), ORANGE Labs, Inria (French National Institute for Research in Computer Science and Control), ISIR

laboratory (Institute for Intelligent Systems and Robotics), WIZARBOX (French video game Development Company) and COVEA Insurance group.

The ambient assisted living robots for elderly and dependent people are expected to become a fast growing market in the coming years. These robots aim firstly to meet the needs of dependent older adults and their caregivers and secondly to "reinforce" the ambient assisted living ecosystem with the objective to improve its effectiveness. Under these circumstances, robot assistance for homecare could represent a pertinent solution for individuals who have some functional limitations but who are not dependent on medical care.

The Market for Personal Service Robots

Despite the economic crisis, the world market for service robots is experiencing exponential growth with turnover of approximately €10bn in 2011, expected to hit €25bn in 2015 [1], including around €5bn for personal service robots. In this particular segment, sales are mainly dominated by robotic vacuum cleaners and toy-like robots.

It should be noted that robot market segments have differing maturity levels. The service robots segment is still in the experimentation phase, as confirmed by the Gartner Hype Curve which in 2010 estimated that mobile personal service robots were expected to reach consumer markets in around ten years [2, 3].

Value Analysis Method for Analyzing User Requirements

A value analysis (or value engineering [4]) has been carried out in order to get an insight of potential user's needs and the utility of robot's functions for the final user. The aim of the Value Analysis method is to design a product or service that optimally meets user needs. First of all, PRAMAD partners agreed on a total of 130 delivery functions organized into eight basic functions, along with three constraint functions as described in **Fig. 1**.

Basic functions
F1-To improve the security of the person
F2-To improve home safety
F3-To assist the person in everyday life
F4-To provide assistance to caregivers, family ...
F5-To facilitate individual's health monitoring
F6-To maintain social ties and prevent isolation
F7-To help stay fit and stimulate
Constraint functions
C1-To meet safety requirements
C2-To be acceptable
C3-Easy installation and maintenance of the system

Fig. 1: List of basic and constraint functions

The list of functions was presented to participants from two different groups "healthy older adults living at home" and "older adults with chronic diseases living at home". Participants were asked to rank the seven functions by order of priority.

NB: the eighth function “Assist Healthcare Professionals” was not treated here because a “Professionals” group was not included in the study.

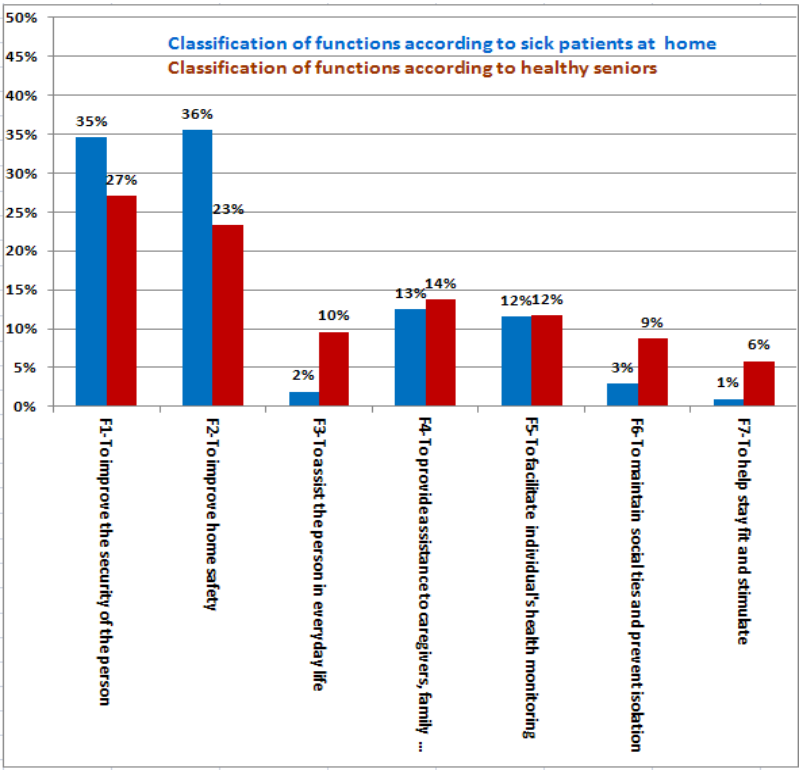


Fig. 2: Bar chart showing evaluation of functions by ‘elderly people in good health’ and by ‘elderly sick at home’

Fig. 2 presents mean ranking of each function in each users group. Opinions on function ranking can be split depending on senior’s group, respondents' age, preferences and lifestyles. However, there are some points of convergence:

- F1 and F2 (‘To improve individual’s security’ and ‘To improve home safety’), were the top-ranked preferences since the two respondents groups want both to "be rescued and helped more quickly in case of emergency (detection of falls, leak detection and intrusion, night surveillance, obstacle detection…).
- F4 and F5 (‘To provide assistance to caregivers and family’ and ‘To facilitate individual’s health monitoring’) have also been plebiscite by

both groups being in favor of the robot in order to "reassure the family", when 'elderly sick at home' were interested by video-consultation and measuring vital parameters and 'elderly people in good health' found the "medical monitoring support" function useful, but "for other people".

- F3 ('To assist the person in everyday life') in contradiction with experts projections, was not perceived as so important by patients. This result suggests that nowadays older adults tend to reject assistive robots with physical contact, but on the contrary they tend to accept household robots. This is consistent with our qualitative and focus group surveys and also with Georgia Institute of Technology conclusions [5] "*Seniors (ages 65 to 93 years) preferred robotic more than human help for chores such as cleaning the kitchen, doing laundry and taking out the trash, but not for help getting dressed, eating and bathing, or for social activities*".

One of our findings is that there is today a deficit projection from the seniors regarding the use of assistive robots in daily life (either because of stigmatization, fear of difficulties in mastering this new technology, or just a rejection of robotic help for personal care tasks…). Such an observation is consistent with Gartner Hype Curve estimation which indicates that robot technology will not take off for 10 years [3]. In the future, this attitude could be reversed if the robot (or global home automation) were perceived as a general service tool, supporting in some way all those involved in the homecare social ecosystem.

References

[1] http://www.ifr.org/service-robots/statistics/
[2] http://www.gartner.com/technology/research/methodologies/hype-cycle.jsp
[3] http://www.gartner.com/hc/images/215650_0001.gif
[4] http://www.npd-solutions.com/va.html
[5] http://www.kurzweilai.net/seniors-to-robots-dont-get-too-familiar

Image Transfer & Data Processing

AIO HD Camera System

K. Han
Rebonson Inc., USA

Rebonson Inc. will show ***AIO HD Camera System*** at Med-e-Tel 2013, **booth # 1C32**. *All In One (AIO) HD Camera System* can be used for tele - conferences and tele-education through Ethernet cables. The system works with or without a PC and can be applied in many different areas of medicine:

- In family medicine and telemedicine as a general exam camera;
- In gynecology as a video colposcope;
- In ENT (ear, nose, throat) as a video otoscope;
- In dermatology as a video dermascope;
- In proctology as a video rectoscope;
- As video endoscopy system.

This is the first HD medical camera in the world that has practice management software in the main system unit of the camera. Users do not need to install the software into their computers; they can simply connect the camera to a monitor. The device has High Definition image quality (4 Megapixels) and 2 GB SD card so doctors could save 80,000 pictures in the camera system. With or without using a computer, doctors could create the

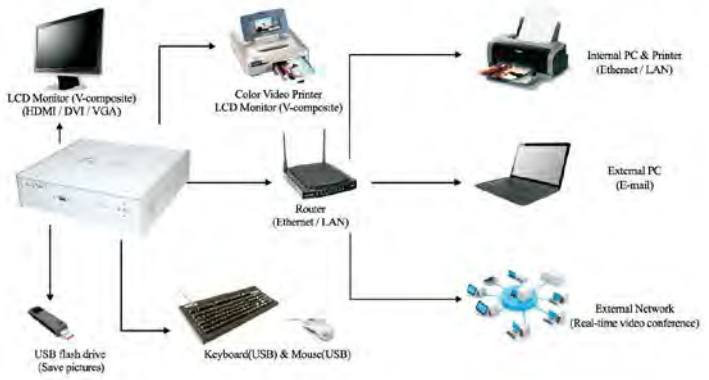


Fig. 1: Advanced network solution in hospital and telemedicine by AIO HD Camera System

database of their patients, take before and after pictures, make comments to the images and directly print images with the data through a color video printer or save them into a USB flash drive. Other unique feature of the AIO HD camera is the ability of doctors to have real time video conferences with their colleagues.

Company Information

Rebonson Inc. has 15 year experience in manufacturing and distribution of medical equipment. We provide not only products but also opportunity to distribute or use our equipment with confidence and comfort through our well established customer service and maintenance. We consistently make an effort of developing new products and upgrading current products to satisfy our partners and customers, and we will do our best to let them get the best of it.

Fig. 2: AIO HD Camera System

Visit us at: www.rebonson.com

Address: 965 Oakland Rd., Suite 2B, Lawrenceville, GA 30044, U.S.A.

Toll Free: 1 866 356 0854
Phone: 1 770 825 0100
Fax: 1 770 849 9733

Keith Han is a founder of Rebonson Inc and Sometech Corp, located in Atlanta, USA. He developed 139 telemedicine vans all over Mexico. Currently he is providing a telemedicine diagnostic imaging system all over the United States.

New 3D Vision is the Future of the Telemedicine

V. Gueorguiev[1], I. Evgeniev[1], D. Georgieva[2]
[1]Technical University Sofia, veg@tu-sofia.bg; iei@tu-sofia.bg
blvd. „Kliment Ohridski" 8, Sofia, Bulgaria
[2]New Bulgarian University Sofia, dvelcheva@nbu.bg
blvd. „Montevideo" 8, Sofia, Bulgaria

Abstract: **The aim of this paper is to present some ideas and result of current research oriented to using stereoscopy equipment for telemedicine. We target our preliminary tests and investigations of 3D teleconference and telepresence based on join work with physician from Medical University Sofia.**

Introduction

Telemedical applications have the potential to reduce differences in life quality for many people because they allow the treatment of patients over long distances. This is the main goal of the Telemedicine - to provide permanent and rapid remote access to physicians using telecommunications, computer and information technologies, regardless of the patient's and the physician's locations:

- E-Doctors on telemedical centres (via telemedical equipment) offer easy and almost immediate and/or simple access;
- It is quite common for serious medical conditions to be diagnosed at a later stage because it is often difficult for patients in rural areas to travel to large cities to get medical consultations in a tertiary hospital. Telemedicine enables and/or increases the access to an expert physician;
- Patients may require further monitoring and consulting after the treatment given to them in hospital at their first visit. Telemedicine becomes a reasonable alternative to hospital physician visits and helps to monitor chronic conditions: this increases patient's mobility and quality of life in post-hospital stages of the treatment.

All these predetermine the need of a wide variety of communication technologies for telemedicine purposes: from simple phones and emails, via satellite communications and reach to video-monitoring and video-conference systems. As a result the quality of telemedical applications is unambiguous depending from the quality of live images & video, live sounds & audio, real-time stream of vital data and information for patients.

The movie “Star Wars” (1977) changes the understanding for computer graphics and animation. This changed the life in general and industries that didn’t understand this lesson dramatically lost market positions.

The movie “Avatar” (2009) changed the understanding for 3D video and audio realism. Today many industries exchange their 2D-based tools and applications to 3D- and 4D-based. This is the future and it comes fast. Telemedicine is part of our life and the need to exchange to basis from 2D to 3D communication is already obvious.

The aim of this paper to present some preliminary results of our research of current 3D capturing and visualization systems: we test some of available tools/systems and analyze their characteristics and abilities for telemedical purposes.

The Problem

Using up-to-date technologies is of crucial importance for telemedicine. Video communication in telemedicine into videoconference and telepresence offer the following [1]:

- The main goal of video-conference applications in telemedicine is to provide real-time visual and audio patient assessment. This type of applications was developed to connect physicians with patients located in isolated areas at which climatic or geographical conditions makes doctor or patient transportation difficult and costly, resulting in inequalities in patient care. Teleconsultation, telepsychiatry and tele-education are well-known examples;
- Telepresence in general means projecting virtual images of the operative field to remote sites. Surgical telementoring, teledermatology, teleophtalmology, teletrauma, and emergency telemedicine are some examples of telepresence practice in telemedicine.

Three-dimensional (3D) graphics was creating new abilities to present visual data and information. In Telemedicine this adds many new ideas for 3D visualization of human internal organs in their true form and shape, analyzing and manipulation of 3D structures from the captured 3D image(s). This is significant for a number of diagnostic and therapeutic applications but this is an off-line activity. Surgical telemonitoring, emergency telemedicine and telepsychiatry need real-time activities. They need real-time 3D vision.

In past 2 years our test with high power computer configuration (NVIDIA Cuda-based system with 512 processors) allowed to conclude that this type of 3D reconstruction isn’t suitable for real-time 3D telemedical purposes.

New 3D Vision

Two elements of current video communication technology have critical importance for Telemedicine: peripherals (sensors, devices) and a video-audio-

data transfer. Our tests and analyzes show that video-audio transfer is not the main problem for using new 3D vision technologies in Telemedicine: todays technology allows the transferring of high-quality video and audio data over extremely short delay times (latency).

The main problem is in devices. We split our investigations in two directions: devices for capturing real 3D images and devices for 3D visualization. During tests we ascertain the fact that the input of 3D visualization device is a dominant characteristic for 3D vision system. This is the result of more limited number of real 3D visualization devices.

As 3D capturing devices we investigated many different devices and technologies:

- 3D scanners: We investigate the market of 3D scanners and our tests with selected devices show that even the 3D scanner has enough speed for on-line activities the quality isn't suitable for medical purposes;
- Stereoscopy based on linked 2D cameras: Our tests are oriented to investigate the abilities to use two classical 2D photo cameras for creating 3D live vision. The result shows that the main limiting characteristic is possibility to control directly camera's firmware (the ability to send remotely command to camera's firmware). Our opinion is that today only two photo camera brands have this possibility: Canon and Olympus (very limited amount of models). The second problem is the video output format and how to connect with existing 3D autostereoscopy monitors. This is one of the reasons for our conclusion about 3D display's input as a dominant limitation feature;
- Stereoscopy cameras: We test two different brands – based on industrial cameras and 3D photo camera. Our opinion is that from 3D photo cameras on the market Lumix DMC-3D1 is the most suitable for telemedical purposes. The cons are closed firmware which restricts possibility for real-time 3D vision and remote control (but for 3D playback is a good choice). Our choice is 3D real-time capturing based on industrial stereo cameras. The advantage of this decision is good quality (resolution 1280 x 720, 30 fps, true-type colours) and possibility for manual and remote control. The limitation is a commitment between industrial stereo cameras and 3D stereo output device. We think that in the future the market will decrease this limitation.

The second part of the 3D vision systems is the 3D visualization device. We tested two existing types – glasses-based and glass-free stereo monitors:

- Today's market announces two types of glasses-based stereoscopy devices – passive glasses and active glasses. Based on the quality of 3D vision our preference for telemedical visualization devices is NVIDIA GeForse 3DVision technology. It uses active glasses and presented speed and quality of 3D are remarkable. The main problems and limitation is

glasses. For gamer this is not a problem but for medical purposes (psychiatry, surgery) this is a real limitation and we think that this technology hasn't future in the telemedicine (max 5-6 years).

- The glass-free 3D vision is the future of telemedical 3D video communication. The limitations are two: a) the price (more than 6000 Euro per monitor and more than 20000 Euro for bi-directional 3D video communication) and b) the number of viewers. Today's technology has solutions for 1 or 2 persons per stereo monitor but for bigger groups (4, 5 and more) it is not possible to create real-time video. For all medical purposes which need simulation of 'face-to-face' meeting this technology will be the only solution.

Conclusion

Today our world is computer-based. We need to understand computer limitation and we need to understand the future of computer technologies. Doctors want to be only doctors (no technicians) but computer technologies can increase doctors' sensing. Because we are not only doctors and engineers but we are patients too, we need to use new computer technologies that can increase the quality of the diagnoses and the treatment.

Acknowledgment

This research is partially funded by Bulgarian NSF projects DO 02-113 and D01-1250.

References

[1] D. Dinevski, R. Kelc, B. Dugonik, Video Communication in Telemedicine, in "Advances in Telemedicine: Technologies, Enabling Factors and Scenarios",InTech, 2011, pp. 211-232.

[2] H. Orosco, L. Wang, Y. Chen, Content Aware Burst Assembly – Supporting Telesurgery and Telemedicine in Optical Burst Switching Networks, Journal of Systemics, Cybernetics & Informatics, 2010, vol. 8, issue 4, p. 14.

[3] M. K. McGee, 11 Telemedicine Tools Transforming Healthcare, InformationWeek: Healthcare, March 2012, http://www.informationweek.com/healthcare/mobile-wireless/11-telemedicine-tools-transforming-healt/232602982.

[4] C. Kitamura, L. Zurawel-Balaura, R. K. S. Wong. How effective is video consultation in clinical oncology? A systematic review. Current Oncology, 17 (3), June 2010, pp. 17-27.

[5] K. Ibrahim, S. Fahim, Cooperative Remote Video Consultation on Demand for e-Patients. Journal of Medical Systems, 33, 6, Dec 2009, pp. 475-483.

[6] G. Welch, H. Fuchs, B. Cairns, K. Mayer-Patel, D. H. Sonnenwald, Ruigang Yang. A. State, H. Towles, A. Ilie, M. Noland, V. Noel, and Hua Yang, Improving, Expanding and Extending 3D Telepresence. In Proceedings of the 2005 International Workshop on Advanced Information Processing for Ubiquitous Networks, with ICAT 2005, Christchurch, New Zealand, December 2005.

[7] Sharper 3D Vision: for Knowledge Exchange and Home Entertainment, Knowledge Transfer Office Newsletter, No. 4, September 2010.

Remote Quantitative Diagnostics of Radiographic Images of Osteoporotic Vertebral Fractures

W. Glinkowski[1,3], J. Narloch[2], A. Górecki[1]
[1]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Medical University of Warsaw, Poland
[2]Student's Scientific Club - "TeleHealth", Medical University of Warsaw, Poland
[3]Polish Telemedicine Society, Warsaw, Poland

Abstract: **Store-and-forward telemedicine, using e-mail to send clinical data and digital images, offers a low-cost alternative for physicians to obtain second opinions from specialists. Telemedicine may be used as a suitable tool for multicenter studies. Underdiagnosis and undertreatment of vertebral fracture (VFx) is a well-known problem worldwide. Scout CT lateral radiographs were found as diagnostic images suitable for the detection of osteoporotic vertebral fractures. A semi-automated quantitative vertebral morphometric measurement was developed to facilitate identification of VFx. Computed tomography (CT) scouts of 252 patients suffering osteoporosis and with or without vertebral fractures were used for this study. Tiff images were converted from digital source of the PACS system. Tiff files of CT scouts were sent over the email. An average email transmission time for every 10 images was less than 1 minute. The method requires less time than conventional morphometry. Lossless TIFF image format was used for analyses. Semi-automated quantitative vertebral morphometry based on shape-based statistical modeling (SpineAnalyzer, Optasia Medical, Cheadle, UK) was utilized in this study. In the literature, reliability was found excellent for vertebral height measurements, good for height ratios, and comparable to semi-quantitative grading by radiologists for identification of vertebral fractures. This study confirmed the usability of the simple semi-automated quantitative vertebral morphometric measurements from CT lateral scout views for semi quantitative teleconsultation for the remote diagnosis of vertebral fractures, and may provide further facilitation of VFx assessment.**

Introduction

Spinal deformities and vertebral fracture are the common types of spine pathology associated with a significant increase in disability morbidity, and deterioration of the quality of life [1-4]. Store-and-forward telemedicine, using e-mail to send clinical data and digital images, offers a low-cost alternative for physicians to obtain second opinions from specialists [5-7]. Telemedicine may be used as a suitable tool for multicenter studies. Underdiagnosis and undertreatment of vertebral fracture (VFx) is a well-known problem worldwide. This study was designed as a quantitative diagnostic trial in which anonymized images were transmitted over the Internet for measurements to improve semiquantitative diagnosis.

Material and Methods

Scout CT lateral radiographs were found as diagnostic images suitable for the detection of osteoporotic vertebral fractures. Semi-automated quantitative vertebral morphometric measurements were developed to facilitate identification of VFx [8, 9]. CT scouts of 252 patients suffering osteoporosis and with or without vertebral fractures were used for this study. Tiff images were converted from digital source of the PACS system. Tiff files of CT scouts were sent over the email. Lossless TIFF format images were used for analyses. Semi-automated quantitative vertebral morphometry based on shape-based statistical modeling (SpineAnalyzer, Optasia Medical, Cheadle, UK) was utilized in this study. Semi-automated quantitative vertebral fracture assessment was performed using a model-based shape recognition algorithm that provides standard six-point morphometry, plus detailed annotation to define the vertebral body margins of each vertebra between T4 to L4. The individual analysis begins with the manual pointing the approximate vertebral body centers. Selected points serve as a reference for the automatically identifying the contours and characteristic six points of each vertebra algorithm. Additionally, reference points of adjacent vertebrae are utilized during calculations. Upon review, inaccurate margins can be manually adjusted. Vertebral morphometry measurements are automatically recalculated, thus providing an updated vertebral fracture assessment results. Vertebral fractures were identified based on deformity percentages derived from morphometry, utilizing Genant's semi-quantitative scale, measurements and classification for wedge shaped fractures, biconcave, and crush deformities. In the study the time necessary to transfer images for further analysis was measured. Twenty four email drafts containing sets of TIFF images were prepared for this study. A response was issued subsequently in order to confirm the delivery. Time

elapsed between the dispatch and the reply was calculated and defined the efficiency of the procedure. Images were transferred between three locations: the capital city and two remote rural areas of southern Poland. The student t-test and summary statistics were calculated. We used data analysis software system STATISTICA, version 10. (StatSoft, Inc.).

Results

One thousand four hundred and eighty five vertebral bodies were examined in 252 patients. The SpineAnalyzer detected 234 wedge vertebral fractures, 420 - biconcave and 73 - simple crush fractures. Vertebral fractures were confirmed by clinical observation. The method required less time than conventional morphometry. In location A (350 km distance) the Internet connection was provided over Wi-Fi network through the server (Kęty). The download speed was 5.72 Mb/s and upload speed was 1.79 Mb/s (ping - 18 ms). In location B (338 km distance) the Internet connection was provided over GSM provider through the server (Warsaw). The download speeds was 0.26 Mb/s and upload 0.10 Mb/s (ping - 179 ms). The mean transmission time was 53,7 sec [from 32,0 to 126,9 sec.] for WiFi and 32,42 sec [from 15,0 to 77,7 sec.] for GSM. Kolmogorov-Smirnov test for the Normal distribution confirmed Normality (WiFi - P=0,1388; 3G - P=0,0952). No statistical difference was confirmed by the T-test for Independent Samples (t-value=1,79; p>0,05).

Discussion

In the literature, reliability was found excellent for vertebral height measurements, good for height ratios, and comparable to semi-quantitative grading by radiologists for identification of vertebral fractures [9]. This study confirmed the usability of the simple semi-automated quantitative vertebral morphometric measurements from CT lateral scout views for semi quantitative teleconsultation for the remote diagnosis of vertebral fractures, and may provide further facilitation of VFx assessment. In order to the email-based telemedicine the literature shows rather underutilization of this telemedicine practicing method [10]. It was shown that email-based telemedicine can be practiced in image-based specialties [5, 6, 11]. Email is also often used in general practice as an adjunct for face-to-face consultation. The ability to encrypt ordinary email thereby securing patient. Confidentiality is also regarded as difficult when using ordinary email. Diagnostic accuracy of transmitted images was the predominant topic of research lately. The use of the tiff format deriving from the DICOM source warrants its quality because it uses lossless compression. Lossless means

there is no quality loss due to compression. The results show email as a valid means of delivering medical imaging services. However, using anonymized images cannot violate the sensitive patient's data. The results obtained in this efficiency study empower the further research in this field.

Acknowledgment

This study was supported by grant N404 695940 financed by National Center of Science.

References

[1] C. T. Pike et al. Prevalence and costs of osteoporotic patients with subsequent non-vertebral fractures in the US. Osteoporosis international: A journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2011;22:2611-21.

[2] K. Horikawa et al. Prevalence of osteoarthritis, osteoporotic vertebral fractures, and spondylolisthesis among the elderly in a Japanese village. Journal of orthopaedic surgery 2006;14:9-12.

[3] C. Wu, C. van Kuijk, J. Li, et al. Comparison of digitized images with original radiography for semiquantitative assessment of osteoporotic fractures. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2000;11:25-30.

[4] H. K. Genant et al. Comparison of semiquantitative visual and quantitative morphometric assessment of prevalent and incident vertebral fractures in osteoporosis The Study of Osteoporotic Fractures Research Group. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1996;11:984-96.

[5] H. A. Brandling-Bennett et al. Delivering health care in rural Cambodia via store-and-forward telemedicine: a pilot study. Telemed J E Health 2005;11:56-62.

[6] W. Glinkowski. eMedicine - e-mail, teleconsulation in orthopedics and traumatology of the motor apparatus. Ortop Traumatol Rehabil 2002;4:99-100.

[7] J. Settakorn, T. Kuakpaetoon, F. J. Leong, K. Thamprasert, K. Ichijima. Store-and-forward diagnostic telepathology of small biopsies by e-mail attachment: a feasibility pilot study with a view for future application in Thailand diagnostic pathology services. Telemed J E Health 2002;8:333-41.

[8] Y. M. Kim et al. Identification of prevalent vertebral fractures using CT lateral scout views: a comparison of semi-automated quantitative vertebral morphometry and radiologist semi-quantitative grading. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2012;23:1007-16.

[9] Y. M. Kim et al. Intra-and inter-reader reliability of semi-automated quantitative morphometry measurements and vertebral fracture assessment using lateral scout views from computed tomography. Osteoporosis international : a journal established as result of cooperation between the European Foundation for Osteoporosis and the National Osteoporosis Foundation of the USA 2011;22:2677-88.

[10] L. J. Caffery, A. C. Smith. A literature review of email-based telemedicine. Stud Health Technol Inform 2010;161:20-34.

[11] E. Blank et al. Early analysis of the United States Army's telemedicine orthopaedic consultation program. J Surg Orthop Adv 2011;20:50-5.

Speed-up the Image Retrieval of Lung Nodules in the BigData Age

M. C. Oliveira[1], D. C. da Silva[1], K. B. C. dos Santos[1]
[1]Instituto de Computação(IC) e Laboratório de Telemedicina e Informática Médica do Hospital Universitário(HUPAA) da Universidade Federal de Alagoas (UFAL), Av. Lourival Melo Mota, s/n, Tabuleiro do Martins, Maceió, 57072-900, Brazil, oliveiramc@ic.ufal.br

Abstract: **The Content-Based Image Retrieval (CBIR) has received great attention in the medical community because it is capable of retrieving similar images that have known pathologies. However, the sheer volume of data produced in radiology centers has precluded the use of CBIR in the daily routine of hospitals. The volume of medical images produced in medical centers has increased fast. The annual data produced from exams in the big radiology centers is greater than 10 Terabytes. Therefore, we have reached to an unprecedented age of "BigData". We here present a bag-of task approach to speed up the images retrieval of lung nodules stored in a large medical images database. This solution combines texture attributes and registration algorithms that together were capable of retrieving images of benign lung nodules with greater-than-72% precision and greater-than-67% in malignant cases, yet running in a few minutes over the Grid, making it usable in the clinical routine.**

Introduction

The volume of data produced in medical centers has increasing fast. The annual production of the big radiology centers is about 10 Terabytes. This situation exists due to the ease that the data of the patients are obtained and stored, resulting mainly from the reduction of the cost of the equipment during the last years.

The Content-Based Image Retrieval (CBIR) has received great attention in the medical community because it is capable of retrieving similar images that have known pathologies. However, the sheer volume of images produced in radiology centers has precluded the use of CBIR in the daily routine of hospitals. Therefore, we have reached to an unprecedented age of "BigData" and it has been motivating research and companies to find new solutions.

The Grid Computing (GC) technology represent one of the most recent and promising tool in distributed computing. GC is the integration of many computers distributed geographically, making it possible to create a virtual computing platform, giving to users and institutions a virtually unlimited capacity to solve problems related to the storage and access of data, and also to process applications with high computational costs. Techniques focused on the medical image retrieval are a major beneficiary of the GC technology due to their characteristics and necessities: high processing and large storage. Besides, GC is a low cost solution for public hospitals and small clinics, because, it is able to use the idle recourses of computers [1]. This paper presents a Bag-of-Task GC approach to speed up the images retrieval of lung nodules stored in a big medical images database.

Application Description

The overall application is described in Figure 1 and a detailed description is given in the sections below. All the images inserted in the PACS have removed the patients` information in respect to the HIPAA [2]. We have used 20,000 images from the Lung Image Database Consortium (LIDC), which is a BigData of lung cancer [3]. In the LIDC each nodule is manually segmented and then classified in benign or malignant by physicians. To use as reference we selected 100 benign nodules and 100 malignant nodules

The application has two CBIR modules. The first module uses the second-order Texture Analysis (TA) (co-occurrence matrix) to filter the 1000 most similar images into the second module. The second module uses the Image Registration (IR) algorithms to find the similarity between an image defined by the user as a reference and the images filtered by the first module. The second module starts when the specialists select the registration module. The IR algorithm is executed in parallel on the grid machines using the reference image and the images classified by the first module. The application sorts in a list the most similar nodules according to the Cross Correlation values. Based on the DICOM protocol information, the application can also retrieve the information stored on the LIDC to aid the physician.

Because of the high computational cost related to the IR algorithms, the second module is processed on the OurGrid computational grid (www.ourgrid.org). This grid is free-to-join and cooperative, where sites share their idle computing resources and, when necessary, receive idle resources from other sites. OurGrid assumes that the parallel applications that run on it are a Bag-of-Tasks (BoT), i.e., those tasks are independent from each other. Currently, the OurGrid is composed of nearly 500 computers [4].

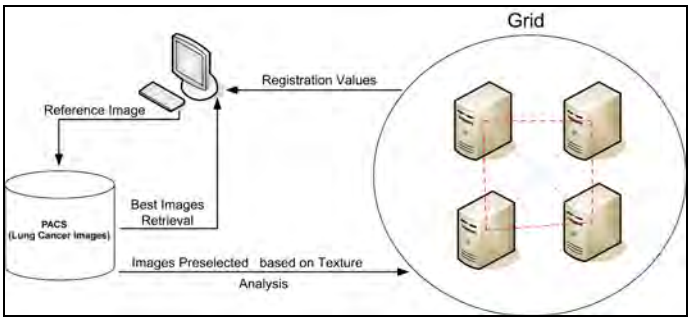


Fig. 1 CBIR lung cancer image retrieval schema using Grids

Results

The results of the CBIR tool developed in this work were assessed by the leave-one-out technic. The tests were repeated five times for each module and we have used different kinds of nodules for each test (ten benign nodules and ten malignant nodules). The nodules were selected in a random way. The algorithm precision was obtained by dividing the type number of nodules retrieved over the number of nodules retrieved.

The first module's time processing average was 1.9 minutes. This time was related to the calculation of the Manhattan Distance between the characteristic vector of each DICOM server's image and the characteristic vector of the reference image. The average precision of retrieving obtained by the first module was 0.73 (benign nodules) and 0.76 (malignant nodules), considering the ten most relevant nodules retrieved. To analyze the image retrieval capacity of the second module, a group of 1000 most similar nodules filtered by the first module has used in the second module. The average precision of retrieving obtained by the second module was 0.72 (benign nodules) and 0.67 (malignant nodules). In all the experiments, the results produced by the IR algorithms were very close to the traditional TA technique.

The Bag-of-Task approach was able to greatly reduce the high processing time of the IR algorithm. The GC was able to amortize the total time of the algorithm in 116.97 minutes, compared to the processing time obtained in one machine. The experiments used 50 Grid processors and 100 MB/s LAN. The application total time, considering the time to calculate the Manhattan Distance and the time to execute the IR, was 5.02 min.

Discussion and Conclusion

A computational algorithm was developed in this work, capable of using the high processing power of the Grid Computing technology to make feasible the CBIR using the Image Registration algorithms against a BigData of lung cancer images. Oliveira MC and colleagues [1] showed a preliminary work using IR as CBIR technique. However, the authors did not focus his attention in a specific disease. To our knowledge the results using IR and TA to retrieve lung nodules have never been published. Furthermore, our results evidenced that IR is precise and effective in retrieve similar lung nodules, besides that, the IR has showed very close results to the traditional TA technique.

The retrieval processing time was more than 100 minutes in only one computer using IR techniques. This time is impracticable for a CBIR to be applied in the clinical routine. In the grid, however, this time was reduced to less than 3 minutes in mean, making it affordable for clinical use. Therefore, a Bag-of-Task approach was fundamental to amortize the total processing time of the Image Registration algorithms against a BigData of lung cancer images. Besides this, we have shown a new methodology to evolve CBIR's state of art techniques through the Image Registration techniques.

Acknowledgment

This study was supported by Fundação de Amparo à Pesquisa do Estado de Alagoas (FAPEAL) and Hospital Universitário Prof. Alberto Antunes (HUPAA/UFAL).

References

[1] M. C. Oliveira Cirne, Walfredo, Marques, P. M. Azevedo, "Towards applying content-based image retrieval in the clinical routine," *Future Generation Computer Systems*, vol. 23, pp. 466–474, 2007.

[2] B. J. Liu Z. Zhou, H. K. Huang, "A HIPAA-Compliant Architecture for Securing Clinical Images," *Journal of Digital Imaging*, vol. 19, no. 2, pp. 172–180, 2006.

[3] H. Lin, Z. Chen, and W. Wang, "A pulmonary nodule view system for the Lung Image Database Consortium (LIDC).," *Academic radiology*, vol. 18, no. 9, pp. 1181–5, Sep. 2011.

[4] W. Cirne, Brasileiro F, Andrade N, Costa L, Andrade A, Novaes R, and M. M., "Labs of the World, Unite!!!," *Journal of Grid Computing*, vol. 4, no. 3, pp. 225–246, 2006.

Marcelo Costa Oliveira is member of the faculty at Computer Institute of the Federal University of Alagoas, in Brazil. Dr. Oliveira holds a PhD. in Medical Informatics from University of São Paulo (USP), M.Sc degree in Physics Applied to Medicine and B.Sc in Computer Science. Dr. Oliveira heads the Research and the Telehealth Project of the Hospital of the University of Alagoas. His current research interests include BigData Health, Cloud Computing and Medical Image Processing.

Darlan Chrystian da Silva is an undergraduate student at Federal University of Alagoas, in Brazil. He is member in the Research and the Telehealth Project of the Hospital of the University of Alagoas. His research interest BigData Health.

Keila Costa Barbosa's degree in Systems Analysis from the University of Northern Paraná, in Brazil. Degree in Systems Analysis and Development of Health State University of Alagoas. He is currently a MS in Computational Modeling Knowledge Federal University of Alagoas and Post graduate in Technologies for Web Applications at the University of Northern Paraná. His research interests include Health BigData, Cloud Computing and electronic medical records.

Teledermatology: The Experience of a Telehealth Service in Brazil

T. G. P. Assis[1, 2], M. S. Marcolino[1, 2], M. B. M. Alkmin[1]
[1]Telehealth Center, University Hospital, Universidade Federal de Minas Gerais. 110 Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil, telessaude@hc.ufmg.br
[2]Medical School, Universidade Federal de Minas Gerais. 190 Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil

Abstract: **Teledermatology is very useful in isolated cities with limited access to a specialist. In a country with the proportions of Brazil, where healthcare professionals are unevenly distributed, this scenario becomes much more important. The objective of this study is to report the experience of the Telehealth Network of Minas Gerais (TNMG), a public telehealth service in Brazil, in the field of teledermatology. All teleconsultations performed by the TNMG until August 2012 were evaluated. Of those, the ones performed from January 2010 to May 2010 were analysed regarding the types of queries. During the study period, 8724 teleconsultations in dermatology were performed (20% of the total), making dermatology the most frequently requested subspecialty. The majority of the queries were sent by nurses (58%) or physicians (39%), and 39% were originated from municipalities with <5000 inhabitants. The most frequently asked questions were about pharmacological treatment (68%) and etiology (60%). In conclusion, telehealth is an effective tool to offer specialized care in dermatology to small and isolated cities, improving the quality of primary care in these remote areas.**

Introduction

Dermatology diagnosis has a strong visual component, which makes it a good specialty for the use of telemedicine [1]. Teledermatology can be very useful in isolated cities with limited access to a specialist, to triage cases to limit unnecessary dermatologic clinic referrals, save the expenses involving travelling to bigger cities that offer specialized care, reduce the waiting time for a specialist, when necessary, and to follow-up treatment after a first dermatologist consult [1]. Several studies proved the diagnostic efficacy of teledermatology when compared to in person dermatology [2].

In a country with the proportions of Brazil, where healthcare professionals are unevenly distributed, this scenario becomes much more important. The Telehealth Network of Minas Gerais (TNMG) is a public telehealth service established in 2005. Currently, it provides support to primary care practitioners of 658 of the 853 municipalities in the state of Minas Gerais, Brazil, by performing teleconsultations and tele-electrocardiography. The teleconsultations are in the offline or store-and-forward mode [3]. This study has the objective to report the experience of this telehealth service in the field of teledermatology.

Methods

All teleconsultations performed by the TNMG from the beginning of the service in 2007 until August 31 of 2012 were assessed. The teleconsultations were classified according to the professional who requested the teleconsultation and the municipality from where it was submitted. Since there are 658 cities in the state of Minas Gerais covered by the Telehealth Network, they were divided into six different categories, depending of the number of inhabitants.

In addition, all teleconsultations performed from January 2010 to May 2010 were deeply analysed regarding the type of doubt to serve as an example of the total.

Results

During the study period, a total of 8,724 teleconsultations in dermatology were performed. That represents 20% of the total performed by the network (n=43,429 teleconsultations), making dermatology the most frequently requested subspecialty.

Regarding the healthcare professional who requested the teleconsultation, 58% of them were nurses, 39% doctors and 3% were other healthcare professionals.

Most of the teleconsultations were originated in municipalities with <5000 inhabitants, and there was an inverse relation between the number of inhabitants and the number of teleconsultations in dermatology (Table 1).

The analysis of the teleconsultations submitted from January to May 2010 revealed that 413 teleconsultations in teledermatology were performed in that period (17% of the total). The healthcare professionals who requested the teleconsultations were similar to the overall analysis: 53% were nurses, 46% physicians and 1% other healthcare professionals. The grand majority of the teleconsultations referred to the assistance of a particular patient (93%), when compared to educational doubts (7%). Table 2 illustrates the most frequent types of doubt.

Table 1 – Municipalities That Requested the Teleconsultations (n=8724)

Municipalities (population)	% of teleconsultations requested
Less than 5,000 inhabitants	39%
From 5,000 to 10,000 inhabitants	29.5%
From 10,000 to 20,000 inhabitants	24.5%
From 20,000 to 50,000 inhabitants	5.5%
From 50,000 to 100,000 inhabitants	1.0%
Over 100,000 inhabitants	0.5%

Table 2 – Most Frequently Asked Questions (N=413)

Type of doubt	%*
Pharmacological Treatment	68%
Etiology	60%
General medical advice	17%
Non-pharmacological treatment	14%
Propaedeutics	13%

*More than one type of doubt was possible in the same teleconsultation

Discussion

Analyzing the experience of the TNMG in the field of teledermatology, it is clear how this specialty represents the most frequently requested subspecialty among all offered, contributing with one fifth of the total. This can be related to a deficiency in the teaching of dermatology during the medical course, so primary care physicians lack the necessary knowledge to solve the cases. In that way, the large number of teleconsultations can reflect the potential of telemedicine to help solving the simpler cases in the local areas and avoiding unnecessary referrals to specialists. The larger presence of nurses, who requested almost 20% more teleconsultations than physicians, could be a result of the shortage of physicians due to uneven national distribution, increasing the risk of inadequate management of skin diseases, and making teledermatology even more important.

According to the analysis of the city where the teleconsultations came from, there is an inverse correspondence between the number of inhabitants and use of the service. That means that the municipalities with the smallest populations (less than 5,000 inhabitants) are the ones that most send

teleconsultations, 39% of the total, and the ones with more than 100,000 inhabitants contribute with only 0.4% of the total. All the municipalities with less than 20,000 inhabitants combined account for more than 90% of the teleconsultations requested.

The major importance of the analysis of the teleconsultations submitted from January to May 2010 is the classification of the type of queries included. Pharmacological treatment and etiology appear as the most frequent type of query, followed by general medical advice and non-pharmacological treatment. It is important to state that many teleconsultations from nurses include questions concerning pharmacological treatment, representing a paradox, since nurses are not allowed to prescribe in Brazil´s legislation.

Conclusion

The lack of specialists in the small municipalities of the state in combination with the difficulty of primary care physicians in these remote areas to manage skin diseases can explain the large request for teledermatology in the TNMG. This study helps to develop strategies to improve the medical teaching process in order to solve those problems, as well as points out the areas that need more attention.

Currently, telehealth is an effective and beneficial tool to offer specialized care in dermatology to small and isolated cities. It is a good example of the use of technology in favor of medicine, helping to solve the cases faster and improving the quality of primary care in these remote areas.

References

[1] E. Warshaw et al. “Teledermatology for Diagnosis and Management of Skin Conditions: A Systematic Review of the Evidence”. VA-ESP Project #09-009; 2009.

[2] J. Ribas, M. G. S. Cunha, A. P. M. Schettini, C. R. Ribas. “Agreement between dermatological diagnoses made by live examination compared to analysis of digital images”. An Bras Dermatol.2010;85(4):441-7, (in portuguese)

[3] M. B. Alkmin et al. “Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil”. Bull World Health Organ 2012; 90:373–378. doi:10.2471/BLT.11.099408

Tati Guerra Pezzini Assis - 4th year’s Medical Student of the Universidade Federal de Minas Gerais, Brazil, which was recently ranked among the 10 Best Universities of Latin America by QS World University Rankings®. She has been undertaking research at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, since July 2012.

Milena Soriano Marcolino - Bachelor’s Degree in Medicine from the Universidade Federal de Minas Gerais (2004), residency in Internal

Medicine (2007), and doctorate in Internal Medicine from the Universidade Federal de Minas Gerais (2011). She is currently a Professor at the Medical School, Universidade Federal de Minas Gerais and Quality Control Manager at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais.

Maria Beatriz Moreira Alkmim - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1979), residency in Clinical Pathology and specialization course in Hospital Management. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais. She is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry.

Telediagnostic Software for Spinal Curvature Measurement and Vertebral Fractures Classification with a Remote Database

Ł. Markiewicz[1,2], J. Narloch[2], T. Miścior[1,2], R. Sitnik[1], W. Glinkowski[3,4]
[1]Institute of Micromechanics and Photonics, Warsaw University of Technology, Warsaw, Poland
[2]Student's Scientific Club - "TeleHealth", Medical University of Warsaw, Poland
[3]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Medical University of Warsaw, Poland
[4]Polish Telemedicine Society, Warsaw, Poland

Abstract: **Spinal deformities and vertebral fractures are the common types of spine pathology associated with a significant increase in disability morbidity, and deterioration of the quality of life. Classifications and semi quantitative assessment enhance the diagnosis, treatment decision making and follow-up. The aim of this paper was to describe methods implemented to newly developed application for vertebral fractures assessment. Several tools were integrated to enhance telediagnostics for radiologists and clinicians, namely: precise angular measurements, zooming images, automation of the calculation process, contrast adjustment, and few more. For the clinical purposes the application was integrated with online survey service. The application was additionally equipped with an advanced search engine and statistical tools. The program was designed to be fully compatible with DICOM standard. Anonymization tools warrant sensitive data protection. A series of digital radiograms were successfully evaluated and measured in the pilot study.**

Introduction

Spinal deformities and vertebral fracture are the common types of spine pathology associated with a significant increase in disability morbidity, and deterioration of the quality of life. The aim of the study was to design and develop an application to facilitate and speed up the assessment of the spinal radiograms. Diagnosis, treatment decision making and follow-up enhancement was ensured by the classifications and semi quantitative assessment [1, 2]. Angular measurements of the overall curvature of spine

or just some specific angles between vertebra could be done using two methods: Centroid [3] and/or Cobb [3-6]. Manually it is time-consuming and difficult to evaluate an angle precisely. Vertebral fractures can be graded using several semi quantitative classifications. The aim of this paper was to describe methods implemented to newly developed application for vertebral fractures assessment.

Material and Methods

The application was developed to enhance physician's abilities to assess vertebral fractures. Several tools were integrated to enhance telediagnostics for radiologists and clinicians, namely: precise angular measurements, zooming images, automation of the calculation process, contrast adjustment, precision tool, classification modules and surveying module. Zooming images and making the calculation process automatic results gain reproducibility and measurements achieve higher precision. In presented application the accuracy is enhanced with a smart magnifier tool. The visibility of the vertebra is improved by the dint of live contrast adjustment of the zoomed section under the mouse pointer. Classifications module contains a comprehensive tool designed to assess fractures. Each vertebra can be assessed separately. The result can be sorted by vertebra, type of fracture, or the deformity grade. There is a short description and a reference pattern available, for every type of fracture. The user gains the enhancement of classification with no need of switching of windows to compare real fracture with a model one. For the clinical purposes the application was integrated with online survey service, allowing the clinician to use the quality of life assessing questionnaires, spine oriented questionnaires like Oswestry Disability Index (ODI), and Visual Analog Pain Scale (VAS). The input of clinical data is required to make it complementary for patient's evaluation for clinical and research purposes. The application runs easily with 2D DICOM image data and selected tags. The metadata encapsulated in a DICOM file can be used to automatically fill patient info, which reduces amount of time needed for setting up a new treatment for the patient. The user is able to import, export and convert images stored in several formats including JPG, TIFF or BMP. Anonymizing tool allows removing sensitive data from elaborated file. The built-in module was implemented for research purposes, enabling anonymous export of images. The metadata, containing confidential information from a DICOM file header are removed efficiently. It ensures complete anonymization of exported data. User is allowed to store and download the entire necessary patient's data (including previous treatments' results) through the Internet. The database system can operate locally or/and through the Intranet or

Internet. The data are protected from an unauthorized access. Database system is based on MySQL solutions, which makes the whole project easily extendable, e.g. the database can be common for both application and dedicated websites viewers. The application is also equipped with a simple statistical tool, providing information, e.g. which vertebra was broken the most among specific group of patients, etc. The user is provided with a possibility to create reports of the current treatment and save them to the XML file, designed for Excel. The program has also built-in web browser and a tool for auto scaling, based on four selected corners.

Results &Conclusions

The system was developed to meet the technical requirements and ensure high-level usability for physicians. The user is able to edit previous evaluations, just by dragging a specific point by mouse. For every single image the user has possibility to store unlimited number of measurements. Changes between methods are intuitive and fast. During evaluation of angle, window can be split into two to show comparison between current and previous measurement. The online surveying service provides the user with an opportunity to assess the patient clinically. Since the surveys could be uploaded to the server, it creates extensive possibilities of patient monitoring. Additionally, the user interface is intuitive, enabling easy and manageable work. Finally, convenient database creates a variety of access points for research purposes, together with a basic statistical application facilitating a creation of a study design. The data protection is of fundamental importance to almost any sector of health care system, thus the anonymization aspect was also considered. A series of digital radiograms were successfully evaluated and measured in the pilot study. We expect that intuitive interface and several facilitations will show sufficiently response rate from end users.

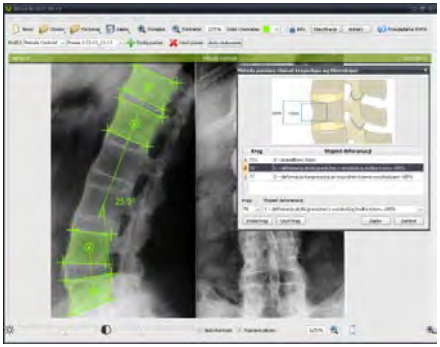


Fig.1 Screenshot from the application presenting classification module and Centroid curvature measurement tool

Acknowledgment

This study was supported by grant N404 695940 financed by National Center of Science.

References

[1] L. J. Melton 3rd, B. L. Riggs, T. M. Keaveny, S. J. Achenbach, D. Kopperdahl, J. J. Camp et al. Relation of vertebral deformities to bone density, structure, and strength. Journal of bone and mineral research: the official journal of the American Society for Bone and Mineral Research 2010;25:1922-30.

[2] H. K. Genant, M. Jergas, L. Palermo et al. Comparison of semiquantitative visual and quantitative morphometric assessment of prevalent and incident vertebral fractures in osteoporosis The Study of Osteoporotic Fractures Research Group. Journal of bone and mineral research : the official journal of the American Society for Bone and Mineral Research 1996;11:984-96.

[3] A. M. Briggs, T. V. Wrigley, E. A. Tully, P. E. Adams, A. M. Greig, K. L. Bennell. Radiographic measures of thoracic kyphosis in osteoporosis: Cobb and vertebral centroid angles. Skeletal radiology 2007;36:761-7.

[4] J. Y. Hong, S. W. Suh, H. N. Modi, J. M. Lee, S. Y. Park. Centroid method: an alternative method of determining coronal curvature in scoliosis. A comparative study versus Cobb method in the degenerative spine. Spine J 2013.

[5] S. D. Jiang, Q. Z. Wu, S. H. Lan, L. Y. Dai. Reliability of the measurement of thoracolumbar burst fracture kyphosis with Cobb angle, Gardner angle, and sagittal index. Arch Orthop Trauma Surg 2012;132:221-5.

[6] J. Zhang, E. Lou, X. Shi et al. A computer-aided Cobb angle measurement method and its reliability. J Spinal Disord Tech 2010;23:383-7.

Łukasz Markiewicz has received his Bachelor of Engineering degree in Automatic Control and Robotics by the Warsaw University Technology in 2013. He is continuing his studies on a second degree, currently as a recepient of Erasmus Program. Involved in the development of telemedicine software programming since 2012.

The Virtual International Pathology Institute (VIPI): Idea – Implementation – Work

K. Kayser[1], S. Borkenfeld[2], A. Djenouni[3], G. Kayser[4]
[1]Institute of Pathology, Charite University, Berlin, Germany
Klaus.kayser@charite.de
[2]International Academy of Telepathology, Heidelberg, Germany
[3]Laboratoire d'Anatomie et Cytologie Pathologiques, Batna, Algeria
[4]Institute of Pathology, University Freiburg, Freiburg, Germany

Introduction

Telepathology is one of the most frequently involved medical disciplines in telemedicine [1, 2]. Its roots range back to the early beginning of telecommunication in medicine. Its practical value was successfully demonstrated by assistance of intra-operative diagnosis as well as quality assurance in tissue – based diagnosis, board examinations, and expert consultation [1, 2]. The development of open access forums and whole slide digitalization (virtual slides) opened new doors for telecommunication in surgical pathology [3].

Herein, we report about the latest development which has created and implemented the first Virtual International Pathology Institute (VIPI, www.diagnomx.eu/vipi).

The Virtual International Pathology Institute

The Virtual International Pathology Institute (VIPI) is the first joint telemedical practice of pathologists organized in an institute – like manner. Its configuration is based upon the experiences of a small group of pathologists headed by Dr. Oberholzer which provided the basic diagnostics for the Salomon Islands for several years in the beginning of this century [4, 5]. This service could fulfill all requirements of primary diagnostics, and was bound to one surgical theatre located in Honiara, the capital of the Salomon Islands [4, 5].

The aims of VIPI are related to this early implementation in principle; however, they cover significant additional issues. VIPI wants to serve for primary and secondary tissue – based diagnosis which include the individual laboratory quality in physical terms (tissue fixation, embedding, cutting, stains, etc.), the virtual aspects (imaging, electronic transmission, selection of areas of interest, etc.), the diagnostics (accuracy, mandatory

physical examinations, grading, therapeutic influence) and issues of medical standardization (ICD, SNOMED, etc.).

Thus, it has been designed for purposes of tissue - based diagnosis in developed and in developing countries. These include expert consultation using still images and virtual slides; automated translation of findings and diagnosis in several languages; fast access to medical libraries and open access journals (PubMed, Diagnosticpathology.org, etc.), sophisticated viewer with zooming, annotations, etc., free choice of a) submitting a consultation, or b) a liable diagnosis report, assurance of fast services by a duty plan of members, advices for additional physical examinations, control of image quality, and standardization of stated diagnoses.

In a second step, the submitted images will be analyzed for image quality, and corrected if necessary.

The third step will permit the construction of individual case cohorts to permit image measurements and grading, diagnosis assistance in individually tailored cohorts, etc. All these additional aims will be implemented in different servers. Thus, they can be developed by specific programs and ideas related to the latest technological progress [6-8].

Implementation

VIPI is based upon the open PHP software. It is arranged in the scheme of a forum, that includes mandatory registration and password, several specific forums such as <acute cases>, <closed cases>, type-in of text, formally arranged patient's data, upload of associated images, and reply mode. A list of colleagues on duty is included as well as automated search for latest references at the US National Library of medicine (PubMed), access to open access scientific peer reviewed journals (for example diagnosticpathology.org), and selection of preferred languages.

The private patient's data are only shown in the optional liable diagnostic expert report in order to assure private data security. Both the expert and the client can agree on a liable diagnosis report which is printed out in .PDF format. Otherwise, a less obligatory expert consultation report is presented. A specific viewer that handles still images of various formats (jpg, bmp, tiff, etc.) is provided as well as links to several virtual slide viewers (3D-Histech, Aperio, Huron, Leica, Motic, and others).

Operation and Results

VIPI started its services on January 1, 2013. Within the first two weeks, 15 consultation cases have been submitted, and diagnosed by its experts. The system notifies the experts on duty by email, SMS, Skype, or other alarms, if a new case has been submitted for diagnosis / consultation. All

submitted cases have been worked out and could be closed within a period of two days after submission. No failures or hazards have been noted until today.

Discussion

The Virtual International Pathology Institute is an innovative foundation of engaged surgical pathologists to implement and promote recently developed technologies in routine tissue-based diagnosis. It takes advantage of the development of wireless and glass fibre connections that permit a moderate to high bandwidth in developed and also developing countries. The so – called globalization in medicine is founded on improved communication in both improved signal speed and non-stationary issues [9, 10]. Thus, the evaluation of image information obtained from microscopic glass slides can be separated in time and location from the "hardware production", i.e. the tissue processing, staining and cutting by this technology which forms the basis of VIPI [3].

The open source tools of such a system permit a fast and time shared development of communication programs, although the efforts of fine tuning have not to be underestimated [11, 12]. Fine tuning or adjusting a communication system to the individual workflow still requires specific intervention with the common source, and still requires essential individual programming. In respect to VIPI, the introduction and automated handling of a calendar as well as the diagnosis related frames required non negligible efforts at the beginning. The general benefit of such investment is great in terms of future adjustments for similar further jobs, for example serial analysis of image content information or automated diagnosis assistants [11, 12].

Basically, VIPI demonstrates that electronic communication in surgical pathology comes with several advantages. These include fast and reliable diagnosis, laboratory advices based upon the latest literature, contemporary "multiple heads" diagnosis, and a reduction of the medical gap between developing and developed countries. VIPI is a medical organization that works similar as a conventional pathology institute with fixed duty plans, liable diagnosis reports, and automated notifying of experts on duty. It combines medical experience with recently available technologies such as mobile communication and information transfer. In addition, improved image digitalization, reliable image content information measurement systems (EAMUSTM), and derived diagnosis assistants point to the direction which telepathology will develop in the near future [9, 13, 14].

The successful start of VIPI can be considered as first step in the development of electronically implemented, diagnosis related international collaboration and medical institutes.

References

[1] K. Kayser, B. Molnar, and R. S. Weinstein, Virtual Microscopy - Fundamentals - Applications - perspectives of Electronic Tissue - based Diagnosis. 2006: VSV Interdisciplinary Medical Publishing.

[2] K. Kayser, J. Szymas, and R.S. Weinstein, Telepathology: Telecommunication, Electronic Education and Publication in Pathology. 1999, Berlin, Heidelberg, New Yorck: Springer.

[3] K. Kayser et al., History and structures of telecommunication in pathology, focusing on open access platforms. Diagnostic Pathology 2011. 6: p. 110.

[4] K. Brauchli et al., Telepathology on the Solomon Islands--two years' experience with a hybrid Web- and email-based telepathology system. J Telemed Telecare, 2004. 10 Suppl 1: p. 14-7.

[5] M. Oberholzer et al., Modern telepathology: a distributed system with open standards. Curr Probl Dermatol, 2003. 32: p. 102-14.

[6] E. Ayad, and F. Sicurello, Telepathology in emerging countries pilot project between Italy and Egypt. Diagn Pathol, 2008. 3 Suppl 1: p. S2.

[7] Y. Tsuchihashi. Expanding application of digital pathology in Japan--from education, telepathology to autodiagnosis. Diagn Pathol, 2011. 6 Suppl 1: p. S19.

[8] R. S. Weinstein et al., Overview of telepathology, virtual microscopy, and whole slide imaging: prospects for the future. Hum Pathol, 2009. 40(8): p. 1057-69.

[9] A. M. Lopez et al., Virtual slide telepathology enables an innovative telehealth rapid breast care clinic. Semin Diagn Pathol, 2009. 26(4): p. 177-86.

[10] Y. Yagi et al., Webcasting pathology department conferences in a geographically distributed medical center. Hum Pathol, 2004. 35(7): p. 790-7.

[11] K. Kayser et al., AI (artificial intelligence) in histopathology--from image analysis to automated diagnosis. Folia Histochem Cytobiol, 2009. 47(3): p. 355-61.

[12] K. Kayser et al., How to measure diagnosis-associated information in virtual slides. Diagn Pathol, 2011. 6 Suppl 1: p. S9.

[13] K. Kayser et al., Interactive and automated application of virtual microscopy. Diagn Pathol, 2011. 6 Suppl 1: p. S10.

[14] B. Tetu et al., The challenges of implementing a "patient-oriented" telepathology network; the Eastern Quebec telepathology project experience. Anal Cell Pathol (Amst), 2012. 35(1): p. 11-8.

Klaus Kayser, MD, PhD, Professor of Pathology and Epidemiology, Dr. rer.nat., Dr. med, Dr. honoris causae mult.

Graduated from the University of Heidelberg, Physics (1965), The University of Heidelberg, Medical School (1975), Training in Epidemiology (Righshospitalet, Copenhagen, Denmark (1975), diagnostic pathology (Armed Forces Institute of Pathology, Washington, DC, USA (1981), PhD in physics (1970), MD (1975), Specialized in Pathology (1982), in Medical Informatics (1984), and in Molecular Pathology (2002). Certificate of Appreciation, United States Army, MEDDAC, Heidelberg, 2001.

	Stephan Borkenfeld - Date of birth June, 23,.1962, Study of informatics, University of Applied Sciences, Dortmund (1982 – 1986, Diploma in informatics (1986), authorized signatories and member of the managing Board of Douglas-Informatik & Service GmbH (1993-2009) General Manager, IVS Informationsverarbeitung Soest GmbH and DiagnomX GmbH, Waltrop (2009- today)
	Amina Djenouni , MD, Surgical Pathologist -Born : 02-10-1974 in Annaba - Algeria -Study of General Medicine, Faculty of Medicine, University of Annaba - Algeria 1992 - 1999 - Board of Medical Specialties, 2000 - Specialist Doctor in Anatomic Pathology and Cytology, 2005 - Pathologist Assistant in Anatomic Pathology and Cytology Laboratory, Hospital El-Zahraoui, M'sila - Algeria, 2006-2007 - Supervisor and Responsible, Cervical Screening Evaluation Unit, Gynecology Establishment Hospital, Batna - Algeria 2007-2008 - Director, Anatomic Pathology and Cytology Laboratory, Batna, Algeria 2010 to date
	Dr. Gian Kayser - 1993 – 1999 Medical School, University of Heidelberg 1999 Graduation from Medical School, University of Heidelberg 2000 – 2001 Internship at the Department of Cardiovascular Surgery, University Hospital Freiburg 2001 – 2008 Residency at the Institute of Pathology, University Hospital Freiburg 2008 German National Boards in Pathology 2009 Consultant at the Institute of Pathology, University Hospital Freiburg Since 2010 Managing Consultant at the Institute of Pathology, University Hospital Freiburg

Improving Care of the Elderly

Dietary Logging and Analysis for Tele-Care Using Harmony Rules

I. Vassányi[1], B. Pintér[1], M. Nemes[1], I. Kósa[1], E. Mák[2], Gy. Kozmann[1]
[1] University of Pannonia, Department of El. Eng. and Info. Systems,
vassanyi@almos.vein.hu
Egyetem u. 10. Veszprem, H-8200, Hungary
[2] Semmelweis University, Dept. of Dietetics, Budapest, Hungary

Abstract: **The paper gives an overview of the MenuGene nutrition counseling expert system focusing on its logging and analysis capabilities. Our results show that a considerable part of dietary counseling in tele-care can be supported by implementing rule based evaluation of dietary logs.**

Introduction

Tele-care and home monitoring systems have a big potential for providing cost-efficient healthcare solutions. MenuGene is our nutrition and lifestyle counseling expert system developed at University of Pannonia with help from dietetic experts at Semmelweis University. Our system supports all major steps of dietary counseling: synthesis (weekly meal plan generation), analysis, logging, (PC and smartphone), anamnesis, and easy knowledge base maintenance and was used in a clinical trial with neuro-degenerative elderly patients with good results [1]. We are now developing new features in the system to support more complex clinical trials for other patient groups like diabetic patients.

Dietary Logging

The first step in case of the monitoring process is the registration and evaluation of some physiological parameters from the patients. Our system uses a simple form to achieve this goal: the patient has to enter the age, height, weight, gender, type of work, and level of physical activity. An additional feature compared to existing systems is that we also record the combination of known diseases, which is also used by our algorithm to calculate Recommended Daily Allowance (RDA) values for the user, and also to select the suitable meal groups. The calculated values can be overridden by the supervising dietetic expert or doctor.

After the anamnesis the logging period can begin. Our system collects the following data: consumed meals, physical activity, and body weight, blood glucose, blood pressure measurements.

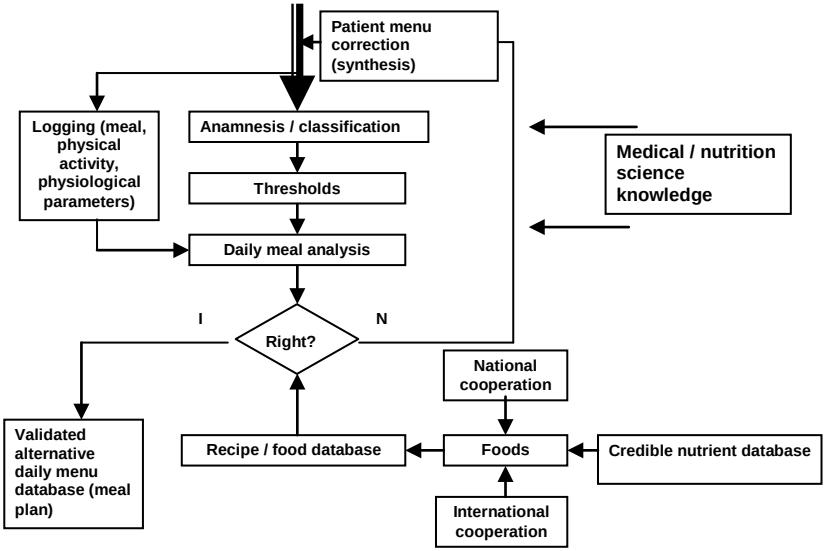


Fig. 1 Workflow of the MenuGene system

Our latest and ongoing development is the logging interface developed for smartphones with Android OS. The application is a thin client application, which uses the services provided by our system. After entering the consumed meals the system displays the basic nutrient contents (energy, fat, carbohydrate, protein) immediately. By sending the data to our servers a more detailed evaluation can be initiated, in which we can also check the foods against the patient's known disease(es) and display hints to the patients. For example if a patient with diabetes selects Coke for drink, we display a hint saying "You should avoid beverages with added sugar, water or 100% fruit and vegetable juice is recommended instead". The application is also able to show charts for selected time intervals, so changes in the nutrient ratios or physiological parameters are easy to see. Physiological measurements can only be entered manually, but we are working on communication interfaces to devices with Bluetooth protocol.

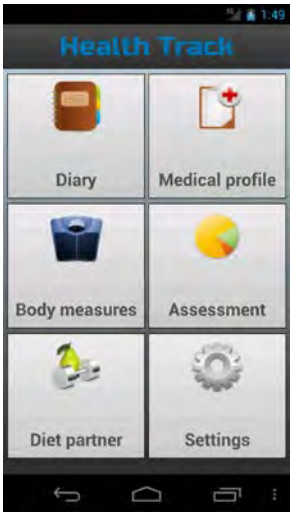


Fig. 2 Main screen

Fig. 3 Dietary logging

Dietary Analysis

The simplest way of analyzing the logged meal is the numerical evaluation of the recorded nutrients. We have a large food composition database populated from freely available sources and also by our dietetic experts. If we know the exact amount of the consumed meal we can compute its nutrient content. These values are compared to the personal RDA values calculated by the anamnesis module, and the user can see the current status on simple bar charts.

A more complex numerical evaluation is the computation of food pyramid. Meals are arranged into the following sets corresponding to the pyramid categories: “Cereal”, “Fruit”, “Vegetable”, “Meat, egg, oily seed, legume”, “Milk product”, “Fat”, “Sweet”. For a whole day we calculate how much energy comes from which group, and draw the pyramid according to that value. For foods which contribute to multiple pyramid categories we have special energy units added for the categories.

The most advanced evaluation is based on the so called harmony rules. These rules have either a scientific, common-sense or cultural origin and normally refer to the co-occurrence of specific or general food groups, e.g. “breakfast is the composition of bakery product and drink”. The (often fuzzy) classification of meals, dishes and foods into sets is the core of the expert knowledge. Such sets are for example: “meals recommended for

breakfast", "Fish products for breakfast", "Muesli, cereal". The previous rule can be described by using two sets: bakery product, and drink, and defining an AND relation between them. We have several such rules, and the logged meals have to be matched against these rules. Rules can be more complex, e.g. "there should be at least one lunch which include fish as main dish". These complex rules can be described as tree patterns, which are harder to match. Rules are also arranged into sets like "rules for healthy adults" and "rules for diabetic children". With priority assigned to the rules we are able to resolve conflicts. These harmony rules have also scores assigned, which makes them applicable in the fitness function of our menu generation multi level genetic algorithm described in [2]. A similar GA based approach without harmony rules has been described in [3].

Results

We presented our nutrition and life style counseling expert system's dietary and lifestyle logging capability, including the aspects of the evaluation of logged data. This software solution will be used in a clinical trial in Hungary supporting diabetic patients. The status of the project can be followed on [4].

Acknowledgement

We acknowledge the financial support of the Hungarian State and the European Union under the programme TÁMOP-4.2.2.A-2011/1/KONV-2012-0073 and TÁMOP-4.2.2/B-10/1-2010-0025.

References

[1] I. Vassányi et. al. Applications of medical intelligence in remote monitoring. XXIII International Conference of the European Federation for Medical Informatics (MIE2011), Oslo, Norway, 28-31 Aug. 2011. In: Studies in Health Technology and Informatics, vol. 169.: User Centered Networked Health Care, ISSN 0926-9630, pp. 671-675, 2011.

[2] B. Gaál, I. Vassányi, G. Kozmann. "A Novel Artificial Intelligence Method for Weekly Dietary Menu Planning" Methods Inf Med 2005; 44: 655–64. (ISSN: 0026-1270)

[3] B. K. Seljak. "Dietary Menu Planning Using an Evolutionary Method" Proc. Int. Conf. on Intelligent Engineering Systems, London, UK, 26-28 June 2006, pp. 108-113.

[4] The MenuGene project home page at http://www.menugene.com/ (Jan. 2013)

Balazs Pinter graduated as Engineering Information Technologist, MSc in 2009 at University of Pannonia located in Veszprém, Hungary. He is now working as PhD student at the Doctoral School of Information Science and Technology at the same institute on the research topic "I.T. support of primary and secondary prevention in healthcare", which covers the research and development of MenuGene nutrition and lifestyle counseling expert system, and also other telemedicine systems."

Gerontechnologies: State of the Art and Technology validation

C. Lejeune, J. Petermans, D. Gilain
CHU Liège, avenue de l'Hôpital, 4000 Liège, Belgium

Abstract: **We will describe here test and analysis carried out during the HDC Interreg Project in the field of the gerontechnologies.**

Introduction

The HDC project is an Interreg 4b project involving several partners from 5 different countries (Belgium (CHU Liège), France (CHU Strasbourg, CHU Brest, CHR Metz-Thionville, Conseil Général du Bas-Rhin), Germany (Central Institute of Mental Health of Manheim), Luxembourg (CHL) and The Nederlands (Department of Psychiatry of Maastricht).

The evaluation of the gerontechnology market was the target of one of the working group. We will present here the result of the analysis and of the first tests.

The Project

After a market overview, three different domains have been defined: RTLS (location system), actimetry and technologies improving social link for olders. These domains were found to be sufficiently mature to allow test in real environment.

Location Systems

Location systems use the GPS or WIFI technology and can be used inside or outside the hospitals. We have tested the WIFI technology in two hospitals (CHU Liège, CHLuxembourg). In Luxembourg, at risk patients are identified when entering the emergency unit and receive a b racelet allowing hospital staff to find them if needed. In Liège, similar test has been carried on in the neurology and in the geriatric unit.

These systems have demonstrated their usefulness for patient and care givers. Staff stops wasting time searching for patient that get lost or who tried to run away from the hospital.

The acceptance level of the system (bracelet) is high probably because it is coupled with an alert system which increases the security of the patient that could be in trouble outside the care unit.

This type of system will also be use in Liège in a project aiming at decreasing the use of physical contention for some patients. The question of the medical prescription as well as the protocol to be written has still to be validated. We should be aware that we are going from a physical to a "virtual contention" with this system.

At home, the GPS technology has been tested coupled with an alarm system connected to an external operator. This system allows the emergency team to locate directly the caller even if he has some communication problem. The device is well accepted as it's not an additional one (installed on the patient mobile phone).

Actimetry

Actimetry gives information to the caregivers concerning the activity of the patient. It can be used as an alarm device or as an information provider concerning, for example, the reality of sleep of the patient, the influence of drugs and treatment and the activity of the demented patients according some situations like, stress, delirium, pain,….

Different studies have been made in Liège and Strasbourg during the project:

- In the geriatric care unit two different devices have been compared with good results of acceptance by the patient. Another study has shown that this type of tool could be useful in the domain of the risk of fall prevention;
- In the sleep analysis clinic of the CHU Liège, a study will try to link the actimetric signal with the EEG signals;
- In a psychogeriatric clinic, the tool will be used to measure the influence of lost of light on the behavior and activity during the day. The influence of the additional light on confusion, depression and treatments will also be studied. The purpose is also to measure with the actimetry the influence of such parameters on the demented persons' activities;
- In a nursing home, the system is also used as an alerting device;
- At home, the same system can be considered as an alarm system, linked with a telealarm service. It doesn't give the opportunity to localize the user outside of his home but it can raise alarms linked with actimetric value out of normal range. The challenge is to determine these ranges knowing that these values vary from one person to another.

The most tested system looks like a watch (and is also watch) and is then easily accepted by the patients. The results of these analysis show that the

activity curve can be linked with quality and quantity of sleep but also with clinical events or drugs effects.

In much specific and deep research, actimetry associated with accelerometry can also demonstrate specific patterns of gait according to cognitive profiles and could be useful in the follow up and prevention of gait disorders in this population.

Social Link

Social link technologies are used in the hospital through bedside terminals or at home via "tablet like" devices.

At home, the tests demonstrate that olders are able to use that kind of system due to the design of the interface and like it. These systems are not only a new communication channel but also gives an easy access to useful information, creates new social links and is a new occupation for lonely people. However, problems can occur, with family members, who don't realize the interest of such systems.

In the hospital, patients use the device and often ask if they can bring it at home at the end of the stay. The interface of these new tools is easier to understand than the remote controls that we use at home. First studies show that age doesn't influence the level of acceptance.

These tools increase the quality of stay of the patient by allowing them to communicate easily with their family or friends. A special interface allow strongly handicapped people to be independent from the hospital staff for several actions (phone, TV, internet, light, heating, …).

It can also be used for care by including, for example, reeducation games in the device.

Conclusion

These technologies should be taken into account for the care and the supervision of the old people. In order to do this, information has to be provided to the healthcare professional about the possible uses of these technologies. However, for every new project, privacy and ethical factors must be reconsidered.

Another recommendation concerns the initiation of partnerships with providers in order to define and develop technologies dedicated to old people to help in the supervision but also in the prevention of functional decline in the future.

The research and development of such technique should be encouraged in connection with industrial partners, because it could be considered as a specific resource of wealth in the European economical network.

Ir. Christophe Lejeune, IT Operations Director at the Liège University Hospital. MD in Electro-mechanical Engeneering (robotics) in University of Liège. 20 years in the IT sector as analyst, project or team leader. From the bank and consulting domain to the healthcare sector (10 years) where he managed the infrastructure team during 6 years and now the production team. In charge of the coordination of the technical workgroup inside the Interreg HDC Project.

LIFE 2.0: Geographical Positioning Services to Support Independent Living and Social Interaction of Elderly People

J. Benavent, J.C. Castro, A. Cervera
i2Cat Foundation, {josep.benavent, joanc.castro. andrea.cervera}@i2cat.net
C\ Gran Capità 2-4, Nexus I Building, office 203, 08034 Barcelona, Spain

Abstract: **Life 2.0 project aims to make the network of social interactions of elderly people more visible through an ICT approach in order to support independent living conditions. The project is being developed with a cyclic co-creation approach together with ethnographic studies in order to develop a platform that will be adapted to elderly concerns and needs. Concretely, the platform will allow elderly users to exchange particular services offers or requests, a section where organizations will be able to announce their activities to elderly and also one where local companies will be able to announce their products.**

Introduction

The number of people over 50 years will rise by 35% between 2005 and population around 85 years will triple by 2050. Recent OECD analyses forecast escalating costs as a result of ageing populations in Japan, the US and Europe. In addition, European Commission [1] predicted that in 2010, 32% of people Europeans with 65+ years old will be living alone and the proportion will rise to 45% in the case of people with 85+ years old.

In this future context of an aged society, the number of healthy elderly living alone will rise and their wellbeing is already becoming a public concern. Welfare of elderly living alone is usually understood as maintain their independent living conditions, i.e. the ability to manage their life styles in their preferred environment, maintaining a high degree of independence and autonomy or enhancing their mobility and quality of life.

Life 2.0 project [2] aims to make the network of social interactions more visible in order to support independent living conditions with an ICT based solution. The target users of Life 2.0 are elderly people living independently, their relatives, assistants and older people service providers

(including companies and other organizations devoted to provide services for elderly).

Development Process: A Co-creation Approach

Life 2.0 started on 2010 and is being developed with a co-creation approach with strong participation of end-users, elderly organizations and commercial companies during the whole project. During initial phase, Living Lab initiatives have been set up in four European countries (Denmark, Finland, Italy and Spain) in order to study elderly habits, expectations and concerns regarding the use of social networks.

Living Lab activities are continuing during the development of the platform in order to validate, in a cyclic process, the technical outcomes that will result in the final Life 2.0 platform. Fig. 1 shows the cyclic process implemented within Life 2.0 project: initial user expectations and concerns compiled by ethnographers were translated to functional requirements and then, technical developers transform it to technical requirements. In a general assembly, with representatives from ethnographers and technical staff, is decided if the functionality with the related technical effort is technically implemented. Finally, the new technical functionality for Life 2.0 platform is validated with the different users groups and the cyclic process starts again, until the technical implementation, which each cycle is refined, is at least accepted by users.

A cyclic co-creation process is also applied to develop Life 2.0 system intended to allow companies or elderly organizations to offer their products or services into the platform and also, to develop the business model that will guarantee Life 2.0 economical sustainability.

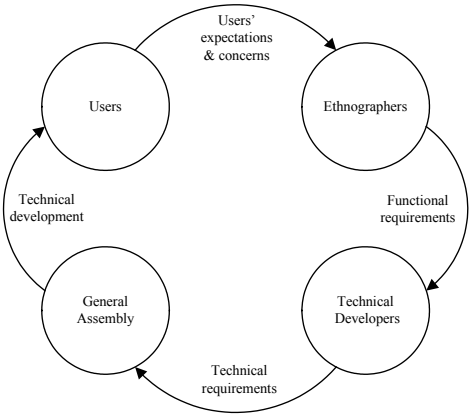


Fig. 1 Cyclic co-creation process conducted in Life 2.0

Life2.0 Platform Description

Life 2.0 aims to improve social living conditions of elderly living alone and social interactions though provide them with an ICT platform (available for iOS, Android or web access) developed on the resulting ethnographic analysis [3 -5], which has been conducted during initial phases of the project, together with the cyclic co-creation approach previously described. Ethnography revealed privacy and trust as main concerns of elderly people as well as insights about the benefits they expect from the use of this social network. Considerations such as hide exact users' location, aiming to protect their privacy, and a r egister process supervised by elderly associations, which will manage the platform during exploitation phases.

The scenarios developed to accomplish to project objectives and concerns detected during users' ethnography are described following:

Mutual-help Scenario

In this section elderly users can offer or demand services to other participants. In order to protect user's privacy, announcements are shown particularized (geolocated in a map) by the region where user is registered without revealing any data about the exact address of the advertiser.

Events Organization Scenario

This scenario aims to provide organizations which supply services to elderly (social centers, elderly activity centers, municipalities…); known as HUBs in Life 2.0 terminology, with a space where they can announce the services they offer to elderly people.

Marketplace Scenario

This section contains offers of products or services that local companies will provide to Life 2.0 elderly participants. In addition, this scenario will assure economic sustainability of the platform because, according to the business model that is being developed, companies will have to pay a small fee to announce their products here.

Current Status of the Project

Life 2.0 is in the last annuity of the project. Currently the Marketplace scenario and the related business model are being developed, with a cyclic

co-creation approach, through direct contact with surrounding local business of organizations that are conducting Living Labs.

Acknowledgment

Life 2.0 project is partially funded by European program CIP ICT PSP.

References

[1] A. Walker "Quality of life in old age in Europe." in *Growing older in Europe*. Open University Press, Buckingham, 2005, pp 1–29

[2] Life 2.0 (CIP ICT PSP-4-270965) project homepage. Available at: http://www.life2project.eu/

[3] V. Righi, S. Sayago, J. Blat, "Older people's use of Social Network Sites while participating in local online communities from an ethnographical perspective". CIRN 2012 Community Informatics Conference: 'Ideals meet Reality', 7 – 9 Nov 2012, Prato (Italy), ISBN: 978-0-9874652-0-7 Best Paper Award

[4] M. Kälviäinen. "Elderly as content providers in their everyday life supporting services, in Northern World Mandate", Cumulus Helsinki Conference. 2012, Helsinki

[5] Life 2.0 consortium "D1.1 - Ethnographic report" 2011. Available at: http://www.life2project.eu/deliverables/public/LIFE_2.0_D1.3_final.pdf

Josep Benavent Marco has a B Sc. in Telecommunications and a M. Sc. in Telecommunications Engineering (MASTEAM) both by Universitat Politècnia de Catalunya (UPC). Nowadays, he is Project Engineer and PhD student at i2CAT Foundation. His research interest is focused on co-creation techniques and stakeholders' involvement environments in order to develop multidisciplinary IT projects.

Juan Carlos Castro has a B.Sc. in Computer Science from Autonomous University of Barcelona (UAB), a M.Sc. in TeleMedicine from the Open University of Catalonia (UOC) and is currently PhD candidate at the Technical University of Catalonia (UPC). He is a Health Level 7 (HL7) certified specialist. His main research interests include clinical data standardization and integration of biomedicine systems.

Andrea Cervera Forner has a B.Sc. in Telecommunications from Technical University of Catalonia (UPC) and currently is studying a M.Sc. in Telemedicine from the Open University of Catalonia (UOC). She is involved in several European Funded projects like HIPERMED and National funded Projects like Bariatric Surgery or i2HealthSantPau LivingLab. She holds HL7-CDA certification and extensive DICOM and SNOMED knowledge.

Supporting Healthy Ageing with Shared Self-prevention e-Health Stations

M. Bogdanski, B. Gluszak, M. Kosiedowski, A. Stroinski
Poznan Supercomputing and Networking Center, bogdan@man.poznan.pl; bglus@man.poznan.pl; kat@man.poznan.pl; edwin@man.poznan.pl
ul. Noskowskiego 10, 61-704 Poznan, Poland

Abstract: **The challenge related to the ageing of the society carries a significant impact on the burden of health- and social-care. This especially concerns a relatively high rate of chronic diseases incidence in the elderly population. Extended prevention actions are therefore recommended as a tool to improve the quality of life of the elderly and decrease the effect of chronic diseases on the economical efficiency of public healthcare systems. At the same time several studies show that e-care interventions allow for primary and secondary prevention in such areas as cardiovascular or metabolic diseases. In this paper we discuss the concept of establishing a self-prevention e-health station shared by a community of the elderly created around a day care facility. This activity is carried as part of the HELPS project co-funded by the Central Europe Program.**

Introduction

In recent years we have been witnessing deep socio-demographic changes concerned with progressive ageing of populations. In the European Union, the total ageing-related spending is projected to increase by 4.75% points of GDP by 2060 [1]. This trend represents a threat to the sustainability and efficiency of healthcare systems. Due to that, various initiatives are being established at different levels to promote new forms of care for the older members of communities.

One of recent initiatives to design, pilot and promote such new forms of care has been proposed by the Central Europe Program through the strategic project HELPS (http://www.helps-project.eu/). HELPS aims to investigate innovative housing and home-care solutions for the elderly and disabled, applicable in urban areas of the Central European countries. As part of the project eight pilot actions are performed, aimed at experimenting selected innovative care solutions in all eight countries forming the Central Europe region. The Polish pilot action, conducted by Poznan Supercomputing and Networking Center, is designed around the use of advanced ICT to provide

assisted living applications in home and neighborhood levels. One such experimented application relates to establishing a shared e-health facility allowing providing means of a cost-effective health prevention scheme accessible at the local level.

Motivation

According to the recent PolSenior study [2], about 76% of the Polish 65+ population suffer from hypertension, over 70% are overweight or obese, about 45% suffer from chronic kidney disease, over 40% have improper level of glucose, about 18% suffer from chronic pulmonary diseases and over 10% suffer from hyper- or hypothyroidism. The authors of the study recommend that an extended scope of preventive actions is implemented to help improve the quality of life of the elderly and lower the effect of chronic diseases on the economical efficiency of the healthcare system.

At the same time a number of studies have been performed reporting that use of telemonitoring showed good effects in controlling the key health factors such as, for example, blood pressure or body weight. In [3] AbuDagga, Resnick and Alwan analyzed the impact of blood pressure telemonitoring studies conducted between 1995 and 2009. These studies targeted patients with hypertension as the primary diagnosis. According to their analysis the efficacy of blood pressure monitoring in tele-settings is comparable to the efficacy recorded in trials of some antihypertensive drugs. A German study performed by Luley et al. [4] proved that a telemonitoring program enables to successfully apply preventive actions aimed at reduction of body weight in obese patients. Their program resulted also in the discontinuation of antidiabetic drugs in about 40% of patients covered by the trial.

Methodology

The shared e-prevention scheme designed as part of the Poland's HELPS pilot action, is based upon the use of state-of-the-art ICT solutions, including middleware platforms and personal devices. The scheme develops on the creation of an easy-to-use, shared self-prevention e-Health station capable of taking measurements and performing simple analysis of vital health parameters. In this section we describe the concept of this station in the context of its functioning within the HELPS pilot installation, and the aim of the study conducted in relation to its establishment.

Technical Foundation

The shared self-prevention e-Health station is built with the use of personal medical devices such as a blood pressure monitor, scales with a

body analyzer, a pulse-oximeter and a spirometer, connected to a touch screen personal computer using the Bluetooth protocol. The applications running on the computer guides the user through the process of self-measurement, allows automatically evaluating the results and storing them in a remote PHR repository, as well as connects other personal medical devices such as glucometers. The station is installed on the premises of a day care facility and is shared by a group of elderly frequenting this facility, thus enabling cost-efficient prevention without the need of direct involvement of the medical personnel.

The self-prevention is one of several application scenarios planned as part of the Poland's HELPS pilot action. This pilot action is aimed at creating an ambient assisted living environment based on an open source universAAL platform [5] and state-of-the-art equipment enabling to maintain personal smart spaces. Apart from providing means to investigate shared application scenarios, the developed environment will be also immersed in real homes of end beneficiaries – elderly and disabled – and is foreseen to serve as both: a living laboratory of specialized AAL and e-Health services, and a platform to provide support to those cared for by formal and informal carers within public and non-profit care formats.

Aim of the Study

The primary aim of the study related to the establishment of the shared e-prevention facility is to confirm usefulness of the technology used to create the application and to verify the acceptance of the technology-enhanced prevention scheme by the end beneficiaries – the elderly. This will draw short-term recommendations for the wider utilization of such facilities at local levels. These recommendations will be subject for inclusion into the elaboration of strategic summary of recommended actions

Another dimension of the study is a longer term perspective, in which the analysis should focus on the actual health effects for the population actively using the health station. In this area we aim to engage into cooperation with relevant medical experts, enabling us to adequately evaluate our results in comparison with the analysis of a control group. This part of the study is planned to look into how the shared e-health station supports the management of most common health-related problems of the elderly population, such as hypertension, inappropriate body weight or chronic pulmonary conditions. This part of the study should also allow evaluating the cost-effectiveness of the proposed health prevention scheme.

Summary

In this paper we presented the concept of the development of disease self-prevention scheme based on the use of state-of-the-art Information and Communication Technologies, such as ambient assisted living platforms, personal health records, personal medical devices and smart applications. This concept aims to propose a cost-effective solution for promoting disease prevention among the elderly in local communities at the neighborhood level. Prevention is one of the key recommendations following recent studies on the needs of the ageing society and the needs and requirements of the older adults, such as the PolSenior study performed in years 2009-2011. Using e-health methods gives a high potential of delivering cost-effective prevention solutions that cover a large part of the population in question.

Acknowledgment

The HELPS project is implemented through the CENTRAL EUROPE Programme co-financed by the European Regional Development Fund. The work presented in this paper is also co-financed by a grant from the fund for science for years 2011-2014 awarded for the realization of an international cooperation project by the Ministry of Science and Higher Education of the Republic of Poland.

References

[1] European Commission, "Ageing Report: Economic and budgetary projections for the EU-27 Member States (2008-2060), European Economy, 2, 2009

[2] M. Mossakowska, A. Wiecek, and P. Bledowski (eds.), "Aspekty medyczne, psychologiczne, socjologiczne i ekonomiczne starzenia się ludzi w Polsce", Termedia, Poznań, 2012 (in Polish)

[3] A. AbuDagga, H.E. Resnick, and M. Alwan, "Impact of blood pressure telemonitoring on hypertension outcomes: a literature review", Telemedicine and e-Health, vol. 16(7), pp. 830-838, 2010

[4] C. Luley, A. Blaik, K. Reschke, S. Klose, and S. Westphal, "Weight loss in obese patients with type 2 diabetes: effects of telemonitoring plus a diet combination - the Active Body Control (ABC) Program", Diabetes Research and Clinical practice Studies in Health Technology and Informatics, vol. 91(3), pp. 286-292, 2011

[5] S. Hanke et al., "universAAL – An Open and Consolidated AAL Platform", In *Ambient Assisted Living, 4. AAL-Kongress 2011,* pp. 127-140, 2011

Maciej Bogdanski has been part of the Network Services Department at Poznan Supercomputing and Networking Center since August 2001. His professional interests include ICT application in domains of education and healthcare, as well as most recently, ambient assisted living. Maciej participated in the realization of several ICT-based solutions for the healthcare domain. These included the "Wielkopolska Center of Telemedicine" regional telemedical platform and medical education portals. His responsibilities in those projects involved design of the specialized portal and middleware solutions.

Bartosz Gluszak has been employed by Poznan Supercomputing and Networking Center in the Network Services Department since 2010. His professional interests include web, mobile and web services technologies within domains of e-health and ambient assisted living. Bartosz has been participating in the realization of the Silhouette project aimed at analyzing innovative use of ICT for supporting activity of the elderly. He has also been part of the development team that created the “Wielkopolska Center of Telemedicine” regional telemedical platform.

Michal Kosiedowski is the leader of the Portals and Communication Systems team at Poznan Supercomputing and Networking Center (PSNC). His professional interests include service oriented systems, web technologies, e-health and ambient assisted living. Michal has been the main architect of the "Wielkopolska Center of Telemedicine" regional telemedical platform. He has coordinated the international Silhouette project, which has investigated innovative use of ICT for supporting activity of the elderly. Michal also coordinates PSNC's participation to the HELPS project, where innovative housing and care solutions in urban areas are explored. He is the author or co-author of over 20 papers in professional journals and conference proceedings.

Aleksander Stroinski has joined Poznan Supercomputing and Networking Center in 2008. His professional interests covers application of web technologies and mobile computing in the domain of eHealth and Future Internet. He has been involved in developing health information repositories within the Future Internet Engineering and Wielkopolska Center of Telemedicine projects. Aleksander also serves as a teacher of network technology courses at the Poznan University of Technology.

Telescreening of Critical Eye Diseases in Rural Areas in Lithuania

A. Paunksnis[1], L. Valius[1], K. Andrijauskas[2], G. Andziukevicius[1]
D. Imbrasiene[1], R. Kizlaitis[3]
[1]Lithuanian University of Health Sciences, alvydas@stratelus.com
Eiveniu str.2, Kaunas LT-50009, Lithuania
[2]Kaltinenai Primary Care Centre, Lithuania
[3]Vilnius University, Lithuania

Abstract: **A study comparing the stage of critical eye diseases diagnosed in selected rural and urban areas in Lithuania was conducted. It was observed that critical eye diseases are diagnosed at an earlier stage in urban areas as compared to rural areas, and that use of telemedicine and cooperation of primary and tertiary level physicians can advance early diagnostics in rural areas.**

Introduction

A comparative study on effectiveness of screening for eye diseases was conducted in rural and urban areas of Lithuania with the aim to determine how the collaboration of tertiary and primary level physicians through screenings, remote diagnostics and use of suitable diagnostic equipment could enable earlier diagnostics of eye diseases in rural areas. Advanced eye disease diagnostics and treatment in Lithuania are concentrated in two main tertiary centers, and is characterized by the fact that people in rural areas have lower access to advanced healthcare services due to the shortage of specialty doctors, long waiting times and distance to points of service, as compared to urban areas. Lower access to advanced services can have negative impact on early detection and timely treatment of diseases which also has public health, social and economic aspects as many of those diagnosed with critical eye diseases are of working age.

Stratelus JSC, Telemedicine Research Center in conjunction with the Telemedicine Centre of the Lithuanian University of Health Sciences and the Family Clinic of the Lithuanian University of Health Sciences identified a pilot group of primary care physicians and trained them for cooperation with the tertiary level physicians and appropriate diagnostic protocols, techniques and equipment, such as telescreening and handheld digital fundus camera. Primary care physicians at rural locations were tasked to screen the population, detect eye diseases and assess the degree of

advancement of the disease when the disease is diagnosed for the first time, and transfer data for evaluation of the tertiary level physicians. The study was conducted in several groups of patients in urban and rural areas. The following eye diseases were screened and diagnosed: glaucoma, aging macular degeneration and diabetic retinopathy. It has been observed that many patients in rural areas diagnosed glaucoma, aging macular degeneration or diabetic retinopathy for the first time had the disease in a more advanced stage as compared to the urban areas.

Methodology

Primary care physicians at a remote Kaltinenai Primary Care Centre were trained telemedicine protocols, performed preventive eye screening, acquired digital eye fundus images of the patients screened and transmitted them via the telemedicine network for evaluation and consultation of the tertiary level ophthalmologists associated with the Lithuanian University of Health Sciences in Kaunas. Same methodology was applied at two family clinics in an urban area in Kaunas, and digital eye fundus images were transmitted via the telemedicine network for evaluation and consultation of the tertiary level ophthalmologists associated with the Lithuanian University of Health Sciences in Kaunas.

Findings

Three critical eye diseases – diabetic retinopathy, aging macula degeneration, and glaucoma – were diagnosed. The stage of disease was evaluated for the patients who were diagnosed with the disease for the first time. The combined data collected is represented in Table 1.

Table 1

Area	Rural	Rural	Urban	Urban
Year	2011	2012	2011	2012
Disease and Stage of Disease	Number of patients with Early/Advanced stage	Number of patients with Early/Advanced stage	Number of patients with Early/Advanced stage	Number of patients with Early/Advanced stage
Diabetic retinopathy	5/30	2/27	40/-	58/-
Aging macula degeneration	1/-	2/-	37/-	42/-
Glaucoma	9/35	1/39	31/-	62/-

Observations indicate a tendency that early changes to the eye fundus are more frequently diagnosed in urban areas than remote rural areas. Of the patients who were diagnosed with diabetic retinopathy, aging macula degeneration, and glaucoma for the first time in the rural areas, they had advanced stage of disease more often than early stage of disease, particularly in case of diabetic retinopathy and glaucoma.

The project will continue and larger sets of data collected will be analysed. The findings confirm the assumption that critical eye diseases - diabetic retinopathy, aging macula degeneration, and glaucoma - are diagnosed at an earlier stage in urban areas as compared to rural areas. Late diagnostics of these critical eye diseases, their diagnosis at an advanced stage is an area of concern as it may have negative impact on treatment outcomes, patient health and potential disability.

Among the likely reasons of differences in disease stages diagnosed between urban and rural areas are that urban population are taking better care of their health, have better access to specialists and advanced healthcare services. In rural areas, where percentage of critical eye diseases diagnosed at an advanced stage was higher, lower access to advanced healthcare, lack of specialist physicians, remoteness to advanced care centers, behavioural aspects (people in rural areas often tend to be less focused on health prevention) can explain the higher number of neglected cases. This study also confirmed that proactive preventive population screenings in rural areas, patient education, tertiary and primary level physician cooperation, use of remote diagnostics via telemedicine and appropriate diagnostic medical equipment in detecting critical eye diseases can bring the service closer to the patient and effectively enable earlier diagnosis of eye diseases in rural areas. Use of telemedicine in rural areas involved in the project was also found to be economically efficient. Diagnosing diseases at an earlier stage is important in improving the prospects for treatment effectiveness, outcomes, patient disability and mortality, and long-term social and economic costs.

Lessons Learned from National eHealth Initiatives

A Personal Health Ecosystem: SharingCare

T. Namli[1], S. Postaci[1], M. Gençtürk[1], A. Doğaç[1], A. Yalçinkaya[2], İ. Kiremitçi[2], C. Taşkin[2], E. Erkel[2]
[1]Software Research, Development and Consultancy Ltd., METU Technopolis, METU, Ankara, 06531, Turkey
Tel: +90 312 2101763, Fax: + 90 312 2101837, tuncay@srdc.com.tr
[2]Turk Telekom Group R&D, METU Technopolis, METU, Ankara, Turkey
Tel: +90 312 5556710, cebrail.taskın@turktelekom.com.tr

Abstract: **This article describes a Personal Health Ecosystem, namely SharingCare, designed to address the adoption challenges of the Personal Health Record Systems which can be categorized as lack of effective computer mediated doctor-patient relationship; the increasing cost of integrating PHR systems with the existing healthcare systems, and the security and privacy concerns of the patients. To address these challenges SharingCare is designed as a Personal Health Ecosystem by providing a common personal health data model, a secure PHR storage account, and a central repository to be operated by Turkish Telekom.**

Overview

Although Personal Record Systems are becoming popular in some countries such as the US [1], many governmental and private PHR activities are being suspended [2] due to low acceptance, increasing costs and the privacy/security concerns of the patients. In this article, we describe a PHR system, namely, SharingCare implemented to address these challenges:

- The studies show that patients not only want free access to their health records, but also expect to use technologies to communicate with the clinicians [3]. On the other hand, physicians are less likely than patients to anticipate the benefits of PHRs [4], and more likely to anticipate problems from patient PHR use [5]. The main objection is that PHR adoption will create unreimbursed work [6], although some providers seemed to view PHRs very useful as a source of medical information when the patient's record is unavailable [7]. SharingCare solution to this problem is to act as a utility or assistant and give the physicians the choice to access the PHR of the patient only during face-to-face encounters.
- The second challenge, the cost of PHR systems lies in the difficulty in integrating them with the existing healthcare systems. Given that the

new generation personal health applications are provided as Web or mobile applications; they need to operate on patient data in a more granular way on remote servers. For example, in a HL7 CDA based environment, a diabetes management application trying to render latest diagnoses of a patient has to retrieve all "Discharge Summary Documents", must process the related sections, and collect the diagnosis entries from each document. For a Web based or a mobile application that has limited resources this is inefficient and very hard to implement. SharingCare addresses this challenge by using a granular approach to interoperability rather than using the existing "Message" or "Document" standards.

- As for the security/privacy issues which are already a concern in any web-based application, it is more profound for PHR systems where patients are uploading private health information to a server [8]. On the other hand, evaluations show that most of the users welcomed the idea of sharing data with clinicians and many with other individuals as well. Clinicians also believe that data sharing and collaboration as one of the key component that would be helpful in care process. The patient controlled privacy would seem the basic solution that effectively addresses privacy concerns and this approach is chosen in the SharingCare.

Finally, SharingCare is implemented as a personal health eco system by providing a common personal health data model, a secure PHR storage account, and a central repository to be operated by Turkish Telekom. However, in SharingCare, the personal health ecosystem concept is extended with functionalities such as maintaining terminologies and value sets, integrating with medical knowledge (e.g. description of medical concepts for patients) and resources (e.g. a database of nutritional values of foods); utilization of social networks; and implementing a publish/subscribe mechanism as well as a marketplace for discreet bundles of care services (e.g. periodic diabetes monitoring, dietetic service, exercise coaching, etc) that physicians or healthcare organizations provide for patients.

Methods

A comprehensive literature survey and a requirements analysis have been carried out. Usability issues both for patients, physicians as well as 3rd party developers have been clarified through workshops and discussions.

Results

SharingCare provides the same functionalities as the other personal health eco systems, including a single data model for PHR; a secure storage and

easy to use REST services for securely access to the PHR and administrative records of patients and perform CRUD (Create, Read, Update, Delete) operations on them. However, to facilitate its use by 3rd party developers, SharingCare also:

- Handles terminology maintenance and provides services for personal health applications to retrieve and query these terminologies;
- Provides REST services for personal health applications to access to certain medical or scientific knowledge such as nutritional facts on foods, information for certain exercises like calories burned, or performance guidelines, all in the form of structured resources;
- Another utility service that SharingCare Mobile platform provides is the medical device integration. A device connector component enables the user to connect to Continua Health Alliance compliant medical devices and retrieve the measurements from them. The measurements are integrated into the PHR of the patient and sent to SharingCare repository like other PHR records. Furthermore, several adapters are integrated with the device connector to support some specific medical devices that are popular in Turkey.

To address the adoptability challenges of the personal health record systems, SharingCare:

- Enables physicians or healthcare organizations to register to the ecosystem and publish their care service offers. To improve the communication between the patients and physicians while realizing the actual care services, the personal health applications served over SharingCare are designed to be a utility or assistant. Hence, based on the care service that they want to provide, the physicians have the flexibility to decide on the extent to use the personal health applications in the care processes.
- Existing healthcare standards like HL7 v2, HL7 v3 and ISO/EN 13606 have originated from the requirements of traditional healthcare and provide interoperability based on the concepts of “Message” and “Clinical Document”. On the other hand, new generation personal health applications are provided as Web or mobile applications. Therefore they need to operate on patient data in a more granular way on remote servers and this approach is taken in SharingCare.
- The personal health ecosystems provide a good opportunity for healthcare systems to implement efficient patient controlled privacy mechanisms. They can act as an Identity, Assertion and Consent (Privacy Policies) Provider on behalf of patients not only for the privacy of PHRs but also for all medical information of patients scattered among different healthcare systems. In SharingCare, we

extend the general personal health ecosystem idea with these mechanisms.

- By considering the shift towards smart mobile devices, the SharingCare extends the idea of personal health ecosystem into IOS and Android mobile environments by providing native libraries for these environments that facilitate the communication with the SharingCare repository and offline caching of records. In this way, the application developers can only concentrate on the functionalities of their applications and their visualization.

Discussion

Current barriers to PHR adoption among patients include cost, concerns that information is not protected or private, inconvenience, design shortcomings, and the inability to share information across organizations. SharingCare is designed and implemented to address these issues.

References

[1] MyPHR, http://www.myphr.com/

[2] J. Caumanns. Health Record Architecture(s) in Germany: Motivation and Architecture, congres 'Architectuur in de zorg', Utrecht, June 2012.

[3] J. Walker, D. K. Ahern, L. X. Le et al. Insights for internists: "I want the computer to know who I am". J Gen Intern Med 2009;24:727–32.

[4] HCM Division, N, Archer, U. Fevrier-Thomas. An empirical study of Canadian consumer and physician perceptions of electronic personal health records. In: HCM Division (Ed.). Annual Conference, Administrative Sciences Association of Canada. Regina, Saskatchewan: ASAC, 2010.

[5] S. E. Ross, J. Todd, L. A. Moore et al. Expectations of patients and physicians regarding patient-accessible medical records. J Med Internet Res 2005;7:e13.

[6] A. F. Kittler, G. L. Carlson, C. Harris et al. Primary care physician attitudes towards using a secure web-based portal designed to facilitate electronic communication with patients. Inform Prim Care 2004;12:1, 29–38.

[7] M. J. Witry, W. R. Doucette, J. M. Daly et al. Family physician perceptions of personal health records. Perspect Health Info Managment, 2010:1–13.

[8] L. S. Liu, P. C. Shih, G. R. Hayes. Barriers to the adoption and use of personal health record systems, iConference '11 Proceedings of the 2011 iConference Pages 363-370Open Handset Alliance http://www.openhandsetalliance.com/

Mert Gençtürk has graduated from the Department of Computer Engineering, Middle East Technical University, Ankara/TURKEY and he is currently an MSc candidate from the same department. He has been working at SRDC - Software Research & Development and Consultancy Ltd. (http://www.srdc.com.tr) as a Computer Engineer in R&D projects for more than two years. His field of study is based on the development of mobile and web based personal health record systems by providing connectivity among patients, healthcare professionals and personal medical devices in a secure way.

Brazilian Teledentistry Network Experience

A. E. Haddad[1], M.Rendeiro[2], A. D. M. S. Correia[3], C. Bavaresco[4], M. C. Morita[5], M. C.Skelton-Macedo[1]
[1]School of Dentistry, University of Sao Paulo, Coordinator for the Brazilian Program of Telehealth from Ministry of Health (2006-2012), aehaddad@gmail.com; mmacedo@uol.com.br; 2227 Prof. Lineu Prestes Street - Cidade Universitária CEP: São Paulo, Brazil
[2]State University of Rio de Janeiro, Brazil mmrendeiro@yahoo.com
[3]State Program of Telehealth, Secretary of Health, Mato Grosso do Sul, Brazil, adeliamotta@yahoo.com.br
[4]State Program of Telehealth, Federal University of Rio Grande do Sul, Brazil, c_bavaresco@yahoo.com.br
[5]State University of Londrina PR, Brazilian Association of Dental Education, Brazil, moritamc@gmail.com;

Abstract: **This paper describes the Brazilian experience of creating and developing a National Teledentistry Network (RNTO), as part of the Brazilian eHealth Strategy and Brazilian Telehealth Program. Many institutions from all over the country participate or are being trained and receiving support to constitute their own Telehealth and Teledentistry Centers. Multiple initiatives are held in an articulated plan so that we are able to develop capacity building, expand and consolidate a network for collaborative work and exchange of experiences in telehealth, teledentistry and the use of information and communication technologies applied to education for health professionals and healthcare, especially those from Dentistry.**

Brazil has adopted eHealth as a national policy applied to healthcare and education since 2006. It started as part of Ministry of Health national policy for development and capacity building of human resources for health. Many strategies have been developed and adopted aiming to reorient health professionals competencies to the healthcare model established in its universal access health system, based on primary health care. The strategies deal with undergraduate students, technical level health workers, residency and post graduate programs. The educational policy implemented is based on three main guidelines: integration between universities and health services, a wider concept of health-disease process, based on the social determinants of health and new pedagogical approach based on active

methodologies, including the use of information and communication technologies (ICT) [1, 5].

Brazil assumed health as a right of each citizen and for that its Federal Constitution created in 1988 the Unified Health System (SUS) which applies currently to more than 190 million inhabitants. One of the greatest challenges faced by universal health systems is how deal with the overpowering increase of new technologies applied to healthcare and, at the same time, guarantee universal access of population to high quality of care with sustainability. Human health resources play a central hole in this equation [2].

A special issue number of the Lancet with a series of papers about the Unified Health System (SUS) from Brazil was published in 2011. As far as the Millennium Development Goals – MDG are concerned, the editors highlight SUS achievements as the reduction of 50% in low birth weight and two thirds decrease in infant mortality in the last decade [3,4].

In this context, where we have SUS and more recently a national policy for human health resources, is that Brazilian eHealth strategies emerged and have been developed [6, 8, 10-14].

The multiple strategies for eHealth include mainly the Brazilian Telehealth Program (www.telessaudebrasil.org.br), Open University of the Unified National Health System - UNA SUS (www.unasus.gov.br) and Telemedicine University Network – RUTE (www.rute.rnp.br). The activities grew faster between physicians and nurses. It has also a great acceptance and demand by Health Community Workers.

Dentistry has gained strength within SUS in 2000, when the dentists starting to integrate Family Health Teams at the primary health care level, and also with the creation of the Centers of Dental Specialties in 2005. By 2012 we reached approximately 18.000 out of 32.000 Family Health Teams that included dentists and 800 Centers of Dental Specialties all over the country. Until that most of the population had difficulties to dental treatment access. Epidemiological studies comparing the situation in 2000 and 2010 showed considerable improvement in dental health indicators, although we still have a great cumulative demand accumulated along many years before, especially in relation to adult oral health needs.

This active inclusion of Dentistry within SUS created the necessity for undergraduate programs to prepare better students to a new professional activity pattern, facing the challenge of working in a multi professional team, at public services and not only in private offices. Many programs and strategies are being promoted by the federal Government, specially by the Ministries of Health, of Education and of Science, Technology and

Innovation to face the new challenges involving all health professionals, including dentists.

One of them is the eHealth strategy and to better integrate Dentistry [7,9], it was created the National Teledentistry Network - RNTO (http://programa.telessaudebrasil.org.br/vhl/teleodontologia-em-foco/rede-nacional-de-teleodontologia-e-nucleos) in 2011. Its goal is to share and exchange successful experiences of telehealth applied to teledentistry, nationally and abroad. Two relevant RNTO initiatives must be mentioned. One of them is the e-learning course destined to institutions interested in developing Teledentistry Centers. It is divided in three modules: 1. How to implement and manage a Teledentistry Center; 2. How to train and stimulate professors to use more widely information and communication technologies (ICT) in the teaching-learning process; 3. How to support a service of teleconsultancies and Formative Second Opinion for health professionals. Each module has been structured by experienced professors and dentists already engaged on Brazilian Telehealth Program and UNA SUS, establishing guidelines and learned lessons that may help new partners to better perform in the network. After defining the content and validating it by an experienced external committee, the module is developed with the support of an instructional design that has a pedagogical background. It is expected that this course may serve as a reference for teachers, health professionals, faculties of Dentistry and health services willing to start using ICT for teaching and learning and healthcare support.

The second initiative, as part of RUTE, is the creation of a Special Interest Group (SIG) in Teledentistry. It represents one, out of more than 40 SIGs already at work, in different specialties most of them in Medicine and Nursery. The Teledentistry SIG is a virtual space in which education and research institutions from all over the country get together virtually through video and webconference, discuss, share their experience and learn how to better work as an effectively connected network. This huge movement of education and research in health network was made possible by a cooperative initiative run by the Ministry of Science and Technology, with partnership with the Ministries of Education and of Health. A backbone of wide band has been built connecting all the public university hospitals and other relevant health services, connecting this national wide network dedicated to education and research in health field. There is a Social Organization, the National Network of Education and Research (www.rnp.br), from the Ministry of Science and Technology which is responsible for the development and management of RUTE.

The RNTO is run by the Brazilian Association of Dental Education (www.abeno.org.br) and by the Teledentistry Center of the Faculty of

Dentistry of University of Sao Paulo (www.teleodonto.fo.usp.br), in partnership with the Telehealth Centers of the University of the State of Rio de Janeiro – UERJ (http://www.telessaude.uerj.br), Federal University of Rio Grande do Sul - UFRGS (http://www.ufrgs.br/telessauders) and the State Secretary of Health of Mato Grosso do Sul (http://telessaude.saude.ms.gov.br). The project is supported by the Ministry of Health (www.saude.gov.br) with the cooperation of Pan American Health Organization (PAHO). The two initiatives are articulated and their effects on the function, strengthen and extension of the RNTO. It has also contributed for the improvement of healthcare, research and education in undergraduate and pos graduate dentistry courses all over the country.

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] A. E. Haddad, F. E. Campos, G. C. Cury, J. R. Ferreira. "Pró-Saúde – Programa nacional de reorientação da formação profissional em saúde: objetivos, implementação e desenvolvimento potencial.". Brasília, DF: Ministério da Saúde; 2007. 87 p.

[2] A. E. Haddad "A Odontologia na Política de Formação dos Profissionais de Saúde, o papel da Teleodontologia como ferramenta do processo de ensino-aprendizagem e a criação do Núcleo de Teleodontologia da FOUSP." Tese de Livre-Docência. Faculdade de Odontologia da USP. 2011. 198p.

[3] S. Kleinert, R. Horton. Brazil: towards sustainability and equity in health. Lancet.; vol. 377(9779), p.1721-2 May, 2011.

[4] C. G. Victora, M. L. Barreto, M. C. Leal, C. A. Monteiro, M. I. Schidt, J. Paim, et al. "Health conditions and health-policy innovations in Brazil: the way forward." Lancet v.377 (9782), p.2042-53 June 2011.

[5] N. Almeida-Filho. "Higher education and health care in Brazil." Lancet v. 377(9781), p.1898-900. June 2011.

[6] A. E. Haddad "Brazilian Experience in Telehealth Brazil Program." In: Gold Book 50º Congresso Científico do HUPE. eBook. Tecnologia em Educação e Saúde. 2012. http://www.telessaude.uerj.br/goldbook/artigos/

[7] M. Bradley, P. Black, R. Noble, R. Thompson, P. J. Lamey. "Application of Teledentistry in oral medicine in a Community Dental Service, Northern Ireland". Br Dent J. vol. 209(8), p.399-404 2010.

[8] A. E. Haddad, M. C. Skelton-Macedo, C. A. Costa, P. E. Souza, L. W. Chao, F. E. Campos. "Brazil Telehealth Program in the Amazon Region: Brazilian Strategy to Reach isolated populations." In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luxembourg, vol.3 pp. 64-8, 2010.

[9] A. E. Haddad, A. C. Guedes-Pinto, C. J. F. Alencar, E. Sequeira, J. H. Antoniazzi, L. B. Oliveira, et al. Teleodontologia: potencialidades no ensino e na prática odontológica. In: Guedes-Pinto AC, Bonecker M, Rodrigues CRMD (Org.). Fundamentos da odontologia: odontopediatria. 1. ed. São Paulo: Santos; 2009. v. 1, p. 437-45.

[10] E. Harzheim, V. J. P. Dias, R. R. Witt, T. Silveira, J. H. G. Kolling, P. Fontanive, et al. "Telenursing in Primary Health Care: Report of Experience in Southern Brazil." Stud Health Technol Informatics vol.146, p.202-6. 2009.

[11] A. E. Haddad, M. C. Skelton-Macedo, E. D. Castro Filho, V. Abdala, R. M. P. Andrade, F. E. Campos. “Formative Second Opinion: Qualifying Primary Health Care in Brazil.” In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luxembourg, 2010;3:546-50.
[12] A. E. Haddad, F. E. Campos, M. B. M. Alkmim, L. W. Chao, S. Roschkes “Brazilian National Telehealth Program” Med-e-Tel 2007. The International Educational and Networking Forum for eHealth, Telemedicine and Health ICT Proceedings, pp,. 321-3.
[13] F. E. Campos, A. E. Haddad, L. W. Chao, M. B. M. Alkmim, P. M. Cury “The Nacional Telehealth Program in Brazil: an instrument of support for primary health care.” Latin Am J Telehealth. Vol. 1(1), p.39-66 2009.
[14] R. S. Gundim, L. W. Chao. “A graphical representation model for telemedicine and telehealth center sustainability.” Telemed J E Health. vol. 17 (3), pp.164-8. 2011.

Ana Estela Haddad - Associate Professor of the Orthodontics and Paediatric Dentistry Department, Researcher at the Teledentistry Center at the Faculty of Dentistry, University of Sao Paulo, Brazil. Coordinator of Telehealth Brazilian Program from Ministry of Health from its creation and implementation in 2006 until 2011, Alternate Member representing Brazil at the Advisor Committee of Bireme (Latin-American and Caribbean Center for Health Information/PAHO), Member of the Advisor Committee for the Brazilian University Telemedicine Network (RUTE). Former Director for Human Health Resources Education, Ministry of Education (2006-2011).

E-Health and Telemedicine Priorities in Mongolia

D. Jargalsaikhan[1], S. Enkhbold[2], N. Odongua[2], E. Enkhtuul[2]
[1]Global TFH Fund
[2]School of Public Health, HSUM, Mongolia

Background

Mongolia is a landlocked country in East and Central Asia, most sparsely populated independent country in the world with a population of around 2.75 million people at 1,564,116 square kilometers [1]. Since 1990, key health indicators like life expectancy and infant and child mortality have steadily improved, both due to social changes and to improvement in the health sector. Average life expectancy is 68.5 years (2011) [2]. At present, there are 27.7 physicians and 75.7 hospital beds per 10,000 inhabitants [3]. Regarding the health information technology, there has been introduced couple of telemedicine and e-hospital initiatives into the health sector of Mongolia. However, still serious disparity health problems due to remoteness remain, especially in the countryside [4]. As ensuring health information high technology contributes greatly to the health sector in terms of providing the accessible health care services for the population, regardless of time and distance there is a rising need to define priorities to develop e-health and telemedicine. Unfortunately, because of a lack of proper coordination, and standardization, instead of making things simpler and easier, some efforts have led to additional workload and have made matters more complicated.

Objective

The purpose of this study is to identify current environment of the telemedicine and e-health, information flow within the health sector, its connectivity, telemedicine initiatives, health facility based information system and workforce capability and attitude on existed e-health applications and determine priorities to better management health information system in Mongolia.

Materials and Methods

The study was used document and desk reviews, and questionnaires with 362 users from 105 health care facilities. The data were analyzed using by qualitative and quantitative methods. In the qualitative values used

document and desk review findings. In the quantitative indicative values used questionnaires' findings from health care providers at the primary, secondary and tertiary level hospitals. The comprising analysis was carried out using the SPSS. Outcome measures were calculated with Power for Cross-sectional Studies (CR and PD).

Results

The environment of the telemedicine and e-health: The national fiber optic network of Mongolia is extended to reach all 21 aimag and 170 of total 331 soum centers by 2011. As plan, all soum centers will connect through fiber optic network by 2014[5]. Since 2009, MobiCom, Skytel and Unitel (http://www.unitel.mn) have launched 3G, high-speed mobile broadband, services in Mongolia, offering new services to their customers, such as Video call, Mobile broadband with high speed connection through mobile phones. All subscribers of these mobile service providers can have access to these services with the condition that their mobile phones support these services. The 3G service is currently offered in 31 soums and settlements, reaching over 171,000 users. At present, internet services in Mongolia are distributed via xDSL (ADSL, HDSL, VDSL), Fiber optic, GPRS (including 3G, EVDO and EDGE), WiMax, WiFi technologies, dial-up and VSAT. Furthermore, companies are expanding their network to broadband which provides EPON and GPON technology. In the beginning of 2011, the number of Internet subscribers was 199,849 representing an increase of over 53% compared to 2009 [6].

The information flow within health sector: The vertical health information flow regulates in the health sector of Mongolia. Ministry of Health (MoH) is placed at the top policy coordinating level. Department of Health-Government Implementing Agency of Mongolia (DoH-GIAM) is collected data from specialized hospital at the tertiary level, private hospital, City and Aimag's Department of Health and submitted data to MoH and NSO. The City and Aimag's Department of Health is collected data from general hospitals at secondary level, soum and family health centers at primary level of health care. Regulated information is routine data and health insurance claims of specialized hospital. In regard, H-info-2 is provided to DoH-GIAM, general hospitals of 21 aimags and 9 districts and tertiary level specialized hospitals. The above mentioned hospitals, which used H-Info-2, are making data collection, processing, data management and reporting in code of ICD-10. However, H-info-2 created on old language Borland Delphi, not supported Unicode standard. In addition, it has not health data dictionary that is big challenge to develop e-health in

health sector of Mongolia. Therefore, H-info 2.0 is upgrading by local consultants under the support of Third Health Sector Development Project, ADB for 2011-2012.

The connectivity infrastructure of e-health: The general hospitals of 21 aimags and 9 districts, 16 specialized hospitals and maternal hospitals of the capital city connected with fiber optic internet with VPN. The soum and family health centers did not connected yet. Internet speed increased from 10-180 mbps for 2009-2012. In promoting telemedicine, several projects had introduced under support of the international partners.

Telemedicine support projects: Health Sector Development Project-2 (HSDP-2) funded by ADB had introduced health information technology in rural 4 aimags for 2005-2008 and HSDP-3 provided telemedicine support in pilot 5 aimag and 2 districts. Project in Telemedicine support maternal and child health care service executed by UNFPA and MN Cardio-MON/003 project supported by Government of Luxemburg and Luxemburg Development Agency had implemented in 8 aimags and its expansion project MON/005 is implementing since 2012 in 21 aimags. In addition, project in creating of telemedicine network in Mongolia supported by Sweden Development Agency is implementing in country. The overall objective of the current project MON/005 is focused on health services in the areas of cardiovascular diseases and maternal and child health which is in line with the Health Sector Strategic Master Plan 2006-2015. The service provided by the telemedicine project is particularly important for women in remote rural regions who do not have the funding to travel for expert opinion. Such as several TM initiatives are going well in rural areas. In terms of national networking, the regulation of telemedicine activities started as approval of the Minister's order 372 in 2010.

Health care facility based information system: Regarding the clinical information system (CIS), 82.6% of the health care facilities use only Computerized Physician Order Entry (CPOE) out of CIS such as Drug Information System (DIS), Laboratory Information System (LIS) and Radiology Information System (RIS). In the district hospitals, couple of software modules installed and in use that is including outpatient hospital registration, physician's examination, H-info-2 information including ICD-10 codes (the International Statistical Classification of Diseases and Related Health Problems), and effective home control information (postnatal mother and infants), vaccination, and child's growth control information. This system covers approximately 650,000 residents in 7 districts of Ulaanbaatar.

But, 50% of the existed e-health software is not integrated in the health care facilities. In the data management, 27.0% of the health care facilities

that used e-health applications had no backup solution.

Workforce attitude on existed e-health application: The workforce attitude on e-health is unsatisfactory and 45.5% of total responders said that the information technology human resource is insufficient. 70.0% of users responded as there did not any continues training program in health information technology. The study was determined lack of functions and difficulty of using the existed e-health applications and inadequate software operation and not user-friendliness are the causes of the most of dissatisfactions. 80.8% of responders agreed with performance of health care service improved by using the computer software, 18.5% did not agree on that and 0.7% have completely opposite opinion.

Conclusion

A supportive environment for telemedicine and e-health is getting started, vertical health information flow and H-info-2 set up within the health sector. In the clinical information system, a most health care facilities installed in use CPOE software and a few numbers use LIS, DIS and RIS. However there is no integration of e-health software and lack of its capacity. It is required a modern integrated health information system in the health sector of Mongolia.

References

[1] National Statistical Office of Mongolia. Statistical yearbook, 2011.

[2] Department of Health-Government Implementing Agency of Mongolia. Health indicator, 2010.

[3] Department of Health-Government Implementing Agency of Mongolia. Health indicator, 2011.

[4] United Nations. "Human Development Report 2011". http://hdr.undp.org/en/media/HDR_2011_EN_Tables.pdf. Retrieved 27 Jan, 2012

[5] Government Resolution #101. E-Government, National program, 2012

[6] MoH, World Bank and NIPA. Feasibility study on e-health development, 2012.

S. Enkhbold - Education: 2007: Nagoya University Graduate School of Medicine, Nagoya, Japan; Master of Science in Health Care Administration; 2003: Health Science University of Mongolia, Ulaanbaatar, Diploma of the Master science in Medicine; 1997: National Medical University of Mongolia, Ulaanbaatar, Professional diploma on Mongolian Traditional Medicine. Work Experience: 2001-2012 Director and Deputy, SPPD and IMED, MoH, Mongolia; 2000-2001 Lecturer, "Monos" Medical College, Mongolia; 1997-1999 Physician, "GEM" Private hospital, Katowice, Poland. Email: serenkhbold@yahoo.com

Health Center of Excellence - HCE

Health Network of Excellence and the Vision for Inter-Country Collaboration

N. Asllani[1], K. Brauchli[2], M. Hubler[2]
[1]Multi Care Medical Group – Kosova, asllani@amoko-int.com
[2]Basys Data - iPath Network, Basel in Switzerland

Mission

To balance the human and intellectual product/service offered from health professionals against the technological product/service offered from the machine.

Proposal

The human mind is the most complex information-processing tool we have. And it is our common experience that the things we know have great practical value only if they are shared with mutual respect for our differing perspectives.

Health Centers of Excellence (HCE) can foster South Eastern Europe (SEE) development and interaction. They can be crucial to establish better cooperation among people within and beyond borders, especially in the fields of education and health-sciences. Collaborating HCE through their interaction are important to develop mutual respect, thereby to change attitudes of the past. Knowledge sharing in e.g. the medical fields of Radiology, Pathology, Cardiology, Dermatology, etc. as well as Bioengineering and other health sciences, will bring professionals of the SEE countries closer to each other and to West Europe, and truly expedite their integration into the broader Europe Community.

Realization of the HCE Objective through

1. Recognition and employment of professional and intellectual capital;
2. Continual challenge of optimizing use of recent ICT technologies;
3. Create a governing project, the support of which would be justified as a valuable investment in the growing well-being of the region;
4. Make obvious the mutual advantage of sharing experience and knowledge;
5. Continually improving the productivity of knowledge, to further a self-sustaining process to common regional advantage

Project is preordained to be developed into three steps:

a. Country Pilot Project – Kosovo: Kosova is the newborn country in South Eastern Europe. Investment in ICT technology and training programs are widely promoted and implemented. Kosovars are pro-western oriented. Besides Albanian Kosova's official language are English and Serbian. About 70% of Kosovo youth is fluent in English and 60% are younger than 25 years. The nation is friendly and appreciative towards west Europe and USA. Kosovo democratic elected government is trying to do the best on its first steps on market economy.

b. Neighborhood Project (Albania, Macedonia, Montenegro, Kosovo): Second step is the establishment of four interactive Health Centers of Excellence in Albania, Macedonia, Montenegro and Kosovo. Recent visits to health, biotech, ICT and education specialists in these four countries confirmed the usefulness of the HCE idea to be well accepted. Telemedicine projects in the Balkans exploiting new technology will also, when emphasized for their profitable investment opportunities, simultaneously enable the development and sharing of knowledge through internet-based common reference centers. A concentric regional expansion of the HCE concept will be proposed to closely follow the initial steps, both to draw in the relatively advanced resources of the Western Europe countries, and to benefit regional social welfare and harmony through a progressive expansion of HCE into neighboring countries farther to the east, north- and southeast of Europe.

c. South Eastern Europe Project (Albania, Bosnia, Bulgaria, Croatia, Kosovo, Macedonia, Montenegro, Romania, Serbia, Slovenia): In ten countries of SEE we have explored professional and ICT availability to create HCE, combining cross-borders interest where seen most needed, and practicable politically (e.g. Kosova/Monte Negro, Albania/Macedonia, Bosnia/Serbia, Montenegro/Croatia etc.)

Multi Care Medical Group (MCMG)

MCMG proposal is to establish Health Centers of Excellence as integral part of the Health Network of Excellence. HCE will offer services, in ten countries in SEE, to enable cross-border health services and sustainable collaboration among health professionals. Having extensive professional contacts throughout SEE, I have proposed within this circle of personal and professional associates a collaborative development of a knowledge sharing and cooperating network throughout the region. Collaborating where possible with existing Tele-Medicine projects in the Balkans, and through access to advanced technologies we intend development of "health centers

of excellence", with the always present focus on cross-border cooperation and building sustainable peace in the region.

Project Background

MCMG idea to initiate HCE has evolved for a long time and intensified after Luxembourg Med-e-Tel Conference. Consultation with several experts in the country and abroad has strengthened project initiative. Health Center is meant to offer knowledge sharing and training programs for health professionals, e-library and services/referrals for patients looking for second opinion and specialized tertiary health services in the country and abroad.

This is local initiative from developing country perspective. HCE would provide services and training courses, depending on necessity of the SEE countries. It will also serve as a training and resource center for health institutions, private clinics, insurance companies and international organizations present in the region. Services for such centers will be provided from national and international experts, specialized institutes and service organizations in Europe, USA, Australia and etc.

Possible Tools and Concerns

Building on the FOSS iPath network, we project phased development of the "Application Package" concept as currently being developed for implementation elsewhere by iPath network.

Software

As an established and proven health diagnostic reference and distance learning tool, the iPath Open Source software is considered for cost-effective employment. Being of FOSS design (free and open source software), the iPath software itself is available for any group able to employ and support it. To take continual advantage of its near-universal capabilities wherever used for knowledge transfer or database access, further and indeed continual development must be planned to enable continual benefit from technology improvement.

Infrastructure

The network "backbone" is dependent upon a capable communication infrastructure. Regardless of where, this has varied between "fundamental" as via low-speed connection or portable hand-held telephony, up through the advantage of high-speed internet technology. Time and advantage will hasten the deployment of increasing capability.

On-site Implementation and Initial Training

These are obvious necessities to an effective deployment of such a HCE system. Eventually, however, the capabilities and their adaptation by design as an ICT tool would be managed locally and at a distance.

Community Groups: For interaction and exchange and in cooperation with iPath, we have started these groups:

- HCE - Cardiology (hidden group)
- HCE - Dermatology (hidden group) https://www.ipath-network.com/ipath/group/view/224
- HCE - Gynecology (hidden group) https://www.ipath-network.com/ipath/group/view/227
- HCE - Oncology/ Haematology (hidden group) https://www.ipath-network.com/ipath/group/view/227
- HCE - Ophtalmology (hidden group) https://www.ipath-network.com/ipath/group/view/223
- HCE - Pathology (hidden group) https://www.ipath-network.com/ipath/group/view/220
- HCE - Radiology (hidden group)
- HCE - Surgery (hidden group)

Neshad Asllani, MD, Prishtina, Kosova graduated in 1984 at Medical Faculty, University of Prishtina, Kosova.
In 1990, when the opportunity to think out of the box was given to people in Eastern and South Eastern Europe, Dr. Neshad Asllani has open the first private clinic in Kosovo. Tens of patients each day were looking for health service and perceiving the private clinic as an open window for their future life. Encouraged with initial success, in 1995 the first CT Scanner was brought and introduced to Kosovo. Patients from Kosovo, Albania, Serbia and Macedonia has benefited from this investment. In 1997, diagnostic center "Dr. Asllani" participated in European Congress of Radiology in Vienna. Three presentations were made in this important Congress of Radiology.
In 2000 the Multi Care Medical Group was established. In 2010 the Health Center of Excellence, new concept and platform for cooperation was initiated. Starting and introducing something new was a motivation for the new thinking.
Besides health, Dr. Asllani is an active civic leader in education and human rights learning, and Rotary leader in South Eastern Europe.
He is also a board member of Kosovo American Education Fund - KAEF, Board member PDHRE and member of the Three Country Advisory Board for Rotary Clubs in Albania, Kosova and Macedonia.

Integrated Model for Standardization of Electronic Medical Records by Levels of Hospital in the Telehealth Center in Colombia

L. J. R. López, C. Molano, Y. P. Vanegas
Nueva Granada Military University, Telemedicine Research Group - TIGUM, leonardo.ramirez@unimilitar.edu.co
Cra. 11 No. 101-80, Bogotá, Colombia

Abstract: **Colombia is currently facing the challenge of the standardization of Electronic Medical Records due to the incorporation of new providers that have implemented an information system based on new information and communication technologies without interacting among them. It leads to considering medical records as a collection of the information raised through the relationship between a patient and their physician and NOT as part of an integrated medical information system. The Ministry of Health is responsible for "regulating the collection, transfer and disclosure of the information in the subsystem where the members of the system compulsorily converge." Through Resolution 3374 of 2000, the Ministry of Health establishes the basic details that health service providers must issue. In this regard, the Telehealth Center of the Universidad Militar Nueva Granada creates an Electronic Medical Record model by levels of hospital care with an aim to record the required patient information depending on the needs and thus integrate the information raised by different health centers, clinics, dispensaries, hospitals, etc. The model is being validated in Level I hospitals in Bogota, where there is NOT standardization of Electronic Clinical Records gaining responsiveness from government bodies.**

Introduction

Background

The levels of healthcare in Colombia are classified by activities, interventions and procedures. According to the provisions of Resolution 5261 of 1994, medical services can be sorted by different levels of accountability and levels of care. Care Classification: Level I: Self Care or Minimal Care, Level II: Moderate or intermediate, Level III: Intensive Care, and Level IV: Critical Care. In Colombia the hospitals types are: Type 1:

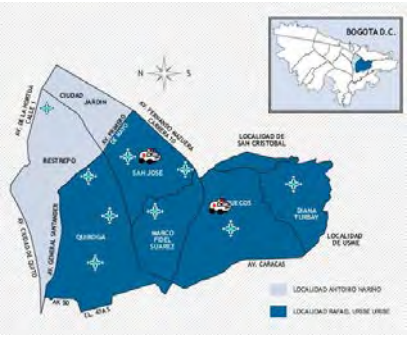
<20,000 s/p and 20-60 beds, Type II: 20-60,000 s/p and 60-150 beds, Type III: 60-100,000 s/p and 150-300 beds, and Type IV: >100,000 s/p and >300 beds [1].

Problem Identified

Level 1 facilities establish the first contact with patients for care and registration. The problem of standardization of Electronic Medical Records has not facilitated the integration and interoperability among health services furnished to users at a distance. Despite the fact that the Government has created laws and resolutions so that providers of computer-based services enable the integration of different providers, this task has not been accomplished [2].

Case Study: Rafael Uribe Uribe Town (Bogotá)

The hospital facilities of the town known as Rafael Uribe Uribe in Bogota are made up of three Immediate Medical Attention Centers (CAMIS, Spanish Acronym), six Healthcare Primary Units (UPAS, Spanish Acronym) and one Basic Mobile Attention Center.



Services: general care and hospitalization, emergencies, observation for adults and children, pediatrics, obstetrics, low-risk childbirth, clinical laboratories, imaging and pharmacies.

Goal: consolidating databases and enabling operations among the services to ensure a better quality of life and primary healthcare with their constituent facilities.

Actors involved in the process: Board of Directors, Management, Steering Committee, Planning and Quality Office, Facility Coordinators, Process References, User Associations and COPACOS.

Requirements

This model meets the need of digitalizing, organizing and sharing information of the users receiving services from LEVEL I hospitals. The first step is integrating data in a unique Electronic Medical Records System (EMRS). Then covering all specifications of the services furnished for LEVEL I and enabling the possibility of sharing reliable patient information regardless of which care facility is contacted to file the request. Another

step is generating two main actors - healthcare professionals and resource administrators [3].

Integrated EMRS Model

The EMRS model (Level I) is the first contact point for the user to provide information, which must be authentic, safe and intangible. The following model is proposed, which gradually escalates to other levels increasing the amount of services and the incorporation of new information. This EMRS model arises from the need of consolidating and standardizing user information according to the service used enabling information scalability and interoperability in order to use all the telemedicine services across the four levels. The model sets forth the following items which are shared by all levels starting from: scheduling, referral control and counter-referral, basic medical records, fees and agreements, financial records and collection, pharmacies and supplies [4-5].

Scheduling: Means scheduling of medical appointments taking into account the user, service provider operation hours and assignment of available resources.

Referral and Counter-Referral: Refers to the mechanism for information exchange among healthcare professionals regarding referral, authorization or visits from users.

Basic Medical Records: Summarizes the basic initial details from all users where it is possible to add information.

Fees and Agreements: Enables definition and modification of fees and application to agreements.

Financial Records and Collection: It comprises the financial module of the medical records as well as billing keeping and portfolio.

Pharmacies and Supplies: It consists of the inventory module for medicine and hospital supplies for internal use and sale of prescription drugs.

Beneficiaries

The potential beneficiaries in the 20 towns, more than 1,200 neighborhoods, density of 4,270 people per square kilometer, being of around 7.5 million inhabitants. The model is currently being applied in the Rafael Uribe Uribe town comprising 1,310.1 ha in 20 neighborhoods with about 500,000 inhabitants.

Results of Integrated Model

Emergency services: 24-hour low-complexity medical emergencies. Hospitalization services: Level 1 hospital care

Delivery room: Low-risk pregnant women including ultrasound and belly monitoring.

Outpatient care: General Medicine, General Dental Care, Vision care, Optometry, Social Work, Psychology, Endodontics, Screening and specific protection actions, Nutrition and Dietetics.

Promotion and Prevention Programs: Carrusel de los Niños (Children Carousel), Vive tu Salud en Grande (Live your life at your fullest), Servicio Amigable para Adolescentes (Friendly Service for Teenagers), Tejidos Lazos de ternura (Affection Bonds), Cultivemos Nuestros Hogares (Building our homes).

Rehabilitation: Facilities for physical, respiratory, occupations and language therapy.

Diagnostic tests: Level I imaging and clinical laboratory.

Public health: Public health management in local territories, sanitary surveillance, operation in community daily life, institutional health service providers (IPS), work, school, family; projects for the local development fund (FDL), Extended Immunization Program.

Ancillary services: Basic Assistance Transportation, Tilt Table Test, Pharmaceutical Service, Health Route.

Conclusions

The model submitted was validated in the Rafael Uribe Uribe town in Bogota, Colombia. It was interoperable, adjustable depending on the particular requirements of each Level 1 Hospital, low-cost and of wide geographical coverage. Leverage of telemedicine is critical to widen coverage and lower operability costs of healthcare services in Level 1.

References

[1] Ministerio De Protección Social. Documento Técnico de Construcción del Ordenamiento (Ranking) de Instituciones Prestadoras de Servicios de Salud, basado en el Sistema Único de Habilitación y la incorporación de indicadores financieros y de resultado, Bogotá, D.C. Septiembre de 2006.

[2] J. Carnicero. De la historia clínica a la historia de salud electrónica. Inf. six. Pamplona: Sociedad Española de Informática de la Salud, 2003.

[3] Ministerio de Salud. Resolución 3374 de 2000.

[4] L. V. Dyk, J. Fortuin and C. Schutte. A Maturity Model for Telemedicine,) IARIA, pp 78-84, Spain, 2012.

[5] Ministerio de Salud. Decreto 176 de Mayo de 2010 “Por el cual se definen los lineamientos para la conformación articulada de un Sistema Integrado de Gestión en las entidades del Distrito Capital y se asignan unas funciones”, 2010.

Leonardo Juan Ramírez López - Chief of Division Technology Development and Innovation at the Nueva Granada Military University, Bogota - Colombia. Ph.D. 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) since 2010. IEEE member of EMBS Society since 2000. Associate Professor and leader of Telemedicine Group TIGUM-UMNG.

Catherine Molano Durango - Telecommunications engineer from the Universidad Militar Nueva Granada, 2013. Research Assistant telemedicine research group of Nueva Granada Military University - TIGUM-, Bogota, Colombia. Grade in System Information Security, 2008.

Yenny Paola Vanegas García - Telecommunications engineer from the Universidad Militar Nueva Granada, 2013. Research Assistant telemedicine research group of Nueva Granada Military University - TIGUM-, Bogota, Colombia. Primarily in the development of interactive applications for telemedicine. Electronics and Telecommunications Technologist at Catholic University in Bogota Colombia, 2008.

National Network of Teleaudiology in Clinical Practice for Cochlear Implant Patients

A. Wąsowski[1], H. Skarżyński[1], L. Bruski[2], A. Lorens[1], A. Obrycka[1], P. H. Skarżyński[1,2,3]

[1] World Hearing Center of the Institute of Physiology and Pathology of Hearing, Kajetany, Mokra 17, 05-830 Nadarzyn, Poland

[2] Institute of Sensory Organs, Kajetany, Mokra 1, 05-830 Nadarzyn, Poland

Abstract: **To improve the quality of care over the cochlear implant patients, the 'telefitting' – remote fitting of the electrical stimulation parameters - has been proposed. The aim of this paper is to present the results of a large-scale introduction of telefitting into clinical practice in the National Network of Teleaudiology. The Network proved to be a reliable platform for telefitting. The method and the proposed model of postoperative care for implanted patients using telemedicine seems to be a reliable alternative to the standard model. It improves the quality of service provided to patients and saves substantial time and money.**

Introduction

To obtain hearing benefits after cochlear implantation it is crucial to optimally, individually fit the electrical stimulation parameters. It is usually done according to a specific fitting procedure, requiring an experienced, multidisciplinary team to undertake repeated sessions with the patient. These sessions are often associated with high travel costs, time loss and weariness, which limit the reliability of the test results and the fitting outcomes. Moreover, a rapid increase in the number of cochlear implant recipients in recent years, and projected further development in this area, make managing the procedure more difficult.

One solution to address the aforementioned problems is to transfer some parts of the procedure to smaller, cooperating centers spread around the country. These centers are usually sufficiently equipped and have teams ready to provide medical and rehabilitation care at a satisfactory level. However, some parts of the procedure, like psychophysical measurements or programming of cochlear implant system, cannot be conducted by those teams due to a lack of trained specialists and limited experience. To overcome this problem the telemedical solutions are in use. They allow cooperating polyclinics to conduct some parts of the procedure, like basic audiological tests and rehabilitation evaluation, then experienced specialists

from the CI clinic, using Internet connection and supported by local staff, perform the final part of the procedure: psychophysical and objective measurements and speech processor programming.

The basis of this approach has already been described in the recent years [1-3]. The Internet allows specialists from the CI clinic to set up a teleconference for audio and video contact with the patient and support specialist, and allows remote desktop software to access a remote computer and perform measurements and fitting. This method has been assessed under the controlled conditions in which the patients undergo a fitting procedure twice: in the standard face-to-face mode and in the simulated remote mode, usually performed in the same building, but using telemedical technology. Those studies proved the telefitting to be safe, reliable, and well accepted by both patients and specialists. Electrical stimulation parameters obtained during telefitting did not differ from values obtained during the standard, face-to-face fitting. However, the results of the introduction of the proposed method into clinical practice were still missing, especially for the patients' assessment of the "real life" quality of the service without a backup of a second, standard fitting. In addition, estimates of the cost and time savings that can be obtained in real life were lacking.

National Network of Teleaudiology

The National Network of Teleaudiology was introduced in 2009, with the aim of providing a wide range of telehealth applications like telefitting, telediagnostics, speech and hearing telerehabilitation or teleeducation. It was developed based on previous experiences of the Institute's team in the field of telemedicine in audiology and otorhinolaryngology dating back to the 2000. The development of the Network received a support from Norway through the Norway Finance Mechanism.

The Network consists of 20 cooperating centers in Poland and 1 in the Ukraine. The center of the Network is the World Hearing Center in Kajetany, from where experienced specialists provide teleconsultations for patients in cooperating polyclinics. Every node of the Network is equipped with HDX8006 teleconference terminals from Polycom Inc. with 32″ LCD screens, zoomable and movable Polycom cameras, and is connected to a system with 2 Mbit/s symmetrical Internet connections. In the World Hearing Center there are two videoconference studios: OTX 300 and RPX HD 418 utilized for the telemedical services. In every policlinic there is a PC computer equipped with clinical interface boxes with appropriate fitting software and speech therapy software. The 'Logmein.com' application is used to provide remote desktop functionality. Forty one support specialists were trained in the cooperating centers; they are responsible for helping in

the communication process and in the basic technical tasks like connecting the speech processor to the interface. In the World Hearing Center more than 20 experts from different fields use the Network in daily clinical practice, consulting up to 200 cases every month.

Material and Method

The study group consisted of 211 patients that underwent a teleconsultation procedure developed for the cochlear implant users [4]. They were presented with a questionnaire consisting of questions relating to quality and time effectiveness of telefitting and preparation process, assessment of an ease of contact with the audiologist, sense of security and calm during the session, and overall assessment of its usefulness as an alternative to different kinds of standard visits.

Results

In most cases patients stated that the quality of the audio-video connection, level of contact with the audiologist and patient satisfaction from the course and outcome of telefitting were high. In the overall assessment of the new procedure the majority agreed that telefitting was a good method for standard follow-up visits, but only in 31 cases they agreed that it could be used for a first visit, reaffirming authors' belief that first fitting should be done in the traditional way. Overwhelmingly, 93% of patients would use telefitting in the future. The mean time saved by patients would be 10.5 hours, with SD = 8.85 h, minimum reported as 40 minutes, maximum 48 hours. A travel cost reduction assessment (as specified in the 2007 regulation set by the Minister of Infrastructure) revealed that the mean saving was 12.5% of the national average salary in Poland.

Conclusions

The Nationwide Network of Teleaudiology, as introduced into clinical practice, has proved to be a reliable platform for the telefitting. The method and the proposed model of postoperative care of implanted patients seems to be a reliable alternative to the standard model, improving quality of service for the patients and providing substantial time and money savings. At the same time, there may be patients who do not comfortably fit into the telemedical environment – for them the standard path of postoperative care should be followed.

The impact of the Nationwide Network of Teleaudiology on healthcare could be very large, allowing quality healthcare to be provided through telecommunications technology to underserved populations in Poland and abroad [4]. The authors believe that the proposed method leads to an

improvement in the quality of postoperative care after cochlear implantation, and the telefitting method could and should be a part of the normal clinical practice.

References

[1] T. Wesarg et al. „Remote fitting in Nucleus cochlear implant recipients" Acta Otolaryngol. 2010; 130(12): 1379-88.

[2] A. Wasowski et al. "Remote fitting of cochlear implant system" Cochlear Implants Int. 2010; 11 (1): 489-92.

[3] C. Rodríguez et al. "Use of telemedicine in the remote programming of cochlear implants" Cochlear Implants Int. 2010; 11 (1): 461-4.

[4] A. Wasowski et al. "The telefitting method used in the National Network of Teleaudiology: assessment of quality and cost effectiveness" Journal of Hearing Science 2012; 2 (2): 81-85

Arkadiusz Wąsowski, Ph.D., Eng. - Graduate of the Warsaw University of Technology, in 2008 obtained Ph.D. in bioengineering. Since 2001 employed in the Institute of Physiology and Pathology of Hearing, Polan, since 2006 responsible for development and introduction of the telefitting and hearing telerehabilitation programs. Since 2009 coordinates the polish National Network of Teleaudiology. Since 2012 is the head of the Teleaudiology Department.

Security and Privacy Issues for Enabling the Secondary Use of EHRs in Clinical Research

E. Eryilmaz, G.B. Laleci Erturkmen
SRDC- Software Research & Development and Consultancy Ltd., Silikon Bina 1. Kat No: 14 ODTU Teknokent 06800 Cankaya, Ankara, Turkey,
elif@srdc.com.tr , gokce@srdc.com.tr

Abstract: **Re-using Electronic Healthcare Records (EHR) for facilitating clinical research studies has a great potential. Besides interoperability, safeguarding the security and privacy of the medical data in the context of secondary use for clinical research is one of the most important challenges in this respect. In this presentation we will introduce the SALUS security architecture, including de-identification and pseudonymization mechanisms applied to the queried clinical instances as well as additional security services compatible with IHE ATNA Profile that guarantees the safe use of EHRs for the clinical research studies.**

Introduction

In the SALUS Project [1], which is co-financed by the European Commission within the 7th Framework Program (FP7), we aim to create the necessary infrastructure to enable secondary use of EHRs in an efficient and effective way for reinforcing the post market safety studies so that patient safety can be ensured through early detection of rare adverse events. We are developing functional interoperability profiles to query population based EHR data from distributed EHR systems for carrying out post market safety studies. As a result of these population based queries, a set of medical summaries of the eligible patients can be shared in standard based medical summary formats, one of which is Health Level Seven (HL7) Clinical Document Architecture (CDA) Release 2 [2] document templates. From the security and privacy point of view, we have developed novel data protection mechanisms to work directly on top of clinical data represented in CDA based templates for the post-market safety studies.

In the literature, there are several efforts [3-5] that describe generic frameworks enabling anonymization and pseudonymization of patient data in research networks. Among these, the Pommerening approach [3] is a pioneering work as a result of a study that was carried out by the TMF of Germany (the Telematics Platform for the Medical Research Networks of

the Federal Ministry of Education and Research). It provides the basic requirements of ensuring safety of patient data in research studies, and five different models for pseudonymization. However, in these scenarios, the purpose is creating a separate data warehouse (DWH) that is set up for the purpose of clinical research studies and the proposed pseudonymization services are used to create such a DWH. However, in SALUS project, we claim that without the need of such separate clinical research data warehouses, EHR systems can be involved in clinical research studies, by accepting population based queries from trusted parties and sharing de-identified medical summaries of the eligible patients through secure channels.

For this reason, we have applied data protection mechanisms on top of the clinical data instances shared as result sets of population based queries instead of securing all data elements in the DWH of the responsible parties. The mechanisms developed in this scope include de-identification and pseudonymization services providing that clinical information is shared securely within the interoperable parties in SALUS architecture in an effective way, complying with all necessary legal requirements designed to protect patient rights and interests. Additional mechanisms such as auditing of events and message level security compliant with the Integrating the Healthcare Enterprise (IHE) standards complement this data level security approach in our infrastructure.

In order to build a generic security infrastructure for this purpose, we have analyzed many different approaches for enabling safety of the medical data in the context of secondary use for clinical research by taking into account the available policies and regulations within EU. In conformance to the selected standards, guidelines, and well-accepted methodologies, we have tried to find a balance between the privacy concerns for the use of personal data and the requirements of clinical research environments that aim to serve to the public good. In this respect, we have created a flexible security architecture, where some thresholds for the uncommon cases can be configured with the Data Protection Offices of EHR sources according to their preferences.

In this paper, we present the overview of the extensible security framework that is compliant with legal and ethical requirements analyzed at the European level. At the end of the SALUS project, we will provide a fully functional open source toolset that will enable the developers to self-enhance this security infrastructure for their research purposes according to the rules and regulations valid in their sites.

Materials and Methods

In order to explain the security infrastructure that we have developed in the SALUS project in a more systematic way, we have separated the data protection mechanisms, where we have a novel approach to deal with the privacy of clinical data represented in CDA templates, from the additional security mechanisms supporting this approach.

In the composition diagram below, SALUS security and privacy services with these two separate sides are shown:

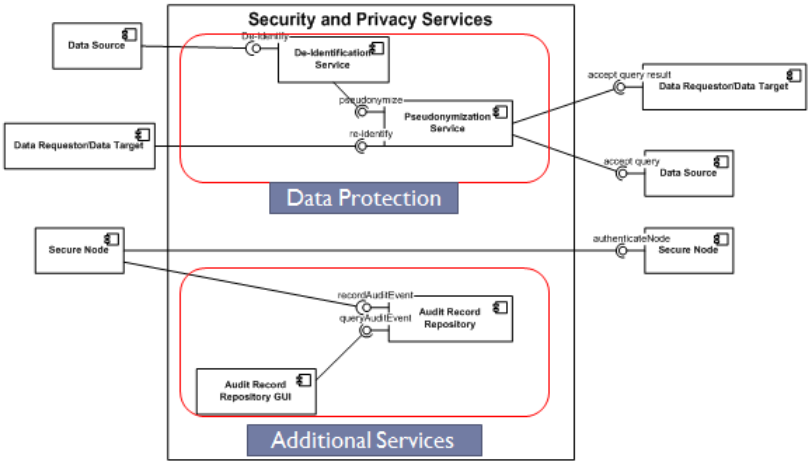


Figure 1 – Composition diagram for SALUS Security and Privacy Services

As pointed out in Figure 1, regarding the data level protection, De-Identification Service is called at the Data Source side, after collecting the queried clinical data instances from the underlying Data Source throughout the SALUS interoperability services. The Data Requester is hosted outside the Care Zone in our architecture. The De-identification Service is configured for each selected element in the SALUS content models. After de-identifying the clinical data set based on the configuration, this data set is passed to the Pseudonymization Service for the selected data items to be pseudonymized.

As additional mechanisms to support the data level protection, SALUS security architecture includes the implementation of IHE Audit Trail and Node Authentication (ATNA) Profile [6] for the secure exchange of healthcare information and the auditing of events related to the access, production or modification of healthcare information. These mechanisms

ensure the secure exchange of clinical data at the message level and provide the audit records in conformance to existing interoperability standards.

Acknowledgment

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement no ICT-287800, SALUS Project (Scalable, Standard based Interoperability Framework for Sustainable Proactive Post Market Safety Studies).

References

[1] SALUS Project- Scalable, Standard based Interoperability Framework for Sustainable Proactive Post Market Safety Studies, http://www.salusproject.eu/
[2] Clinical Document Architecture (CDA) http://www.cdc.gov/nhsn/cda_esurveillance.html
[3] K. Pommerening, M. Reng. Secondary use of the Electronic Health Record via pseudonymisation. In: L. Bos, S. Laxminarayan, A. Marsh (eds.): Medical Care Compunetics 1, IOS Press, Amsterdam 2004; pp. 441–446
[4] C. Thielscher, M. Gottfried, S. Umbreit, F. Boegner, J. Haack, N. Schroeders. Patent: Data processing system for patient data. Int. Patent, WO 03/034294 A2 (2005).
[5] R. Noumeir, A. Lemay, J. M. Lina. Pseudonymization of ra-diology data for research purposes. J Digit Imaging. 2007 Sep;20(3):284-95.
[6] IHE Audit Trail and Node Authentication (ATNA) Profile, http://wiki.ihe.net/index.php?title=Audit_Trail_and_Node_Authentication

Elif has graduated from the Department of Computer Engineering, Middle East Technical University, Ankara/TURKEY and she is currently an MSc candidate from the same department. She has been working at SRDC- Software Research & Development and Consultancy Ltd. (http://www.srdc.com.tr) as a Computer Engineer and Researcher in EU co-financed projects for more than two years. Her principal research interests lie in the field of technical interoperability in eHealth domains, clinical decision support systems, standard based integration of clinical information systems, security and privacy of clinical data in clinical/non-clinical settings. Her field of study is based on the development of an extensible security infrastructure for the secondary use of Electronic Health Records (EHRs) represented in HL7 Clinical Document Architecture (HL7 CDA) for clinical research.

Space Medicine, Telemedical Ecology and Telemedicine: Prospects for Cooperation and Development

O. I. Orlov[1], V. I. Pougatchev[2], R. M. Baevsky[1], A. G. Chernikova[1]
[1]State scientific center – Institute for biomedical problems, Academy of Science, Russian, olegtm@bk.ru
76A Chroshevskoye sh., 123007, Moscow, Russia
[2] Biocom Technologies, vpougatchev@biocomtech.com
20270 Front Street NE, Suite 203, Poulsbo, USA

Abstract: **Technical progress, whether manned space missions or developing and complication of Internet technologies and telemedicine systems, should not obscure to us the main goal of medical research and practice - maintaining and improving human health and, as a result, the quality of life. The experience of our joint work for the last few years (2008-2011) at carrying out long-term health and environmental research under the "Mars-500" project has allowed starting a developing of new system to meet the challenges of preventive medicine - telemedicine system for prenosological individual control. This article is devoted to presentation and justification of basic background features for such systems.**

Introduction

Actually, the past experience of medical and physiological investigations in space clearly shows that the main challenges for the future of medicine in space as well as on Earth are prevention, individualization and telecare [1]. The remote health assessment of crew members and forecasting of possible health risks on the base of prenosological diagnostics methods have long been used in space medicine. Space medicine has also had a lot of experience in individual health assessment of cosmonauts and characteristics of their adaptation, as individual differences (age, genetic, typological factors, etc.) make it difficult to interpret the results of medical observations and tests, to conclude about essentiality of detected deviations for health maintaining.

Preventive orientation, early detection of health deviations are the main trends in the development of telemedicine [2]. However the objects of telemedicine usually are patients with various diseases, telemedicine study of healthy people practically is not provided. The focus is on the diagnosis

and detection of already existing disease. A large complex of medical information on healthy people was transferred from around the world to Moscow via Internet in the satellite project "Mars-500" for the first time. This new methodology of distance investigation of environmental influence on health initiated a new scientific and practical direction - a telemedical ecology [3]. Besides the problem of health monitoring different methods of data collection and transmission have been tested in the satellite studies.

Background

Prenosological Diagnostics

Prenosological principles of diagnosis are successfully applied in space to assess the health of cosmonauts, to identify functional states, border between health and disease and to prevent health disorders. Similarly, the main goal of Earth medicine is to keep everyone (patients or non-patients) on this verge. These prenosological states may both precede disease and follow it in recovery periods (Fig. 1). Prenosological states tend to arise in healthy people relating to adaptation to the changed environment or increased loads.

According to the results of previous studies [4], the disorders of adaptation and appearance of prenosological and premorbid functional states correlate in great extent with ecological and social factors, age, changes in physical, emotional and mental loads, variations in weather and reducing of self-reported health status.

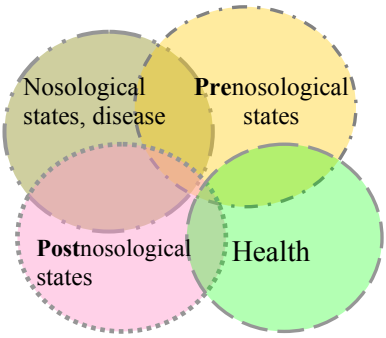


Figure 1. Prenosological diagnostics – early detection of states on the border between health and disease

Adaptation Risks

Prenosological diagnostics principles were further developed in space medicine in the concept of "adaptation risks" [5], based on a probabilistic assessment of possible adaptation risks according to the heart rate variability (HRV) analysis results. Adaptation risk characterizes the reserve of adaptation abilities ("health reserve") unlike the concept of clinical risks, where a set of signs (symptoms and syndromes), sufficient (or insufficient) for production of clinical diagnosis is considered. This new approach has been tested both during long-term space flights [5], and in the "Mars-500" project [4]. The proposed classification of functional states on the base of HRV analysis in rest position really reflects both the resting conditions and the functional reserves, which is usually evaluated during functional tests. Adaptation risk as a new concept of prenosological diagnostics can be applied in various fields of physiology and medicine, especially when assessing the health of people (non-patients), living and working under unusual conditions.

Individual Prenosological Control

Different ways of health assessment were examined in carrying out the longitudinal medical-environmental research in the satellite project Mars-500: group monthly surveys in Russia and some European countries (Czech Republic, Germany, Belarus) and weekly surveys at home conditions, in participants from the USA and Canada [6]. Data transferring was carried out usually via e-mail, but the cloud-based client-server technology was used in the USA and Canada.

The results demonstrated that unlike monthly examinations in other regions weekly individual prenosological assessment can detect disturbances of the autonomic balance prior to appearance of any health problems. Just such assessment with immediate demonstration of results when compared with the answers to a questionnaire about lifestyle factors and environmental influences have a greater impact on peoples mind in relation to lifestyle changes, correction of loads, nutrition, etc. to maintain health.

Conclusion

This experience has allowed starting a developing of new system to meet the challenges of preventive medicine - telemedicine system for prenosological individual control. The theoretical and methodological background of these systems is the prenosological diagnostics and the assessment of possible adaptation risks according to the heart rate variability (HRV) analysis results in rest position. The "Heart Wizard -

Mars-500" instrument, which was created as a result of cooperation between the Institute of Biomedical Problems and the American company "Biocom Technologies" for use in long-term medical and environmental studies in Canadian and American participants, may be used as a prototype of these new systems. The new Russian-Canadian-American system for individual prenosological control with using the evaluation criteria on human health, developed in space medicine, is designed now on the basis of this instrument. New system will include the current health conditions assessment, valuable information about its long-term history and recommendations on life optimization.

Such cooperation of experts and specialists in the field of space medicine, telemedicine and telemedical ecology has already proved its usefulness while conducting scientific researches. The continuation of joint work can make a contribution to our main common problem – maintaining human health.

References

[1] R. Gerzer. Linking Earth and Space medicine: unique opportunities during simulations of interplanetary missions. International symposium on the results of the experiments, simulating manned mission to Mars (Mars-500). April 23-25, 2012. Moscow. Abstract book, 88-9.

[2] O. I. Orlov, "Telemedicine in management of medical care", Slovo, Moscow, Russia, 2002, 39p., (in Russian).

[3] O. I. Orlov, E. Y. Bersenev, A. P. Berseneva, A. G. Chernikova, R. M. Baevsky. Telemedical aspects of long-term eco-medical researches", In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Vol. 3, Publ. ISfTeH, Luxembourg, 2010, pp. 310-314.

[4] R. Baevsky, O. Orlov, A. Berseneva, A. Chernikova. Telemedical ecology: preliminary results of longitude medical environmental research project «Mars-500». In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates. Knowledge Resources. Publ. ISfTeH, Vol. 5, 2012, Luxembourg, pp. 478-483.

[5] A. Chenikova, R. Baevsky, I. Funtova. Adaptation risk in space medicine. 2012., IAC-12, ID-14827.

[6] O. Orlov, V. Pougatcev, A. Berseneva, A. Chernikova, R. Baevsky, Y. Zhirnov, E. Gribkov, O. N. Isaeva. Telemedical system for individual prenosological health assessment. In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources. Publ. ISfTeH, Vol.5, 2012, Luxembourg, pp. 433-437.

Telemedicine and eHealth in Poland: A Review (Polish Telemedicine Society Perspective)

W. Glinkowski[1,2], M. Karlińska[1,3]
[1]Polish Telemedicine Society, Targowa 39A#5, 03-728 Warszawa, Poland
[2]Chair and Department of Orthopaedics and Traumatology of Locomotor System, Center of Excellence "TeleOrto", Medical University of Warsaw, Poland
[3]Department of Medical Informatics and Telemedicine, Medical University of Warsaw, Poland

Abstract: **The telemedicine and eHealth implementations have been reported across medical specialties in Poland, but a comprehensive review of these reports is lacking. The aim of this study was to conduct a systematic review of the published literature on telemedicine and eHealth. Ultimately 99 articles met eligibility criteria and were included in the review. The telemedicine and eHealth were implemented and reported mainly in cardiology, pathology, family medicine, oncology, psychiatry, radiology, ENT, orthopaedics and elearning. Despite more frequent deployments of telemedicine and eHealth projects in Poland works published in international journals are still relatively rare.**

Introduction

The telemedicine and eHealth implementations have been reported across medical specialties in Poland, but a comprehensive review of these reports is lacking. The aim of this study was to conduct a systematic review of the published literature on telemedicine and eHealth.

Materials and Methods

We conducted a literature search to identify papers reporting experience with the use of telemedicine and eHealth in Poland. Pubmed MEDLINE (1950 to December 2012) and EMBASE (1980 to December 2012) databases were searched. We screened the papers and excluded those that did not have an abstract and those that were not published in English. We reviewed the abstracts and further excluded papers that did not report the actual use of telemedicine or eHealth. Data were extracted from the full text of the remaining articles using predefined data fields. Studies were included if the abstract or core test expressed use of telemedicine or eHealth in Poland. Articles were hierarchized within a specialty category. Publications

were included if they: 1) clearly addressed the issue of telemedicine or eHealth in Poland; 2) reported original findings or reviewed the literature; 3) were published in a peer reviewed journal. Data extraction was done using a predefined form. We collected information about: 1) the year of publication; 2) details of the publishing journal; 3) area of medicine; 4) addressed telemedical technology; 5) the type of publication (original contribution or invited review); 6) methodology (observational or randomized); 7) main results; 8) involvement of Polish Telemedicine Society. Data analysis was semiquantitative.

Results

The literature search produced a total of 211 potential articles, 118 in Pubmed MEDLINE and 93 in EMBASE. Ultimately 99 articles met eligibility criteria and were included in the review. The telemedicine and eHealth were implemented and reported mainly in cardiology, pathology and family medicine. Oncology, psychiatry, radiology, laryngology, orthopaedics and elearning are less frequently reported as implemented in Poland. The society members were infrequently involved in reviewed papers. Despite more frequent deployments of telemedicine and e Health in Poland works published in international journals are relatively rare on this topic. The first peer-reviewed publication from the field of Polish telemedicine and eHealth was published in 1995. The number of papers per year was fluctuating, but with is a clear increasing trend since 1999. Papers were written mostly in English (67.4%) or bilingually (11,6%). Papers were published in international journals (76,8%). Impact factor was calculated for 53.5% of the journals (median 1.4 points, range: 0.3-7.1). Papers in 65.8% reported original contribution, including 11 randomized studies. The manuscripts were usually submitted by multiple authors (75.3%), with a median of 3 authors per paper (range: 1-22). Members of Polish Telemedicine Society were involved only in 7 (7.1%) publications. The papers were focused cardiology (19.2%), pathology (14.1%), diabetology (9.1%), family medicine (8.1%) and radiology (7.1%). Due to the large number of included studies and their heterogeneity, it was not possible to present the main findings reported in the reviewed papers neither in a form of a qualitative summary nor a brief description of particular papers.

Discussion

In general, there are a few specialized centers for the implementation of modern ICT technologies in the areas of medicine, such as cardiology, pathology, family medicine, diabetes care, ENT and orthopaedics in Poland. We have observed growing interest in the subject and the problems of

telemedicine and eHealth in the last 5 years. Sixty one articles were published recently. In 1995 the BERMED project linked Virchow-Klinikum in Berlin and Wroclaw Medical University [1]. This cooperation consisted of video conferencing, satellite links connected with the transmission of image data (CT and MRI). In 1999 telemicroscope was used through the Internet for pathology [2]. Overall, 14 papers were found in the field of pathology from 1999 to 2011. Few of them were concerned in use telepathology as a tool for medical education [3]. Recent works mostly concern in image analysis and the collaboration between pathologists [4]. The field of cardiology is well represented. Independent studies presented home monitoring of patients with implanted cardioverter-defibrillators (ICD) [5, 6]. Home telerehabilitation was introduced as the optimal form of physical activity for heart failure patients [7]. The telecardiological, GRID type system Kardionet has been developed and launched to support interventional cardiology [8]. A wearable heart rate variability monitor connected via wireless digital link to a home-embedded infrastructure of multimodal health surveillance system was developed with the coin-size wearable recorder [9]. Several projects in family medicine oriented telemedicine were implemented in lower Silesia [10-13]. A telematic systems aiming at support of diabetes treatment have been designed, developed and implemented [14-16]. Specialized approaches were implemented in ENT [17], radiology [18] and orthopaedics and traumatology [19, 20].

Conclusions

Despite more frequent deployments of telemedicine and eHealth projects in Poland works published in international journals appear relatively rare on this topic. Authors who publish in the field are rarely members of the National Telemedicine Society. Further analysis of the current state of development in this area is needed.

References

[1] J. Ricke, L. Kleinholz, N. Hosten et al. Telemedicine in rural areas. Experience with medical desktop-conferencing via satellite. J Telemed Telecare 1995;1:224-8.

[2] J. Szymas, G. Wolf. Remote microscopy through the internet. Polish journal of pathology : official journal of the Polish Society of Pathologists 1999;50:37-42.

[3] J. Slodkowska, L. Chyczewski, M. Wojciechowski. Virtual slides: application in pulmonary pathology consultations. Folia histochemica et cytobiologica / Polish Academy of Sciences, Polish Histochemical and Cytochemical Society 2008;46:121-4.

[4] M. Garcia Rojo, V. Punys, J. Slodkowska, T. Schrader, C. Daniel, B. Blobel. Digital pathology in Europe: coordinating patient care and research efforts. Stud Health Technol Inform 2009;150:997-1001.

[5] M. Chudzik, J. Gawlowska, J. K. Wranicz. The new era of remote monitoring in patients with implantable cardioverter-defibrillators. Cardiology journal 2009;16:276-8.
[6] A. Przybylski, J. Zakrzewska-Koperska, A. Maciag, P. Derejko, M. Orczykowski, L. Szumowski, et al. Technical and practical aspects of remote monitoring of implantable cardioverter-defibrillator patients in Poland - preliminary results. Kardiologia polska 2009;67:505-11.
[7] E. Piotrowicz. How to do: telerehabilitation in heart failure patients. Cardiology journal 2012;19:243-8.
[8] J. Sierdzinski, P. Bala, R. Rudowski, M. Grabowski, G. Karpinski, B. Kaczynski. KARDIONET: telecardiology based on GRID technology. Stud Health Technol Inform 2009;150:463-7.
[9] P. Augustyniak. Wearable wireless heart rate monitor for continuous long-term variability studies. Journal of electrocardiology 2011;44:195-200.
[10] M. M. Bujnowska-Fedak, E. Puchala, A. Steciwko. The impact of telehome care on health status and quality of life among patients with diabetes in a primary care setting in Poland. Telemed J E Health 2011;17:153-63.
[11] H. K. Andreassen, M. M. Bujnowska-Fedak, C. E. Chronaki, et al. European citizens' use of E-health services: a study of seven countries. BMC Public Health 2007;7:53.
[12] M. M. Bujnowska-Fedak, E. Puchala, A. Steciwko. Telemedicine for diabetes support in family doctors' practices: a pilot project. J Telemed Telecare 2006;12 Suppl 1:8-10.
[13] M. M. Bujnowska-Fedak, A. Staniszewski, A. Steciwko, E. Puchala. System of telemedicine services designed for family doctors' practices. Telemed J E Health 2000;6:449-52.
[14] P. Foltynski, J. M. Wojcicki, P. Ladyzynski, et al. Monitoring of diabetic foot syndrome treatment: some new perspectives. Artificial organs 2011;35:176-82.
[15] P. Ladyzynski, J. M. Wojcicki. Home telecare during intensive insulin treatment--metabolic control does not improve as much as expected. J Telemed Telecare 2007;13:44-7.
[16] J. M. Wojcicki, P. Ladyzynski, J. Krzymien, et al. What we can really expect from telemedicine in intensive diabetes treatment: results from 3-year study on type 1 pregnant diabetic women. Diabetes technology & therapeutics 2001;3:581-9.
[17] T. Wesarg, A. Wasowski, H. Skarzynski, et al. Remote fitting in Nucleus cochlear implant recipients. Acta oto-laryngologica 2010;130:1379-88.
[18] L. Czekierda, T. Masternak, K. Zielinski. Evolutionary approach to development of collaborative teleconsultation system for imaging medicine. IEEE transactions on information technology in biomedicine : a publication of the IEEE Engineering in Medicine and Biology Society 2012;16:550-60.
[19] W. Glinkowski, J. Michonski, B. Glinkowska, A. Zukowska, R. Sitnik, A. Gorecki. Telediagnostic 3D school screening of back curvatures and posture using structured light method - pilot study. Stud Health Technol Inform 2012;176:291-4.
[20] W. Glinkowski. Web-based support for fracture healing evaluation and monitoring. Telemed J E Health 2011;17:201-10.

Telemedicine Service Measurably Reduces the Costs of Healthcare

T. Harju[1], L. Toivonen[2]
[1]RemoteA Ltd, Lars Sonckin kaari 10-16, FI-02600 Espoo, Finland
tuomas.harju@remotea.com
[2]Heart Counsel Ltd, Komentajankatu 8 D 32, FI-02600 Espoo, Finland

Abstract: **This paper explains how a telemedicine Holter ECG consultation service is organized and describes the benefits of the service model compared to the traditional procedure. Especially the cost differences between a conventional clinical pathway of an arrhythmia patient and a modified pathway where the telemedicine consultation service is in use at a primary care clinic are examined.**

Background

In continuous ambulatory monitoring of a person's electrocardiogram, or Holter ECG, the electrical activity of the heart is recorded for an extended period of time, usually 24 hours. Electrodes that connect to the monitoring device via lead cables are attached to the patient's chest area and a small digital recording device is carried around the waist. In order for the monitoring to be as realistic as possible the patient is encouraged to act and work normally during the monitoring period and to keep a diary of any symptoms and activities.

The Holter ECG method is used to detect arrhythmias, which are abnormal events in the heart rhythm. Arrhythmias can cause a wide variety of symptoms [1]. Individuals suffering from arrhythmias may for example experience palpitations, sensations of skipped heartbeats or fluttering. The more severe arrhythmias may cause fainting and even death. Holter ECG is a useful tool for detecting arrhythmias that occur paroxysmally, i.e. from time to time. A paroxysmal arrhythmia might not manifest itself during the often quite short time a rest ECG is recorded for. Also, since Holter ECG allows the patient to work and act normally during the registration period it is possible to get valuable information about the function of the heart during activity and to link the symptoms in the diary to events in the monitoring data.

In Finland, municipalities are required to finance both primary and secondary care for their inhabitants. Primary care is provided by municipality health centers employing mainly general practitioners and nurses, and sel-

dom any specialists. Therefore, when a general practitioner decides that a patient needs specialist attention, he or she is usually referred to a larger secondary care sector hospital. This is often problematic since the municipalities cannot know in advance the costs of referring a patient to the secondary care sector. Also, the referral waiting times and the distances between municipalities and secondary care facilities can be very long.

In the telemedicine service concept featured in this study, a telemedicine center equips a clinic with one or more Holter ECG monitoring devices. A nurse initiates the monitoring at the clinic. The next day the patient returns with the device and the nurse uploads the monitoring data along with anonymous patient information onto a remote server over a secure connection. The data is checked for accuracy by technicians and put forward for specialist (a cardiologist specialized in arrhythmias) analysis. The specialist writes a report complete with treatment recommendations, which is then made available for the clinic to download.

The service charges are based on the number of delivered reports. The service model provides hospital-level specialist consultations to primary care facilities and makes it possible to refer only the patients who actually need secondary care treatment. Furthermore, with this model the specialists making the consultation reports can put their expertise to a much more efficient use than normally.

In addition to Holter ECG the system includes ambulatory blood pressure monitoring and sleep apnea monitoring services. The service model is in use in 200 locations in Finland, Sweden, Portugal and the United Kingdom. During 2012 nearly 15000 consultation reports were delivered, of which roughly 9000 were Holter ECG reports.

Objectives

The purpose of the research project was to compare the overall costs of a traditional clinical pathway where patients are referred to secondary care for Holter ECG examinations with a modified pathway where a telemedicine consultation service is in use at a primary care facility. These costs included for example prices of various tests, cost of nurse's work and cost of doctor's work.

Methodology

The two recent studies that this paper refers to were implemented by Laurea University of Applied Sciences. The studies were limited to the public sector municipality healthcare centers. Six clinics were chosen for the comparison. Three were clinics that do not use the telemedicine consultation service and the remaining three were clinics that use the service. The clinics

that do not use the service were the municipality health centers of Hyrynsalmi, Puolanka and Lempäälä. The clinics that use the service were the municipality health centers of Karkkila, Taivalkoski and Saarijärvi. The basis for selecting the sample was the degree to which the clinics represent the typical primary care facility in Finland.

Qualitative interviews at the six clinics were used to clearly identify the clinical pathways in order to accurately analyze the costs. Three different patient types were identified and selected as examples to illustrate the clinical pathways:

A: A patient that has fainted multiple times.

B: A patient that experiences difficult recurrent palpitations.

C: A patient that experiences disturbing arrhythmia sensations daily.

It was estimated that each of these patient types and symptoms would lead to a Holter ECG being performed in the primary or secondary care sector.

The traditional clinical pathways for these patient types as well as the modified pathways utilizing the telemedicine service were carefully mapped, analyzed and compared. The clinical pathways were defined as starting from the moment the patients first come into contact with the healthcare system to the successful delivery of the specialist doctor's diagnosis.

Finally, a sample of the first 200 telemedicine consultation reports from May 2012 was examined to determine the incidence of referral recommendations.

Results

The results show that the costs of the clinical pathways in the three clinics using the telemedicine service are considerably lower than in the three clinics that do not use the service. For example, the maximum cost of the clinical pathway at Karkkila health center (telemedicine service user) is € 279,76 whereas the maximum cost at Hyrynsalmi (non-user) is € 879,20 [2].

Also, out of the sample of 200 reports delivered via the telemedicine consultation service 153 did not include a recommendation to refer the patient to secondary care [3].

The telemedicine service model offers significant cost savings compared to the traditional method of referring arrhythmia patients to the secondary care sector for Holter ECG and diagnosis.

Conclusions and discussion

Based on the results the telemedicine consultation service significantly decreases the costs of diagnosing arrhythmia patients.

The cost-savings associated with using the telemedicine consultation service are mostly related to lower cost for the telemedicine Holter ECG compared to the price of the study in the secondary care sector and to the fact that when a patient is referred to the secondary care sector also other tests besides the Holter ECG will be performed.

Even though also some of the patients that are diagnosed with the telemedicine service end up being referred to secondary care 153 out of 200 reports in the sample did not include a recommendation to refer the patient.

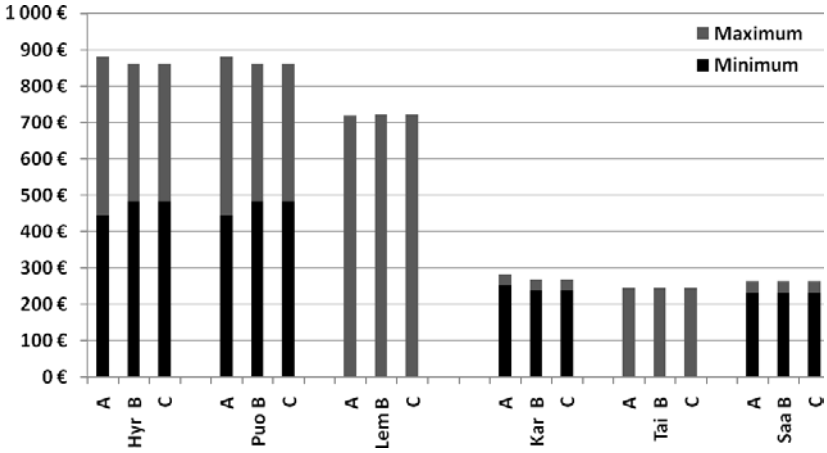


Fig 1. Costs of a clinical pathway in health centers that do not use the telemedicine service (three on the left) and in centers that use the service.

References

[1] M. Crawford et al. "American College of Cardiology/American Heart Association guidelines for ambulatory electrocardiography. A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to Revise the Guidelines for Ambulatory Electrocardiography)," p,. 888, 1999.

[2] N. Tammi. "Holter-hoitopolun kustannusselvitys". Laurea University of Applied Sciences, unpublished.

[3] A. Puhakka. "Telelääketieteen tuoma kustannustehokkuus Holter- tutkimukseen johtavan hoitopolun aikana julkiselle terveydenhuollolle," Laurea University of Applied Sciences, p. 30, 2012.

Tuomas Harju is the International Sales Manager of RemoteA Ltd, an export-oriented spinoff company of Remote Analysis Ltd. He has accumulated several years of experience in the practical applications of telemedicine consultation systems. He has collaborated with Remote Analysis Ltd since 2007. Lauri Toivonen works as Chief Physician in the Cardiac Arrhythmia Division of the Department of Cardiology in University Hos-

pital, Helsinki, Finland. His scientific interest is focused on cardiac risk assessment, inherited cardiac arrhythmias and cardiac pharmacology. He has been the leading cardiologist in collaborative research program in Biomedical Engineering Laboratory in Helsinki University of Technology. Toivonen is the author of more than 200 original scientific articles. He has collaborated with Remote Analysis Ltd since 2005.

Telemedicine Support on Maternal and Newborn Health in Mongolia: Analysis of Content in Communication

T. Baatar[1], N. Suldsuren[1], S. Bayanbileg[1], K. Dorjsuren[2,]
[1]UNFPA Country office, Mongolia
[2]National Center of Maternal and Child Health

Introduction

Mongolia is the least densely populated country in the world with an overall population density of 1.7 person per square kilometer, which makes it difficult to deliver health services to remote areas. It has been also very challenging for the government to retain qualified specialists, who also lack in-service training opportunities, at the provincial level. The limited capacity at provincial level leads to numerous costly referrals to the reference center. In order to reduce this burden on the rural population, the establishment of telemedicine network was seen as excellent commodity in Mongolia's situation. The first network was established for heart disease management by the support of the Government of the Grand Duchy of Luxembourg and was later expanded in 2007 to cover maternal and newborn health. Although it's been a decade since the introduction of telemedicine service in the country, no substantive research has been conducted into telemedicine utilization in Mongolia. In order to better understand the types of health conditions communicated through the system, the present study aimed to identify the overall use of the information transmission platform and clinical conditions on which the experts provided distance clinical decision making support to colleagues in the rural areas.

Materials and Methods

The research method used for this study was a qualitative content analysis into four-year telecommunication experience from 2009-2012 with coding approach. The telemedicine software used was Campus Medicus, a collaborative platform for an exchange of medical knowledge, distance consultations, forums and distant teaching in medicine, provided by Mon Tel Net project of Swiss Surgical Team. Images uploaded in series and shared videos allow doctors to view the same live scenario, hold discussions and exchange opinions on complicated cases. Relational analysis was used

to identify the relationships between the concepts identified in experts' comments and suggestions.

Results

Types of physicians' communication: Five types of communication were identified for cases of: (1) high risk pregnancy complications, including associated medical conditions (27.6%), (2) prenatal US image transferred for fetal growth evaluation (24.5%), (3) newborn complications (16.7%), (4) physicians' posts (14.62%) including learning materials, guidelines, group announcements and notifications uploaded for social networking purposes and (5) cervical pathology diagnostics (10.34%).

Disease category for obtaining second opinions: Out of 611 complicated obstetric cases, 320 (52.4%) were uploaded for experts' advice on high-risk and complicated pregnancies. In 287 (46.8%) of cases rural specialists asked for experts' opinion on prenatal ultrasound evaluation of the fetus. Five rare cases (0.8%) were posted: abdominal pregnancies, ruptured uterus, a IUGR in a Rh(-) woman, and a case of tuberculosis meningitis in a pregnant woman. In regard to other women's health problems, the most common conditions consulted were cervical cytology and pathology

Disease category	Clinical cases requested		Frequency of attached analysis			
	N of patients	*Percent(%)*	*ultrasound image*	*Cl. lab analysis*	*other analysis*	*No analysis*
Obstetrics problems	**611**	**100.0**	**412 (67.3%)**	**280**	**1**	44
High risk pregnancy management	320	52.4	123	277	0	44
Prenatal US diagnostics	286	46.8	286	0	0	0
Rare case	5	0.8	3	3	1	0
Gynecology problems	**192**	**100.0**	**144 (75%)**	**25**	0	**13**
General gynecological surgical pathology	71	37.0	33	19	29	13
Cervical pathology	121	63.0	111	6	0	0
Neonatology problems	**196**	100.0	**7(3.5%)**	**96**	**20**	**29**
Preterm newborn	91	46.4	3	52	13	23
Early neonatal complications	61	31.3	4	19	5	
Congenital defects	44	22.3	11	25	2	6
Total	**999**	100.0	**569(56.9)**	**401 (40.1%)**	**21(2.1%)**	**86(8.6%)**

Table1. List of common complications, in which rural physicians required experts' consultation

(63.0%) followed by pelvic mass ultrasound and surgery complications (37.0%). The major complications consulted on newborn care were on the management of preterm or low birth weight newborn (46.4%), followed by early newborn resuscitation (31.3%) and congenital birth defects (22.3%, Table 1). The social networking using the platform included posting related

to e-learning, latest news in the field, announcements, notifications, greetings, congratulations and questions about referred patients.

Physicians 'request types and expert's reaction: The common request from remote physicians were consultation on diagnosis and treatment options (88.9%) and seeking of referral to center (11.0%) in total.

Disease groups	Common requests		Experts response rate			Experts' responds			
	Referral to NCMCH	*Diagnosis and treatment tactic*	*Total number of replies*	*At least one reply*	*no reply*	*Agree****	*Disagree*	*Need referral*	*Need more analysis*
Obstetric problems	***27***	***588***	***672***	***376 (61.7)***	***135 (22.2%)***	***511 (76%)***	***81 (12.05%)***	***21 (3.12%)***	***89 (13.2%)***
High risk pregnancy and childbirth complication	14	285	336	56	85	236	44	13	37
Prenatal US diagnostics confirmation	7	280	301	245	49	245	36	4	52
Pregnancy management with fetal abnormality	4	17	31	15	1	29	0	2	0
Very rare cases	3	2	4	1	0	1	1	3	0
Gynecological problems	***53***	***157***	***198***	***104 (53%)***	***12 (5.7%)***	***118 (61%)***	***6 (3%)***	***43 (20.4%)***	***31 (15.6%)***
Gyne-surgery	32	49	49	32	10	15	2	34	10
Cervical pathology	21	108	137	72	2	100	6	7	21
Neonatology problems	***27***	***117.0***	***152***	***96 (66.6%)***	***52 (36%)***	***82 (54%)***	***47 (31%)***	***15 (10.5%)***	***0***
Preterm newborn	10	40	22	43	11	41	12	13	
Early neonatal complications	12	19	100	33	37	22	27	0	
Congenital birth defects	5	18	30	20	4	17	8	2	
Total	**107 (11.0%)***	**862 (88.9%)***	**1022**	**576 (59.4%)****	**199 (20.5%)****	**711 (73.3%)****	**134 (13.8%)****	**79 (8.1%)****	**120 (12.3%)**

*Percentage calculated from total number of cases (107+862=969)
**Percentage calculated from total cases of 969
***Experts agreed with diagnosis and treatment tactic, however, additional information about treatment was provided

Table2. Analysis into experts' response

As shown in Table 2, totally 969 clinical cases were uploaded by rural physicians for experts' advice and 770 cases were responded by the experts (in general 1022 comments were given by different experts), making response rate 79.3%.In terms of referral, rural physicians requested a referral for 107 (11%) cases, out of which only 79 (8.1%) cases were agreed by the experts for referral. Based on tele-consultation results, it was found that almost 80 percent of cases were managed locally whereas 134 (14 %) cases presented a disagreement between rural physicians and experts in regard to treatment. Experts requested additional analysis from rural physicians before making final diagnosis in 120 (12.3%) cases.

Discussion

This is the first study made into communication between rural health practitioners and experts at central level in field of Maternal and newborn telemedicine services in Mongolia. The results of the study indicate that the

majority of cases were uploaded to obtain second opinion from experts on complicated clinical situations. These findings were also indicated in R. Wootton's study [3].

Diseases of circulatory and respiratory systems dominated in maternal complications followed by fetal growth evaluation. It shows similar result with the Baseline assessment of Telemedicine project [1] and health indicators of 2009, MoH [2].

US images are the most common among the attachments sent to expert's opinions like it was shown in other studies on TM utilization [10]. Remote interpretation of digitized images transmitted over the network must have the potential to provide access to high quality resolution [5]. Besides, it requires more skills from remote physicians to send high quality image for consultation. The most common request for second opinion was about consultation on diagnosis or treatment options [6]. Experts' response rate was 79.3% which is comparable to other studies [7]. In no-response cases, there is a high chance that experts replied via telephone, based on the context of communication text. As Horwitz & Detsky [4] found, asynchronous communication is almost never appropriate for urgent or complex situations in which the communicator needs to know immediately that the communication has been received. On the other hand, synchronous communication is highly inefficient for routine or non-urgent situations.

Communication text on Campus Medicus platform was unstructured, which definitely presented difficulties during the analysis process. Related to this situation, standardization for case introduction and case consultation is needed [4] in "*store and forward*" telemedicine. Physicians' skills to communicate through telemedicine system are also one of the important factors for successful utilization of the services.

There is no similar study that analyzed expert's comments and opinions combined with other several suggestions as our study reveals. Physicians' skills to communicate through TM system are also one of the important factors for successful utilization of the services.

In some cases expert's comments were not provided due to lack of sufficient information about the patient. Referral rate (11%) was not high, which was different from TM study result conducted by Latifi [8]. Another interesting finding of the study is the role of social networking in physician to physician telecommunication. It can play a significant role in improving quality of health care service as Taiwan's case shows [9] and this type of communication plays important role for having better improved information access. This study is an initial stage of future in-depth studies. As a newly developed form of health care service, there are many topics on which further researches can be done. Cost effective analysis, evaluation and user

satisfaction analysis may be most important studies to show potential benefits and disadvantages of TM service in Mongolia.

References

[1] "Telemedicine support for Maternal and Newborn health" project baseline assessment report 2011

[2] Annual health statistic, MoH, Ulaanbaatar, Mongolia, 2009

[3] R. Wootton, & L. Bonnardot. In what circumstances is Telemedicine appropriate in the developing world? JRSM short reports, 1 (5), 37, 2010.

[4] Horwitz & Detsky, Physician communication in the 21st century: to talk or to text? JAMA: 305 (11), 2011, 1128-1129.

[5] J. H. Eichhorn et al., Internet based gynaecologic telecytology with remote automated image selection: results of a first –phase developmental trial. Am J Clin Pathol, 2008, May: 2008, 129 (5): 686-96.

[6] Scalvini, Rivadossi, Comini, Muiesan et al., Telemedicine: The role of specialist second opinion for GPs in the care of hypertensive patients. Blood pressure, 2011, 20(3),158-65.

[7] R. Wootton et all. Follow up data for patients managed by store and forward telemedicine in developing countries. J. Telemed Telecare, 2009, 15 (2), 83-88.

[8] R. Latifi, R. Merrell et al. "Initiate –build-operate-transfer" a strategy for establishing sustainable telemedicine programs in developing countries: initial lessons from the Balkans. Telemedicine Journal and e-Health: the official journal of the American Telemedicine Association, 2009, 15 (10), 956-969.

[9] S. S. Abdul, C. W. Lin et al. Facebook use leads to health –care reform in Taiwan. Lancet, 2011, 377 (0783), 2083-2084.

[10] S. Khoja, R. E. Scott, A. F. M. Ishaq, M. Mohsin, A. Casebeer. 'Developing a conceptual framework for e-health readiness assessment tools for developing countries'. 'International Hospital Federation Reference Book'. 2007/2008: 079-81.

Dr. Tsedmaa Baatar - Graduated from Medical Academy, Moscow, Russia. Received Masters degree in Reproductive Medicine from the Singapore National University in 2001.
She has 20 years experience in clinical gynecology and reproductive health research. Since 2007, she has been with UNFPA, Mongolia, as Telemedicine project manager and interested in eHealth and cost effective Telemedicine services.

Dr. Narmandakh Suldsuren - Graduated from Health Sciences University of Mongolia (HSUM), specialized in Obstetrics and Gynecology and Reproductive health research. She is currently pursuing her Master's degree at HSUM. Her areas of research are pre-eclampsia and high risk obstetrics.
She has joined the Telemedicine project as "Project Medical assistant" and responsible for tele-consultation data management.

Dr. Khishgee Seded - Graduated from Health Science University of Mongolia and specialized in high risk obstetrics and prenatal diagnostics.

Senior consultant and trainer for Tele-consultation and leads expert team at National Center for Maternal and Child health.
Member of Professional board of OBGYN services at MoH and author of major operational studies on maternal health.

Dr. Shinetugs Bayanbileg - Graduated from Instituto Superior de Sciencias Medicas, Universidad de La Habana, Havana, Cuba and specialized in Obstetrics and Gynecology. Completed a course"Master in Medical Science" (no degree). He has experience in medical teaching and proposal development.
Nov 2003 to date: Technical Adviser, Reproductive Health,UNFPA-Mongolia: to provide technical assistance to the UNFPA CO in Mongolia and MOH in implementing RH sub-program nationally and in provinces and urban districts under UNFPA's focused assistance.

The Mongolian Model of Telemedicine and Telepathology: Concept and Practice

D. Erdenetsogt[1], M. Oberholzer[2]
[1]The Mongolian E-Medicine Center, Pathology Department of Health Science University, erdenetsogtod@gmail.com S. Zorig Street 3, Khoroo 1, SukhBator District, UlanBator 14000, Mongolia
[2] Swiss Academies for Military and Disaster Medicine, SAMK. Martin.Oberholzer@vtg.admin.ch Armed Forces Logistics – Services Worblentalstrasse 36 CH-3063 Ittigen, Switzerland

Abstract: **One of most challenging issues in Mongolian health care system is to ensure equal access to health care for the urban and rural population. Rated at 17th place by the territory Mongolia is the least dense country in the world and the majority of population lives in remote rural area. Thus one of the obstacles for the Mongolians to reach health facilities is the geographical remoteness. Another issue is the capacity and availability of specialized health personnel at rural health centers. Therefore for the advanced diagnostic and treatment purpose rural people have to travel in average 250-2000 km and get specialized care at tertiary level hospital, which are located only in capital city. For the same reason capacity building and in-service training of the medical personnel also become a challenge for those who work in provinces. The Swiss surgical Team has been addressing these challenges during last decade. Jointly with SDC they initiated and successfully implemented telemedicine project named Mon-Tel-Net. The project consists of three standard hardware packages such as TelePathology, TeleTeaching, TeleHospital with software support from Campus Medicus® (CM) Software developed by Klughammer GmbH, Germany. The project aimed to provide opportunity for distance diagnostics particularly to obtain specialists' opinion covering most critical areas such as obstetrics and gynecology, surgery, pathology, imaging diagnostics, pediatrics and oncology. Improvement of diagnostic capacity of rural health centers in many critical areas particularly pre-operative diagnostics, diagnosing of infant hip dysplasia, early detection of some type of cancers and other positively contributed to the overall capacity and the development of Mongolian health system.**

Introduction

Since the place of telemedicine in richer countries has yet to be definitively established, its use in poorer countries remains speculative at this stage. However, there appear to be at least two reasons why telemedicine may be relevant to developing countries [1].

First, the developing countries have large rural and remote areas and relatively few specialized health-care staff.

Second, developing countries have major problems on quality of health-care delivery.

This is also actual in case of Mongolia where the half of population lives in remote rural area and according to health system statistics for 100.000 populations there are 1-4 specialized medical personnel in countryside. Due to this situation, project has been focused on improvement surgical care in rural area, thus the Telepathology part was implemented prior to others. After that other parts of the whole package were implemented and other clinical areas were covered gradually under this project. The collaboration with other Donor organizations was one of the important milestones, which ensured comprehensive approach and effective collaboration between different disciplines. Here we can mention the UNFPA project on improvement of maternal and child distance care implemented since 2009, Project on early detection and treatment of infant hip dysplasia by ultrasonography implemented by Swiss paediatrics team since 2011, MCA-Mongolia health project on early detection of breast and cervical cancer.

The purpose of this article is to show the telemedicine system was implemented in Mongolia, the lessons learned as well as its implication to the overall health care provision.

Materials and Methods

Telemedicine sites were established at province and district health centers and at the same time the reference centers with expert team were established at some tertiary specialized centers in Ulaanbaatar city. These sites and centers were connected through internet for the reference as well as a training purpose. Here we utilized TelePathology (TP); TeleHospital (TH); TeleTeaching (TT) packages. Technical requirements for the installation of each package were defined. Telepathology and telemedicine rooms with medium speed internet should have following tools:

1. TP - full computer system, a digital camera (Infinity 1 CMOS USB 2.0 Camera Integrated with Image-Pro®) connected to a microscope (Olympus CX-41) to capture images from the microscope, an extra photo-camera is connected for gross pathology;

2. TH - full computer system, Light table - Reflecta, Digital Camera, XGA, portable with camera control software and Magic arm (stand for fastening camera);
3. TT – full computer system, Beamer; Printer Canon I-Sensys LBP 6650;
4. Suitable software for image processing and image transfer by internet (in our case the Campus Medicus®).

Results

The Mongolian telemedicine network MonTelNet project (7F-06566.01) was launched officially on 1st December 2008 with the financial support from Swiss Surgical team (SST) and Swiss Development Agency (SDC). SST was the main facilitator of this project, which was implemented in two phases. First phase (from December 01, 2008 till December 31, 2011) telemedicine packages were installed at 17 sites covering 13 provinces health centers (54 % of all secondary level facilities) while in Ulaanbaatar city 5 specialized reference centers were established with TH, TP and TT packages. For the software support the complex distance clinical diagnostic web-based program with telepathology module developed by Klughammer GmbH Germany was employed. At the beginning 197 users of 14 groups formed three communities. In total 9000 cases were saved at CM and were discussed and diagnosed through international communities within the first phase of this project. During second phase of the project there are already 6 communities consisting 18 groups of 287 users. We have formed community on early detection and treatment of newborn hip dysplasia and within the life of project in total 10600 newborn who were born at Maternal and Child health Center of UB city have been examined by ultrasonography and with the distance support and cooperation with Swiss pediatric team 1400 cases were diagnosed and successfully treated.

In scope of Millennium Challenge Account NCDI project the preventive screening program for the breast and cervical cancer was linked to CM system. This allowed cytologists from any of 21 provinces and 9 UB city districts to get immediate support from reference center at National cancer center and by today approximately 1000 stains were analyzed and diagnosis clarified.

To summarize our activities, beside the highly specialized scientific value of analyzing the cases and knowledge exchange, there is an enormous economic benefit for customers as well as for the system. Specialists noticed dramatic decrease of time required for diagnostics (ranges from 4 to 6 minutes per case) and at the same time the quality of these analyses improved.

Discussion

This project showed that comprehensive approach in planning and implementation of telemedicine such as covering different clinical areas, using standard packages for distance diagnostics and training of medical staff would be an effective model for the time saving and cost effective-measures. Once started this opened many other opportunities on its application to other clinical areas and expansion to electronic medical recording and other modern technologies successfully employed in developed countries. Although social conditions differ remarkably in the various countries, the use of telepathology seems to offer new standards in morphological diagnostic service [2].

Acknowledgment

This research project would not have been possible without the support of Swiss Surgical Team and Swiss Agency for Development and Cooperation SDC. Deepest gratitude are also due to the all members of the supervisory micro-team, Martin Oberholzer-Riss Prof.em., Dr. med., Dr.h.c.; Beat Kehrer, Dr. med., Dr.h.c., Team leader SST; Anna E. Schmaus, Klughammer (LLB hons) CEO; and Robert A. Ettlin, Dr. med. Fellow IATP/ATS, ERT, without whose knowledge and assistance this study would not have been successful.

References

[1] R. Wootton. "The Possible Use of Telemedicine in Developing Countries," Online Journal of Space Communication Winter 2009; Issue No 14: Satellites and Health

[2] K. Kayser, J. Szymas and Ronald S. Weinstein. "Telepathology and Telemedicine" *Communication, Electronic Education and Publication in e-Health,* VSV interdisciplinary Medical Publishing, Berlin, 2005, pp.236-237

Dr.med., MMedSc.; D. Erdenetsogt - Coordinator of Telemedicine project in Mongolia with 5 years experience, I have showed capacity to lead projects about Tele-screenings and Tele-Pathology. Exceptional communication skills in English and Russian, Keep up-to-date with changes in technology and their practical applications in medicine, where I can express my ideas and implement them

Prof.em.Dr.med.Dr.h.c.; Martin Oberholzer-Riss - Solid working experiences and scientific interests include among others the pathology of hormone-producing glands (Endocrine pathology) and the development of telemedicine applications for diagnosis and teaching.

Mobile eHealth

A Journey towards Implementation of Innovative mHealth in Health Services

O. Oguntuase[1], P. A. Cudd[1], J. Elliott[2], E. A. Williams[3], R. Bacigalupo[1]
[1]School of Health and Related Research, University of Sheffield, 30, Regent Court, Regent Street, Sheffield, S1 4DA, UK
o.oguntuase@shef.ac.uk , p.cudd@shef.ac.uk, r.bacigalupo@shef.ac.uk
[2]Human Metabolism, University of Sheffield, Beech Hill Road, Sheffield, S10 2RX, UK, j.elliott@shef.ac.uk
[3]Human Nutrition Unit, University of Sheffield, Beech Hill Road, Sheffield, S10 2RX, UK, E.A.Williams@shef.ac.uk

Abstract: **This case study reports observations in a journey from identification of a promising mHealth intervention by health researchers, to getting a clinical team to consider its use within a clinical setting for a research study. A pragmatic approach was more effective than a systematic approach to find promising and evidenced technologies. A device useful for tackling obesity and reducing HbA1c was found. The team involved in developing the intended trial of the device expanded to include nutritionists and clinical diabetologists. Despite the published evidence the latter required local evidence of acceptability and effectiveness before they could ask their clinical team to consider how the identified technology could be used within their local clinical protocols and setting (i.e. for a pragmatic trial).**

Introduction

The UK Collaboration for Leadership in Applied Health Research and Care' projects (CLAHRCs) [1] aim to speed, without loss of quality of care, the implementation of constructive research findings in evidence based health services. The South Yorkshire CLAHRC specifically has a remit to look at innovation of services using ICT for long term conditions [2].This paper presents a case study of a journey from identification of a promising mHealth intervention for weight loss by health researchers to getting a clinical team to consider its use within a clinical setting for a proposed research study.

Steps in the Journey

Table 1 shows a sequence of steps or processes that were imagined at the beginning of the work. This paper discusses aspects that affect steps 1 to 4.

A little thought about the table will raise questions about what exactly these steps involve as they will critically depend on the criteria used in the first step. In this case a mHealth intervention was sought that was beyond proof of concept and had sufficient evidence of efficacy and effectiveness that further study was thought worthwhile. An evidenced based approach to identify suitable interventions based on literature searching was explored [3]. This highlighted the complexity of what counts as 'novel', and the time consuming process of generically considering which novel interventions are best across many disciplines. However even if a best mHealth intervention is found, the owners of the intervention are in no way obliged to work with any team who want to work with it. Only if resources are available to buy devices and/or services for a study would this barrier be removed.

In the end a far more pragmatic and immediate approach was to attend exhibitions where state-of-the-art telehealth and/or mHealth technologies were being promoted. There were ten devices found that had been used as part of a health intervention with the required published effectiveness. Of these only two owners of devices (i.e. manufacturers or inventors) expressed immediate interest in adding stronger evidence in a new project. Of those who were not interested, most often quoted timing as the reason - subsequently two more owners from these expressed interest, while two were already evidence building. Technologies that were not yet ready or were already well established were either not present or self-evident.

The next step, i.e. step 2 from Table 1, was to discuss the potential devices with appropriate local expert contacts to explore their interest and evaluation of potential. Following matching an expressed interest in mHealth aimed at aiding weight loss with that of the manufacturer [4], the latter presented their technology to an open meeting of South Yorkshire researchers and clinicians. The majority of the audience was critical about its accuracy of measurement of diet and exercise; in the end this was overridden by the device's motivational change potential.

Table 1: An ordered overview of steps in trialing an effective intervention

Step No.	Step
1	Find Interventions of interest
2	Examine details of the 'best'
3	Form project team for study
4	Develop study protocol
5	Obtain funding and approvals
6	Conduct the study
7	Analyse results
8	Disseminate and build upon findings

The matched expression of interest in step 2 identified individuals willing to join the team, thus initiating step 3. Team building has continued through matching needed expertise to willing colleagues to span public health, technology, clinical diabetology and nutrition expertise. Step 3 and Step 4 (the study protocol) required evidence of the need for and the appropriateness of study proposals. Evidence from random control trials (RCTs) conducted in Germany reported clinical effectiveness using the device for weight loss [5] and for reduction of HbA1c [6]. However, these trials were conducted by researchers involved in developing the intervention. A systematic review of RCTs of mHealth weight loss interventions [7] suggested further studies are needed. The latter also showed that not many RCTs have been published up to August 2012 and, improved reporting is needed.

A part of appropriateness of a proposed study is to make sure that it is actually achievable and practical within the context(s) of the study setting(s). This fundamentally requires a dialogue between the researchers and clinical teams involved. In well-designed studies typically lengthy and detailed discussions working through how the novel intervention can operate within the clinical service occur – meeting all the required ethical, operational and study requirements. A pilot tests the intended trial [8] allowing the protocols to be improved as needed [9]. In this case study it was suggested the clinicians lead on deciding how the intervention could operate in service, by purely discussing it in a forum. This was not possible because the clinical team needed more evidence.

What is Sufficient Evidence?

The effectiveness in what would be a different culture and health service (re the different countries) needs to be confirmed. This was always explicitly part of the intended study. Reduced confidence in the evidence [5-6] due to potential bias associated with involvement in the development of the intervention also needs to be addressed. Discussion led to the need to determine: if the device was used within a similar intervention would local people lose weight – approximating the published results; if the local overweight/obese population would adhere to use of the device. Armed with positive answers to these questions it would be possible to ask the clinical team to consider how the identified technology could be used within their local clinical protocols and setting (i.e. for a pragmatic trial).

Final Comments

The steps shown in Table 1 should not be considered as strictly sequential or general. Indeed as a case study is reported the observations may be just a

specific route through the steps. This is reflected by the methods used being described together with the correlating specific results/observations made.

Possibly at the price of less well evidenced decisions, much time and resource could be saved by networking with manufacturers. While open sharing of all needs or requirements as early as possible should lead to a more efficient route to a workable protocol. It should be noted clinical team led development of study protocol operation in service remains untested.

Acknowledgments

This paper presents independent research by the National Institute for Health Research Collaboration for Leadership in Applied Health Research and Care for South Yorkshire (NIHR CLAHRC SY). The views and opinions expressed are those of the authors, and not necessarily those of the NHS, the NIHR or the Department of Health.

CLAHRC SY would also like to acknowledge the participation and resources of our partner organisations. Further details can be found at www.clahrc-sy.nihr.ac.uk.

References

[1] National Institute for Health Research 2012. Collaborations for Leadership in Applied Health Research and Care (CLAHRCs) version 5 http://www.nihr.ac.uk/files/pdfs/Briefing%20documents/4.5%20Collaborations%20for%20Leadership%20in%20Appiled%20Health%20Research%20and%20Care.pdf

[2] CLAHRC for South Yorkshire http://clahrc-sy.nihr.ac.uk/

[3] S. Blackburn, P. Cudd, M. Hawley. A horizon scanning system for identifying new telehealth innovations, In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Vol.3, pp.326-330, 2010.

[4] Aipermon http://www.aipermon.com/eng/about-aipermon.htm

[5] C. Luley, A. Blaik, S. Aronica, J. Dierkes, S. Kropf, S. Westphal. Evaluation of three new strategies to fight obesity in families, J Nutr Metab, 2010 http://www.hindawi.com/journals/jnume/2010/751905/

[6] C. Luley, A. Blaik, K. Reschke, S. Klose, S. Westphal. Weight loss in obese patients with type 2 diabetes: effects of telemonitoring plus a diet combination – the Active Body Control (ABC) program, Diabetes Res Clin Pract, Vol 91, pp. 286–292, 2011

[7] R. Bacigalupo, P. Cudd, C. Littlewood, P. Bissell, M. Hawley, Buckley Woods H. Interventions employing mobile technology for overweight and obesity: an early systematic review of randomized controlled trials, Obesity Reviews, 2012 http://onlinelibrary.wiley.com/doi/10.1111/obr.12006/full

[8] D. Fitzsimmons, J. Thompson, M. Hawley, G. Mountain. Preventative tele-health supported services for early stage chronic obstructive pulmonary disease: a protocol for a pragmatic randomized controlled trial pilot, Trials, Vol. 12, pp. 6, 2011 http://www.trialsjournal.com/content/12/1/6

[9] J. Kendall. Designing a research project: randomized controlled trials and their principles, Emerg Med J, Vol 20, pp164-168, 2003.

Olubukola Oguntuase is a Research Assistant at the School Of Health and Related Research at the University of Sheffield, UK. She has a Masters in Public Health. Her interest is in mHealth with an unpublished systematic review around the use of mHealth in AIDS. She currently works on the Telehealth & Care Technologies theme of the South Yorkshire Collaboration for Leadership in applied Health Research and Care.

Peter Cudd is a Senior Research Associate with over 15 years experience in user specification, design and evaluation of technology and associated services. Recently he has focused on telehealth and mHealth. The use of smart phones and other portable devices for weight management is an example of his wider interest in their burgeoning use for health purposes.

Jackie Elliott is a Clinical Lecturer in Diabetes at the University of Sheffield, UK. Her main research interests are in the field of complex interventions for patients with type 1 and type 2 diabetes. She has been involved in several diabetes trials which have focused on patient education, continuous subcutaneous insulin infusion, and restoration of hypoglycaemia awareness.

Dr Liz Williams PhD is a Senior Lecturer in Human Nutrition with over 15 years experience of nutrition research. Her research interests include diet and intestinal health, the nutrition, health and well-being of older adults, and the development and use of technology for the assessment of dietary intake.

Ruth Bacigalupo BA (Hons), MSc., PhD has worked in the field of health informatics since 1993 and was awarded her PhD in 2000. Working for the University of Sheffield as Sustainability Lead within the CLAHRC Obesity Theme, she is particularly interested in how technological interventions can help in weight reduction and maintenance.

Effectiveness of mHealth Services in the Use of Pictogram to Telemonitor Hypertensive Patients in F.M.C, Owerri, Nigeria

H. C. Nwuke[1], A. N Ogini[2], N. C. Anyanwu[1], C. N. Nwako[1], S. K. Nwafuru[1]
[1]Pharmacy Department, Federal Medical Centre, Nigeria
[2]Telemedicine unit/Nursing Services Department, Federal Medical Centre, Owerri, PMB 1010, Imo state, Nigeria dumohen@yahoo.com

Introduction

Adherence is a primary determinant of the effectiveness of treatment [1, 2] because poor adherence attenuates optimum clinical benefit [3, 4]. Good adherence improves the effectiveness of interventions aimed at promoting healthy lifestyles, such as diet modification, increased physical activity, non-smoking and safe sexual behaviour, [5-7] and of the pharmacological-based risk-reduction interventions [1, 8-10]. It also affects secondary prevention and disease treatment interventions. Low adherence to medication has been identified as the primary cause of unsatisfactory control of blood pressure [11], which in turn, leads to complications associated with the disease like chronic renal disease, angina, unstable angina, and congestive heart failure and stroke, etc. Good adherence has been shown to improve blood pressure control [12] and reduce the complications of hypertension [13-15]

The World Health Organization [16] has identified patient-centred care [17] as a core component in quality health care in the 21st century, and we suggest that patient-centred care will increase the effectiveness of telemonitoring. Telemonitoring needs to focus on patients' self-care instead of reporting data [18].

There is need for patient-centred approach that will enhance cognition of medication instruction by pictorial representation of the dosage form, the dose, the frequency of administration, duration and ancillary label and ensure adequate adherence by telemonitoring the medication usage.

The aim of this study is to assess the effectiveness of proper patient counselling, by the use of pictogram and telemonitoring of patient's medication to enhance adherence.

Method

126 participants of age, 20 and above was drawn from consultant's out-patient section of Federal Medical Center, Owerri, 5 declined and 6 has no functional mobile phone line and were excluded. The remaining 115 patient, who consented to informed consent, were divided into 58 patients for telemonitoring group while 57 patients were non-telemonitored group (control). Both groups were adequately counselled with oral and pictogram (FIP). The telemonitored group were called 5 times in accordance to the duration of their medication which must be at least 2 months, or while told to call, if there is suspected adverse reaction.

Fig 1: Various color codes used to differentiate drugs

Various medications taken by one patient were clearly differentiated by colour coding (Fig. 1.). The colour codes were tagged on the printed pictorial instruction viz-a-viz the drug container, of similar colour. We have different colour codes, for different drugs.

The Telemonitoring patient medication chart was divided into the demographical and medication data. The demographical data consist of name of patient, mobile phone number of the patient, date, sex, educational level, and age range while the medication data include name, dosage and duration of medication, date and time of contact, space to chart readings of diastolic and systolic blood pressures.

The adherence level was assessed using 4 questions, Morisky et al. [19] method and pill counting method [20], both were used concurrently. Morisky 4 questions: (1) In the cause of this treatment, did you ever forget to take your medication? (2) In the cause of this treatment, were you careless at times about taking your medicine? (3) In the cause of this treatment, when you feel better, did you sometimes stop taking your medicine? (4) In the cause of this treatment, if you sometimes felt worse, did you stop taking your medicine? If patients answered yes to any of these four questions, they were asked to specify how often that had happened.

Pill Counting: Adherence was assessed using "pill counting" or counting the numbers of tablets returned versus those issued. The actual counts at each medication-dispensing visit were calculated the ratio of the tablets returned over those that should have been taken as a percentage and communicated these results to the study team [20].

Results

The pictorially aided, telemonitored medication adherence study showed the following results: The effect of education on the adherence indicated those in post-secondary cadre in both groups adhered more than those without education at all. Those within the age bracket of 60 and above adhered more than others with those in the range of 30-39 being the least. Effect on both diastolic and systolic blood pressures showed that the telemonitored have 84.5% adherence and 63.8% (n=37) had their blood pressure ≤130/80 while the control 70.8% adherence 43.9% (n=25) had their blood pressure ≤130/80.

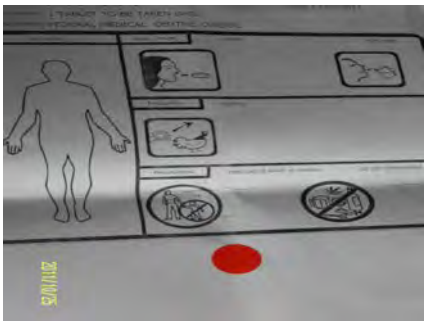


Fig 2: Pictorial representation of prescribed drug dosage (pictogram) sample

Table 1**:** Patients' Demographical Arrangement

	Categories	No of patients telemonitored	No of patients non-telemonitored (control)
Age	20-29	-	-
	30-39	8	5
	40-49	10	12
	50-59	14	12
	60 and >60	26	28
Education	Nil	5	8
	Primary	15	4
	Secondary	14	6
	Post-secondary	23	38
Gender	Male	21	30
	female	37	27

Table 2: Impact of Telemonitoring on Blood Pressure Measurement

Blood pressure	Telemonitored (%)	Non-Telemonitored (Control) (%)
Number of patients with BP≥130/80	21 (36.8)	32(56.1)

Number of patients with BP≤130/80	37 (63.8)	25 (43.9)

Table 3: Patients Adherence Assessment

Methods	Telemonitored (%)	Non-Telemonitored (Control)(%)
Pill Counting	92.7	81.4
Morisky's	76.3	60.2
Mean Adherence	84.5	70.8

Conclusion

When there is enhanced understanding of prescription instruction and telemonitoring of medication, obviously, there is improvement in the adherence level which results in better therapeutic outcome.

References

[1] The World Health Report 2002: Reducing Risks, Promoting Healthy Life.Geneva,World Health Organization, 2002.

[2] J. A. Cramer. Consequences of intermittent treatment for hypertension: the case for medication compliance and persistence. American Journal of Managed Care, 1998, 4:1563-1568.

[3] J. Dunbar-Jacob, J. A. Erlen, E. A. Schlenk, et al. Adherence in chronic disease. Annual Review of Nursing Research, 2000, 18:48-90.

[4] L. M. Sarquis et al. [Compliance in antihypertensive therapy: analyses in scientific articles.] [Portuguese] Revista Da Escola de Enfermagem Da USP, 1998, 32:335-353.

[5] D. O. Clark. Issues of adherence, penetration, and measurement in physical activity effectiveness studies. Medical Care, 2001, 39:409-412.

[6] C. A. Green. What can patient health education coordinators learn from ten years of compliance research? Patient Education & Counseling, 1987, 10:167-174.

[7] R. B. Rayma. Health promotion: a perspective. Aviation Space & Environmental Medicine, 1988, 59:379-381.

[8] A. J. Scheen. [Therapeutic non-compliance: a major problem in the prevention of cardiovascular diseases.] [French] Revue Medicale de Liege, 1999, 54:914-920.

[9] Macroeconomics and Health: Investing in Health for Economic Development –Report of the Commission on Macroeconomics and Health. Geneva,World Health Organization, 2001.

[1]. L. E. Burke, J. M. Dunbar-Jacob, M, N. Hill, Compliance with cardiovascular disease prevention strategies: a review of the research. Annals of Behavioral Medicine, 1997, 19:239-263.

[11] B. Waeber, M. Burnier, H. R. Brunner. How to improve adherence with prescribed treatment in hypertensive patients? Journal of Cardiovascular Pharmacology, 2000, 35 (Suppl 3):S23-S26.

[12] T. F. Luscher, H. Vetter, W. Siegenthaler, W. Vetter. Compliance in hypertension: facts and concepts. Journal of Hypertension (Suppl), 1985, 3:S3-S9.

[13] B. M. Psaty et al. The relative risk of incident coronary heart disease associated with recently stopping the use of beta-blockers. Journal of the American Medical Association, 1990, 263:1653-1657.

[14] P. G. Rogers, W. Bullman. Prescription medicine compliance: review of the baseline of knowledge – report of the National Council on Patient Information and Education. Journal of Pharmacoepidemiology, 1995, 3:3-36.
[15] G. L. Beckles et al. Population-based assessment of the level of care among adults with diabetes in the U.S. Diabetes Care, 1998, 21:1432-1438.
[16] Preparing a health care workforce for the 21st century: the Challenge of chronic conditions. Geneva: World Health Organization, 2005. (http://whqlibdoc.who.int/publications/2005/9241562803.pdf)
[17] N. Mead, P. Bower. Patient-centredness: a conceptual framework and review of the empirical literature. Soc Sci Med 2000; 51:1087-110.
[18] J. G. Cleland, I. Ekman. Enlisting the help of the largest health care workforce — patients. JAMA 2010;304:1383-4.
[19] D. E. Morisky, L. W. Green, D. M. Levine. Concurrent and predictive validity of a self-reported measure of medication adherence. Med Care 1986;24:67–74.
[20] S. Frangou, I. Sachpazidis, A. Stasinakis, G. Sakas. Telemonitoring of Medication Adherence in Patients with Schizophrenia.

Nwuke Henry C. presently working in the capacity of clinical pharmacist 1, in federal medical center, Owerri, Nigeria with 5 years post-qualification experience. Presently M.Pharm holder in pharmacology and toxicology, with special interest in anti-inflammatory, patient adherence improvement. University of Nigeria, Nsukka, dumohen@yahoo.com

First Experience in Using Telemedicine System Heart Wizard MARS-500 in Individual Prenosological Health Monitoring in Russia

O. N. Isaeva, O. I. Orlov, R. M. Baevsky, A. G. Chernikova
State Scientific Center – Institute for Biomedical Problems, Russian Academy of Science, Moscow, Russia, olga.isaeva33@yandex.ru
76A Khoroshevskoye sh, 123007, Moscow, Russia

Abstract: **One of the main goals of telemedicine is early detection of changes in the health level. When symptoms of a disease have already appeared it considerably reduces costs and recovery time. In most cases a pre-disease is preceded with different specific and non-specific stages which are successfully identified with the help of methods of prenosological diagnostics.**

Introduction

The new methods in health monitoring which have been worked out in the Russian space medicine for examining practically healthy people exposed to constant stress and current telemedicine technologies of remote health control and correction combined with individual approach to assessment of functional state are important and promising directions of scientific research. Methods of prenosological diagnostics make it possible to detect different specific and non-specific stages of pre-disease or so called prenosological states [2]. It's very important to detect these prenosological states between norm and pathology in advance because lowering of functional reserves and overstress of regulatory systems can turn prenosological state into premorbid state. The probabilistic approach helps to assess risk of developing one or the other state. High risk means high probability of a definite event. Already in prenosological state pathology progress risk becomes higher as compared with normal physiological state. When the probability of premorbid state is high pathology progress risk increases [3-4].

Methods

Individual weekly monitoring was conducted with «Heart Wizard» instrument («Biocom Technologies») which previously had been used in the long-term environmental and telemedical researches in the USA and

Canada in the framework of satellite «Mars-500» project [5]. The research data were transmitted via Internet and stored on the central server. The paper describes individual weekly tests which were done by five volunteers in Moscow and Vladimir (male and female aged 24 – 66). To provide privacy of research [6-8] every user had a personal protected authorization code.

The main method of research was HRV analysis, a well-known noninvasive method for functional capability assessment [9]. Cardio intervals were decoded according to data recording of pulse wave which was done with photoplethysmographic sensor [10]. The software was updated to the innovative method in the Russian space medicine – the probabilistic approach to adaptation risk assessment [3-4].

Results and Discussion

Volunteers A, B and C conducted tests during working hours and the other two volunteers (D and E) did it at home. During preparation for an important task at work (November 2012) volunteer C demonstrated intense increase of regulatory systems (SI =184,38 c. u., vs. 106,5 c. u.). The probabilistic approach showed that during this period the probability of normal functional state decreased (31% vs. 78%), the probability of prenosological functional state increased (67% vs. 22%) and adaptation risk grew as well (Fig. 1).

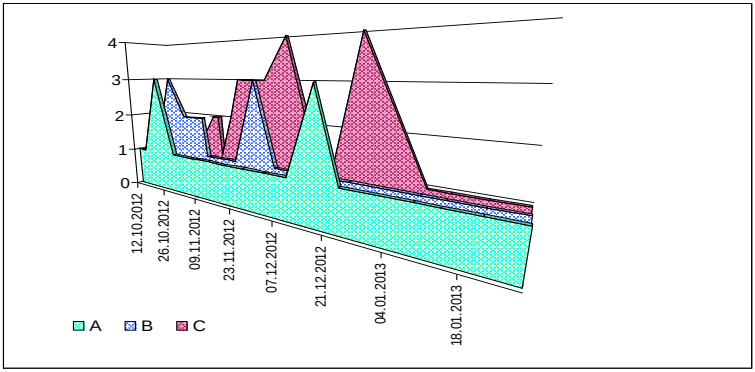


Figure 1. Risks of adaptation disorder represented by volunteers A, B, C

After ten days of New Year vacation functional state of all the research participants came back normal: the probability of normal functional state

increased (92% vs. 75%), the probability of prenosological functional state decreased (Fig. 2).

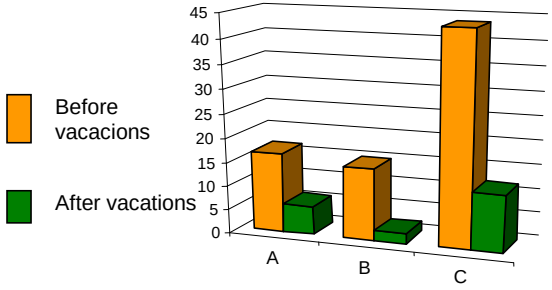


Figure 2. Probability of deviation from normal functional state before and after vacation

The tests which were done by the oldest volunteer E at home proved to be the most informative (Fig. 3). In comparison with the younger research participant D his risks of adaptation disorder were significantly higher and sometimes reached the highest point. His stress reaction was also evident (1 – at the beginning of monitoring, 3 – as a result of household appliances breakdown). The food poisoning declared itself noticeably (Fig. 2, point 2). The day after the food poisoning the shift of autonomic regulation toward reduced parasympathetic activity was observed (HF 8% vs. 26%) and increased sympathetic activity (SI =718,77 y.e. vs. 505,84 y.e.). The probability of premorbid state became higher (89% vs. 14%).

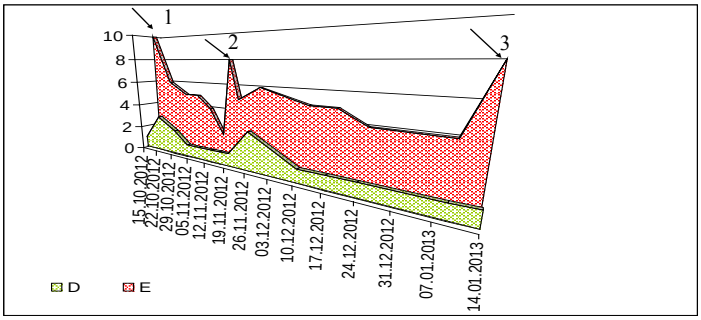


Figure 3. Adaptation risks of volunteer D (age 24) and E (age 66)

Conclusion

The analysis of test results confirmed that our method is sensitive to various factors and proved the effectiveness of regular personal monitoring of functional state. Probabilistic assessment of different functional states and adaptation risks opens up possibilities to effective health monitoring in changing environmental conditions. The first experience of «Heart Wizard Mars-500» in Russia enables us to make some preliminary conclusions about its further development. Population age norms cannot be always applied for individual monitoring. Therefore we need to work out assessment criteria just for individual telemedical prenosological control and also add lifestyle and nutrition recommendations. It is necessary to provide the opportunity to conduct monitoring without access to Internet and save results on the local computer which will be very helpful in present-day Russian reality [8]. After operation testing is over and all the necessary improvements are added this system of individual prenosological health monitoring will go into series production. It means that thousands of people worldwide will be able to use this technology for their well-being and improving of quality of life.

References

[1] A. I. Grigoriev, O. I. Orlov, V.A. Loginov, D.V. Drozdov, A.V. Isaev, Y. G. Revyakin and A.A. Sukhanov. Clinical Telemedicine, Moscow, 2001 (in Russian).

[2] R. M. Baevsky and A. P. Berseneva. Introduction in Prenosological Diagnostics, Moscow: Slovo, 2008 (in Russian).

[3] R. M. Baevsky, A. G. Chernikova. To the Problem of Physiological Norm: the Mathematical Model of Functional States on the Base of Heart Rate Variability Analysis //Aviaspace and Ecological Medicine, 2002, № 5, 34–7 (Article in Russian).

[4] A. G. Chernikova, R. M. Baevsky, I. I. Funtova. Adaptation Risks in Space Medicine IAC-12-A1,2,22,x14827 // 63rd International Astronautical Congress, 1 – 5 October 2012, Naples, Italy.

[5] R. M. Baevsky, O. I. Orlov, A. P. Berseneva and A. G. Chernikova. Telemedical Ecology: Preliminary Results of Longitude Medical Environmental Research Project «Mars-500» // In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates. Knowledge Resources, Publ. ISfTeH, Luxembourg, Vol.5, 2012, pp. 478 – 483.

[6] O. I. Orlov. Telemedicine in Management of Medical Care, Moscow: Slovo, Russia, 2002 (in Russian).

[7] V. M. Levanov, O. V. Perevedentsev, O. I. Orlov. Basics of Hardware and Software Telemedicine Services, Moscow, 2006 (in Russian).

[8] A. I. Grigoriev, O. I. Orlov, P. L. Salmanov, A. A. Sukhanov, V. M. Levanov. Preparation of Medical Information in Telemedicine, Slovo, Moscow, 2007 (in Russian).

[9] Heart Rate Variability. Standards of Measurement, Physiological Interpretation and Clinical Use, Circulation, Vol. 93, 1996, 1043 – 1065.

[10] O. I. Orlov, V. I Pougatchev, A. P. Berseneva, A. G. Chernikova, R. M. Baevsky, Y. N. Zhirnov, Y. N. Gribkov, O. N. Isaeva. Telemedical System for Individual Prenosological Health Assessment. In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates. Knowledge Resources, Publ. ISfTeH, Luxembourg, Vol.5, 2012, pp. 433 – 437.

Interactive Mobile Platform Structure to Monitor, Organize and Evaluate Medical Home Care Protocols

F. Dérout[1], C. Gorius[1], L. Billonnet[1], A. Dussartre[2], J.-M. Dumas[1], C. Lesmarie[1]
[1]Université de Limoges, Limoges, France
[2]Soins et Santé, Limoges, France
laurent.billonnet@unilim.fr

Abstract: **Thanks to the many structures of support and care, people return later in institution. However, the conditions for a suitable home support goes through the actual effectiveness of the prescription, administration and monitoring protocols of care. We present a system of audit to globalize the nursing process and its effectiveness, initial management to assess the impact of care on the well-being of the person. The proposed solutions pass through the definition of interactive mobile device to optimize both the definition of adequate care protocols, in administrative and medical terms, and the optimization caregivers' practices.**

Subject and Context

Home Care establishment Soins et Santé is based in Limoges in France. It manages several services (Nursing home care day and night, therapeutic day care for people with cognitive impairments, two home care teams specialized in Alzheimer patients, a twenty-four hours a day nursing centre, and a support platform for family aid ants). Referring to the large diversity of the competences and provided care services, the structure has to manage multiple medical file formats, with the increasing necessity of correlating them. The objective is to ensure more homogeneity and continuity in the medical support for patients who would be connected to different services. This care centre aims to develop innovation through the use of new technologies and in particular to adequately and efficiently define and use digital archives for Personal Medical Records (PMR) rather than paper archives or separate electronic file systems.

Needs, Corresponding Tool and Data Structure Profiles

The main need of the care structure focuses on the design of mobile connected devices that would impact positively as well as standardize the care organization, from the evaluation of the patient's needs at home or in the structure services, to the logistical management of the patient's data within the structure and transversally for all the services. Several attempts have been conducted using a PMR-based approach but the originality here is to decline several interface types according to the phase of the care protocol while using the same structure format and the same software platform and standards.

In this approach, the first step concerns the evaluation of the patient's environment (including the patient himself). This is carried out during a preliminary patient-nurse meeting. It is then necessary to define a protocol than can lead to standardize the audit and to derive the functionalities of the ICT (Information and Communication Technologies) tool. This standardization will permit to put forward important information. An equivalent methodology has been conducted in [1].

In terms of interface (the definition of the interaction mode itself between the user and the mobile equipment), the main aspects for an efficient use are identified thanks to a semiotic approach since a good appropriation of the ICT object is the key to an efficient usage. The interface should then be easy to use and to appropriate and must help the user in terms of time spent for the audit. Contextual help can here be of interest. Uploading and downloading of data during the evaluation, as well as pre-processing of prescription data also have to be implemented to assist the evaluation in real-time.

Then, to be at the same time standardized for all the services, and evaluative (with possible service expansion and reconfigurability), the data structure has to be thought transversally. In particular, the multiplication of specific medical practitioners implies that patients have very different information coming from several medical services. Even within the structure itself, the patients can use several services that, up to now, were not connected since there was no existing common tools and database.

Our first work has thus been to list and analyze all file types existing in the structure, on the one hand those already used, and on the other hand those which could be necessary. From the patients and caregivers' points of view, the tools must include the personal and medical patients' data. For the administrative point of view, the tools should provide all the information for care billing as well as flexibility in the coordination of a patient's global care protocol between all the care services.

Our data structure will be based upon a service-dedicated PMR with an administrative-oriented approach. The interface (the ICT object) will propose different interaction modes which will adjust to users throughout the care protocol prescription, validation and post-evaluation processes.

At each step, the tool will provide information and contextual assistance, enable real-time validation, and store data for further statistical analysis of both the efficiency of a single protocol or of the medical path of a given patient. Global statistics will be also provided to evaluate the improvement in terms of administrative management and service coordination and connection.

Implementing Functionalities

Audits and patient follow-up are crucial aspects of patient care. Soins et Santé is very concerned about improving their workflow and exchanging information seamlessly between their many services.

Meeting such complex needs and accommodating a wide range of users led to a twofold solution. We opted for an interactive mobile device combined with a software and online database capable of processing information on demand.

After the initial medical prescription, a member of staff will carry out an audit to collect relevant particulars such as identity, marital status, financial means, meaningful relatives, helpers and so on. Then it should support and guide inputs performed by staff from different professional domains (medical and administrative for instance), using appropriate relevant language and reference. Various members of the services, whatever their status is, will contribute and input details on a day-to-day basis to follow up patients and avoid unnecessary repetitions.

This immediately raises an ethical issue: it is indispensable to filter information and grant different access to staff depending on their position. That's why the data needs to be processed by software which can sort and display records selectively according to accreditations.

The device has to be user-friendly and light-weight as the Home Care staff will carry it around when visiting patients. Computers are much heavier and far less friendly. The tool should also be quick and powerful enough not to be time-consuming. Mobility combined with data retrieval and transmission implies that 3G networking is indispensable. Mobile phones are familiar commonplace tools, but they cannot be used for extensive data management. Moreover in many cases 3G connection is

unreliable, particularly in rural areas. It implies that the tool should have built-in memories for quick retrieval and instant storage of recent data.

Touchpads benefit from advanced sophisticated capabilities meeting all these technical requirements while providing users with a pleasant interactive experience.

More and more businesses as well as education institutions are providing their staff with touchpads and consider them as valuable professional tools. Sufficient autonomy for a day's work can usually be granted by the better tablets.

Mobility and cloud computing are becoming standard business models, on the other hand they can meet the needs of versatile health care facilities, provided specific requirements are taken into account, which is why a dedicated software is needed.

Apart from the dedicated professional software we are designing there is also an unlimited choice of applications which can complement the touchpad. For example the integration of the agenda with a list of contacts enhanced with photos is also a convenient feature. In some cases it may be used to facilitate communication between patients and helpers.

Visiting staff need to find the residents' houses easily, which can be improved by taking photos and using GPS functionalities as well as mapping software. Being guided to find the best route can definitely save time and hassle and make employees trip both easier and more efficient particularly for a first visit or when commuting between different houses. GPS can also help trace the tablet in case it is lost. It is even possible to delete its contents remotely if it is stolen.

Practically speaking, touchpads should be protected by a shell to prevent damage if dropped, and an optional stylus could be considered. In all cases a hygiene protocol must also be set up. It could consist in washing hands and cleaning the screen between patients. An invisible screen protector is recommended so as not to damage the screen with disinfectants.

In the future, the generalization of the computerized medical file could further expand the coordination strategy that Soins et Santé is developing within its own services.

Acknowledgment

Authors thank the managing staff from Soins et Santé for providing data that helped the definition and development of the data structure.

References

[1] F. Bouillon, L. Galet, F. Mas, L. Billonnet, J-M. Dumas, S. Queriaud, "Assistive tools for real-time optimized audits of homes of people with disabilities or with loss of autonomy", Medetel 2012, The International eHealth, Telemedecine and Health ICT Forum For Education, Networking and Business, Luxembourg, 18 au 20 avril 2012.

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 focuse on AAL, smart interfaces, home automation and ICT for people in loss of autonomy. He is the Director of the BSc "Home automation for elderly and disabled people" and the international MSc "Auton'Hom-e [otɔnɔmi]"

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

mHealth-Based Telecare for the People Affected by Disasters - Organization of Health-related Volunteer Help

S. Massah[1], B. Karimzad Sharifi[2]
[1]University College of Nabi Akram, Tabriz, Iran
solmaz.massah@gmail.com
[2]Department of IT Management, Electronic Branch, Islamic Azad University, Tehran, Iran, b.karimzad@gmail.com

Abstract: **Maintaining the citizens' health after natural and unnatural disasters is of great importance, and right after such events, there usually is a great tendency in the society to help the affected people. This project seeks to organize such tendencies for health-related volunteer support by the public by using communication facilities efficiently based on mobile health.**

Introduction

At 16:53 h and 17:04 h on Aug 11 2012, East Azerbaijan Province in Iran was hit by twin earthquakes measuring 6.3 and 6.4, respectively, on the Richter scale. 300 people died and thousands were injured, mostly in rural areas. The earthquake's magnitude was so intense that 20 villages were entirely flattened, and more than 100 villages were 70—90% ruined [1]. Following this earthquake, the detailed design of this plan was submitted to the health department of Tabriz University of Medical Sciences.

Problem

When disasters strike, they are sudden, unexpected, and "earthshattering" for those affected by them. The people directly exposed often talk about how their lives have been radically altered. They describe a state of confusion, pervasive anxiety and helplessness [2]. Disaster stress research studies have shown that these events affect the lives of people for years and even decades [2]. Maintaining the citizens' health after disasters is of great importance. This is because the people affected by such events are more vulnerable to different physical and mental diseases and immediate attention should be paid to them.

How We Can Help Effectively in Such Cases?

For designing an effective solution model, we need two types of facilities: human resources and technologies. These two factors should efficiently work together to solve such problems. In this plan we focus on volunteer help tendencies as human resource and mobile health as a technology.

Volunteer Help

After such disasters, health systems in all the countries, including even developed ones, are in need of volunteer help along with the predicted and planned actions in order to handle the health crisis caused by such disasters as soon as possible. Also, right after such events, there usually is a great tendency in the society to help the affected people. This helps solve the food and clothing problems, for instance, to some extent, but volunteer help to meet long-term needs of these people including healthcare is usually overlooked. For instance, a physician does not have to try to provide food and clothing for them; instead, his/her medical specialty can be more helpful to the affected people.

mHealth

One of the latest approaches that can be used in this regard is 'mobile health'. The use of mobile phones to improve the quality of care and enhance efficiency of service delivery within healthcare systems is known as mobile health, or mHealth, and is a sub-segment of the broader field of electronic health (eHealth). mHealth tools have shown promise in providing greater access to healthcare to populations in developing countries, as well as creating cost efficiencies and improving the capacity of health systems to provide quality healthcare [3]. The importance of this approach can be found in the fact that wireless mobile networks are accessible worldwide and are less likely to be impaired by such events compared to other communication networks.

At the end of 2011, there were 6 billion mobile subscriptions, estimates The International Telecommunication Union (2011). That is equivalent to 87 percent of the world population. And is a huge increase from 5.4 billion in 2010 and 4.7 billion mobile subscriptions in 2009. Also at the end of 2011 there were 4.5 billion mobile subscriptions in the developing world (76 percent of global subscriptions). Mobile penetration in the developing world now is 79 percent [4].

Frame and Main Components of the System

This project seeks to organize tendencies to help affected people for health-related volunteer support by the public by using communication facilities efficiently based on mobile health; this approach aims at promoting the health level of the damaged people effectively. In the core of

this plan, there is a Health Call Center which is defined under the Ministry of Health. This center links the healthcare workers working in damaged areas with the specialist physicians and healthcare experts. Thus, this system has three main components: a health call center, health workers in damaged areas, and physicians.

Health Call Center

Health call centers/Health care telephone help lines are a service created to deliver health care advice triage services by trained health professionals on the telephone [5]. In low and lower-middle income countries, there has been a growing interest in capitalizing on the ubiquity of mobile technology infrastructure to develop health call centers that can increase accessibility of health advice and information to patients and the public. This approach has been found to overcome widespread health system barriers [5].

In this project because of importance of intensive health management in damaged areas, this center must be defined under the Ministry of Health. Transferring the calls to the physicians can be done either manually through an operator or automatically through selecting an option.

Health workers in Damaged Areas

In majority of cases, such disasters and crises happen far away from urban areas and are great in volume. Since connecting the affected people directly to this system is not reasonable and would lead to a chaotic situation, by defining a link between the health-related workers in these areas and the specialists, more high-level and specialized services can be delivered. In this plan, the health-related workers, who might be staying in these areas temporarily or permanently, are going to be given particularly registered phone lines, which makes their contacts with the health center identifiable.

Volunteer Physicians

Volunteer specialists who want to participate in this project should sign up for this plan and specify when they are available to serve this system. For example a cardiologist should specify that he/she could be on call every Sundays on 8:00 to 10:00 AM till end of April 2013 for related contacts. This center transfers the calls from healthcare workers in damaged areas to the physicians, depending on their availability and specialty. As a result, virtual presence of the medical specialists in damaged areas is feasible and 'teleconsulting' can be utilized to serve the people in need of these services.

Text, Voice or Video?

If there is access to higher-level networks such as 3G, then the best way of contact is through video calls. However, since such networks are not

widely available, voice call can be the best possible option. Although in this way, collecting data and reporting is not possible compared to texts, the most common way of using mobile phones in majority of societies is bilateral audio connections. Also, hearing a doctor's voice would lead to a peace of mind for a patient.

Conclusion

The areas affected by disasters are in need of specialized health services while the specialists mostly reside in the urban areas and their presence in the affected areas for a long time may not be possible. This project provides an opportunity for them to be present in these areas virtually. This project can also pave the way for the volunteer specialists who live in foreign countries and speak the language of the affected people to offer their help.

References

[1] S. E. J. Golzari, K. Ghabili, "Twin earthquakes in northwest Iran" The Lancet, 20 October 2012, 380, 9851, 1384 Available Online: http://www.thelancet.com/journals/lancet/article/PIIS0140-6736(12)61798-X/fulltext

[2] Standing Committee on Crisis and Disaster Psychology, "Lessons learned in psychosocial care after disasters", European Federation of Psychologists' Associations (EFPA), 2010.

[3] J. Lemaire, "mHealth in Developing Countries" Advanced Development for Africa, Actevis Consulting Group 2011.

[4] mobiThinking "Global Mobile Statistics 2011" Retrieved June 3, 2011 [Online] Available Online: http://mobithinking.com/mobile-marketing-tools/latest-mobile-stats/a#subscribers

[5] WHO "mHealth, New horizons for health through mobile technologies", Global Observatory for eHealth series - Volume 3, 2011.

Solmaz Massah has received her B.S. in electronic engineering from Azad University of Lahijan and her M.S. in industrial engineering, system and productivity management, from Tarbiat Modares University of Tehran, Iran. She is interested in e-Health, Telecommunication, CRM and Business Models. She is now working as a GSM expert in telecommunication industry and also teaching Systems Analysis and Design, Management Information Systems and Industrial Relations in University College of Nabi Akram, Tabriz, Iran.

Behzad Karimzad Sharifi has done his B.S. in mechanical engineering at University of Tabriz, Iran. Currently, he is doing his Master's thesis in IT Management, advanced information systems, entitled: "A System Architecture for Small Clinics CRM (PRM) in Iran" at Electronic Branch, Islamic Azad University, Tehran, Iran. His areas of interest include Developing Businesses using IT, e-Health, CRM, Decision Support Systems, Expert Systems and also Pump Industry. He is now working as head of sales engineering section in Pumpiran Company, Tabriz, Iran.

Mobile Personal Health Application for Empowering Diabetic Patients: The Case within EMPOWER Project

I. Lamprinos[1], Chr. Papadaki[1], H. Schmuhl[2], H. Demski[2]
[1]Intracom Telecom, Telco Software Department, labil@intracom.com
19.7 km Markopoulou Ave. GR-19002 Peania, Athens, Greece
[2]Helmholtz Zentrum München, Institute for Biological and Medical Imaging, Laboratory for Medical Information Systems, Germany

Abstract: **In this paper we present the functional characteristics of a mobile Personal Health Application that aims to support self-management of Type 1 and Type 2 diabetic patients. The application supports the collection of observations of daily living e.g. vital signs, nutrition and sleep schedule, physical parameters such as weight, mental parameters such as self-assessment of quality of life, level of mood and stress, and physical activity related information. Notwithstanding the fact that the application can operate in stand-alone mode, it can also be integrated with a server based patient empowerment framework that further facilitates disease management with the active involvement of healthcare professionals and the exploitation of inclusive knowledge such as disease guidelines.**

Introduction

According to a recent market research report that tackles the impact of smartphone applications on the mobile health industry [1], the majority of today's mHealth smartphone applications fall into the category of general health-tracking and fitness tools. Generally, these apps have a low to medium sophistication level in terms of range of functionality, usage of sensors, integration of medical services and linkage to existing medical databases. The main target group of those applications is health-conscious people who want to track health status indicators, e.g. calorie consumption, weight, blood pressure, body mass index (BMI) and exercise progress.

In EMPOWER project [3] we aim at developing a modular and standards-based patient empowerment framework, which facilitates self-management of diabetic patients, based on Personal Health Records (PHRs) and on context-aware, personalized services. While, adopting a patient-centric perspective, still the project keeps healthcare professionals in the

disease management loop; also, it aims at providing experts' knowledge-based disease self-management pathways for diabetes patients. This includes services for the specification and execution of actions to change behavior according to diabetes-specific healthcare needs and formal disease management guidelines; and, services for monitoring of vital, physical and mental parameters as well as physical and lifestyle activities. To accomplish the latter objective, a mobile application for the collection of Observations of Daily Living (ODLs) is being developed, the basic features of which are presented in the subsequent section.

The EMPOWER Mobile App

The EMPOWER mobile app is an application running at Android-based smartphones and tablets that enables end-users to record ODLs by leveraging various sensors embedded in those devices and communicating with high-end medical equipment, as well as to visualize valuable information in a way that helps them assess their long-term performance and adapt their lifestyle.

The application is developed in Java and runs efficiently on Android v2.3 or later versions. The choice of the particular versions of the Android platform was motivated by the results of a recent survey on current distribution of the versions of the Android platform [3], which clearly depicts that earlier Android versions (Android 2.2 or earlier) are obsolete and run on a limited number of devices. Based on the figures presented in [3], the EMPOWER mobile application is able to run on approximately 88.4% percent of all active Android devices.

From a functionality perspective, the implemented application allows patient to measure and record a set of vital signs (such as glucose level, blood pressure, pulse etc) that are meaningful for diabetes management. The patient can insert a new measurement either manually through a user-friendly submit form or automatically, should the medical device supports proper communication features. In effect, the application leverages Android's Bluetooth network stack to wirelessly communicate with such medical devices.

Furthermore, the EMPOWER mobile application allows indoor and outdoor physical activity monitoring. In practice, the application utilizes the GPS sensor and Android's Network Location Provider to acquire the user location and provide real-time route-tracking map during the activity. Although GPS is mostly accurate, it works properly only outdoors, it quickly consumes battery power, and does not return the location as quickly as required for providing real-time feedback. On the other hand, Network Location Provider determines user location using cell tower and Wi-Fi

signals, providing location information in a way that works both indoors and outdoors, uses less battery power, and responds faster. Based on the above, we defined and adjusted a model that makes use of both technologies, achieving better application performance –in terms of positioning accuracy- and energy efficiency. The co-analysis of input from the GPS the motion sensors embedded on the mobile, enables the provision of detailed real-time feedback regarding the duration, distance, speed, pace and altitude of the activity, as well as calories consumed by the subject. In addition, the application supports the option of marking walking or jogging routes as favorites so as users can follow them next time.

Another user-motivating feature of the application is the possibility to set a workout goal before starting a physical activity session and monitor performance during execution. The workout goal is usually related to total activity duration, distance to be covered, calories to be consumed or maximum speed.

As far as indoor activity monitoring is concerned, the patient is allowed to add an entry manually, including all the attributive information (date, time, number of sets, intensity, duration, speed, calories etc).

The EMPOWER mobile application also provides a tool that assists diabetic patients to manage their diet. In fact, the patient is able to evaluate the nutritional characteristics of her meals, using a food search engine embedded in the application and a locally stored nutrition database. While the patient records her meals' details, the application calculates and presents the maximum values for a set of food/drink indexes, such as glycemic index, calories, fat, proteins, carbohydrates and fiber.

The application also presents simple yet inclusive visualization reports that summarize trends over a week or month period. The visualization of recorded data series enables the patient to regularly check data trends, intuitively recognize correlation between specific parameters and constantly keep track of the outcome of the behavioral change attempts.

Using the EMPOWER mobile application, the patient can also set up a weekly sleep schedule by defining reusable sleep sessions (intended sleep and waking up time, repeat, movement monitoring, ringtone, vibration, description of session e.g. nap after work). The application makes use of the smartphone's inertial sensors, to assess the subject's sleep pattern, record sleeping and waking up instances and calculate and store the duration of each particular sleep session. Additionally, the mobile device records the intensity of the patient's movement during sleep by using the embedded accelerometer. Based on this info, the application assesses the sleep phases and the overall sleep quality (deep, light). Finally, the patient has access to

an extended list of relaxing sounds that comfort her mind and assists her to fall asleep smoothly.

In all the above-mentioned use cases of the EMPOWER mobile app, the user is prompted to input information related to mental parameters such as self-assessment of quality of life, level of mood and stress level.

All the collected information is stored locally on the mobile device, assuring availability at any time. Furthermore, this info is automatically uploaded at the EMPOWER PHR-S database as soon as the mobile device is connected to the Internet. On the opposite direction, the mobile app is fed with weekly reports that summarize the evolution of the monitored ODLs and provide insight regarding the correlation between specific vital signs and mood/stress related recordings.

Discussion

The work presented in this paper focuses on the description of the main functional features of a mobile application that empowers diabetic patients in the management of their chronic disease. The foundation of the importance of such an application is the fact that, nowadays, mobile devices are the "beloved" gadgets of a continuously expanding group of people, who use them not only to communicate, but also to consume multimedia content and access the web. As such, it is an integral part of the daily routine and is used everywhere. By offering diabetes management services in the form of a mobile personal health application, the disease self-management becomes part of the gadget's usage pattern and is not seen anymore as bothering, as it might be the case if using a PC was necessary.

Based on this ascertainment our group intends to further exploit inherent features of modern mobile devices to enhance users' experience in disease self-management through mobile applications.

Acknowledgment

The work presented in this paper is partially funded by the European Community's Seventh Framework Program (FP7/2007-2013) under grant agreement No 288209, EMPOWER Project.

References

[1] Mobile Health Market Report 2010-2015: The Impact of Smartphone Applications on the Mobile Health Industry (Vol. 2)

[2] Empower Project Homepage. Available from: http://www.empower-fp7.eu, last visited 31.01.2013

[3] Official Android developers site, Android Platform versions: Current Distribution http://developer.android.com/about/dashboards/index.html

Mobile Video Transmission System Using IP Network Camera and MiFi

T. Kanchanarin[1], P. Sribuachum[1], S. Panasuriyasombat[1], A. Thaiudom[2]
[1]Phramongkutklao Hospital and College of Medicine, Thailand
[2]The Royal Thai Army Nursing College, Thailand

Abstract: **Pre-hospital telemedicine provides real-time pertinent information, connecting EMS personnel with physicians at long distance. However, live video transmission in moving ambulances is problematic in Thailand due to absence of fixed IP address support and limited bandwidth. Phramongkutklao (PMK) Hospital has developed a highly innovative system designed to work with EDGE/3G cellular networks. The systems incorporates an IP camera, a MiFi (personal mobile WiFi), and a Lithium-ion mobile power charger. The Pan/Tilt camera has a plug and play feature, obviating the need of fixed IP address. With maximum 640x480 pixels, 30 frames per second, and H.264 video compression, the camera is connected to the internet via MiFi. A 12,000 mAh Lithium-ion battery supports both camera and MiFi to remain online up to 6 hours. Live broadcasting from incident scenes and from high-speed moving ambulances was acceptable. Physicians can monitor real-time events and control the camera remotely with any PCs, iPads, or smart phones. The network access storage function provides recoding of the video and snapshot files. Bandwidth requirement, depending on resolution and frame rate settings, ranges from 64 kbps to 512 kbps. At optimum setting (320x240 pixels, 4 frames per second), the bandwidth is approximately 140 kbps. This novel system demonstrated excellent performance in terms of user-friendly operation, auto-reconnection, data compression ability, bandwidth optimization, streaming technology, and network access storage function. The Low cost (800 USD/Unit) allows for installation on all ambulances and volunteer EMS.**

Introduction

Video telesurveillance or remote visual monitoring has many benefits in pre-hospital care. Cellular communications offer flexibility, high bandwidth, rapid deployment, and cost effective solutions for video transmission. In more developed countries, there are several technologies for vehicle telesurveillance such as mobile DVR, LTE, WiMAX, and

cellular bounding. However, live video broadcasting from moving vehicles is technically challenging in Thailand or in many countries due to lack of higher bandwidth and no fixed IP address support.

In Thailand, EDGE networks provide available data rates of 100-200 Kbps. While 3G networks can theoretically provide data rates of 384 Kbps – 7.2 Mbps, its real available bandwidth and coverage area are limited in Thailand at the present.

Fixed or static IP address is given by internet service provider and permanent even a mobile phone is restarted or turned off. The fixed IP address enables easily remote access to the router and to devices connected to the router. Dynamic IP, on contrary, is a temporary IP, meaning that when a mobile phone is connected next time, there will be a different IP.

The objective of our system is to transmit live video streams over EDGE/3G cellular networks without fixed IP address support.

Materials and Methods

PMK Hospital has developed a multi-transmitter telesurveillance system based on EDGE/3G cellular networks. Each handheld streaming video transmitter (0.8 kg) comprises an IP camera, a personal mobile WiFi (MiFi), and a Lithium-ion mobile power charger. Fig.1 depicts a transmitter and its components.

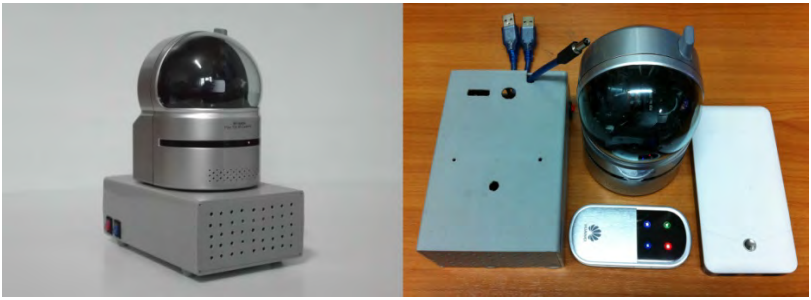


Figure 1: A mobile video transmitter and its components

The Pan/Tilt IP camera with built-in microphone has a plug and play feature, obviating the need for fixed IP address, offers maximum resolution 640x480 pixels, 30 frames per second (fps), and H.264 video compression ability. The camera is connected to the internet via MIFi.

MiFi, a personal mobile WiFi, is an intelligent device that creates a personal cloud of high-speed internet connectivity from anywhere when cellular connection is available, even in fast moving vehicles. When moving

across cellular base stations, MiFi automatically switches network coverage from one base station to another.

The 12,000 mAh, 3.6 V, Lithium-ion mobile power charger supports IP camera and MiFi to remain online up to 6 hours. Continuous operation can be done by connecting to a power outlet.

A series of 20 technical tests was carried out in March 2012. Comparisons of the live video transmission over EDGE and 3G networks were done using two transmitters with different SIM cards (EDGE versus 3G). The duration of each transmission test was 60 minutes at various speeds (0-160 km/h). The latency, image quality, video fluidity and frame losses were observed. The data transfer was depicted by using GKB Zip View and Bandwidth Meter Pro.

Besides technical tests, a retrospective study of 30 real life events during a 6 month period (April-September 2012) was reviewed. The actual field data included non-trauma cases, trauma cases, a mass casualty incident from a van accident and a potential disaster situation; anti-government protest blocking the entrance to the parliament.

Results

The bandwidth of a transmitter ranges from 64 kbps to 512 kbps, depending on resolution (160x120, 320x240 and 640x480) and frame rate (1-30 fps) settings. At optimum setting (320x240, 4fps), the bandwidth is approximately 140 kbps.

The transmitted video quality is dependent on the video parameter settings and the cellular network performance. When dropped connections occurred, the system automatically reconnected. In 3G networks, the video transmission was good in terms of telecommunication parameters (latency, image quality, video fluidity, and frame losses) with delay lime less than 2 seconds despite the vehicle speed of 160 km/hr. In EDGE networks or low internet speed conditions, a transmitter can work but long latency and less performance.

Discussion

This innovation provides the best bandwidth efficiency and outstanding performance. Physicians at the far end can visualize real-time events and control cameras remotely with any PCs, i Pads, or smart phones. Multipoint features allow multiple specialties to view real-time scenarios for multidisciplinary real-time case consulting. A viewer can also view video feeds from multiple cameras simultaneously. The network access storage function provides recording of the video and snapshot files. The video files

can be directly recorded to the camera's SD-Card without network packets loss problem.

In complex scenarios or dangerous scenes, having real-time video being monitored by the far-end specialists are highly valuable. Multiple transmitters can be deployed in disasters to provide real-time visual and reliable information.

Conclusion

This novel system demonstrated excellent theoretical and practical results. The Low cost (800 USD/Unit) allows for installation on all ambulances and volunteer EMS.

Acknowledgement

The prototype equipment was funded by the Lady Prapasri Kamlang-ek Foundation. We would like to thank RX for technicians support and AIS for internet SIM cards and airtime support. Lastly, we express our gratitude to the Royal Thai Army for "The Best Invention Award of 2012" and Innovation Thailand, a joint initiative between the Department of Intellectual Property, Ministry of Commerce and Google Thailand for "The Innovation Idol Awards of 2012".

References

[1] T. Kanchanarin, et al. "A Novel Handheld Streaming Video Transmitter for Prehospital Telemonittoring," Book of Abstracts, EuSEM 2012, 7th European Congress on Emergency Medicine, Turkey 2012, pp. 309.

[2] T. Kanchanarin, et al. "Real-Time Disaster Telesurveillance Using Mobile Streaming Video Transmitters," Abstract Book, ICMM Pan Asia Pacific Symposium of Medical Relief in Disasters, China 2012, pp.7.

[3] T. Kanchanarin, et al. "Phramongkutklao EMS Telemedicine," Program and Abstract Book, 2nd ICMM Pan Asia Pacific Congress on Military Medicine, Thailand 2012, pp. 101.

[4] Innovation Idols, 2012, www.innovationthailand.org

[5] Telemedicine, ICT Expo'12, http://www.youtube.com/watch?v=dLM3N0I30co

Col. Tavatchai Kanchanarin, M.D., FICS
Chief of Trauma Center, Phramongkutklao Hospital
Diplomat Thai Board of General Surgery
Diplomat Thai Subspecialty Board of Trauma Surgery
Diploma in Clinical Oncology, University of London

Lt. Paweena Sribuachum, B.N.S
Registered Nurse and Sleep Disorder Technician
Department of Otolaryngology, Phramongkutklao Hospital

Mr. Sayan Panasuriyasombat, B. Science (Pharmacy)
Telemedicine Consultant, Phramongkutklao Hospital
Medical Equipment Division Manager, R.X. Co., Ltd
Bachelor degree in Pharmacy (Manufacturing), Chulalongkorn University

Maj. Ann Thaiudom, RN., M.S.
Nursing Instructor, Medical and Surgical Nursing Department,
The Royal Thai Army Nursing College
Master of Nursing, The University of Wollongong, Australia

Mobilicare: A Health Monitoring System for Chronic Patients

V. Roesler[1], C. Iochpe[1], A. Bordignon[2], L. Tizatto[3]
[1]Federal University of Rio Grande do Sul, Brazil, {roesler, ciochpe}@inf.ufrgs.br
[2]I9access Technology, Porto Alegre, Brazil, abordignon@i9access.com.br
[3]Unit Care Technology, Sao Paulo, Brazil
luiz.tizatto@unicaresaude.com.br

Abstract: **Chronic diseases are a major problem around the world due to several factors, as the population nutritional habits, lack of physical exercises and population ageing. Diabetes Mellitus, Hypertension and obesity affect millions of people nowadays and the statistics are growing, causing hundreds of deaths daily. Many of these deaths can be avoided with a steady monitoring over the risk population, preventing the vital signs to reach critical stages and providing knowledge for the population about their health. Mobilicare is a mobile health promotion system designed to: a) remote monitoring of patient´s vital signs in real time and in their homes; b) support of a Healthcare center; c) self-awareness of the disease and motivation.**

Introduction

In 1985, there was an estimate of 30 million adults with Diabetes Mellitus around the world. This number grew to 135 million in 1995 and to 173 million in 2002, with a projection to reach 300 million in 2030. About two thirds of these people live in development countries, where the epidemic has more intensity, with a growing rate in young citizens [1].

This number is increasing due to the population growth, population ageing, greater urbanization and the increasing prevalence of obesity and sedentarism. Besides that, the people with Diabetes Mellitus are living more due to advances in medicine [2].

The Mobilicare objectives are manifold, providing: a) vital signs graphics to the monitored patient and also to a central health station; b) alarms when the vital signs are out of threshold; c) videoconference with doctors and family; d) patient risk analysis; e) educational videos about the diseases, food and exercise habits. All of that changes the way the treatment is done nowadays, from reactive after something bad happens to active before something happens.

The Mobilicare system is composed of three main entities, as depicted in Figure 1: a) the equipment in the patient´s home; b) the servers in the cloud; c) the medical center, or health care center. The system works with web browsers, being suitable for many platforms, however, the main focus at the patient´s home is the tablet with Bluetooth access to the measurements, minimizing digitation errors and improving the usability.

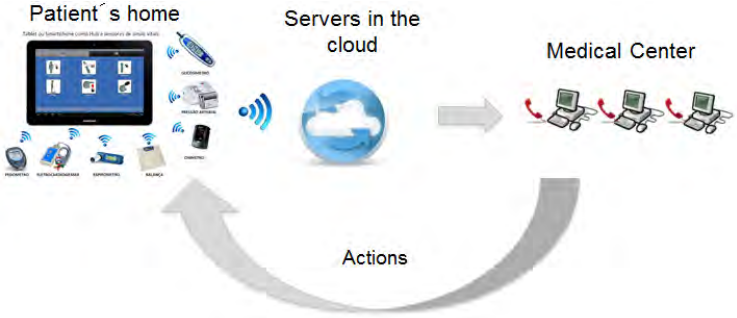


Figure 1. General view of Mobilicare

Project Details

The three main entities of the system are detailed in the following items:

The equipment in the patient´s home

The equipment in the patient´s home are composed of a 3G tablet and a variable number of vital monitoring sensors according to their chronic diseases, as seen in Figure 2. The most common sensors are Glucometer (for diabetes), Blood pressure (for hypertension) and Scale (for weight control). Some of them receive a Pedometer, used to monitor the amount of physical exercises.

The software in the tablet allows the monitoring, graphic generation and two way communications (with the sensors, gathering the data via Bluetooth, and with the HealthCare Center, sending the data via 3G). Besides, it also allows videoconference with their doctor, family and the Healthcare center. It also has some video tutorials about the patient´s disease to improve their knowledge and motivate them even more.

Figure 2. Detail of the mobile device in the patient´s home

Figure 3 left shows the interface of the videoconference with four possibilities, which are the health center, health coach, family and friends in a social network of diabetic people. Figure 3 right shows the possibility of the patient see the historic graphs of their vital signs – in this case for glucose.

Figure 3. Videoconference rooms (left) and glucose graphics (right)

The servers in the cloud

The servers in the cloud are used to store all the information and allow transparent web access through the Internet.

The medical center

The Medical Center, or Healthcare Center, concentrates all patient´s data. If there is an alarm on a patient, their data appear in the beginning of the list, and a sound is generated, followed by a yellow message. Figure 4 shows an image example of the interface. The Healthcare Center has also all

the information about the patients, as their performance bar charts, telephone, name and telephone of close people, name of doctors, medicines that the person is taking, visit records, among other. This information can be used for decision making, as for example to call the patient and offer help. In extreme cases, it is possible to send immediately an ambulance to the patients' home.

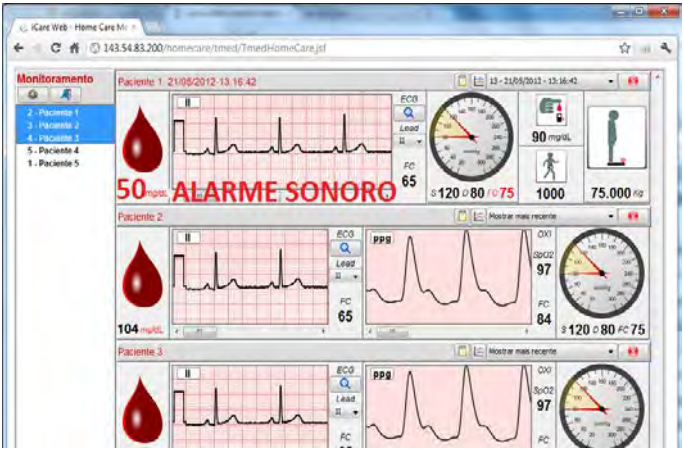


Figure 4. Example of image in the Medical Center

Final Remarks

This paper presented a new mobile monitoring system for health promotion, called Mobilicare. The system works on any browser, so, it is suitable to many platforms, like computers, tablets and mobile devices.

The system was validated through a master´s thesis, showing great improvements in the life of the 5 monitored patients. Nowadays it is being used to monitor the life of 100 patients with Diabetes Mellitus in Sao Paulo, Brazil.

References

[1] S. Wild, G. Roglic, A. Green, R. Sicree, H. King. Global prevalence of diabetes. Estimates for the year 2000 and projections for 2030. Diabetes Care. 2004; 27(5):1047-53.

[2] World Health Organization. The World Health Organization Report 2002: reducing risks, promoting healthy life. Geneve, WHO, 2002.

Valter Roesler has Bachelor´s degree in Electrical Engineering (1988), Master degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at Federal University of Rio Grande do Sul, Brazil. He coordinates the PRAV laboratory (Projects in Audio and Video) – www.inf.ufrgs.br/prav, with about 30 researchers and projects related to Remote Education and E-Health, in traditional computers and mobile devices.

Cirano Iochpe is an associated professor at Federal University of Rio Grande do Sul (UFRGS), Brazil. He was granted a PhD degree (1999) in Computer Science by the University of Karlsruhe, Germany. At present, Prof. Iochpe´s research in the area of Telehealth concentrates in decision-support systems for heart beat classification as well as tele-assistance in home care.

Alexandro Bordignon has Bachelor's degree in Information Systems (2006) and Master Degree in Computer Science (2012). Nowadays he is Director at i9Access Technology (http://www.i9access.com.br), a Brazilian company that develops web and mobile systems for telemedicine and telehealth.

Doctor Luiz Tizatto was graduated from Passo Fundo University, Brazil. Specialization in Management of Hospitals and Healthcare Systems (Getulio Vargas Foundation - EAESP and Clinicas Hospital of Sao Paulo University). Executive Education from Harvard Business School. CEO of the Unit Care group, market leader in the healthcare technology area in Brazil, developing research activities in connection to the Federal University of Rio Grande do Sul in the telehealth field.

Roles and Places of Women in eHealth and Telemedicine

Closing the Gender and Digital Gaps to Improve Women's Health

Millennia2015 Women and eHealth Study 2010 - 2012

Key Findings and Action Plans

V. I. Thouvenot[1], K. Holmes[2], L. P. Chavolla[3]
[1]Women and eHealth International Working Group, Millennia2015, Namur, Wallonia, Belgium, thouvenot.veronique@millennia2015.org
[2]Union University, USA, kholmes@uu.edu
[3]Hilliard, OH 43026, USA, perez-chavolla.2@osu.edu

Introduction

The Millennia2015 Women and eHealth International Working Group (WeHealth: http://www.millennia2015.org/Women_and_eHealth) has been launched on 1st August 2010 in Namur, Wallonia, Belgium, under the auspices of Marie-Anne Delahaut, head and founder of Millennia2015 (www.millennia2015.org) and Véronique Inès Thouvenot, eHealth senior expert, head of WeHealth, with the mandate of conducting a two-years study at the convergence of three major areas, Women, Health and Information and Communication Technologies (ICTs).

Its principal goal is to explore through informal collaborative networks and women's local communities, how women have access and use ICTs for health, with a particular attention to women living in conflicts, refugee camps and natural disasters. It aims at giving a voice to local communities and silent populations living in difficult contexts. The study does not pretend to be scientific although the data collection and analysis follows the rigorous scientific, technical and ethical requirements of the foresight methodology described on Millennia2015 website and in WeHealth guidelines.

Study Key Figures

The study is documented by 2.500 emails, 82 Skype conferences, 175 publications, 1.500 web articles, 4.267 HIFA2015 messages (www.hifa2015.org), 15 conferences attended by WeHealth members, 99 online interviews in 13 countries, and collaborations with 27 organizations, 7 partners and 6 Millennia2015 regional communities. About 60% of the data has been analyzed to date. Eighty per cent of the data is in English, the rest in French and Spanish.

Key Findings

These Key Findings are the result of a two-year data collection process conducted by the WeHealth network of 511 members in 62 countries. The data analysis applied an original qualitative approach that employed the overall themes of Women, Health, and ICTs to generate action plans to close the gender and digital gaps, to empower women and promote connectivity in their communities.

The vast majority of the information provided by WeHealth members acknowledges that the access to and use of ICTs for health by women is a fundamental need and an essential factor contributing to their empowerment. Non-economic benefits of these technologies include more rapid and effective communication in areas of conflict, during disasters, and to support women during their pregnancies.

Barriers and Challenges

1. Education and Training

Providing access to education and training on ICTs usage are two main areas of concern mentioned often in interviews and reports. Other major impediments that limit the ability of women to use ICTs are illiteracy and disabilities.

2. Languages and Dialects

It is important for women that eHealth services are delivered in their own languages and dialects. This encompasses all kind of eHealth activities, including, but not limited to, mHealth, telemedicine, electronic medical records (EMR), and SMSs.

3. Cost and Complexity

In most instances, ICT solutions do not satisfy women's needs, particularly those living in rural communities or isolated areas. For many, these technologies are still unaffordable when considering their average income levels, and too complex for their level of education and technical

skills. These technologies are usually not adapted to conditions present in specific contexts where these women live, such as refugee camps, wars and conflict situations, natural disasters, and areas with unreliable power supply.

4. Sustainability

Long-term sustainability remains problematic, as devices and ICT applications are constantly evolving and proliferating. For women in developing countries, having access to the appropriate technology with basic functionalities might be more effective in the long-term, than ensuring their access to the latest innovations. In the absence of continuous education and empowerment, this has major consequences on the access and use of new solutions by women.

Proposed ICT Solutions

1. Radios and Televisions

Radios and TVs continue to play a major role in the dissemination of health information and should be incorporated with mobile phones and Internet services to reach more women.

2. Mobiles, Tablets, and Other Electronic Devices

mHealth or mobile health shows interesting results but remains limited to pilot projects that hardly expand at national and regional levels. Most women who received health related SMSs on their mobile phones prefer messages delivered by voice, using voice commands. An example of this speech-to-text application is the iPhone's "Siri", in which the user only has to be able to speak, not to read or write. Incoming messages could have a text-to-speech option, so that messages are "read" out loud to those unable to read.

3. Telemedicine

Telemedicine remains a "male" sector at all levels: medical, technical, and engineering. Women are beneficiaries as patients where such services are made available, yet just a few female doctors, nurses or midwives are active in Telemedicine services.

4. Free Call Lines

Many WeHealth members emphasized the need to promote the adoption of free call lines that enable women to reach health centers and health service workers. These lines can be used in particular to support women living in difficult situations, such as domestic violence, natural disasters, war/conflicts, and as refugees.

5. Alternative Energy Solutions

Where energy is scarce or unreliable, local solutions using solar or wind power show promise. Young girls in India have found a urine-based solution to provide enough energy for mobile phones.

Health Information

One of the most cited areas of interest to women is receiving regular information on maternal and child health, family health, disease control, HIV/AIDS, malaria, cancer and vaccination.

Emerging Trends

1. *Social Media*

Individuals and women in particular, are recognized to be active in using social media, blogs, and twitter to gain access to health information, even prior to consulting health professionals. This is an impressive shift into a new paradigm where doctors are no longer the sole repositories of medical information.

2. *Broadband and Cloud Computing*

Access to broadband and eHealth services, available in Cloud Computing systems, is a key to women—particularly during pregnancy—to facilitate the exchange of digital images, accelerate diagnostics, and decision-making in urgent contexts.

3. *Disabilities*

This vast arena includes assistive technologies that improve the quality of life of women, in particular that of ageing women.

4. *Focus on Young Girls and Adolescents*

Young women are part of the digital generation, used to live in a technological world. Local initiatives focused on training them on First Aid, Emergency Care, and Pregnancy Surveillance, in their own communities, such as the CASA project in Mexico (www.casa.org.mx), have already shown interesting results.

Conclusion

The study highlights a set of barriers, solutions, health information and emerging trends in the arena of Women and eHealth. To address them and to contribute to women's empowerment, the Women and eHealth International Working Group and the Millennia2025 Foundation (http://www.millennia2015.org/millennia2025_foundation) are currently developing projects and partnerships for the next period, 2012 – 2015.

1. ***WeTelemed:*** the Millennia2015 Women and Telemedicine Global Network (WeTelemed) was created on 19 April 2012 (http://www.millennia2015.org/WeTelemed) and launched at the Conference in Panama City (http://www.millennia2015.org/Mujeres_ICTs_Panama), generating a unique global network of women in telemedicine. As of November 2012, 104 members from 25 countries had registered and are now sharing their experiences and education.

2. ***WeObservatory:*** a unique Resource Center on Telemedicine for nurses, to promote women empowerment through the access to and use of advanced technologies, combined with innovative integrated collaborative leadership programs. This resource will be launched on 10 April 2013, in Luxembourg. (http://www.medetel.eu/index.php?rub=educational_program&page=wehealth_session_2013).

In partnership with Connecting Nurses (www.connecting-nurses.com).

3. ***WeLUCY***: an innovative Digital Inclusion Cloud Computing Model dedicated to women, who will benefit of having a dedicated and secured space to express and share their opinions, ideas and solutions, illustrated by their local experiences and stories in daily healthcare.

In partnership with Dominic Foundation and LucyTech (http://www.dominic-foundation.org/ - http://www.lucytech.com).

4. **Universal Nurses, Universal Women:** a unique multilingual online service to empower women to communicate in various health care situations and medical specialities (http://universaldoctor.wordpress.com/2012/12/03/millennia2015-and-universaldoctor-project-partner-on-women-and-ehealth/).

In partnership with Universal Doctors (http://www.universaldoctor.com/)

5. **Working Group on Women (WoW):** A group focused on improving women's participation and inclusion at all levels, in eHealth and Telemedicine. (http://archive.constantcontact.com/fs194/1101836993790/archive/1111333314019.html).

In Partnership with International Society for Telemedicine and eHealth (IsfTeH),(http://www.isfteh.org/)

6. **Global Women South-South Digital Inclusion Initiative (GLOW):** an innovative and integrative model of global collaboration to accelerate the participation of women in applied technology for development across the continents of the south.

In Partnership with Genos Global (http://genosglobal.com)

Future Action Plans

1. Zero Mothers Die: free mobile phones and airtime for pregnant women in isolated communities.
2. WeBroadband: a g lobal advocacy effort to offer free access to broadband services to local nurses, midwives, and pregnant women, for medical imagery.

www.millennia2015.org/Women_and_eHealth

Acknowledgments

The authors wish to acknowledge the support provided by the WeHealth editorial team, Dr. Josephine Alumanah, Dr. Pietro Aparicio, Francisco Grajales, Anna Kotzeva, and Shakeel Panchoo.

Dr. Veronique Inès Thouvenot is a recognized e-Health senior expert and Head of the Millennia2015 "Women and eHealth" International Working Group, with extensive experience in evaluation of e-Health, e-Learning, Telemedicine and Gender projects in developing countries. She currently works at the International Telecommunication Union in Geneva as eHealth Advisor, and previously, at the World Health Organization as scientist in the eHealth unit. She holds a doctorate in Advanced Mathematics and Decision Support Systems in Humanitarian Health, an MBA in Project Management, and post graduate diplomas in Medical Law and Health Economy from the University of Medicine in Lyon, France.

Kristie Holmes, Ph.D. is an Associate Professor of Social Work and actively researches topics related to gender, media and healthcare as well as technology's impact on relationships, and women's overall health and well being. She is in private practice in Los Angeles, California and has spent a significant amount of time in the past two years working on a project with UNESCO, WeHealth/ Millenia2015 and will act as a moderator for an NGO at the United Nations 57th Commission on the Status of Women.

Dr. Lilia Pérez-Chavolla is a consultant for the United Nations system in the area of information and communication technologies and their use for promoting development. Her current research for the International Telecommunication Union focuses on the application of ICTs in the health sector and how such technologies can help developing countries improve maternal and neonatal health.

Connecting Nurses Program

S. Coumel
Stakeholder & Advocacy Project Director, Sanofi Corporate
sylvie.coumel@sanofi.com; contact@connecting-nurses.com

"The Connecting Nurses Initiative" www.connecting-nurses.com (in Partnership with the Foundation Millennia2015)

Nurses are at the fore front of patient care in a wide range of areas, and their role is key in chronic disease management and patient education. Their role will expand and become even more important in the future.

The Connecting Nurses program is an initiative for nurses supported by sanofi and developed in collaboration with Nurses Federations (The Nurse Practitioner Healthcare Foundation (NPHF), International Council of Nurses (ICN), the Secrétariat International Des Infirmières et Infirmiers de l'Espace Francophone (SIDIIEF), and the Association Française pour le Développement de l'Education Thérapeutique (AFDET)).

Connecting Nurses intends to provide a web 2.0 collaborative platforms for nurses from all around the world to share their ideas, advice and innovations.

This worldwide on line nursing recognition program's ambition is to help turn caring ideas into reality: nurses from all countries are invited to showcase on line their creativity and their care solutions/practice innovations.

Two Connecting Nurses communities are on line: Care Challenge & Information Shareapy.

Care Challenge (www.care-challenge.com) has been created to celebrate the important role the nursing community plays in healthcare provision around the world, while addressing the challenges which arise within modern healthcare systems.

Information Shareapy (www.connecting-nurses.com) a nursing community focused on patient education for nurses to share high quality, reputable health weblinks to their patients.

The goal of 'Information Shareapy' is to help nurses:

- Connect with other nurses and healthcare professionals
- Be more efficient during their interactions with patients
- Keep updated with the ever changing world of health information on the web

The Connecting Nurses program brings a range of other benefits to nurses such as improving recognition of the nursing community by giving them a

stronger voice. Indeed, it will support dialogue within the nursing community by creating networking opportunities at a national and international level. Helping to share knowledge on nursing techniques will enhance education, research and practice as well as the care of patients.

Recently, Connecting Nurses and the Foundation Millennia2025 have agreed to partner and launch the WeObservatory an innovative Digital Inclusion Platform dedicated to women's global health challenges. The overall objective of the WeObservatory is to serve as a unique Resource Center on Telemedicine for nurses, to promote women empowerment through the access and use of advanced technologies combined with innovative integrated collaborative leadership programs.

About Sanofi: Sanofi, a global and diversified healthcare leader, discovers, develops and distributes therapeutic solutions focused on patients' needs. Sanofi has core strengths in the field of healthcare with seven growth platforms: diabetes solutions, human vaccines, innovative drugs, rare diseases, consumer healthcare, emerging markets and animal health. Sanofi is listed in Paris (EURONEXT: SAN) and in New York (NYSE: SNY).

Health Multilingual Mobile Communication

J. S. Pons[1], V. I. Thouvenot[2]
[1]UniversalDoctor Project, Luis antúnez 6, Barcelona, Spain
jserranopons@universaldoctor.com
[2]Women and eHealth International Working Group, Millennia2015, Namur, Wallonia, Belgium, thouvenot.veronique@millennia2015.org

Introduction

In December 2012, UniversalDoctor Project and Millennia2025 Foundation have launched a partnership to develop multilingual eHealth and mobile health applications dedicated to women's health and Nurses communication.

The main objective of UniversalDoctor Project is to facilitate multilingual communication between health professionals and patients who do not share a common language.

UniversalDoctor Speaker (UDS) is a well thought-out multilingual application that enables a user to select a preferred language and a discussed topic ranging from general symptoms to more specific medical conditions. It offers pre-set multilingual and multimedia questions and answers in order to facilitate communication. Taking a basic (UDS) as a reference UniversalDoctor Project designs customized applications aimed to be used by hospitals, and offers a number of mobile applications that facilitate patient mobility for people suffering medical conditions, including chronic diseases.

Based on the values detailed in Millennia2015 charter, the Millennia2025 "Women and Innovation" Foundation, public utility foundation, is dedicated to: (a) collect funding in order to implement the activities of the Millennia2015 foresight research process led by The Destree Institute and to ensure the realization of the action plans with partner organizations of Millennia2015; (b) develop partnerships and collaborations with universities, NGOs, private companies, to improve women's capacities through digital solidarity; (c) deliver expertise, trainings, consultancies, conferences, publications and seminars within the Millennia2015 framework.

Addressing the Challenge of Multilingual Communication

The biggest challenge between a medical professional and a patient who do not share a common language is obviously the language barrier. This

lack of communication can prevent a patient from receiving suitable, necessary medical assistance and may thus put the patient's health at risk.

The believe of UniversalDoctor Project is that patient health should not be compromised because of a language barrier, as access to medical assistance is a fundamental human right. The need for multilingual communication in a medical setting increases with the higher mobility of people due to migration, business, tourism, and other reasons.

Migration plays a very important role as it is migrants who settle abroad for the long or short term and who may require emergency or ongoing medical care. As the acquisition of foreign language skills by a migrant population is often unlikely to happen either prior or immediately upon arrival to a foreign country, it is precisely during this 'transition' period when UniversalDoctor tools may be of great use. It is important to note that UniversalDoctor tools do not ever aim to substitute the essential and highly valued work of interpreters, which it holds in respect and appreciation. These multimedia and multilingual tools are used in many health care settings as complement in some situations of the interpreters.

How the Tools Aim to Meet This Challenge?

As communication between the medical professional and patient who do not share a common language was identified as the biggest challenge, UniversalDoctor' s tools aimed to meet this challenge in the following way:

1. It offers a communication tool to facilitate contact between a health professional and a patient that don't share the same language in a medical setting;
2. It empowers the health professional to offer medical assistance to a patient in another language;
3. It enables the medical professional to carry out tasks ranging from providing emergency or ongoing medical care, performing a diagnostic interview, providing treatments, or issuing prescriptions in multiple languages;
4. The mobile versions (iPhone and soon in Android) equip patients who travel abroad with medical records in several languages and serves as a communication tool as and if needed, facilitating patient mobility for people suffering from medical conditions, including chronic diseases;
5. New applications focused on specific chronic diseases like diabetes and hepatitis are being developed.

The UniversalDoctor Project sees the solution in addressing the multilingual communication in the medical setting by combing the UniversalDoctor tools with the essential work of medical interpreters.

Human Translation using Pre-Set Questions and Answers

The UniversalDoctor project emerged from the need to develop an initiative that would facilitate multilingual communication in a medical setting. Working on the assumption that machine-translation technology does not necessarily offer ideal or errorless translations, we developed the UniversalDoctor applications using pre-set questions and answers. To guarantee the high quality of these applications and prevent against any linguistic errors that could lead to misunderstandings, all the phrases were translated and proofread by our professional translators.

In terms of the development of the UniversalDoctor application, the phrases were prepared with careful consideration given to a p rofessional medical practice. This means that the factors considered included the great variety of medical settings and topics, as well as medical conditions, treatments and, last but not least, the sequence of questions a doctor asks while carrying out a diagnostic patient interview.

To confirm our assumption that machine-translation technology does not necessarily offer errorless translation we participated in a study carried out by experts in the field of Machine translation: State-of-the-art Machine Translation Quality in the Medical Domain, Marta R. Costa-jussà*, M.Farrús, J.Serrano. A summary of the study is presented in Italic:

Materials and Method: *The analysis starts from the description of the UniversalDoctor tool, which does not employ machine translation technology in order to ensure perfect translations in the medical communication. Parallel multilingual sentences from English into seven different languages used in this tool are extracted and translated through a state-of-the-art statistical machine translation system. The outputs are evaluated by using automatic and human machine translation evaluations.*

Results: *The evaluation results depend in part on the similarity of both source and target languages. Automatic evaluation results vary from a 7.16% BLEU (Basque) to 26.34% BLEU (Spanish), while human translation acceptance varies from 27.2% (Basque) to 86.8% (French).*

Discussion: *Automatic and human evaluation results are highly correlated, and the worse results obtained in English-to-German translations than in English-to-Romance languages could be to the fact that German does not commonly use Latin medical terminology, as English does.*

Conclusion: *Machine translation cannot be currently used as a reliable translation system, and it should be to emergency situations in which no other translations of higher quality and confidence can be provided.*

Medical, Technical and Linguistic Certifications

Within the framework of the UniversalDoctor project, "UniversalDoctorSpeaker: Family Medicine in 9 Languages" was the first

tool to be implemented. At that time the languages available included English, Spanish, French, German, Portuguese, Russian, Romanian, Moroccan Arabic, Mandarin Chinese and Urdu. The application's development was supervised by semFYC (the Spanish Family Doctor Association).

A new extended version of UniversalDoctor Speaker has been implemented in several health centers recently. Hospitals and primary care centers from Spain, Scotland, Portugal, and soon Norway are using customized applications. A new collaboration with health care authorities in Norway will proportionate very soon a very specific customized tool for the Norwegian health system.

The collaboration with multiple University hospitals in different countries and the ongoing interoperability projects with some of them facilitate the continuous update of UniversalDoctor Technology. From the beginning UniversalDoctor has been collaborating with different universities in the technical field (software development) like "Universitat Politècnica de Catalunya", and in the linguistic field like Universidad Alcalá de Henares (near Madrid).

Feedback and Assessment from Health Professionals and Interpreters

The various highly specific implementations carried out in different territories allow us to detect health professionals' requirements with respect to communication with their regular patients. Different professional groups including family doctor associations and gynecologists' associations are constantly asking and being asked for specific solutions, and we believe that this is a symptom of the great need among many health workers to improve communication.

Numbers of UniversalDoctor Speaker tool use in some health care institutions reveals the high number of multilingual encounters in the modern health care settings. In the network of "Institut Català de la Salut" 19.000 entries were registered in the year 2010. Multiple quality and usability test have been passed in order to evaluate the satisfaction of health care professionals with UniversalDoctor' s Tools.

The Camões Institute in Portugal has used the tool to facilitate teaching Portuguese to foreign doctors contracted by the government to work in Portugal. An evaluation was also carried by the same Institute in order to improve the usability of the specific tool customized for them.

Many interpreters have also been validated our tools as possible supportive and educational tools used by them before some interpretation works (in order to prepare themselves with the right vocabulary and anamnesis processes). Many interpreters in different hospitals like for

example Hospital Ramón y Cajal in Madrid have been the tools in a stipulated way with that purpose [2].

Feedback from users of mobile tools: The freeware versions of the mobile applications have been downloaded over 150,000 times by users from across the planet and many other times in pay versions.

Different types of feedback have been received from users including regular travelers, doctors working on humanitarian missions and, above all, patients with chronic diseases keen to contribute with information on their regular mobility requirements.

Partnerships with Multiple Associations and Collaborative Groups

The UniversalDoctor project has been capable of mobilizing different groups with whom collaborative projects have been carried out and has, on occasion, been assessed by different organizations to complete very specific customizations.

The mobilization of other groups has been promoted either by UniversalDoctor or at the initiative of the groups themselves. For example, the **"UniversalDoctor Speaker for Deaf Refugees and Asylum Seekers"** [3], partly funded by the European Commission (New Start, EC Project Reference : 229820-CP-1-DE-GRUNDTVIG-G1) was created thanks to an association of psychiatrists in the Hospital Gregorio Marañon who specialize in mental health who were very concerned about initial communication with this patient group.

The world's most important Family Doctor Association , WONCA , chose to distribute over 3,500 CDs of the "UniversalDoctor Speaker: Family Medicine in 9 Languages" application at the European congress held in Malaga in October 2010.

At present, different groups including medical associations, groups of patients with chronic diseases and different businesses that work in the insurance field are proposing collaboration projects to improve the mobile tools.

New Partnership in Women's Health and Nurses Communication

In December 2012, Millennia2025 Foundation and UniversalDoctor Project announced a partnership to develop multilingual eHealth and mobile health applications dedicated to women's health. This collaboration will result in the launch of *UniversalWomen Speaker* and *UniversalNurse Speaker* in 2013. With 484 experts from over 65 countries organized into regional communities and international working groups, Millennia2015 has a strong network of experts from which we will draw expertise from on

women's health and nursing issues to ensure these tools are relevant and well-informed.

UniversalWomen Speaker

The UniversalWomen Speaker tool, part of the UniversalWomen Project, will facilitate multilingual communication between women and any healthcare personnel during pregnancy, childbirth and other maternal and women's health issues. Whether you are traveling or working abroad, UniversalWomen aims to support any woman in need throughout the world.

UniversalNurse Speaker

UniversalNurse Speaker will be dedicated to supporting Nurses, enabling them to communicate with patients in several different languages. Nurses will feel more empowered to deliver care to patients in diverse multicultural settings. UniversalNurse Speaker will be tailored to meeting the needs of Nurses across the globe.

UniversalWomen Speaker and UniversalNurse Speaker were announced at the Millennia2015 2nd International Conference at UNESCO Headquarters in Paris on 3 December 2012. The final launching of both tools will be done on 23 September 2013, in New York at the Women Leaders Forum.

References

[1] M. R. Costa-jussà, M. Farrús, J. Serrano Pons. State-of-the-art Machine Translation Quality in the Medical Domain. Barcelona Media Innovation Center, Barcelona, Spain. 2-Corresponding author, Office of Learning Technologies, Universitat Oberta de Catalunya & UniversalDoctor Proeject

[2] B. Navaza, L. Estévez, J. Serrano. Saque_la_lengua,_por_favor: Panorama_actual_de_la_interpretación_sanitaria_en_España, http://www.linkedin.com/profile/view?id=7198559&trk=hb_tab_pro_top

[3] UniversalDoctor Speaker for Deaf Refugees and Asylum Seekers, Hospital Universitario Ramón y Cajal http://www.universaldoctor.com/gestor/universaldoctor_signos.swf

Jordi Serrano Pons is a physician and the founder of the UniversalDoctor Project, the main objective of which is to improve multilingual communication between health professionals and patients using new technologies.

The implementation of UniversalDoctor in different countries has given him an opportunity to get to know different health systems in more detail and to contemplate the state of art of many health information systems. A European project on deafness and communication and a large number of agreements with private foundations and NGOs have reinforced the UniversalDoctor project at the international level.

He is currently working on the launch of new projects related to medical education and mobile applicationss. He collaborates with a number of Universities and other Institutions including regional governments. Jordi is a General Practitioner and holds a Master's degree in Health and Environment and a further postgraduate degree in International Studies from the University of Barcelona.

Women and eHealth

V. Thouvenot[1], A. E. Schmaus-Klughammer[2], L. Lhotska[3], Y. Kwankam[4]
[1]Millennia2015 Women and eHealth, Lyon, France
thouvenot.veronique@millennia2015.org
[2]CEO of Klughammer GmbH Germany, schmaus@klughammer.de
[3]Czech Technical University, Prague, Czech Republic, lhotska@fel.cvut.cz
[4]ISfTeH Executive Director, Switzerland, ykwankam@isfteh.net

The IFsTeH and Med@Tel organisers have expressed their interest vis a vis the implication of women within the arena of eHealth and telemedicine, after the presentation provided by Dr Véronique Thouvenot at Med@Tel 2011, upon the invitation of M. Peteris Zilgalvis, Head of Unit, ICT for Health, DG Information Society, European Commission.

The participation of women in eHealth and Telemedicine is the focus of the two years study, since August 2010, undertaken by the Millennia2015 Women and eHealth (WeHealth) International Working Group chaired by Dr. Veronique Thouvenot. Its goal is to investigate how women get access to, and use, ICT for health. It aims to give a voice to local communities and silent populations living in difficult conditions. A network of 432 volunteers [1] from 61 c ountries actively collects information, ideas, wishes, photos and videos illustrating the theme of women's access and use of ICT for health in their local communities. WeHealth covers three main areas: Women, Health and Technologies.

Fig 1: Women and eHealth (WeHealth), at the intersection of Women, Health and ICTs.

Women considered are of all ages, with a particular attention to those living in low income settings, urban slums and rural communities. Health is taken in its broad dimension, including healthcare, humanitarian emergencies, health prevention, promotion and education, at community, regional, national and international levels. ICTs and technologies cover local radios, television, mobile phones, internet, satellite communications, social media.

The data is collected from September 2010 to October 2012, and the preliminary results of the study were presented at the Millennia2015 Seminar, 21 November 2011, Paris, France (annex 1).

The qualitative analysis of the data permitted to distinguish four dimensions in the places and roles played by women within the arena of eHealth and telemedicine.

Firstly, women appear to be mainly involved as beneficiaries of eHealth and telemedicine services. They are mothers of young children, adolescents sharing health information through social medias such as twitter, blogs or Facebook, pregnant women benefiting of distant medical advice with the support of tele-imagery services.

Second dimension, women are also actively involved as health professionals, doctors, nurses, midwifes, community health workers (CHWs), using the impressive capacity of mobile phones to connect with isolated communities and manage urgent situations.

Third dimension, is the area of the Information and Telecommunication Techonologies (ICTs) and telecom engineering sector, where women graduate as technician and engineers. They contribute to the design of software and hardware in the industry.

And finally, women are implicated at high level, as politicians, parliamentarians, university teachers, CEOs, heads of NGOs and advocate endlessly for women's inclusion in eHealth and telemedicine at all levels.

The programme of the Women and eHealth session is organized along those lines in order to further explore and share with the participants the preliminary results of the WeHealth study and shape the Global Mapping of Women and eHealth.

Annex 1 – WeHealth Preliminary Results 2011

Global Issues

Coordination Mechanisms

The analysis of the information shows significantly that "Women and eHealth" needs to be considered within the context of a complex and multidimensional reality, covering a wide range of sectors and actors, with varied objectives, goals and ambitions. There is an urgent need to improve coordination and communication mechanisms at all levels, with particular attention to women living in refugee camps and conflict areas.

1. *Gender and Digital Gaps.* The combination of the gender gap with the digital divide dramatically affects access of women into the arena of eHealth in various roles – as beneficiaries, users, designers and leaders

– and in particular geographies, such as rural areas where more than 75% of the women live.

2. *Health Information.* Receiving regular information on maternal and child health, family health, disease control, HIV /AIDS, malaria, cancer and vaccination is often cited as an area of interest to women.

Barriers

3. *Cost.* Clearly, the cost of devices, connections and communications are a major barrier for women to have access and use ICTs for health-related purposes.
4. *Education.* Education of women on how to use ICT is of major concern and repetitively mentioned in interviews and reports. Illiteracy and disabilities constitute major impediments to the use of ICT by women.
5. *Language.* It is important for women that eHealth services are delivered in their own languages and dialects. This encompasses all eHealth activities; including (but not limited to) mHealth, telemedicine, EMR, and SMSs.

ICT Solutions

6. *Radio and TVs.* Radio and TV continue to play a major role in the dissemination of health information and should work together with mobile phones and Internet services to reach more women.
7. *Mobiles and voice messaging.* mHealth shows interesting results which, however, remain limited to pilot projects that hardly expand at national and regional levels. Women having the experience of receiving Health related SMSs on their mobile phones appreciate the service when messages are delivered by voice.
8. *Telemedicine.* Telemedicine remains a "male" sector at all levels: medical, technical, and engineering. Women are beneficiaries as patients where such services are available. Very few are doctors, nurses or midwifes active in Telemedicine services. The future *W*eHealth report will provide the experiences of a set of remarkable women working in telemedicine and tele-imagery, who are leading the sector in developing countries.
9. *Toll-free Lines.* Toll-free call lines that allow women to reach health centers and health workers are a need proposed by many *W*eHealth members. In particular, these can be used to support women living in difficult situations such as conditions of violence, natural disasters, war/conflicts, and refugees.

The results of the study will be presented at the upcoming Millennia2015 International Conference at UNESCO, Paris, 3 – 4 December 2012 [2], and will serve to nurture the Women and eHealth session at Med-e-Tel 2013.

References

[1] Millennia2015 counts 7.152 members and WeHealth 431 members (as of 3 September 2012).K. Elissa, “Title of paper if known,” unpublished.
[2] www.millennia2015.org/millennia2015_unesco_conference_2012

Telecardiology

1,000,000 Electrocardiograms by Distance: An Outstanding Milestone for Telehealth in Minas Gerais, Brazil

M. B. Alkmim[1], M. S. Marcolino[1,2], E. V. Santos[1,2], M. P. de Abreu[1], G. A. C. Silva[1], L. R. Cunha[1], A. G. A. Resende[1], R. M. Figueira[1], A. L. P. Ribeiro[1,2]

[1]Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, 110, Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil, telessaude@hc.ufmg.br

[2]Medical School, Universidade Federal de Minas Gerais, 190, Alfredo Balena Avenue, Belo Horizonte, 30130-100, Brazil

Abstract: **The Telehealth Network of Minas Gerais (TNMG) provides teleconsultation and telecardiology services for the primary care system in the State of Minas Gerais, Brazil, to help improving healthcare for the population who live in distant and poor regions. The objective of this study is to describe the evolution of the telecardiology service provided by the TNMG. The service started in 2006 with 82 municipalities and currently connects 660 of the 853 municipalities in the State of Minas Gerais. Using low-cost equipment and simple technology, TNMG has employed various strategies to increase telehealth use. The telecardiology service provided by the TNMG had a progressive increase in the number of EKGs analyzed and nowadays it is a regular health service in the State, integrated to the healthcare system. The service also proved to be economically sound. In conclusion, the telehealth model developed to support primary care in Minas Gerais produced good clinical and economical results.**

Introduction

Minas Gerais is the Brazilian state with the largest number of municipalities (853), most of them with less than 15,000 inhabitants, distributed in an area equivalent to France, with 19 M inhabitants. In this area there are important social, cultural, economic, infra-structural and geographical contrasts. Within this context, telehealth has been used with the objective of improving healthcare for the population who live in distant and poor regions. As Brazil is a developing country, emphasis is put on

financially sound services and thus telehealth must be applied in a manner which optimizes its cost effectiveness.

The Telehealth Network of Minas Gerais (TNMG) provides teleconsultation and telecardiology services for primary care system in Minas Gerais since 2006. The objective of this study is to describe the evolution of the telecardiology service provided by the TNMG.

Implementation and Maintenance

The TNMG started in 2006 with 82 municipalities and currently connects 660 of the 853 municipalities in the State of Minas Gerais. It provides off line teleconsultations for a broad range of specialties, on line teleconsultations in cardiology, analysis of electrocardiograms, Holter and ambulatory blood pressure monitoring; in order to support primary care practitioners.

Financial support is provided by federal, state and municipal government. Using low-cost equipment and simple technology, TNMG has employed various strategies to improve/increase telehealth use. The service keeps an online technical support for the villages. The utilization rates are monitored by a specialized team.

Professionals on Duty

The cardiology activities consist of a duty service. Electrocardiograms (EKGs) are sent by remote health care professionals through the internet to be analyzed by cardiologists who are trained and experienced in the analysis

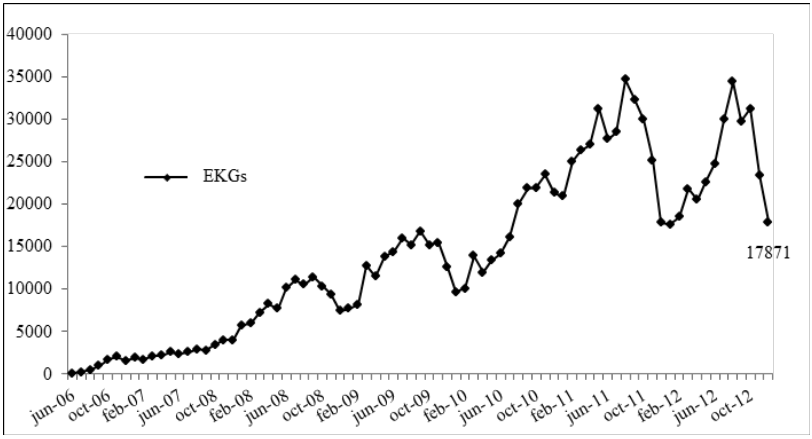


Figure 1: Number of EKGs per month in 657 municipalities from June 2006 to December 2012. EKGs = electrocardiograms

and interpretation of EKGs. When necessary, the cardiologist may discuss the clinical cases with the local physician using the telecardiology system.

Utilization Rates and Economic Analysis

The telecardiology service provided by the TNMG began in June 2006 and had a progressive increase of the number of EKGs analyzed (Figure1). During the whole period, the monthly EKGs' service utilization rates were around 90% (Figure 2), what shows that the service was well accepted by the practitioners and incorporated to the health system of the municipalities [2]. The only exception was the period from April to September 2010, in which the decreased utilization rates match with an implementation phase that doubled the number of municipalities using the service. This decrease was already expected, due to training time required to begin the use of the service.

Therefore, the telecardiology is nowadays regular health service in the State, integrated to the healthcare system. In August 20th 2012 the TNMG

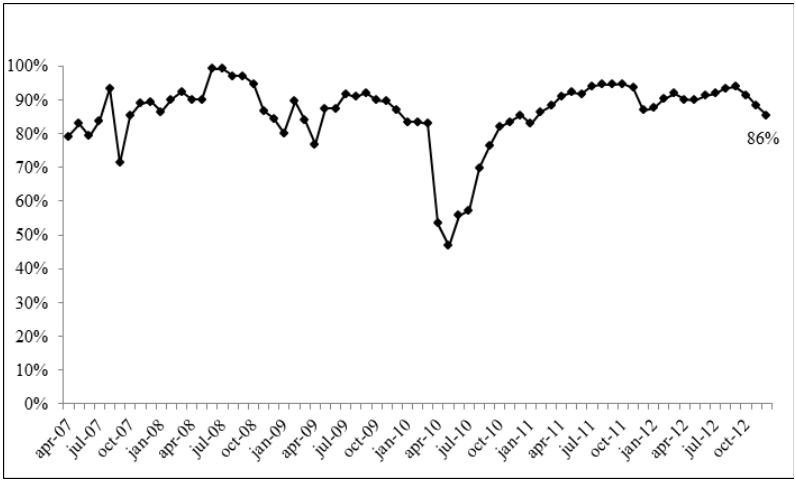


Figure 2: Monthly electrocardiogram utilization rates from April 2007 to December 2012. The rate is calculated by (number of municipalities which used the service in the month)/ (total number of municipalities

reached 1,000,000 electrocardiograms and 43,461 teleconsultations. The primary care physicians reported to feel more satisfied with the structure available for handling cardiovascular diseases after the implementation of the service [5].

In addition, the service proved to be economically sound, promoting savings of 32.5 M USD for an investment of 10 M USD, an outstanding milestone for telehealth in Brazil. To achieve these results, technology and maintenance methodology are constantly evaluated and improved.

In this process, it was possible to identify the main success factors: collaborative network, partnership government and academia, to meet real needs of users, to use simple and low-cost technology, adequate combination between virtual and personal process and economic sustainability. The success in primary care led it also to be adopted in secondary and emergency care.

Conclusion

The telehealth model developed to support primary healthcare in Minas Gerais, Brazil, has produced good clinical and economical results. As a consequence, it is now a regular health service in the State, covering 660 of the 853 municipalities and integrated to the healthcare system. It has also been expanded to secondary and emergency care. The model and technology characteristics permit the replication in other parts of the world.

References

[1] MB Alkmim, RM Figueira, MS Marcolino, CS Cardoso, M Pena de Abreu, LR Cunha, DF da Cunha, AP Antunes, AG Resende, ES Resende, AL Ribeiro. Improving patient access to specialized health care: the Telehealth Network of Minas Gerais, Brazil. Bull World Health Organ. 2012 May 1;90(5):373-8.

[2] MBM Alkmim, ALP Ribeiro, AP Antunes et al. Incorporación de la Telesalud em ele Sistema Público de Salud de Minas Gerais. Santiago: CEPAL; 2012.

[3] ALP Ribeiro, MBM Alkmim, CS Cardoso, GG Carvalho, WT Caiaffa, MV Andrade et al., Implementation of a telecardiology system in the state of Minas Gerais: the Minas TelecardioProject. Arquivos Brasileiros de Cardiologia. 2010; 95 (1), 70-8.

[4] MBM Alkmim, ALP Ribeiro, GG Carvalho, MP Abreu, ML Carvalho. Success Factors and Difficulties for Implementation of telehealth System for Remote Villages: Minas Telecardio Project Case in Brazil. Journal of eHealth Technology and Application. 2007; 5, 197-202.

[5] GL Oliveira et al. Physician satisfaction with care to cardiovascular diseases in the municipalities of Minas Gerais: Cardiosatis-TEAM Scale. Rev. Bras. Epidemiol. 2011;14(2):240-52.

Maria Beatriz Moreira Alkimim: Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1979), residency in Clinical Pathology and specialization course in Hospital Management. She has been working with Telemedicine and Telehealth since 2001, as the coordinator of the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais. She is currently a member of the Executive Committee of Telehealth of the Brazilian Health Ministry.

Milena Soriano Marcolino: Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (2004), residency in Internal Medicine (2007), and doctorate in Internal Medicine from the Universidade Federal de Minas Gerais (2011). She is currently a Professor at the Medical School, Universidade Federal de Minas Gerais and Quality Control Manager at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais.

Emília Valle Santos - 6th year's Medical Student of the Universidade Federal de Minas Gerais, Brazil, which was recently ranked among the 10 Best Universities of Latin America by ***QS World University Rankings®.*** She has been undertaking research at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais, since 2013

Monica Pena De Abreu - Master Degree in Epidemiology (UFMG-2006), Specialist in: Hospital Administration (UERJ-2002), Strategic Business Management (UFMG -2001), Hospital Management (ENSP-1998). Undergraduate in Occupational Therapy (UFMG, 1992). Has experience in Public Health with emphasis on Planning and Management of Health Services. Works in the field of Telemedicine/ Telehealth since 2006. Currently is an advisor of Telehealth Center of Hospital das Clinicas (UFMG) and an executive of Brazilian Telehealth Program, Minas Gerais team.

Geisa Andressa Corrêa Da Silva - Bachelor degree in Actuarial Sciences by the Pontifical Catholic University of Minas Gerais (2010). She has two years of experience on process management, planning and actuarial consultory. Currently works as Data Analyst at the Telehealth Center, University Hospital, Universidade Federal de Minas Gerais.

Lemuel Rodrigues Cunha - Graduated in Information Systems, MBA in Software Engineering and IT Governance. Coordinator in the Clinical Hospital of Federal University of Minas Gerais. Experience in Computer Science with emphasis in Computer Systems operating in the area of health and telehealth.

Adelson Geraldo De A. Resende - Bachelor's Degree in Medicine from Universidade Federal de Juiz de Fora (1974). Postgraduate in Escola Médica de Pós-Graduação PUC-Rio de Janeiro (1975). He is currently Professor at the Medical School, Universidade Federal de Juiz de Fora. Collaborates since 2005 with the University Hospital of UFJF at is Telehealth Center.

Renato Minelli Figueira - 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 Massachussetts Institute of Technology (1983) and a MBA in Finance by UFMG (1994). Collaborates since 2007 with the University Hospital of UFMG at its Telehealth Center working on economic aspects of telehealth.

Antonio Luiz Pinho Ribeiro - Bachelor's Degree in Medicine from the Universidade Federal de Minas Gerais (1988), residency in Internal Medicine (1990) and Cardiology (1992), and doctorate in Medicine from the Universidade Federal de Minas Gerais (2011). He is currently a Full Professor at the Medical School, Universidade Federal de Minas Gerais, and coordinator of the Telehealth Center and the Clinical Hospital, Universidade Federal de Minas Gerais.

Algorithm Evaluation: Identification of Electrocardiogram R Wave

J. Rosario, R. Ferreira, E. Marckmann, I. Scheffler, M. Correa, T. Russomano
Scientific Department, Toth Technology and LIFEMED, Av. Ipiranga, 6681, Predio 99ª, 13° Andar, Porto Alegre, 90619-900 Brazil
contato@tothtecnologia.com.br

Abstract: **Introduction: ECG automatic analysis, as used in patient monitors, is fundamental for a correct evaluation of the patient health condition. Objectives: To evaluate the sensitivity of algorithms of multiparametric cardiac monitors used to identify the R wave of electrocardiograms. Methods: The study consisted of 3 phases: Preparation - obtaining ECG's from a cardiac arrhythmias database to standardize testing and the selection of monitors for the comparative study. Testing – Each monitor was stimulated by ECG waves generated from the discrete samples of the MIT-BIH Database. Data analysis – Correct identification of the R wave peak was assessed by software developed by the project team. The evaluation considered 3 possible situations: Positive-Positive (PP), False-Positive (FP) and False-Negative (FN). Results: Analysis of 43 ECG recordings demonstrated 99.01% sensitivity in the identification of the R wave (PP) by the Lifetouch-10 monitor, with an error of 1.87% being observed between FP and FN. The other monitors evaluated showed lower sensitivity and a higher error. Conclusion: The LIFEMED Lifetouch-10 monitor presented a satisfactory performance of its algorithm when compared to the other monitors.**

Introduction

The heart rate registered by electromedical equipment is determined by detecting the QRS complex from the electrocardiogram signal. This measure is directly influenced by the different forms that an ECG signal can have, which, in turn, are primarily due to cardiovascular diseases, such as cardiac arrhythmias. These differences can cause errors when automated counting is performed [1].

The development of software for the identification of the QRS complex has been the subject of research for more than three decades, with several protocols having been accepted and validated [2-3]. Some variables are

essential in the automatic detection of the QRS complex, such as the shape, amplitude and width of the evaluated waves, as well as filters used to minimize interference that may lead to mistaken identification of the ECG waves [4].

Effective identification of the QRS complex requires that the R point of the curve is first of all identified [5] and from this, the Q and S points can be analyzed, thereby completing the process.

It is necessary that these developed software solutions are subjected to testing in a laboratory environment in order to ensure their correct and appropriate behavior.

Objective

Thus, the aim of this research was to evaluate the sensitivity of the algorithms used by multiparametric monitors in the identification of the R wave of electrocardiograms.

Materials and Methods

The development of this work was divided into three phases: preparation, testing and data analysis.

Preparation – For the standardization of the tests, 43 recordings of DII electrocardiograms were obtained from the MIT-BIH Physionet cardiac arrhythmias database [2], together with the respective indications of the R wave occurrence, as determined by a group of cardiologists. Each recording was approximately 30 minutes and 5 seconds in duration and was digitized with 11-bit resolution (11mV range) at a sampling frequency of 360Hz, resulting in 650,000 samples.

Five multiparametric monitors available on the market were selected, of which the Dixtal was indicated as being the benchmark quality brand: 1) Dixtal, model DX2010; 2) Philips, model MP20 Junior; 3) General Electric, Dash 4000; 4) Mindray, model PM6000; 5) LIFEMED, Lifetouch-10.

Tests – Each monitor was stimulated by a DAQ NI USB-6259 module (National Instruments), which was responsible for generating the continuous electrical ECG waves from the discrete samples of the MIT-BIH recordings. In addition, the module enabled the acquisition of the electrical pulses emitted by the monitors when indicating the occurrence of a heart beat.

Data analysis – A software was developed by the project team for the analysis of the files generated in data acquisition. To assess the correct identification of the R wave peak under investigation, an evaluation window with an interval of 200 ms between consecutive R waves was determined, based on the correct R wave peak indicated by the MIT-BIH and a heart rate

of 300bpm. This frequency was considered by this study as being the maximum rate that would be encountered by a monitor used in a hospital environment.

In order to avoid reading errors, the detection window was set 20 ms forward to compensate for the time of the internal process of each monitor to take place. The evaluation of the comparison between the reference data (R wave peak) of the MIT – BIH and the data from the monitors considered 3 possible situations:

• Positive-Positive (PP): when the heart beat indicated by the monitor occurred within the evaluation window;

• False-Positive (FP): (1) when the heart beat indication occurred outside the evaluation window with or without an indication within this window; (2) when two heart beat indications occurred within the evaluation window.

• False-Negative (FN): when no heart beat indication was identified. These situations were observed together or separately, as shown in Figure 1.

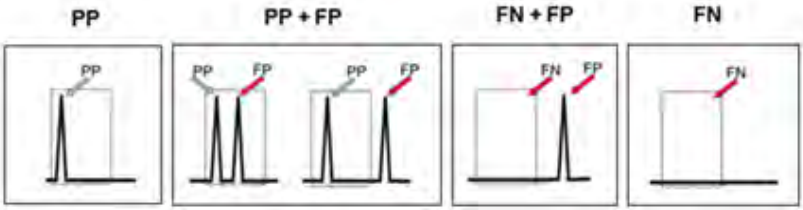


Figure 1: Schematic view of possible results obtained in the analysis of data received by the monitors.

Results

The response of each monitor to the stimulation performed based on the arrhythmias database used is presented in Table 1.

Table 1: Average occurrence values of positive-positive and failure (FN + FP) results from monitor response to stimulation.

	N° of Peaks	**%PP**	**%Failure**
Lifetouch-10	98006	99.01	1.87
DX-2010	98006	98.22	2.01
MP20 Junior	98006	97.82	2.63
Dash4000	98006	92.81	8.15
PM6000	98006	89.52	12.57

Discussion

The MIT-BIH Physionet cardiac arrhythmias database enabled the monitors to be exposed to different waveform morphologies without the need for simultaneous connection of a patient to various monitors. In this way the study was able to be conducted quickly and measure precise responses from each monitor to the stimulation. The results obtained from the analysis of the 43 electrocardiogram recordings by the monitors being assessed showed a sensitivity of 99.01% for the Lifetouch-10 monitor in the identification of the R wave (Positive-Positive), among the 98006 peaks indicated in the analyzed recordings. An error of 1.87% between False-Positives and False-Negatives was also observed (Table 1).

The analysis of the recordings from the other monitors showed a sensitivity of 98.21% for the Dixtal DX-2010, which was 0.79% lower than measured by the Lifetouch-10, and an error of 2.01% between False-Positives and False-Negatives, which was 0.14% higher than for the Lifetouch-10 monitor. Thus, in the tests carried out for this study, the Lifetouch-10 monitor presented a performance at least equal to the other monitors being evaluated, achieving a greater number of true matches (PP) and a lesser number of failures (FP + FN).

Conclusion

The Lifetouch-10 monitor obtained results that demonstrated the reliability of the onboard software. To further develop and better evaluate the algorithm performance, as well as the functionality and operability of this equipment under study, a clinical trial was initiated at the Hospital São Lucas of PUCRS in Porto Alegre, Brazil.

References

[1] B. Köhler, C. Hennig, R. Orglmeister. The principles of software QRS detection. IEEE Engineering in Medicine and Biology. v.21, n.1, pp. 42-57, 2002.

[2] J. Pan, W. J. Tompkins. A real-time QRS detection algorithm. IEEE Transactions on Biomedical Engineering, vol.BME-32, n. 3, pp. 230–236, 1985.

[3] D. Hayn , B. Jammerbund, G. Schreier. QRS detection based ECG quality assessment. Physiol. Meas. v.33, n. 9, pp. 1449–1461, 2012.

[4] F. Gritzali, G. Frangakis, G. Papakonstantinou. Detection of the P and T waves in an ECG. Computers and Biomedical Research. v.22, n.1, pp. 83–91, 1989.

[5] P. S. Hamilton, W. J. Tompkins. Quantitative investigation of QRS detection rules using the MIT/BIH arrhythmic database. IEEE Trans Biomed Eng. v. 33, pp. 1157–65, 1986.

Android® Based mHealth TeleECG System in Ibiraiaras, Brazil

A. Bordignon[1], V. Roesler[2], G. Bônes[3], E. Siqueira[4], R. Timm[4], P. Dias[4], G. Fetter[4], A. Sparenberg[4]
[1] I9access Technology, Brazil, abordignon@i9access.com.br
[2] Federal University of Rio Grande do Sul, Brazil, roesler@inf.ufrgs.br
[3] Hospital São José de Ibiraiaras, Brazil, gtbones@hotmail.com
[4] eHealth Centre of the Instituto de Cardiologia do Rio Grande do Sul (ICFUC), Brazil, edmilson.telecardio@gmail.com, robert.timm@hotmail.com, patriciaod@live.com, gabrielfetter.telecardio@gmail.com, adolfosparenberg@hotmail.com.

Abstract: **Providing qualified health services on a global basis is a major goal as defined by World Health Organization (WHO). eHealth and telemedicine innovative elements, like new mHealth tools, can favor the assistance of remote and underserved populations. This paper describes the implementation of a new Android® based teleECG method in a remote Brazilian village. The main objectives are to validate this system, developed on Android® platform and established in a remote Brazilian region, and to present pilot project results from a 3-month survey period. A total of 131 ECGs were analyzed, and the results brought another light to the expansion of telehealth using mobile for homecare assistance and remote monitoring of patients' vital parameters.**

Introduction

The evolution of telecommunication and electronics has brought, in recent years, a number of new opportunities for the worldwide provision of health services. More recently, the availability of remote transmission of data via mobile devices - through wireless technology - paved the way for the expansion of telehealth with scope for homecare and remote monitoring of patients' vital parameters. Furthermore, new telemedicine tools equipped with 3G/4G and WiFi teletransmission facilities conferred mobility to physicians and healthcare professionals, which usually are overworked. In Brazil, a digital teleeletrocardiography pilot project using Android® operational system was implemented at a community hospital (Fig. 1) in the city of Ibiraiaras - population 7200 inhabitants, located in the state of Rio Grande do Sul (RS). Small cities often have no cardiologists nearby,

making it difficult and lengthy to have an electrocardiogram report. In this case, people need to travel around 31 km to reach another city and have the ECG done, taking at least 7 days until the final interpretation.

Figure 1. Regional Hospital of Ibiraiaras

Project Details

Activities started in September 2012 and the pilot lasted 3 months. This groundbreaking work is the result of a partnership established between four Brazilian institutions:

- Federal University of Rio Grande do Sul (UFRGS), Laboratory of PRAV (Projects in Audio and Video). Responsible mainly for the research specification;
- eHealth Centre of the Institute of Cardiology of RS: responsible for the training of the remote professionals and for the interpretation of the exams using mobile devices;
- Company I9Access: responsible for the software development, as well as the training of the professionals for using it;
- Regional Hospital of Ibiraiaras. Responsible for making available the hospital environment and make the exams in their patients using the system.

Figure 2 shows images of the system signals being viewed using an Android application in a Tablet, a smaller regular Android cell phone and a notebook using a web browser. The system is able to cope with 12 derivations ECGs, and the data is stored in a private cloud, being reachable through any web browser or any Android device version 3.2 or newer, in any part of the world. In a matter of minutes it is possible to perform a complete ECG analysis and receive back the remote doctor's report, allowing the patient to go home with the results or to be directed for treatment in a specialized hospital. Besides the almost immediate knowledge of the patient's condition, the removal only will happen when it is really necessary, saving resources to who really needs them.

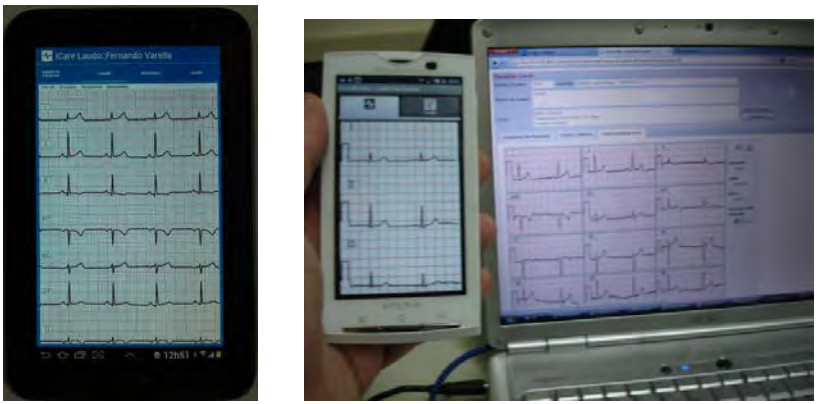


Figure 2. Image of the ECG signal received by a tablet, a regular cell phone and a notebook through a web browser

Methodology

The system was installed in the ECG room of the Ibirariaras' regional hospital, a 7200 inhabitants' village located in the state of Rio Grande do Sul (RS), Brazil. Training sessions for the involved professionals were held both in the Institute of Cardiology of Rio Grande do Sul (ICFUC) and locally in Ibirariaras city, which is about 240 km away. During a 3-month pilot period (between September and December 2012), the ECG exams were performed locally in the remote city and sent through the Internet to a server in the company I9access Technology. Two cardiologists from the ICFUC eHealth Centre - using Android® tablet PCs and mobile phones - analyzed and sent back the final interpretation for elective exams.

Results

A total of 131 ECGs were analyzed: 81 (61,8%) exams were normal, 33 (25,2%) had nonspecific changes, 13 (10%) were analyzed as chronic cases, whereas 4 (3%) were compatible with acute cardiac diseases. No myocardial infarction was found. No major technical issues were reported during the pilot phase.

Most of people (about 70%) that needed ECG in Ibiraiaras city complained about chest pain, headache, breath difficulty, tachycardia and anxiety. About 15% were pre surgery and about 15% were routine. From these patients, only a few of them had to be referred to a bigger hospital to investigate deeply the problem.

The results showed many economic and lifesaving advantages for using the remote ECG system, like: a) reducing time for interpretation – from

about 7 days to a couple of hours; b) referencing to bigger hospitals only when extremely necessary, therefore, reducing costs related to time, transport and healthcare professionals; c) decreasing time for diagnosis and treatment, improving the outcome; d) reduction of lines and congestion on bigger hospitals.

Final Remarks

The big advantage of the method is conferred by its mobile characteristics, allowing two cardiologists to receive digital electrocardiograms accompanied by relevant clinical data and conducting the analysis of teleECGs using last generation cell phones and tablet/portable PCs, both equipped with the Android® platform. The portable technology - "mHealth standard" - of this initiative allows cardiologists to provide 24/7 coverage for the diagnosis of potential cardiac urgencies, wherever they are. This strategy can prove an invaluable technological contribution towards the implementation of regional teleECG networks, with major impact in areas where there is a significant shortage of cardiologists.

Alexandro Bordignon has Bachelor's degree in Information Systems (2006) and Master Degree in Computer Science (2012). Nowadays he is Director at i9Access Technology (http://www.i9access.com.br), a Brazilian company that develops web and mobile systems for telemedicine and telehealth.

Valter Roesler has Bachelor´s degree in Electrical Engineering (1988), Master degree (1993) and PhD degree (2003) in Computer Science. Today he is a professor at Federal University of Rio Grande do Sul, Brazil. He coordinates the PRAV laboratory (Projects in Audio and Video) – www.inf.ufrgs.br/prav, with about 30 researchers and projects related to Remote Education and E-Health, in traditional computers and mobile devices.

Robert Timm was graduated in IT faculty of the Universidade Católica de Pelotas (UCPel) and Post-graduated of web-applications course of Rio Grande University. He is a member of the e-Health Centre of ICFUC-RS and also an individual member of the ISfTeH.

Edmilson K. Siqueira was graduated in IT faculty of SENAC (Porto Alegre/Brazil). He is a member of the e-Health Centre of ICFUC-RS.

Adolfo L. F. Sparenberg, MD, MSc, was graduated in the Medical School of the Federal University of Pelotas/Brazil, in 1985. Cardiologist and head of the eHealth Centre of the Instituto de Cardiologia do RS/Brazil. Coordinator of telemedicine and e-health projects of the Medical Association of Sao Lourenço do Sul (SOMESUL - ISfTeH associated member). Member of the Board of Directors of the ISfTeH (2011-2013) and one of the coordinators of the ISfTeH Students' Working Group.

Gabriel Fetter, MD, was graduated in the Medical School of the Federal University of Santa Catarina/Brazil, in 2005. Cardiologist and one of the coordinators of the ICFUC-RS eHealth Centre. ACLS instructor certified by the American Heart Association since 2006. Also works in the ICU of Nossa Senhora da Conceição Hospital, Porto Alegre-RS / Brazil.

Patrícia Dias, was graduated as nurse in the UNISINOS University, Brazil, in 2009. Attending post-graduation in Urgency, Emergency and Trauma (UET) in SEG Institution. Nurse member of training team of the ICFUC-RS eHealth Centre. Instructor of BLS, certified by the American Heart Association since 2012.

Arterial Plethysmography Project in a Remote Region: Survey Results from 52 Volunteers in Rural Brazil

T. Bohrn[1], M. Petrlík[1], A. Sparenberg[2], A. Born[2], M. R. Dos Santos Hoffmann[2], R. Timm[2], K. Hana[3], J. Kaspar[3], J. Schlenker[3], P. Langer[4]
[1]Advanced Medical Solutions, 119 Videnska, Brno, 61900 Czech Republic
bohrn@amsolutions.cz
[2] Centro da Saúde de Reserva, adolfosparenberg@hotmail.com
São João da Reserva, São Lorenço do Sul, RS Brazil
[3]Czech Technical University in Prague, Faculty of Biomedical Engineering, hana@fbmi.cvut.cz, Studnickova 7/2028 Prague 2, Czech Republic
[4]Brno University of Technology, Department of Biomedical Engineering, Faculty of Electrical Engineering and Communication, Czech Republic

Abstract: **The objective of this study is to prepare the implementation of a sustainable long term, preventive program designed for the early detection of major cardiovascular risk factors in rural areas with specific focus on lower limbs perfusion and the corresponding improved chance for the patients to reverse the pathological processes in time.**

Introduction

Cardiovascular diseases are the most common cause of death and physical incapacity in many countries, with vascular obstructive stenosis affecting cerebrovascular, coronary and other arterial territories. High cardiovascular risk people, like smokers or those suffering from diabetes mellitus are victims of lower limbs arterial obstructive disease, which courses a long period in absence of both symptoms or clinical evidence. Early stage diagnosis, obtained through non-invasive strategies, has been proposed as a means of diagnosing incipient vascular occlusion. In 2012, as a result of a bi-national partnership an arterial plethysmography survey was conducted at "Centro de Saúde da Reserva" (CSR) - a rural hospital located in the city of São Lourenço do Sul / 44,000 inhabitants - in southern Brazil.

Objectives

- To analyze the applicability of a noninvasive diagnostic strategy for the early detection of arterial flow reduction in a rural population of Brazil;
- To introduce an innovative telemedicine platform allowing data storage and transmission for specialized second opinion;
- To promote technical qualification of remote professionals of health sector in the field of new technologies.

Methods

The applied methods and equipment are based on plethysmography principles and were developed at the headquarters of Advanced Medical System Inc. (AMS), in Brno, Czech Republic. In August 2012, the system was installed at the CSR, Brazil. A 3-month pilot period was carried, which included room selection, equipment installation, testing and analyzing data acquired from a group of volunteers. The method consists of two cuffs positioning and inflation during up to 120 seconds, as applied in both inferior limbs. Arterial wave flow data are collected, transmitted through the web and analyzed in two steps: first risk detection by the automated expert installed in the equipment itself and then evaluated and verified by an angiologist. The protocol included collecting blood samples for the analysis of potential risk factors. The core focus of the method is to provide an early and non-invasive diagnostics of the peripheral perfusion which allows to evaluate the quality of the arterial, venous and lymphatic function and to detect the level of cardiovascular and metabolic risk factors.

Results

The plethysmography pilot phase was implemented in the ambulatory sector of the CSR. A 5-day period of capacity building, locally delivered under responsibility of an AMS team expert qualified two nurses, a medical doctor, an IT expert and a medical school student to operate the method. After that, during 2 months, a total of 52 volunteers with a mean age of 50 years - 24 male/28 female - were selected and, after signing a consent form, were submitted to the plethysmography study.

Risk factors detected with the plethysmography diagnosis - evidenced as “abnormal peripheral perfusion indicators, e.g. arterial capacity and altered arterial waves” - were detected in 18 volunteers (34,61%) and 34 volunteers (65,39%) had normal values. In total there were evaluated 10 indicators related to the peripheral perfusion and the arterial wave analysis. The difference between the normal values and those altered corresponding to patients with detected risk factors exceeded 50% in some cases. The presence of Diabetes Mellitus in 11 volunteers (21,15%) and of Cholesterol

disorders in 10 subjects (19,23%) were the most prevalent detected risk factors established based on anamnesis and were verified by standard laboratory tests.

Discussion

Early detection of altered arterial flow indicators will help in the prevention of cardiovascular disease and avoid physical incapacity due to premature limb loss by early introduction of treatment interventions. The patients with altered values of the peripheral perfusion detected during this study are given a better chance to improve and reverse the corresponding pathological processes. That can be especially valuable when applied to underserved areas of the globe, where specialized vascular evaluation facilities are, for obvious reasons, unavailable.

Through the application of a low cost and easy to use arterial plethysmography method, preclinical vascular disease can be anticipated to a population living in remote areas, warning the need for immediate complementary diagnosis and effective therapy. Individual and social benefits are expected to be confirmed through long term evaluation of this strategy, deserving its application in a larger setting of patients.

Development of Telemedical Practice Platform: Application to Telesurveillance of Cardio-Respirographic Function

N. Hamlil, M. Benabdellah
Faculty of Technology, Laboratory for Biomedical Engineering, University of Tlemcen, Algeria, nabilahamlil@gmail.com; m_benabdellah_2000@yahoo.fr

***Abstract*—we propose in this paper to study and develop a human interface device dedicated to Tele monitoring of the cardiopulmonary function. This device can be operated with different communication Protocols and will be a technical equipment able to monitor on the patient in real time and simultaneously three physiological signals representative respectively of the electrical activity of the heart pump (ECG), mechanical activity of ventilation pump (PTG) and respiratory activity of pulmonary interchange (PPG) and transfer these signals through the Tele medical networks view Telemedical application as data archiving at ends of Telemonitoring, IDM preventives,Tele weaning of artificial ventilation at home etc.**

Introduction

This new medical practice which is the Telemedicine made it possible to improve considerably quality of the care and the assumption of responsibility of the fragile people, isolated people and people living in distant zones where the access to care of quality poses problem [1].

We present in this paper:

1- Hardware and software implementation of micro-controlled man-machine interface able to take on the patient a signal unidimensional, to forward them to a local station under the protocol of communication RS232 built under environment MPLAB.

2- The implementation of an application allowing posting, the filing and the digital processing of the various signals built under environment Visual BASIC (VB) and making profitable the Mscomm component of VB in relation to the operating system Windows for standard RS232.

3- The implementation of a Telemedical network for the transfer of the data under protocol TCP-IP using in particular the component Winsock of Visual BASIC which allows the implementation of Client-server architecture [2, 6, 8].

Structure of Telemedical Platform

It comprises:

- The patient source and recipient of medical information.
- DTE (Data Terminal Equipment) charged to collect information on the patient.

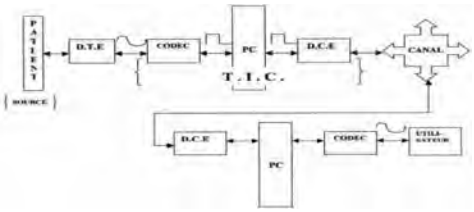


Fig. 1. Structure of telemedical platform

- The CODEC (Coder Decoder) charged to make forward information resulting from the DTE towards the local computer terminals and conversely.
- PC (Computer terminal) local or distant charged to present medical information at the experts of medicine in exploitable and convivial form, to store this information and to lodge the various applications and platforms software of digital processing and transfer of multi-media medical information by means of an environment of programming given.

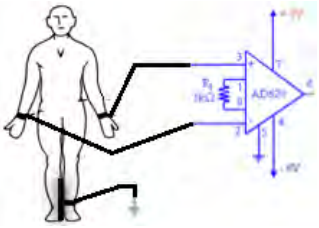


Fig. 2. Instrumentation amplifier

- DCE (Data Communication Equipment) charged to adapt the informational signal to the transmission channel, to transfer the medical data towards distant terminals via the tele medical networks and to maximize the flows by means of the techniques of the high speed.

Techniques and Methods Developed under Protocol RS232

Acquisition Device of ECG Signal

This one is collected by means of an instrumentation amplifier represented by figure 2:

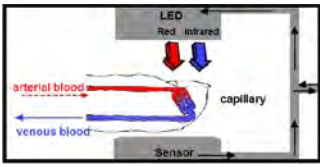


Fig. 3. 9PPG signal acquisition.

Acquisition Device of PPG Signal:

This is obtained by making contributions of two emitting diodes (red and infrared) and a phototransistor as shown in figure 3:

Device of Collection of Signal PTG

This one is acquired by a differential pressure sensorwith variable reluctance shown in figure 4:

Implementation of the CODEC

The CODEC which we implemented articulates around microcontroller 16F876A equipped with a module USART (Universal Serial Asynchronous Receiver Transmitter) and with a module ADC (Analog to DIGITAL Converter) 10 bits.

The parameters RS232 which we used are: Speed transmission 57600 bauds -8 bits of data – Noparity bit - One bit start/stop.

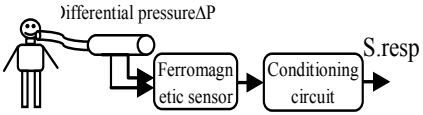


Fig. 4. PTG signal acquisition

The configuration of the registers system of the microcontroller concerning analogical conversion and the speed transmission are: Put in 1 and 0 the bits 6 and 7 respectively of register ADCON0 to choose a frequency of conversion equal to fosc/32 = 625 Khz, which allows a conversion timeof one bit equal to Tad = 1,6 µ S - Set BRGH bit of register TXSTA to choose the mode High speed - Loading of register SPBRG with the decimal value 20 to select a flow of 57600 Bauds.

Interface Software

The software application of reception and displayingdata was implemented under environment Visual BASIC (VB) by means of the Mscomm component of VB which allows the asynchronous reception series of data.

Results achieved:

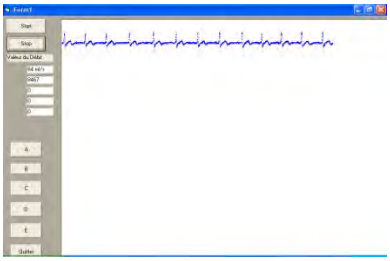


Fig. 5. Layout of Electrocardiogram ECG

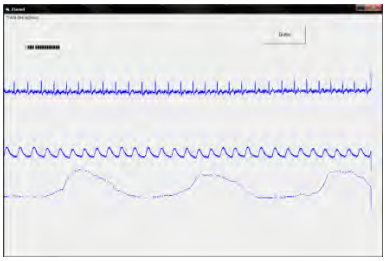


Fig. 6. Simultaneous Acquisition of three signals ECG, PPG and PTG.

This allows simple selection of the different waves on different signals (ECG, PPG and PTG) to show their amplitudes and durations. We also

implemented a numerical integration to calculate tidal volume from the inspiratory flow [3, 4, 7].

Conclusion

The realization of such interface of man-machine communication allows the recording in real time of the physiological signals

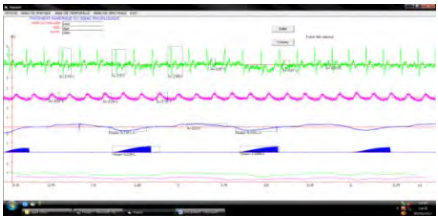


Fig. 7. Viewing magnitudes (1.ECG, 2.PPG, 3.PTG, 4. Tidal Volume VT)

The prospects for this work is to make a Homme interface - Machine of information and Télé communication - medical multidimensional and multi-media intégrative and evolutionary, able to replace a panoply of medical technical plates, to make possible of the characterization multiparametric of different physiological functions and to make digital processing correlativeof physiological signals acquired simultaneously, to file and transmit the medical data to concretize in the long term The concept Tele-Hospital[5].

References

[1] D. A. Prilutskiy, S. V. Selishchev, and A. O. Ustinov, A Device for Wireless Transmission of Electrocardiographicand Electroencephalographic Data,Biomedical Engineering, Vol. 45, No. 6, March, 2012

[2] David ROS: Protocole de transport TCP, Maître de conférences à l'École nationale supérieure des télécommunications (ENST) de Bretagne, DOSSIER Techniques de l'Ingénieur (22/04/2012).

[3] Madhav, Estimation of respiration rate from ECG, BP and PPG signals using empirical mode decomposition, instrumentation and measurement technology conf. 2011 IEEE.

[4] J. Lazaro, "Driving Respiration from the pulse Photoplethysmographic signal", computing in Cardiology 2011.

[5] G. Normand, B. Bonny, L. Raucy, T. Theodoropoulos, Communications dans les systèmes embarqués (24 mars 2011).

[6] G. Pujolle: Protocoles de transmission de données, Professeur à l'Université de Versailles, DOSSIER Techniques de l'Ingénieur (22/04/2012).

[7] M. V. Kamath, F. L. Fallen, "Correction of the Heart Rate Variability Signal for Ectopics and Missing Beats," in M. Malik and A. J. Camm, (eds.), Heart Rate Variability, Armonk, NY: Futura Publishing, 1995, pp. 75–85.

[8] N. Barroca, F. J. Velez, A. S. Lebres. Energy-Aware Medium Access Control Protocols for Wireless Sensor Network Applications, MSc thesis, Universidade da Beira Interior (September 2009)

Nabila, Hamlil Nabila, born 1984 in Algéria, she is PhD in Telemedicine, GBM Laboratory, Tlemcen University. She is biomedical electronics engineer (EBM) (2007), has a Master in EBM (2009). Here research is in acquisition devices of physiological signals, their treatment, their archiving and their transmission

Mohammed Benabdellah received the Diploma of Engineer state degree from the Polytechnic National School, Algiers-Algeria, in, Magister prepared at the National Institute of Health and Research Toulouse (INSERM) , in 1984, Ph.D. New Plan at Paul Sabatier University in Biological and Medical Engineering in 1987, Doctorate state in Biomedical Engineering granted as equivalence in1991.Then, Professor at the University of Tlemcen (Algeria). Team Leader of Telemedicine of Biomedical Engineering Laboratory

Manufacturer Independent Interface for Cardiac Rhythm Disease Management

C. Arthofer[1,2], D. Hayn[1], G. Schreier[1]
[1]AIT Austrian Institute of Technology GmbH, Assistive Healthcare Information Technology, Austria
[2]Graz University of Technology, Biomedical Engineering, Graz, Austria

Abstract: **The number of patients with cardiovascular implantable electronic devices (CIEDs) is steadily growing due to technological developments, additional indications and the increasing number of elderly in the population. To manage this huge amount of patient- and device-related data and to disburden clinicians, the central Platform for Integrated CArdiac Rhythm Disease management (PICARD) was developed by AIT. Although standardized medical data formats for the exchange of CIED data exist, each CIED vendor uses a proprietary file format. Hence data had to be manually entered in the PICARD web form. The aim of the current work was to advance this situation towards an automated import of relevant parameters from programmers, additionally to the manual input of data in the web form. Therefore a Standardized PRogrammer INTerface (SPRINT) for two vendor-specific programmers was designed, prototypically implemented and integrated in the workflow of PICARD. It supported the export of proprietary files via Bluetooth from the programmer to the client computer, automated import of relevant parameters into PICARD and merging with data manually entered by the user. Tests with existing examples of exports from the programmers showed considerable savings in time and an increase in documentation quality is expected.**

Introduction

The number of patients with CIEDs (including pacemakers, implantable cardioverter defibrillators and cardiac resynchronization therapy devices) is steadily increasing due to cardiac arrhythmias such as bradycardia, tachycardia and heart failure. The widening field of indications for CIEDs as well as the growing amount of elderly in the population and technological advancements led to approximately 160.000 CIED implantations in 2011 in Austria and Germany [1, 2]. But selection and implantation of a cardiac device is only the first step in the life-long therapy

management of those patients [3]. According to the HRS/EHRA [1] regular follow-ups to check device settings and stored diagnostic data are crucial. Hence the management of this huge amount of patient- and device-related follow-up data has become a substantial burden and an ongoing issue for clinicians. In order to reorganize the management, AIT developed the web-based PICARD, which represents a central management system for all relevant data related to the patient's CIED therapy. Although medical standards for the exchange of CIED data exist, most vendors use proprietary data formats. Hence, up to now, data had to be manually entered in the PICARD web form, which was very time-consuming and carried the risk of inconsistency. Therefore, the current work aimed at advancing this situation towards an automated import of relevant parameters from proprietary file formats (Biotronik and Boston Scientific).

System Outline

Integration of a Standardized PRogrammer INTerface (SPRINT) into the Follow-up Workflow

The SPRINT software was implemented as a Java Web Start application and integration into the pre-existing workflow was mainly based on the scheme of the IHE Profile Retrieve Form for Data Capture. In the context of this work, the Profile was realized in the following way: SPRINT served as the *Form Filler*, which retrieved data from PICARD (*Form Manager*) and added all available data interrogated by the programmer. All data were sent back to PICARD, which now acted as the *Form Receiver*.

The XForms data exchange format, which is suggested in the IHE Profile, was replaced by the widely used JSON format, since XForms required the installation of browser plugins on the client computer.

As illustrated in Fig. 1 there are two ways of gathering data: manually by entering them in the web form (1) and automated by importing a file, generated by the programmer (2). Parameters from both sources are mapped to PICARD specific parameters, merged, checked for discrepancies (3) and returned to PICARD (4) [3]. These three steps are described in detail in the following.

1. Manual Input of Data

In the pre-existing version of PICARD, follow-up data could be entered manually using a web-form. This form was extended by a button. By clicking this button the data currently entered in the form are extracted using JavaScript, transformed in JSON format and forwarded to the Java Web Start application SPRINT.

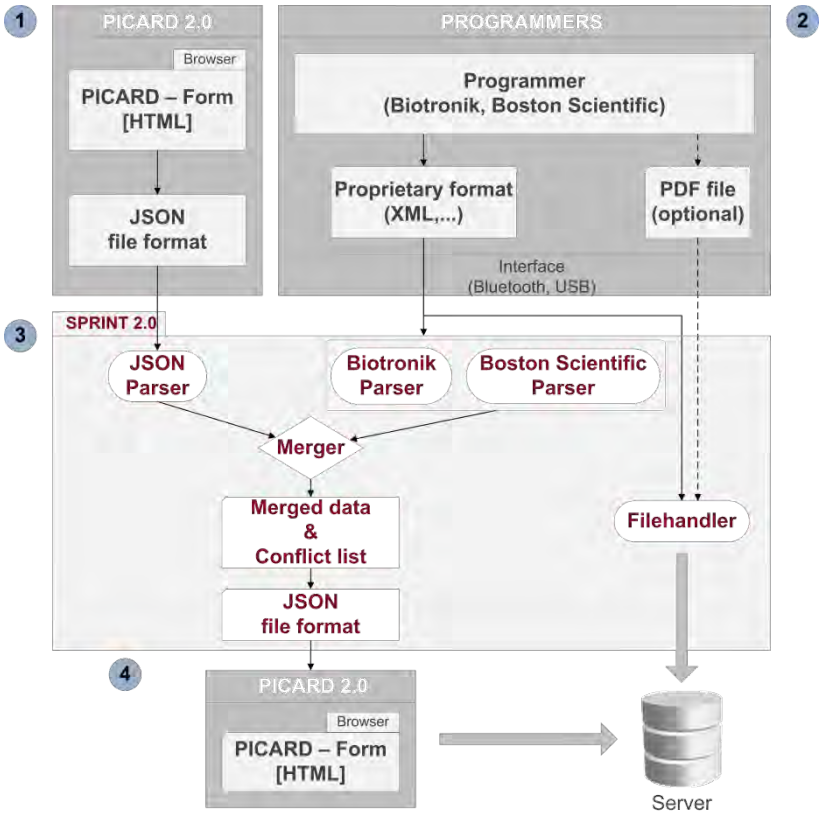


Figure 1: Schematic diagram of the Standardized PRogrammer INTerface (SPRINT) integrated in the workflow of the Platform for Integrated CARdiac Disease management (PICARD). Redrawn from [4]

2. Data Export from the Programmer

On the programmer the user can select files with parameters interrogated from the CIED and export them to the local client computer. According to the supported interfaces of the programmer, the files are exported via Bluetooth, USB device or floppy disk.

3. Data Processing in SPRINT

Once SPRINT is launched, data from both sources (PICARD follow-up form and programmer) are parsed. Parameter values in JSON format are transformed in a JSON Array. Biotronik files are additionally converted from the original Biotronik XML format into the BIO 11073-10103 format

by the freely available Biotronik software adapter. Then the BIO 11073-10103 or Boston Scientific file is parsed and transformed into a Java object hierarchy. The vendor-specific parameters are mapped to PICARD-specific parameters, compared to the manually acquired data in the JSON Array and in case of discrepancies added to a conflict list by the conflict manager.

4. Data Export to PICARD

Finally, the merged data and the result of the conflict manager are transformed to JSON format and transferred back to PICARD. The parameter values are reassigned to their corresponding parameters in the web form and conflicts are displayed in a message field. Furthermore, the original source file and (if available) a PDF file are stored on the server.

Conclusion

SPRINT supports the export of proprietary files from two programmers of different manufacturers to the local computer via Bluetooth and allows the easy, fast and save import of vendor-specific parameters into PICARD. Additionally, the user has the opportunity to add, modify or delete data manually. In case of conflicts in between manually entered values and data from the programmer, the user is warned. The interface could easily be expanded by modules for other vendors and it was tested with examples of exports from Biotronik and Boston Scientific. Using the interface, documentation of follow-ups of CIED patients is expected to a) take significantly less time and b) improve data quality, which finally has the potential to improve the outcome and reduce costs of cardiac rhythm disease management.

References

[1] B. L. Wilkoff, A. Auricchio, J. Brugada, M. Cowie, K. A. Ellenbogen, A. M. Gillis, et al. "HRS/EHRA Expert Consensus on the Monitoring of CIEDs: Description of Techniques, Indications, Personnel, Frequency and Ethical Considerations" Europace 2008, 10, 707-725

[2] A. Auricchio, K.-H. Kuck, R. Hatala, F. Arribas. "The EHRA White Book 2012," Sophia-Antipolis, France: European Heart Rhythm Association; 2012.

[3] D. Hayn, H. Kumpusch, R. Labenbacher, R. Modre-Osprian, G. Schreier. "Information Technology Aspects of Integrated Cardiac Rhythm Disease Management," In Modern Pacemakers – Present and Future. Edited by Das K M, Rijeka, Croatia: InTech; 2011:3-24.

[4] C. Arthofer. Manufacturer Independent Interface for Cardiac Rhythm Management – Master Thesis. Graz University of Technology (unpublished).

Christoph Arthofer is currently finishing his study of biomedical engineering at the technical university of Graz. During his master thesis he developed the presented interface for CIED programmer devices.

Günter Schreier received the Doctoral and Habilitation degrees in electrical engineering/ biomedical informatics from the University of Technology of Graz, Graz, Austria, and the M.Sc. degree in communications and management from the Danube University Krems, Krems, Austria. Following positions in research and industry, he is currently a Senior Scientist at the Austrian Institute of Technology GmbH, Graz. He has authored or co-authored more than 300 scientific publications and presentations, teaches at three Universities in Austria. His research interests include biomedical informatics, mHealth, and telemedicine. Dr. Schreier is currently the Secretary General of the Austrian Society of Biomedical Engineering and chairs the working group “Medical Informatics and eHealth” of the Austrian Computer Society. He serves as the Founder and President of the Annual Scientific Conference on “Health informatics meets eHealth” in Vienna, Austria.

Dieter Hayn received the Ph.D. degree in biomedical engineering from the Health and Life Science University Hall/Tyrol in 2007. Since 2003, he is working as a Scientist at the Austrian Institute of Technology GmbH. His research interests include biosignal processing, data modelling, risk prediction algorithms and mobile-phone based home monitoring. Dr. Hayn is a Co-Editor of the proceedings of of the Annual Scientific Conference on “Health informatics meets eHealth” in Vienna, Austria. In 2004, 2006 and 2011 he was winner of the international “Computing in Cardiology Challenge”, respectively.

The Role of Raised Cosine Shaping Filter Parameters in ECG Transmission Quality via WLAN IEEE802.11b Channel

S. A. Chouakri[1], M. A. Berber[1], A. Taleb-Ahmed[2]
[1]Laboratoire Télécommunications et Traitement Numérique du Signal – LTTNS, Université de Sidi Bel Abbes, BP 89 22000, Alegria
sa_chouakri@hotmail.com; mimouhber@hotmail.fr
[2]Laboratoire LAMIH UMR CNRS 8530, Université de Valenciennes et du Hainaut Cambrésis, France taleb@univ-valenciennes.fr

Abstract: **The purpose of this work is the study of the Nyquist shaping filter. Our study consists on evaluating the performance of the Raised Cosine Filter for ECG signal transmission quality via a 'simulated' WLAN IEEE802.11b channel. The raised cosine filter is defined with a set of parameters that are the sampling and cut-off frequencies F_s and F_c, the roll-off coefficient α and the 'Kaiser' truncation window order. The quantitative (numerical) evaluation as well as qualitative one, concretized by eye diagram and visual perception, demonstrate that for an adequate ECG signal transmission quality (without or with reduced inter symbol interference) a judicious choice of RCF parameters should be taken into account. Our analysis shows that for a comprise of null inter symbol interference ISI and good spectral efficiency the set of the 'Kaiser' truncation window order of 40 and roll-off coefficient α of 0.3 should be utilized for the definition of the Raised Cosine Filter. This combination provides a BER of $9*10^{-4}$ and difference error (between the transmitted and received ECG signal) of (0.0018 ± 0.1024).**

Introduction

Digital communications today require multiple skills: antenna, modulation and filtering (signal processing), and networking. The radio propagation in urban areas or within buildings gives rise to multiple reflections. Signals reflected radios are appointed multipath.

If spreading in time delays of the different routes is large enough, the channel impulse response obtained by sampling at the rate of the transmitted symbols will have several samples not null; which causes interference between symbols (ISI). In addition, in a dynamic scenario, the impulse response of the canal varies over time; which complicates the structures of receivers. To eliminate interference between symbols, the

transmitter ought to have a shaping filter. In baseband transmission, the shaping filter is used to [1-2]: reduce bandwidth channel and cancel the inter-symbol interference (ISI).

Raised Cosine Filter RCF and ISI

Inter Symbol Interference ISI

Inter Symbol Interference occurs if the amplitude of the pulse before sampling in reception depends [3], at the moment of decision, to the neighboring symbols [3]. To cancel the ISI phenomenon, the Nyquist condition, in time and spectral domains, should be respected [3] that are:

$h(nT_S) = \begin{cases} 1 & \text{for } n = 0 \\ 0 & \text{for } n \neq 0 \end{cases}$ (1)	$\frac{1}{T_S}\sum_{K=-\infty}^{+\infty} H\left(f - \frac{k}{T_S}\right) = 1$ (2)

Raised Cosine Filter RCF

The raised cosine filters are a generalized case of Nyquist filter [3].

Its frequency and temporal responses are given by:

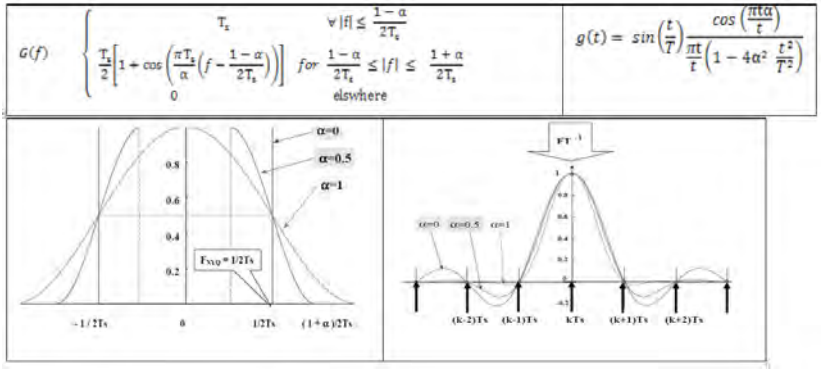


Figure 1: frequency response and impulse response of the raised cosine filter with various roll-off factors α [4]

A compromise situation arises: either reduces the bandwidth (α = 0) to increase the spectral efficiency at the cost of a small reduction of the ISI or either removes the ISI (α = 1) but losses in spectral efficiency. In practice it often operates with the compromise α = 0.3 [4].

The Simulation Description

The quantified ECG signal is transmitted, via the chain of

telecommunication WLAN IEEE 802.11b standard implemented under simulink/MATLAB software. Our study consists of evaluating the performance of the RCF filter assessed by the quality of the signal transmission, which is in our case the ECG signal. To do that, we apply changes to certain parameters of the shaping Raised Cosine Filter RCF. For our study, we fix the sampling frequency F_s and the cutoff frequency F_c to 7khz and 88khz respectively and modify the order of the filter for the truncation Kaiser window; the roll-off factor 'α'.

Results and Discussion

Quantitative evaluation

Some rough remarks can be obtained from the study that can be summarized as follows:

1. For the order of the 'Kaiser' truncation window equal to 64 the bit error rate (BER), for different values α, is larger than that of 40.

2. For an arbitrary value of the order of the 'Kaiser' window, it is noted that the value of the difference between the received and transmitted ECG signal ($\mathbf{X} - \hat{X}$) increases as well as the α parameter decreases;

Moreover, it was noticed that the combination of the 'Kaiser' truncation window order equal to 40 and the roll-off factor 'α' of 0.3 provides the best compromise in sense of bit error rate (BER) and difference value.

Figure 2 illustrates the curves of the BERs for α = 1, α = 0 3 and α = 0 and the 'kaiser' truncation window order equal to 40.

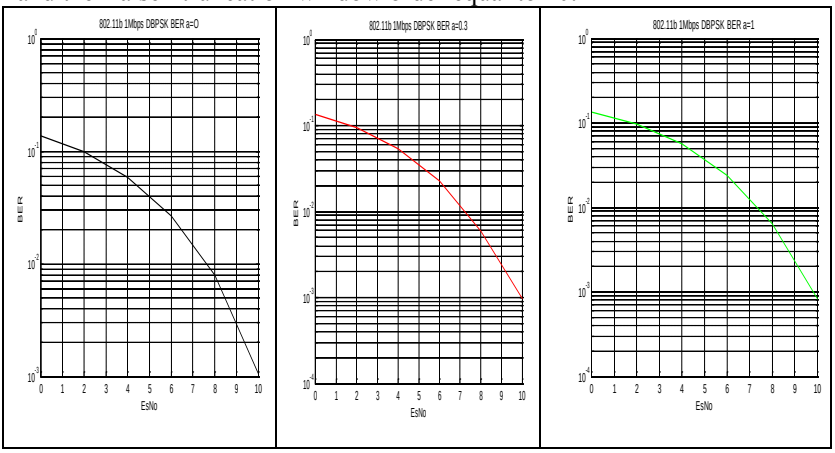


Figure 2: The curves of BERs for $\boldsymbol{\alpha = 1\,;\ 0.3 \text{ and } 0}$.

Qualitative evaluation

The following figure illustrates the evaluation of the RCF parameters.

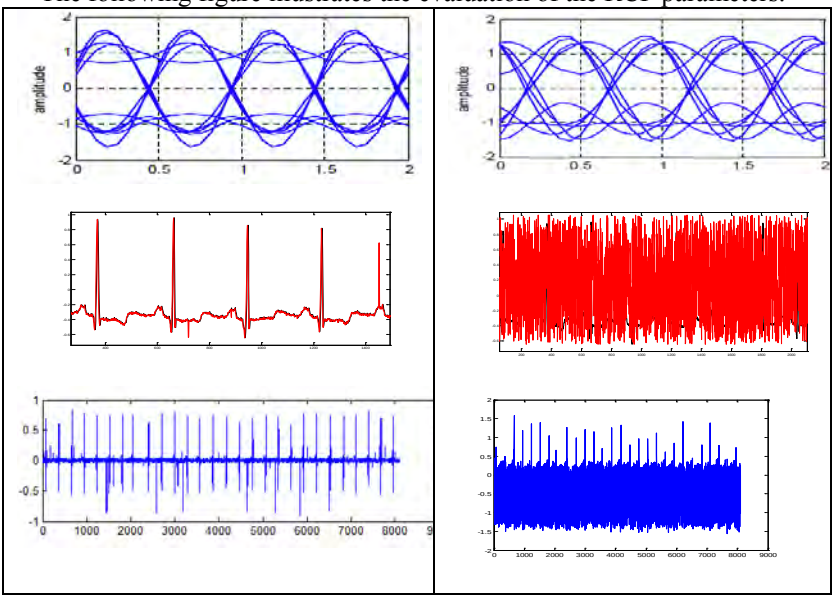


Figure 3: Qualitative evaluation for a combination of 'Kaiser' order of 40 and α of 0.3 (at right) and of 'Kaiser' order of 64 and α of 0 (at left).

Conclusion

The objective of this work is to elaborate a detailed study of the shaping filter and its role in telecommunication systems. Our analysis shows that for a comprise of null inter symbol interference ISI and good spectral efficiency the set of the 'Kaiser' truncation window order of 40 and roll-off coefficient α of 0.3 should be utilized for the definition of the Raised Cosine Filter.

References

[1] Recommendations for the standardization and interpretation of the electrocardiogram , Circulation. 2007;115:1306-1324

[2] J. G. Proakis, "Digital Communications, 3ème édition", McGraw-Hill Book Co., 1995. ISBN 0-07-113814-5

[3] University of Manchester School of Computer Science CS3282: Digital Communications '05-06 Section 6: Inter-symbol interference and pulse shaping BMGC/ 25/08/06 CS3282 Section 6

[4] IUT Marseille Departement De Genie Electrique Et Informatique Industrielle Diplôme Universitaire de Technologie. Cours d'Électronique du Tronc Commun S3. Chapitre 8 : Le filtrage optimisé du signal numérique en bande de base. Notion de BRUIT en télécommunication.

Wrist-Worn Wearable Pulse Oximeter for the Remote and Continuous Health Monitoring without Fingertip Sensor

L. Eisen[1], L. Goldinov[2], L. Shenkman[3]
[1,2]Oxitone Medical Ltd, leon.eisen@oxitone.com
Tzomet Abba Hillel, North Ind. Zone, POB 7284, Ashkelon 78172 Israel
[3]Meir Hospital – Sapir Medical Center, lshenk@post.tau.ac.il
59 Tchernichovsky, Kfar Sava 44410, Israel

Abstract: **Photoplethysmography is the main technique utilized to measure pulse oximetry signals by analyzing the pulsatile components of the detected red and infrared light. Conventionally, this method makes use of transmitted and reflected light intensities. The major practical limitations of pulse oximetry at the wrist are the comparatively low-level and corrupted photoplethysmographic signal resulting from the low-density vascularity of the skin, and high motion artifacts. We discovered that there is a unique location on the wrist that never has been explored by others, and we developed a unique optical sensor using a trans-illumination configuration that results in a dramatic increase of the signal. In addition, a complementary dynamic light scattering (DLS) sensor was exploited for pulsatile blood flow measurements and pulse rate recovery at low perfusion situations. Physiological signals from both sensors were processed using a unique correlative algorithm. As a result, we were able to obtain an AC/DC ratio of around 0.5% whereas any other standard reflection configuration yields only 0.02-0.05% at the wrist. It should be noted that an AC/DC ration of 0.5% is not far from the commonly accepted 1-1.5% for the fingertip transmission signal. The fully functional prototype with Bluetooth transmission and smartphone application was built and verified in more than 100 clinical tests. The correlation between Oxitone and benchmark pulse oximeters was 0.91 (p=0.0001). Oxitone end users include COPD and asthma patients, OSA and CHF patients and elderly people requiring long-term care facilities at home or at points-of-care. The Oxitone wrist-worn pulse oximeter is the world's first wearable health monitor allowing comfortable and non-distracting continuous monitoring throughout daily activity.**

Introduction

Heart rate and blood oxygen saturation are very basic and prominent parameters in physiological monitoring. It is relatively easy to calculate these parameters from pulse signals taken from a fingertip or one's forehead where the signal is sharp [1]. However, it is a very complex task to perform when biosensors are placed at one's wrist. Moreover, it becomes even more complicated when the person performs any physical activities since motion artifacts distort the weak pulse signal so that the blood pulsation can hardly be seen [2].

The main goal of the development of the wrist-worn pulse oximeter without fingertip sensor is providing a comfortable and secure continuous pulse oximetry monitoring in the out-of-hospital environment. Pulse oximetry continuous monitoring helps facilitate early clinical response to acute pulmonary or cardiac dysfunction providing unmatched level of safety.

Materials and Method

The study was performed in 21 white patients aged 57 to 91 years at Meir Hospital (Israel) with COPD. They gave their informed consent to participate in the study, which was approved by the local ethics committee. The patients had been treated in the intensive care unit for at least three days for respiratory problems. The patients were in a stable cardiorespiratory state and some were receiving oxygen supplementation. The wrist-worn Oxitone pulse oximeter and the finger probes of the two pulse oximeters, MASIMO Set and PulseOx 7500 simultaneously tested during the same session were placed on the same hand. MASIMO Set pulse oximeter was used as a benchmark oximeter. In accordance with the clinical test protocol, each measurement session included five measurements of one minute duration each at different levels of oxygenation. The different levels of oxygenation were obtained by changing FIO_2 through the Venturi mask. The fully functional Oxitone prototype and its Android based application are presented in Fig. 1.

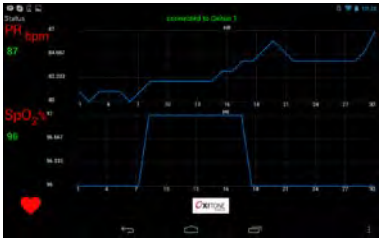


Fig. 1: Wrist-worn pulse oximeter and its Android based application.

Results and Discussions

Simultaneous values of SpO_2 obtained with three pulse oximeters were compared statistically. Error in precision was defined as the SD of the distribution of the SpO_2 differences between the three pulse oximeters. Correlation data was calculated using regression analysis.

The SpO_2 reading of the Oxitone pulse oximeter and MASIMO is represented in a scatter plot in Fig. 2 by the Oxitone SpO_2 – MASIMO SpO_2 simultaneously taking corresponding data points in approximately five sessions for each patient. The oxygen saturation differences are mostly within ±2 digits range and corresponding levels were fairly linear. The correlation is about 0.91 and standard deviation is 2.27 ($p<0.0001$). In patients with low SpO_2 levels, Oxitone showed more accurate results.

The SpO_2 reading on the Oxitone pulse oximeters and PulseOx 7500 is represented on a scatter plot in Fig. 3 by the Oxitone SpO_2 - PulseOx SpO_2 simultaneously taking corresponding data points in approximately five sessions for each patient. The oxygen saturation differences are mostly within ±2 digits range and corresponding levels were fairly linear. The correlation is 0.9 and standard deviation is 2.23 ($p<0.0001$). In patients with the lowest SpO_2 levels, PulseOx did not display any adequate data. The presented study demonstrates the ability of the Oxitone wrist-worn pulse oximeter to perform accurate SpO_2 measurements in a wide range of blood oxygen saturation levels.

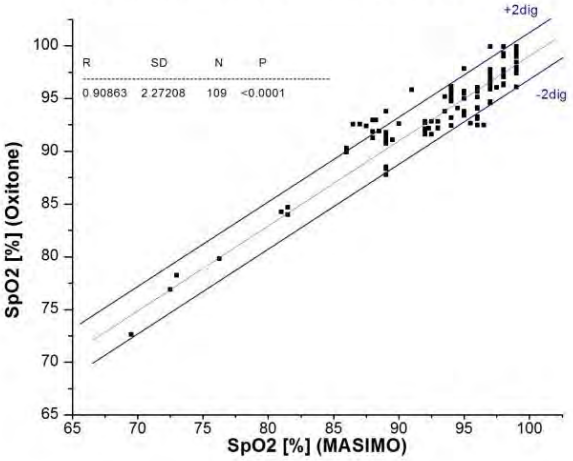


Fig. 2: Scatter plot of the Oxitone data versus the MASIMO data.

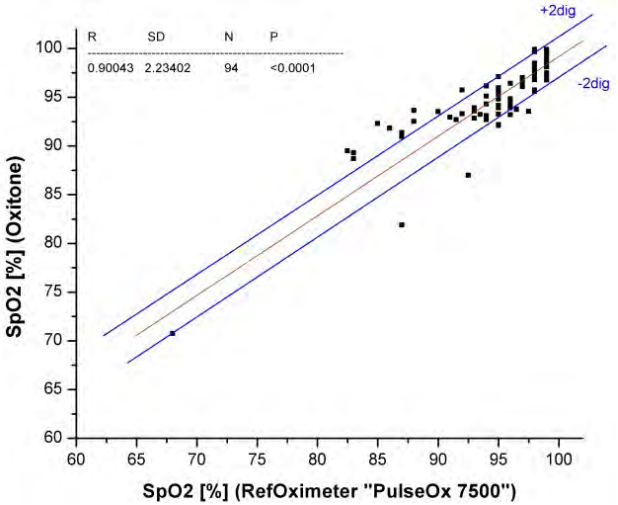


Fig. 3: Scatter plot of the Oxitone data versus the PulsOx 7500 data.

On the basis of these results, we corrected the specific configuration and exact location of the PPG sensors that will be exploited in the next generation of the watch-like wrist-mounted pulse oximeters. Also, we corrected the position of the complementary DLS sensor on the wrist to have strong and robust blood flow signal stable against motion artifacts. We conclude that the wrist-worn pulse oximetry together with the DLS sensor is a reliable and accurate technique for the measurements of the pulse rate and blood oxygen saturation in a continuous manner.

Acknowledgment

Our sincerest thanks go to Dr. Ilya Fine for being our mentor and guide in the Oxitone technology development.

References

[1] J. W. Severinghaus, H. Yoshiyuki. History of blood gas analysis. VII. Pulse oximetry, Journal of Clinical Monitoring, Volume 3, Issue 2, pp 135-138, 1987

[2] M. Maattala at al. Optimum Place for Measuring Pulse Oximeter Signal in Wireless Sensor-Belt or Wrist-Band, International Conference on Convergence Information Technology, IEEE Conference Publication, pp. 1856-1861, 2007

Dr. Leon Eisen is a founder and CEO of the Oxitone Medical Ltd., inventor of the wrist trans-illumination pulse oximetry. Prior to founding the Oxitone Medical, he was working as a CTO and senior physicist at the number of medical device companies. Dr. Eisen holds a PhD in physics from the Weizmann Institute of Science, Israel.

Professor Louis Shenkman, MD, is a former Chairman of Medicine at the Meir Hospital-Sapir Medical Center, Israel, and Program Director of the New York State / American Program of the Sackler School of Medicine at the Tel Aviv University. He is an author of over 130 peer-reviewed articles.

Telemonitoring for Homecare Applications & Management of Chronic Diseases

A Clinical Diary: Supporting Remote Monitoring of Chronic Diseases

I. Secci, G. Lanzola
Department of Computer Engineering and Systems Science, University of Pavia, Pavia, Italy
ignazio.secci01@ateneopv.it, giordano.lanzola@unipv.it

Abstract: **Literature shows that the effectiveness of telemonitoring increases in systems always available to the patient. Mobile technology, because of its own nature, is particularly suitable to realize ubiquitous and unobtrusive systems. This paper describes a mobile patient diary for acquiring data and synchronizing those with a clinic repository. Among its strengths there is the capability to suit the needs of a wide range of different scenarios. This is achieved through a modular architecture providing services which may be easily extended. Wireless communication with external devices has also been implemented for automatic data acquisition. The diary has been tested in scenarios addressing diabetic and nephropathic patients whose relevant parameters can be acquired, saved, viewed and sent to the clinic for any subsequent monitoring or analysis by the treating staff.**

Introduction

The prevalence of chronic diseases is increasing in the last decades [1,2], especially because of the growing of the mean age of the world population and changing habits in diet and lifestyle. A common feature of any chronic disease scenario is the need to manage the patient's conditions in order to avoid or delay the onset of related complications. This is better achieved by a close monitoring over a patient's state and by keeping track of any clinically meaningful event [3]. To this aim, a great expectation rests on the mobile technology which can be used to realize ubiquitous and always available remote monitoring systems able to bridge the gap between the medical staff and outpatients. Such kind of support is important to ensure that easiness of use which is essential to make systems accepted by final users [4]. Besides preventing patients to give up working days for visiting specialists, that approach ensures a near to real-time data and information sharing between the two involved parties which proves to be useful also in supporting a careful symptom reporting during clinical trials involving outpatients [5].

Materials and Methods

Many remote monitoring systems failed to enter the practice because they just captured the requirements of a very narrow domain. Reconfigurability, interoperability and scalability are important instead to ensure a widespread diffusion of those applications and promote their acceptance into the mainstream clinical practice [6]. Following those guidelines, we designed a clinical diary for mobile platforms (e.g. smartphones or tablets) whose main strength is the extensibility of its functionality. This is pursued acting on two separate directions. On one side we allow the possibility to define new data types in order to manage new information which depends on the particular clinical domain being considered. On the other side we also account for the possibility of extending the functionality of the modules responsible for managing those data. That functionality is partitioned into 4 different main categories encompassing: *wireless connection* with devices, specialized screenshots for *data acquisition*, *data viewing and charting*, and *synchronization* with the clinic repository. Data acquisition is available both through manual input or automatic communication with external measurement devices exploiting wireless connections in order to reduce errors and simplify the burden placed on the user as much as possible.

Extensibility is achieved by designing a highly modular architecture foreseeing a central core, which is responsible for managing information and measurements, separated from the ancillary services providing domain specific functionality. The central core exploits a local database service for storing data which may be customized adding new attributes around minimalistic information set characterizing the prototypical medical datum. Services are customized instead by writing new code which extends the already existing ones, shaping a consistent behavior built around a general model of a clinical diary implementing the above mentioned functionalities. More specifically once new data types have been defined into the system, the developer may target the ancillary functionalities of the system. This entails designing new specialized screenshots responsible for data acquisition or for charting their trends. When interfacing with medical devices is required, the developer may add the code implementing the protocol for automatic data acquisition required for storing those data directly into the local database.

In summary this approach guarantees that starting from an already working clinical diary offering a basic set of features for acquiring, visualizing and synchronizing data, the developer may incrementally customize its functionality in order to suit the needs of a specific domain. In doing so he is just asked to extend some aspects while preserving the

underlying system behavior including the overall workflow as perceived by the user, which greatly simplifies the customization work.

Results

The clinical diary has been implemented as an Android application, and its main menu is shown in the left part of Figure 1. Every functional service has been made accessible from the main menu where the user can decide to start manual or automatic data acquisition, visualization and charting, synchronization or even set the application preferences. The latter forces the navigation to be compliant with the generic workflow applicable for a clinical diary although services leverage any customization developed for the specific domain considered.

As a proof of concept we addressed a composite scenario as a testbed for the diary: the remote monitoring of diabetes patients and the management of peritoneal dialysis which represents one of its most frequent complications. Patients affected by diabetes need to continuously record their level of glycemia (BGL), insulin infusions, meals and physical exercise. A complete track of those values allows the physician to better tune the therapy reducing hypo- or hyper-glycemia events, but is also useful for the patient as a self-management aid. Patients undergoing peritoneal dialysis, in addition to requiring the same support as diabetes ones, also need to record several times per day their weight, blood pressure (BP) and heart rate (HR) in order to control the dialysis process. Meeting those requirements entailed defining new data types, such as the BP which actually consists in a

Figure 1. The main menu of the clinical diary on the left, and the customization of the charting services for the diabetes-nephropathy domain on the right

composition of two values (i.e. min - max), and customizing the screens for manually acquiring and managing those. In order to speed up and improve

data entry, we also customized the automatic acquisition of BGL, BP, HR and weight, exploiting wireless connectivity to interface with Bluetooth enabled devices.

We also customized the viewing services by emulating the paper forms customarily used by patients for reporting physiological parameters to the physician. As customization example of charting services the right side of Figure 1 shows a comprehensive plot reporting BGL, weight, and BP on a single chart. The whole local database can be synchronized through a specific background-running service with the clinic repository, so that the medical staff can share the information with the patient adapting the therapy and promptly recalling him whenever needed.

Conclusions

The application effectively proved to greatly simplify and speed-up the process of adapting it to a specific domain such as that of the testbed chosen. Moreover, customizing the viewing services, which emulate the paper forms borrowing the very same paradigm, is a key aspect for improving the acceptance rate by users. Patients may therefore report their measurements in an unobtrusive and quick way thanks to the fact that the diary is portable and always available for use.

References

[1] World Health Organization. The Global Burden of Disease: 2004 Update. WHO Library Cataloguing-in-Publication Data, Geneva, 2008.

[2] R. Beaglehole, S. Ebrahim, S. Reddy, J. Voûte, S. Leeder. Prevention of chronic diseases: a call to action, *The Lancet*, Vol. 370, No. 9605, pp. 2152-2157, December 2007.

[3] N. M. Clark, Management of Chronic Disease by Patients, *Annual Review of Public Health*, Vol. 24, pp. 289-313, 2003.

[4] S. Franc, A. Daoudi, S. Mounier, B. Boucherie, D. Dardari, H. Laroye, B. Neraud, E. Requeda, L. Canipel, G. Charpentier. Telemedicine and Diabetes: Achievements and Prospects, *Diabetes and Metabolism*, Vol. 37, No. 6, pp. 463-476, December 2011.

[5] K. Lauritsen, A. Degl'Innocenti, L. Hendel, J. Praest, M. F. Lytje, K. Clemmensen-Rotne and I. Wiklund. Symptom recording in a randomised clinical trial: paper diaries vs. electronic or telephone data capture. *Controlled Clinical Trials*, Vol. 25, No. 6, pp. 585–597, 2004.

[6] J. Yao, R. Schmitz, S. Warren, A Wearable Point-of-Care System for Home Use That Incorporates Plug-and-Play and Wireless Standards, *IEEE Transactions on Information Technology in Biomedicine*, Vol. 9, No. 3, pp. 363-371, September 2005.

Giordano Lanzola is an Assistant Professor at the University of Pavia, Italy. He graduated in Electronic Engineering from the University of Pavia where he subsequently also earned a PhD in Bioengineering in 1991. His research activity has focused in the past on Knowledge Based Systems, Knowledge Representation and Knowledge Acquisition Systems applied to medical domain. More recently, following the widespread diffusion of networked and mobile technologies his interests switched to telemedicine as a mean of providing remote diagnosis and therapeutic management for chronic patients. He is presently involved in a major EU project addressing the implementation of an Artificial Pancreas for which he designed the telemedicine infrastructure supporting remote monitoring in real time during at home trials.

Ignazio Secci received his Bachelor's degree in Biomedical Engineering from the University of Cagliari in 2010 and his Master degree in Bioengineering in 2012 from the University of Pavia, in Italy. He's presently working on several telemedicine research projects at the Laboratory of Biomedical Informatics of the University of Pavia. His research interests include the development of telemonitoring applications on mobile devices and their interfacing with biomedical instrumentation for data and signal acquisition.

Evaluation of Compliance to Telehomecare in a Group of Patients with Cystic Fibrosis in a Period of 2 Years

S. Bella[1], F. Murgia[1], F. Bianciardi[1], C. Cotognini[2]
[1]Cystic Fibrosis Unit, Italy
[2]Information Systems and Organization Department, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy

Introduction

In chronic lung diseases, the improvement of prognosis in recent years is due to a changed approach in the management of the patient. Continuous monitoring of clinical status, the recognition and early treatment of respiratory complications represent the main criteria guiding [1].

In case of exacerbations, early initiation of antibiotic treatment helps prevent more serious complications, and limits consequently the lung damage in the long term. Early intervention also allows effectively using less invasive antibiotic therapies [2].

In the Cystic Fibrosis (CF) Centre of Bambino Gesù Pediatric Hospital in Rome, since 2001 telehomecare (THC) has been activated in the follow-up of patients at home. In a previous study, we found, in THC patients, some positive effects, such as a statistically significant decrease of outpatient accesses and increase of therapy cycles, and a trend of higher stability of the respiratory function [3].

In CF patients' follow-up, the risk of poor adherence to daily treatments (medications, hysiotherapy, nebulisation, insulin, etc.) is a fact by now well-known [4].

In a recent study the use of telemedicine in chronic obstructive pulmonary disease patients (COPD) has been compared to the use in adult patients with CF. The adherence to telemonitoring was greater in patients with COPD and the results appeared to be more favourable in COPD patients compared to FC's [5].

From psychological perspective, telemedicine represents a type of intervention that supports the patient in the course of illness making him feel thought, aided, surveyed through a mode in which he is active towards treatment. This therapeutic approach helps to make the patient more aware, especially during adolescence, about his illness and the system of care that will be applied. It's long been known as the knowledge of the disease in CF

contributes to increase adherence to treatment [6] and decreases the mental barriers which can condition in the negative [7].

In the present study, we examined data related to adherence to telemonitoring in our CF patients followed at home for a period of 2 years, in the aim to improve the follow-up in terms of efficiency and appropriateness.

Materials and Methods

In a recent study we described and discussed the method we use in the daily practice in support of CF patients, developed and improved over the years using our experience [8].

Currently, about 30 patients are included in the telehomecare program. In all subjects was given the clinical diagnosis of CF, confirmed by genetic study of the CFTR gene. Patients included in the program of telemonitoring are followed-up and treated with the usual protocols, similar to those that do not practice it [9].

Spirotel ™ instrumentation is used that provides the data of a spirometry and nocturnal pulse oximetry and transmits these remotely.

As intervention parameters, for spirometry we consider pathological acute reduction in FEV1 >10% compared to the characteristic value for each subject in stable conditions [10] and / or worsening of one or more symptoms. For the nocturnal oximetry, we consider significant desaturations <80% of the maximum value of haemoglobin oxygen saturation (SaO_2), mean reductions in SaO_2 and increments of T90.

All patients are contacted by telephone for gathering of anamnestic and take note of any special requests. The information gathered data and graphs are examined during a daily briefing to decide on any subsequent action. Those that exceed the intervention parameters are contacted by telephone a second time to communicate treatment decisions. Further transmissions are solicited or, on the basis of personal and clinical history data reported by the patient and on the last antibiotic essay in hospital, can be directly prescribed antibiotic therapy to be practiced at home, preferably orally. Patients can be recalled in Hospital for further assessment and treatment in regimen of Day hospital or hospitalization.

Results

The balance of enrolment in THC to Dec 31, 2012 is reported in table 1. We received in the period from February, 15 2010 to Dec, 31 2012 overall 2097 transmissions in 732 working days (2766 spirometry, 706 nocturnal pulse-oximetry and 1031 questionnaires on symptoms).

The average compliance in the reporting period was 10,47%, with increasing trend (Table 2).

We have established a contact in 1653 cases after a transmission, making 1803 phone calls.

Discussion

In CF subjects, the definition of criteria for inclusion in telemonitoring is difficult as there is no experimental data that ensure in the various expressions and clinical types significant differences about a better efficacy of the THC procedure [11]. On the other hand, since telemonitoring actually in Italy is not yet included in the essential basic assistance levels (LEA), its viability depends in the individual cases from voluntary resources provided by local health authorities.

Among the reasons for drop-out, the main cause was poor or no adherence to individual treatment occurred during the period of inclusion (58,33%). As regards the recommended frequency of the transmissions, the surveys are carried out with variable intervals, depending on the clinical condition of the individual. To allow us to construct a graph of the characteristic values in stable conditions, generally we advise our patients to transmit at least 2 times a week, so that the optimum achievable compliance is 40% (2 transmissions/5 working days). We got in practice mean values of approximately ¼ of the expected optimal value, with a slightly increasing trend over the years. Must be considered that these patients are already burdened with a heavy load of continuous therapy, both medical and physiotherapy, and that this result was obtained without the Centre has requested a detailed timetable of registration, limiting themselves only to indicate a general transmission rate of twice in a week. We report the fact that patients who dropped out reported in many cases an increase in the subjective feeling of anxiety. We therefore sought to overcome this situation, leaving our patients essentially free to transmit and the trend of increase in compliance over the years (Table 2) it is comforting, but the problem certainly merits further studies, in order to achieve a substantial improvement of adherence. In CF has been suggested a complex approach to the problem of poor adherence to treatment [12]. Customize the intervention, in this case via telemedicine, is also a way to foster a good relationship with the patient (or caregiver), this condition to improve the mutual trust that must underlie the process of care. Factors that could increase adherence to treatment may be an explicit and continuous encouragement, present and continuous support of family and caregivers and the introduction of strategies aimed at changing the habits of life and individual behaviour.

We were able to establish immediate contact with the patient or family on an average of only 77 % of cases. The medium that we used usually to establish the contact was the cell phone. When it was not possible to obtain an immediate contact, in all cases has been researched a contact in the hours or the day thereafter. These data certainly does not seem satisfactory and clearly indicate the need to improve the procedure, to ensure the best continuity of care. The phone, in this case, although it has proved a valuable tool, has not always proved completely reliable.

In conclusion, the improvement of outcome in FC necessarily passes through an improvement of the adherence to treatment. More psychological and behavioural studies are needed in order to gradually remove the obstacles which still prevent a further improvement in long-term outcome.

Table 1 Balance of enrolment in THC

Balance of enrolment		
enrolled	37	
active	25	67,57%
drop-out	12	32,43%
poor adherence	7	58,33%
died	4	33,33%
other	1	8,33%

Table 2 General summary of activity from Feb 15, 2010 to Dec 31, 2012

General Summary					
		2010	**2011**	**2012**	**total**
	transmissions	536	730	831	2097
	working days	226	257	248	731
	compliance	8,78	9,62	13,03	mean 10,47%
	spyrometry	658	1048	1060	2766
	pulse oximetry	183	231	292	706
	symptoms		322	709	1031
	inpatients	12	15	49	76
	phone calls	466	592	745	1803
	contacts	451	523	679	1653
	% contacts/trasm		71,64%	81,38%	mean 77,00%

References

[1] M. L. Furnari, M. Conese, F. Pardo, Nuovi orientamenti di terapia in Fibrosi Cistica. Orizzonti FC, 2 (1), 9-11, 2006.

[2] C. Que, P.D. Cullinan, Geddes Improving rate of decline of FEV1 in young adults with cystic Fibrosis, Thorax, 61, 155-7, 2006.

[3] S. Bella, F. Murgia, C. Cotognini et al., Five years of telemedicine in Cystic Fibrosis disease, La Clinica Terapeutica, 160(6), 457-460, 2009.

[4] S. A. Prasad, F.J. Cerny, Factors that influence adherence to exercise and their effectiveness: application to cystic fibrosis, Pediatr Pulmonol, Jul;34(1), 66-72, 2002.

[5] N. A. Jarad, Z. M. Sund, Telemonitoring in chronic obstructive airway disease and adult patients with cystic fibrosis, J Telemed Telecare, 17(3), 127-32, Epub 2010 Dec 16. 2011.

[6] J. Abbott, M. Dodd, L. Gee et al., Ways of coping with cystic fibrosis: implications for treatment adherence, Disabil Rehabil, May 20, 23(8), 315-24. 2001.

[7] M. A. Davis, A. L. Quittner, C. M. Stack et al., Controlled evaluation of the STARBRIGHT CD-ROM program for children and adolescents with Cystic Fibrosis, Pediatr Psychol, Jun;29(4), 259-67, 2004.

[8] F. Murgia, M. Cilli, E. Renzetti et al., Remote Telematic Control in Cystic Fibrosis, La Clinica Terapeutica, 162 (4), e121-124, 2011.

[9] Clinical Practice Guidelines for Cystic Fibrosis Committee, Clinical practice guidelines for cystic fibrosis. Bethesda, MD: Cystic Fibrosis Foundation, 1997.

[10] B. W. Ramsey, P. M. P. Farrell, Pencharz Nutritional assessment and management in cystic fibrosis: a consensus report, The Consensus Committee., Am. J. Clin. Nutr., Jan 55(1), 108-16, 1992.

[11] G. Paré, M. Jaana, C. Sicotte, Systematic Review of Home Telemonitoring for Chronic Diseases: The Evidence Base, J Am Med Inform Assoc, 14(3), 269–277, 2007.

[12] A. C. Modi, C. S. Lim, N. Yu et al., A multi-method assessment of treatment adherence for children with cystic fibrosis, J Cyst Fibros, Aug;5(3):177-85. Epub 2006 May 5., 2006.

Sergio Bella was born in Rome 22 May 1960, he graduated in Medicine at the Catholic University of the Sacred Heart on 23/7/84 with 110/110 votes. Has qualified as a medical professional in the second session of the year 1984. He specialized in Pediatrics at the University of Rome "La Sapienza" on 14/7/88 votes with 70/70 cum laude. Has achieved the second level master in "telemedicine" at the University of Pisa, July 23, 2003 with grades 50/50 and praise, title of thesis: Application of Telemedicine in home care of chronic diseases: cystic fibrosis. He graduated in Economics and Management of Health Services on 17/7/08 at the telematic University "Leonardo da Vinci" based in Torrevecchia Teatina (CH) with 101/110 votes, title of thesis: economic and financial assessment of a system of remote monitoring for patients with cystic fibrosis. From January 2011: High degree Responsibilities: "Continuity of care in chronic diseases" in Pediatric Hospital Bambino Gesù in Rome.

InspectLife - Platform for Providing Telecare and Telehealth

J. Potůček[1], M. Anděl[2], T. Korč[1], P. Koranda[1]
[1] Mediinspect Ltd., info@mediinspect.cz
Evropská 655/116, Prague, Czech Republic
[2] 3rd Medical Faculty, Charles University, michal.andel@lf3.cuni.cz
Ruská 87, Prague, Czech Republic

Abstract: **InspectLife is a platform for telecare and telehealth. Its main components are: surveillance of elderly people, children and chronic patients; ambulatory monitoring of physiological signals and parameters (blood glucose, blood pressure and others) including advanced data processing, visualization and analysis; and communication between all participants involved in the process of surveillance of clients and treatment of chronic patients. The fundamental component is web based information system InspectLife, which is accessible via web browser by authorized users, mainly clients, family members, operators of surveillance assistance centers, physicians and medical staff. The InspectLife solution should ensure preservation of clients´ independence, improvement in their self-sufficiency, safety, quality of life, social contact and also quality of health care. Pilot projects were organized within the Czech Republic and Australia and their results were evaluated.**

Introduction

Number of elderly people and chronic patients (especially with Diabetes Mellitus, obesity and cardiovascular diseases) is growing worldwide during last decades. This situation is unfavorable, not only from medical and social but also from economical point of view. Dangerous are not only chronic diseases themselves, but also their serious complications (i. e. renal failure, blindness or acute myocardial infarction in case of Diabetes Mellitus). Prevention, appropriate lifestyle and continual individual treatment (i. e. optimal compensation in case of Diabetes Mellitus) are irreplaceable in contemporary medicine. Moreover, elderly people and chronic patients demand improvement of their quality of life, independence and self-sufficiency. It is obvious that up-to-date diagnostics, information and communication technologies are widely usable and can help with solving given challenges.

Description of InspectLife Solution

InspectLife [1-4] solution is designed for surveillance of elderly people and ambulatory telemonitoring of physiological signals and parameters (especially blood glucose, blood pressure and other) of chronic patients. Its main component is web-based information system which is securely accessible via web browser from any place connected to the Internet by all authorized users who participates in surveillance and treatment, namely clients, patients, their family members, operators of assistance surveillance centers and physicians. InspectLife solution has several independent specialized subsystems (Surveillance, Diabetes, Hypertension and others) which are able to communicate to each other.

Basic functions of InspectLife information system are: receiving data from peripheral monitoring devices (i. e. surveillance devices – customized senior mobile phones, glucose meters, ambulatory blood pressure monitors and others) via Internet or GSM network (SMS), storing and providing information to the authorized users, processing and visualization of measured values, automatic notification of responsible users in case of emergency situations (i. e. hypo- or hyperglycemia in case of Diabetes Mellitus), communication between users (especially between clients/patients and physicians) and self-education of chronic patients. Every specialized subsystem is designed for selected target groups of users.

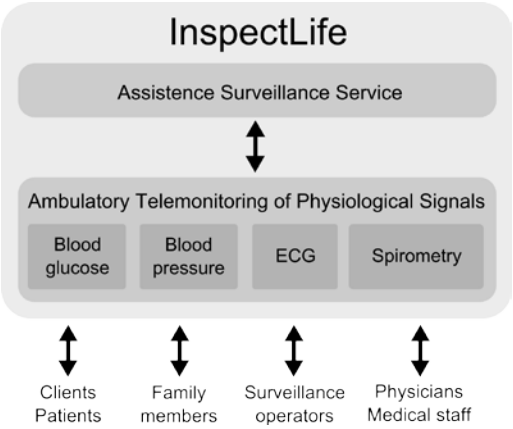


Fig. 1. Main components and participants within InspectLife solution

Methods and Results

InspectLife Surveillance

InspectLife Surveillance solution was operated as a part of Australian telemonitoring and research project "Fall Intervention through Technology" which took place in Australian Capital Territory during 2011 and 2012 in cooperation with the Anglicare organization and the University of Western Sydney (Sydney, Australia).

The trial project goals were: 1) to reduce and prevent falls and reduce the risk of serious consequences following a fall in older people, 2) to efficiently monitor those older people who have dementia, are wanderers, and so reduce their risk of falling.

It was selected 100 clients over 70 years of age who were supervised by Anglicare. These clients were equipped with surveillance devices (commercially available Android smartphone Samsung Galaxy 5 with pre-installed special InspectLife mobile application). Surveillance devices were able to notify responsible operators in cases of emergency and possible fall events. Moreover, devices were collecting their raw movement data (in certain interval before and after possible fall events) which was evaluated retrospectively in connection with real experience of users. Final evaluation of the trial project is still processed.

InspectLife Diabetes

Preliminary testing of InspectLife Diabetes solution was carried out during 2011 in cooperation with the Institute for the Care of Mother and Child (Prague, Czech Republic).

The goals of the preliminary testing were: 1) to verify the functionality of the solution with real users – diabetic patients, 2) to suggest target groups of patients, 3) to suggest validation hypotheses and qualitative and quantitative criteria for subsequent clinical trial which should result in medical device certification of the InspectLife Diabetes solution.

Characteristics of one selected patient were following: 37 years old woman with Diabetes Mellitus Type I diagnosed before 3 years during her first pregnancy, insulin treatment, HbA_{1C} 5.8 % during the first trimester, distant telemonitoring with InspectLife Diabetes between 26 and 35 week of pregnancy, childbirth in 38 week of pregnancy.

The results and influence of distant telemonitoring were following: after 30 week of pregnancy the HbA_{1C} was permanently within the interval 4.3 – 4.6 %, therefore improvement of diabetes compensation was reported during telemonitoring period. Both patient and her diabetologist appreciated the availability and visualization of actual and historical blood glucose data from any place with internet connection and possibility of quick contact and remote communication.

Discussion and Conclusion

InspectLife solution was analyzed and designed. Two components (subsystems) – "Surveillance" and "Diabetes" were implemented and verified within trial projects with real users.

Mediinspect company gained real experience in providing assistance surveillance service to real users and started to operate InspectLife Surveillance solution commercially within the Czech Republic.

InspectLife Diabetes subsystem was also verified in practice. Target groups were suggested: diabetic women during pregnancy, labile diabetics with very unstable metabolic compensation, diabetics before surgical operation and young diabetics. Main validation hypotheses for clinical trial were suggested: long-term metabolic compensation should improve (in terms of HbA_{1C} value), number of critical situations (hypo- and hyperglycemia) should decrease, distant communication between patient and physician should be more frequent, self-education of diabetic patient should improve, and comfort of patient should improve. These validation hypotheses should be validated and InspectLife Diabetes solution should be certified based on clinical trial organized in the Czech Republic

Acknowledgment

The project was supported by the grant of the Ministry of Industry and Trade of the Czech Republic – OPPI 4.2 PT03/270 "Centrum pro vývoj, testování a výrobu technologických prostředků pro personalizovanou medicínu" (in English: The Center for Development, Testing and Production of New Technological Devices for Personalized Medicine).

References

[1] K. Andělová, "InspectLife Diabetes – Telemedicine Information System for Diabetology", 15th Conference on Technologies in Diabetology "Žinkovy dny", poster presentation, 2011 (in Czech).

[2] M. Anděl, K. Andělová, Z. Rušavý, J. Potůček, P. Koranda, "Distatnt Transfer of Data in Diabetes Care" in *Diabetologie, Metabolismum, Endokrinologie, Výživa*, Tigis, Prague, Czech Republic, Vol. 15, No. 2, pp. 119-122 2012 (in Czech)

[3] J. Potůček, T. Korč, P. Koranda, J. Kamrád, J. Douša, "InspectLife – Information System For Surveillance And Telemonitoring, IFA 11th Global Conference on Ageing, Prague, Czech Republic, 2012.

[4] J. Potůček, "InspectLife – Information System for Surveillance and Telemonitoring", ITU Telecom World, Geneva, Switzerland, 2011.

Jiří Potůček, Ph.D., graduated at the Czech Technical University (Prague, Czech Republic) in 1973. In 1976 he completed his Ph.D. thesis "Modelling of Biological Systems on Hybrid Computer" at the Czech University of Chemical Engineering (Prague, Czech Republic). He worked as a scientific worker at the Institute for Clinical and Experimental Medicine (Prague, Czech Republic) and also as external lecturer. He was a research fellow at Technical University Delft (Holland). He was also visiting professor at California State University (Chico, USA). In 1991 - 2005 he was founder, owner and CEO of privately held company Medisoft International Ltd. which developed information system for medical practices. Nowadays he attends to the platform for Telemedicine and Personal Health Systems development.

IT System for Alarming of Possible Health Risks Caused by Geomagnetic Storms

D. Dezeljin, R. Cop
VSS-LGA, Sezana, Slovenia (http://www.viviss.si/lga/),
damir.dezeljin@dezo.org, rudi@artal.si

Abstract: **Intensive researches about the influence from The Sun on the Earth geomagnetic field and consequently to all life species on the Earth began in the second half of the 20th century. Unfortunately the gathered knowledge so far does not enable physicians to take preventive measures and offer advice to individuals in order to protect their state of health during predicted geomagnetic storm. However, studies conducted so far shows that such an advice is justified for a group of patients with chronic heart and vascular diseases. This article presents a system for real time alarming of possible health risks caused by geomagnetic storms (hereafter referred to as GMA-Health System).**

Geomagnetic Storms

A geomagnetic storm is caused by a sudden increase in the strength and duration of the solar wind (which is a form of permanent flow of particles from The Sun to the Earth) and its interaction with the magnetosphere [1]. The storm usually starts with a sudden increase of the geomagnetic field intensity that last for several hours. It is followed by an abrupt decrease and strong disturbances which present a central part of the geomagnetic storm, and the next event is a slowing down and sluggish transition to a normal state. These storms usually last from 1 to 5 days, and the magnitude of the geomagnetic field is up to 100 nT. The geomagnetic storms with a magnitude of the geomagnetic field exceeding 500 nT have been occurring every hundred years. In 1852 General Edward Sabine, an English astronomer and researcher, pioneer of modern geophysics, determined that in accordance with the decrease and increase of the sun spots, the number of geomagnetic storms equally decreases and increases [2].

On the basis of the continual measurements of changes in the geomagnetic field, the geomagnetic activity is defined with the 3-hourly index K [3]. The index K is a value related to the biggest change in the horizontal level of the local geomagnetic field compared to the same level of a geo-magnetically calm day in a period of 3 hours. The biggest deviation from the magnetically calm day is a sum of the greatest positive and

negative deviations, measured any time during the 3-hourly period observed. The index K is almost a logarithmic form and stretches from 0 (magnetically very calm day) to 9 (magnetically extremely active day). If K equals to 0, it is an unusually calm day, as normally during a magnetically calm day the K index is between 1 and 3. During magnetic storms, the index K reaches values between 4 and 9.

Influence of Changes in the Geomagnetic Field on Human Health and Behavior

During the last decade, interest in how The Sun affects on the geomagnetic field has increased due to the transition into a new sun cycle, extraordinary mass ejections on The Sun [4], and the approaching end of some space missions with human crew and the planning of new ones. Heliobiology is a branch of biophysics that studies the influence of changes in solar activity on terrestrial organisms and also various causal connections which explain how solar activity affects all the biological life on Earth. This influence on the behavior of living organisms on Earth is proven on vertebrates and insects, as well as unicellular organisms and viruses [5]. In the second half of the last decade several independently written (overview) articles dealt with the field of Heliobiology [5-7]. These overviews offer guidelines for further research into the field of Heliobiology [8].

The relationship between changes in the geomagnetic field and human health is indirect; these changes affect human health like a resonant phenomenon or they may only indicate the occurrence of changes in the environment that affect human health. Clearly there is no simple or unique influence from space which may be used as an explanation of all human health issues. Among the results of the earlier clinical researches [9-10] – which took into consideration the industrial development of the environment, average human lifetime in this environment and how an interaction between a solar wind and cosmic rays [11] affect human health – the following conclusions are important:

- Both the extremely significant and extremely small disturbances in the geomagnetic field have a negative impact on the human health;
- From 10% to 15% of population is very sensitive to geomagnetic disturbances [12].

The occurrence of extremely strong geomagnetic storms causes an increase of heart attacks, strokes and respiratory problems; they also cause an increase in traffic and work-related accidents [7]. The extremely large geomagnetic disturbances seem to cause twice the number of illnesses and accidents.

The intensity of geomagnetic activity is connected with changes in the state of disease, risk levels and the variation in the number of the affected patients with heart and vascular diseases during the observed period [10]. It is too early to expect that during increased geomagnetic activity we might be able to provide recommendations regarding health safety, which would be customized for an individual patient with heart disease (hypertension) and vascular disease (thrombosis).

GMA-Health System

The IT system for alarming of possible health risks caused by geomagnetic storms, known also as GMA-Health System, warns the subscribed end-users about possible health dangers caused by geomagnetic storms. The system is designed to be user friendly and accessible by the public; however, it is specially targeting the group of people having heart diseases, respiratory diseases and malfunction of the glands of the endocrine system, as they are potentially more affected by geomagnetic storms according to studies conducted so far.

The value of the K index is published by an application available both on computers and handheld devices such as mobile phones. The usage of handheld devices allows further interactions between the physician and the patient [14].

The very same application allows also entering and monitoring personal vital conditions including, but not limited to blood pressure, heart rate, blood glucose, body weight, etc. The correlation of these data including the historic values of the K index allows the end-user to get a better overview of his/her health status.

An important consideration on system design time was end-user data privacy. Consequently all personal information is kept local to the end-user application. If the end-user agrees to contribute to further research in the field of heliobiology, the locally recorded data is first anonymized before its subset (statistical information) is made available to the operator of the system for further studies.

The architecture of the system conforms to the already adopted standard and trends in the field of e-health. This way the system is ready to be integrated with already existing e-health systems as well in e-health systems being developed now and in future.

Benefits of the GMA-Health System

The GMA-Health System promotes the importance of preventive vs. curative health actions. It brings into force the new technological and development concepts in the field of telemedicine and e-health. Its final

goal, however, would only be attained by (i) the appropriate explanation of the K index, and (ii) the presentation of meaning of measurements of variations in the geomagnetic field. The system widens the e-health system use from the basic treatment of urgent cases to education, preventing illness and the announcement of data for a healthier way of living. Additionally the GMA-Health System enables further research in the field of heliobiology.

References

[1] J. Jankowski, C. Sucksdorff. Guide for Magnetic Measurements and Observatory Practice. Boulder: NOAA Space Environment Center; International Association of Geomagnetism and Aeronomy, 1996.

[2] E. W. Cliver. "Solar Activity and Geomagnetic Storms: The First 40 Years," in Eos, Transactions, American Geophysical Union, December 6, 1994, vol. 75, no. 49, p. 569, 574-575.

[3] P. Mayout. Derivation, meaning, and use of geomagnetic indeces. Washington: American Geophisical Union, 1980.

[4] N. Gopalswamy, et al. "Introduction to violent Sun-Earth connection events of October-November 2003," in Journal of Geophysical Research, 2005, vol.110, A09S00.

[5] E. S. Babayev, et al. Potential effects of solar and geomagnetic variability on terrestrial biological systems. Troitsk: Solar- Terrestrial Physics Division of IZMIRIAN; Heliophysical laboratory; Obridko Vladimir Nukhimovich, 2007. Available from: http://helios.izmiran.rssi.ru/hellab/Obridko/ .

[6] S. Palmer, M. Rycroft, M. Cermack. "Solar and geomagnetic activity, extremely low frequency magnetic and electric fields and human health at the Earth's surface," in Surveys in Geophysics, September 2006, vol. 27, n. 5, p. 557-595.

[7] J. A. Marusek. Solar Storm Threat Analysis. Bloomfield: Impact, 2007.

[8] N. B. Crosby. "Health Issues and Space Weather: an Introduction," in Electronic Proceedings of The International eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business. Luxembourg: Luxexpo, 2009. ISSN 1818 – 9334.

[9] G. E. Knox, et al. "Heart attacks and geomagnetic activity," in Nature, Oct.1979, no. 281, p.564–565.

[10] E. Stoupel. "Effect of geomagnetic activity on cardiovascular parameters," in Journal of Clinical and Basic Cardiology, 1999, vol. 2, no.1, 1999, p. 34-40.

[11] I. O. Shumilov, et al. "Study of geomagnetic activity influence on a fetal state using cardiotocography," in Biophysics, 2003, vol. 48, n. 2, p. 355–360.

[12] Space Weather Prediction Center. Boulder: NOAA/National Weather Service; National Centers for Environmental Prediction; Space Weather Prediction Center, November 5, 2007. Available from: http://www.swpc.noaa.gov/ .

[14] H. Hutten, H. "Evaluation of an Advanced Cardiac Telemonitoring System for Multicenter Studies Based on Data Transmission via Internet," in Progress in Biomedical Research, 1999, vol. June, p.221- 224.

Monitoring Biosignals with Low Cost Wearable Sensors

J. F. Oliveira[1], G. Gonçalves[2], R. Sousa[3]
[1]Inovamais, filipeoliveira@inovamais.pt
Rua Dr.Afonso Cordeiro 567, Matosinhos 4450-309, Portugal
[2]Faculdade de Engenharia da Universidade do Porto,
gil.goncalves@feup.up.pt
Rua Dr. Roberto Frias, Porto 4200-465, Portugal
[3]IncreaseTime, Raquel.sousa@itime.pt
Rua Dr.Afonso Cordeiro 877 sala 201, Matosinhos 4450-007, Portugal

Abstract: **With the increase of aging population, we have been witnessing a decline in the quality of life influenced by numerous social, cultural and economic factors. Several studies have addressed these facts and some emerging technologies are capable of monitoring and anticipating these problems. With the advance in the development of smart textiles it's possible to use these technologies in the acquisition of biosignals, which allows obtaining a better comfort regarding the use of smart clothes over traditional Ag/AgCl electrodes. This way it is possible to monitor for longers period reducing the discomfort to the user. This paper reports the development of a low cost sensor with the capability of monitoring the electrical activity of the heart, measuring the heart rate and body temperature and is applied in the scenario: health & wellbeing, targets the continuous measurement of vital signs.**

Introduction

With the increase of the elder population, we have been witnessing a decline in the quality of life influenced by numerous social, cultural and economic factors.

Therefore, there must be a special emphasis on the effective prevention, detection and correction of all these potential risk factors, taking into account that the concept inherent captures not only the actions that prevent the loss of quality of living, but also all care that promotes the recovery.

The appearance of these factors led to the need to monitor vital signs in real time, regardless of the location of the patients, thus contributing to an increase in the quality level of care, providing a higher quality of life.

The major advantage in developing these technologies is their implementation in primary care regarding small communities at the geographic regions far from major urban centers.

Currently, with the reductions in the size of electronic systems, it is possible to have a single compact unit with the capability to acquire multiple vital signs which, combined with the capability of communication, allows the continuous monitoring of people at risk in an assisted environment. This type of electronics has been applied most often in hospitals and health institutions with the aim of exchanging information and data collected with other medical institutions.

Motivation and Scope of the Study

This study proposes to develop a system to monitor the vital signs in real time, including the capacity to communicate with other platforms using different technologies.

The sensor has the ability to measure the electrical activity of the heart, heartbeat and temperature using smart textile. The signals received are acquired with some noise and interference and it will be necessary to take into account the way they will be transferred and stored. The acquired signal will be processed and transmitted through Bluetooth communication to a personal monitoring platform.

The aim is the development and integration of the components needed to implement the concept of proximity to the patient through the continuous monitoring of the patient.

Problem and Motivation

Health & Wellbeing

The continuous measurement of vital signs contributes to an increase regarding the quality in health care. Currently, these data are collected by specific equipment, with several sensors available in a hospital environment, where the concept of proximity to the patient and the ability to provide real time data relating to the health status of the patient is necessary to be put into practice.

The devices able to monitor the patient´s vital conditions must be endowed with capabilities to operate on the network using the same protocol regardless of where they operate:

- Hospital environment
- Ambulance
- Patient's homey

This technology allows the emergency room physician to receive the necessary information (vital patient data) for a pre-diagnosis and to

recommend actions to the paramedics, if necessary, even before the patient arrives at the hospital.

Wireless technology is useful in emergency departments of hospitals, allowing physicians to continue to monitor the needs of their patients, using wireless devices.

This technology allows monitoring patients while they are recovering in their own homes. Medical care at home is one of the fastest growing segments in the health care industry.

System Design

The study enables the development of a low cost device with small dimensions, which allows obtaining measurements from the electrical activity of the heart [1], heart rate and body temperature. This device is constituted by the acquisition module [2] of bio signals where the conditioning is made of the signal from the sensors, module of signal processing and the wireless communication module. The

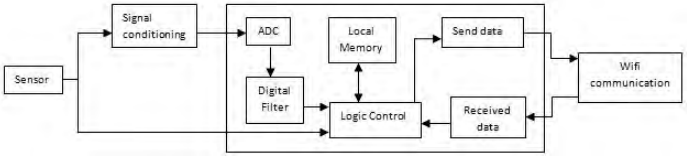


Figure 1: System block diagram

block diagram proposed is presented in Figure 1. The system consists on a digital signal processor (DSP), a powered battery, an acquisition module and a communication module.

The signal acquisition of the electrical activity of the heart is conducted through three textile electrodes incorporated into a t-shirt adjustable to the body. This signal is received and pre-amplified in the signal conditioning module and sent to the processing signal module. It is converted from analog to digital by digital signal processing (DSP) and is filtered with a digital band-pass filter (a combination of high-pass and low-pass filter) to remove the baseline and higher frequency interference. Finally, the signal is transmitted through Bluetooth

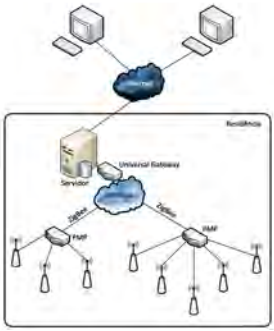


Figure 2: System Architecture

communication to the platform. In Figure 2 is represented the map of the entire monitoring network and its interfaces.

Signal Acquisition

Textile Electrodes

The term "smart textiles" covers a broad range. They include textiles that can sense and analyze the signals [3]. Their response is done in an intelligent way.

The use of smart textiles allows the monitoring of the electrical activity of the heart for a long period of time with a high comfort without causing irritation or skin allergies.

Table 1: System requirements for Biosignals

Bio Signals
Acquire bio signals
Support technology Bluetooth and Zigbee
Storing data for a long period of time
Being able to expand and integrate other features

For the experimental tests various sizes for electrodes textile were defined, 4cm^2 (1) e 2x8cm (2) that were inserted in a self adjustable t-shirt to the body as it can seen below Figure 3.

Electrical Activity of the Hearth (ECG)

In order to obtain results the traditional Ag/AgCl electrodes were used and then were compared with the textile electrodes [4]. Several factors were analyzed to obtain de ECG signal for a prolonged monitoring [5]. The electrodes Ag/AgCl usually have the durability of less than a year, they are not reusable and they can only be used one time during some days. The gel used in the electrodes can cause some irritation to the skin, which causes some stress when obtaining accurate data, after several days of use.

Figure 3: T-shirt with electrodes textile

Some studies have been published based on the textile electrodes and some have positive results: the signal obtained is influenced by the area covered by the fabric textiles conductor.

In Figure the comparison between the ECG signals obtained by two types of electrodes can be observed (Figure 4 and Figure 5).

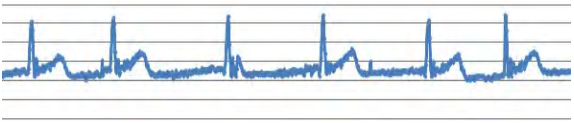


Figure 4: Signal obtained by Ag/AgCl electrodes

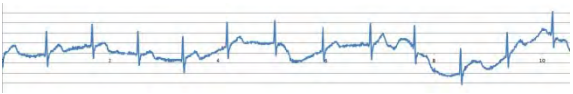


Figure 5: Signal obtained by textile electrodes

Testing and Results

Assisted Residence

This solution consists of a mobile application that provides the user interface for the BioSigMA [6] platform, enabling the user to visualize his monitoring data, and also configure the monitoring parameters, as the limits for triggering alarms and the types of sensors connects to the device. The KeepCare application connects to a remote server (developed using the wise Framework) that receives the data from the smartphone and stores it, so the user is able to see the history of the monitoring on a website. The server also triggers alarms and shows notifications on the website.

We tested the functionalities implemented using as close to real-world examples as possible. The implementation of the bio signal data communication to the Smartphone and from the Smartphone to the remote server was straightforward, so the tests were simple.

This data is received and shown in real time. The alerts are also triggered in real time, sending a notification to the user. We also tested the activity levels by doing walks and runs, so we could adjust the thresholds at which we consider an activity a low level activity or a high level activity.

Conclusions

Throughout this work were developed several technologies that allow carrying out pilot tests on the next scenario: assisted residences.

In this scenario, a Platform for Personal Monitoring was developed in a Smartphone that, taking advantage of a capabilities of this kind of device, implements functionalities that go beyond the simple transmission of the vital signs from the sensors to a remote server.

Acknowledgments

This project was developed in scope of ongoing projects NIDT – Núcleo de Investigação e Desenvolvimento Tecnológico da Inovamais with project nº 1362, TICE.HEALTHY – Health Systems and Quality of Life and in project KeepSafe SIIDT 2012/24707 of IncreaseTime.

References

[1] C. Y. Yeh, J. W. Wang, W. C. Chiou. "A novel fuzzy c-means method for classifying hearthbeat cases from ECG signals." Measurement, vol.43, pp 1542-1555, September 2010.

[2] L. H. B. Spilák. "Digital Filtration of artifacts in ECG" Master´s thesis, Department of Radio electronics, faculty of Electrical engineering and Information Technology SUT.

[3] Y. J. Beak, H. J. An, M. J. Choi, S. K. Park, H. S. Lee, "Flexible polymeric dry electrodes for the long-term monitoring of ECG." Sensors and Actuators B: Chemical, vol. 156, pp. 765-772, February 2011.

[4] V. Marozas, Petrenas, Doukantas, S. Lukosevicius, "A comparison of conductive textile-based and silver/silver chloride gel electrodes in exercise electrocardiogram recordings." Journal of Electrocardiology, vol. 44, pp. 189-194, September 2011.

[5] J. Coosemans, Hermans, B. E Puers, "Integrating wireless ECG monitoring in textiles", Sensors and Actuators, vol. 130, pp. 48-53, December 2006.

[6] BioSigMA platform Internet: http://www.biosigma.com

Filipe Oliveira has a Degree in Computation and Medical Instrumentation Engineering, specialization in Information Systems Programming and Master Degree in Economics and Innovation Management. Currently I am working in some European projects in telemonitoring and alarm systems for health and wellness.

Objective Evaluation of Chronic Dysphonia Laryngeal Origin and Follow-Up of Their Treatments by Implementation of a Telemedical Device

S. Abdelouahed[1], S. Aounallah[2], M. Benabdellah[1]
[1]Faculty of Technology, Laboratory of Biomedical Engineering, University of Tlemcen, Algeria, sarasim1@hotmail.fr; m_benabdellah_2000@yahoo.fr
[2]Faculty of Medecine, University Hospital of Tlemcen, University of Tlemcen, Algeria, hocine571@hotmail.fr

Abstract: **Assessing the quality of voice and perception of the causes of its degradation through various voice indices has always been the main concern of clinical speech pathologists. However, the voice and speech are in essence made to be heard, the subjective evaluation "listening" to "clinical ear" of the expert remains the reference face of objective assessment methods.**

In this paper we develop a system dedicated to the objective characterization of dysphonia chronic laryngeal origin. The purpose of this system is threefold: diagnosis, treatment and monitoring of patient. It includes a telemedical chain made up of:

1. **A hardware with a microphone and a sound card of terminal computer;**
2. **A software with: Vocal Audacity environment for the recording of the acoustic vocal signal - Wamp environment for the establishment of data base on line - Visual BASIC environment for treatment spectro-temporal acoustic voice signal and transfer of the data under protocol TCP/IP making profitable architecture customer server supported by the component Winsock of VB in relation to the operating system Windows.**

For that we have designed an experimental protocol which consists of recording and archiving of the acoustic voice signals by means of the software environment Audacity which makes it possible to deliver a temporal signal under WAVE format. Our contribution consisted of the implementation, under the Visual Basic environment, of an algorithm that allows performing the analysis of a spectro-temporal acoustic voiced speech signal in this case the vowel "a" sustained for three seconds. This algorithm is provided to calculate the following

characteristic indices of the acoustic voice signal: Fundamental frequency, STD, shimmer, jitter, formants. We applied this algorithm on six healthy subjects and six pathological subjects of whose four with cancer of the larynx, one with chronic laryngitis and one presenting an inflammatory polyp of the vocal cords.

Introduction

Today, the voice treatment is a fundamental component of the engineer's sciences. It takes place between digital and language treatment i.e. (symbolical data treatment), since the 60's, this scientific field has known a dazzling expansion linked to the development of the information and communication technical tools [1, 4].

Among the voice treatment applications we distinguish [5]:

1) Spatial-spectro-temporal analysis of speech signal for the objective characterization of original laryngeal dysphonia [6];

2) Quantitative estimation of characteristics parameters of the speech signal during its acoustical representation especially the fundamental frequency of voiced sounds and its dispersion expressed by the factor STD, tones, forming, jitter and shimmer [2].

Results and Clinical Evaluation

Distant sustained of the patient

The patient treated by the radiotherapy (persons suffering from cancer) or by medical treatment (a patient presents a clinical inflamed syndrome) and whose living in isolated area especially the north polar could be distant sustained thank to platform implantation at near the health centers. And thank to the periodical recording of the acoustical signal vocal according to the precedent described protocol and its O.R.L department of University Hospital accordance with the architecture client-server hold up by the component Winsock compatible with the protocol TCP/IP which permitted the transmission of the data toward intranet or internet thus the patient avoiding the inutile movement a condition that he responds favorably to the instituted treatment.

Results & Discussions

This work was done in collaboration with doctors in ORL, ORL department of the University Hospital Tlemcen. We note that for the healthy subjects the fundamental frequency is about 200 Hz corresponding to the value of the physiological fundamental frequency of the vowel 'a' [3]. On the other hand it's reduced in the persons suffering from cancer it's situated around 60HZ. This diminution of the fundamental frequency is also present in the case of chronicle inflamed diseases of the larynx but a lower degree it's around the interval 100-160 HZ. Even the extended spectral is lower in cancerous patients because of the important reduction notice a total absence of the vocals cords vibrations. This limitation of the content of the frequency

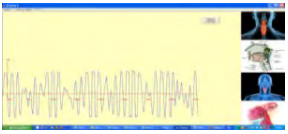


Fig. 1 Temporal layout of vocal signal of a healthy subject. The average fundamental frequency is: 200.60 Hz.

Fig. 2 Frequency layout of vocal signal of a healthy subject. The average fundamental frequency is: 200.60 Hz.

Fig. 3 Temporal layout of vocal signal of a subject whose attains a larynx cancer. The average fundamental frequency is: 62.48 Hz.

Fig. 4 Frequented layout of vocal signal of a subject whose attains a larynx cancer. The average fundamental frequency is: 62.48 Hz.

Table I The average fundamental frequencies of the 6 healthy subjects

Healthy subjects						
Fundamental frequencies F0(Hz)	1st subject	2nd subject	3rd subject	4th subject	5th subject	6th subject
	Male sexe				Female sexe	
1st selection	227.05	200.65	190.09	184.81	200.65	190.09
2nd selection	184.81	211.2	184.8	211.21	211.2	184.8
3rd selection	184.81	184.8	184.8	179.53	184.8	184.8
4th selection	227.05	184.8	216.49	184.81	184.8	216.49
5th selection	195.12	211 .4	184.81	211.21	184.81	184.81
6th selection	184.8	195.37	211.21	184.8	195.37	211.21
The average fundamental frequencies (Hz)	200.6	198.03	196.68	192.72	193.59	195.36

is also present but with a truncated manner in the case of chronicle inflamed diseases of larynx.

Table II The average fundamental frequencies of the 6 sick subjects

Sick subjects						
Fundamental frequences F0(HZ)	1st subject	2nd subject	3rd subject	4th subject	5th subject	6th subject
	Male sexe					
1st selection	73.92	58.08	68.64	47.52	121.44	174.25
2nd selection	73.92	47.52	47.52	52.8	105.6	163.69
3rd selection	52.8	47.5	47.52	52.8	110.88	142.57
4th selection	73.92	42.24	68.64	47.58	100.32	174.81
5th selection	63.36	42.24	68.64	58.08	137.29	163.69
6th selection	73.92	47.52	73.92	58.08	137.29	142.57
The average fundamental frequencies (Hz)	68.64	47.51	62.48	52.81	118.8	160.17

Conclusion

The analysis of the signal vocal treatment in accordance with screening and sustain of the vocals dysphonia stay a vast domain of research. The aim of this work was to design and implement a human-machine interface dedicated to the objective evaluation of laryngeal dysphonia through the spectro-temporal characterization of the acoustic vocal signal. Results in concordance with those are found in the bibliography.

The fundamental frequency presents a large variability in subjects with vocal cord pathology. This variability of F0 seems largely different depending on the type of disease that is inflammatory or tumor.

These recordings performed in vivo and in situ at the ORL department of the University Hospital Tlemcen allowed us to start developing a database on classification of laryngeal pathologies as inflammatory or tumor type for an early detection of laryngeal cancer and its prevention by the epidemiological study of predisposing factors.

References

[1] A. Drygajlo, «Traitement De La Parole», “Interactive Multimodal Information Management (IM)2” , Laboratory of IDIAP (LIDIAP) Institute of Electrical Engineering (IEL) ,Swiss Federal Institute of Technology

[2] A. Ghio, A. Giovanni, B. Teston et al. Balance and perspectives of fifteen evaluation by instrumental methods and voice perception. Acts Study Days on the speech (JEP) (27: 2008 June 9-13: Avignon, FRANCE). Avignon: LIA. 2008

[3] P. Yu, R. Garrel, R. Nicollas, M. Ouaknine, A. Giovanni (2007), "Objective voice analysis in dysphonic patients. New data including non linear measurements", Folia Phoniatrica et Logopaedica, 59:20-30. Lausanne (EPFL).

[4] A. Giovanni, P. Yu, J. Révis, M. D. Guarella, B. Teston, M. Ouaknine. «Objective analysis of dysphonia with EVA equipment. State of play. » Review Oto-Rhino-Laryngology French, 90, 2006, pp. 183-192
[5] B. Teston, The instrumental evaluation of dysphonia. Present state and perspectives. The balance dysphonia. ISBN 2-914513-62-3. Marseille: Solal. 2004, p. 105-169.
[6] G. Almouzni, «Speech Processing»,2011

Sara Abdelouahed, born 1990 in Algéria, she is PhD in Telemedicine, GBM Laboratory, Tlemcen University. She is biomedical electronics licence (EBM) (2009), has a Master in signals and images in medicine (SIM) (2012). Here research is in treatment of voice signal and screening of foodborne illness laryngeal.

Sid Ahmed Aounallah, assistant professor Otolaryngology (ENT), head of Unit at the ENT department of the University Hospital of Tlemcen , surgical oncologist of head and neck, University professor since 1991 at the Faculty of Medicine at the University of Tlemcen, Member of the laboratory of Biomedical Engineering at the University of Tlemcen.

Mohammed Benabdellah received the Diplôme of Engineer state degree from the Polytechnic National School, Algiers-Algeria, in, Magister prepared at the National Institute of Health and Research Toulouse (INSERM) , in 1984, Ph.D. New Plan at Paul Sabatier University in Biological and Medical Engineering in 1987, Doctorate state in Biomedical Engineering granted as equivalence in1991.Then, Professor at the University of Tlemcen (Algeria). Team Leader of Telemedicine of Biomedical Engineering Laboratory.

Safety Analysis of a Remote Patient Monitoring System with a Guideline Based Decision Support

L. Al-Qora'n, S. Sharvia, N. Gordon, Y. Papadopoulos
University of Hull, Department of Computer Science
L.F.AL-Qoran@2011.hull.ac.uk, S.Sharvia@hull.ac.uk,
N.A.Gordon@hull.ac.uk, Y.I.Papadopoulos@hull.ac.uk
Cottingham Road, HU6 7RX, Hull,UK

Abstract: **Home Telehealth systems are used to help in the management of chronic conditions by patients themselves. Effective safety analysis tools are needed to ensure reliability and safety of these high risk systems. We hereby explain how Hierarchically-Performed Hazard Origin and Propagation Studies (HiP-HOPS) can be used to analyse the workflow within a Home Telemonitoring system. The results of using HiP-HOPS include the root causes of hazardous system failures that may put patients' lives at risk. Initial study of this approach shows that it has the potential to improve the safety of Telehealth systems and clinical workflows in general.**

Introduction

Emerging Telehealth systems introduce new practical hazards that may be caused by operational deviations potentially leading to catastrophic consequences including loss of patients' lives. Such systems are, therefore, considered to be safety critical and must be subjected to safety analysis. There is a wealth of knowledge from application of classical safety analysis techniques [1] and [2] in transportation and other safety critical industries. Recently, research has also focused on the importance of risk analysis of health information systems and Telehealth applications (e.g. [3-4]).

In this paper, we argue that modeling and analysis of clinical workflows is key to effective safety analysis in Telehealth applications. Clinical workflow modeling should include clinical activities and identify their order of invocation, synchronization and dataflow between them. Accordingly, if potential contributors leading to system failure can be identified when a clinical workflow is modelled, many system weaknesses may be discovered and improved. This paper provides an approach to systematic safety analysis of the workflow within a Home Telemonitoring system. In particular, we show how a state-of-the-art technique called (HiP-HOPS) [5]

that has been prominently used in mechatronic systems has been used for a safety study of a Tele Guideline Based Decision Support System (GBDSS).

Case Study

An example of a GBDSS for generating recommendations from routinely recorded home Telehealth measurement data was described by [6]. The system was tested on a prospective chronic obstructive pulmonary disease (COPD) home Telehealth trial. The objective of GBDSS is to provide specific recommendations to both patients and carers based on the patient's measurement data which are recorded by the Home Telehealth Unit (HTU). These recommendations could be referral recommendations or home management recommendations.

The workflow of this system starts by creating and sending a reminder to inform patients to perform their measurements, the data are then sent to and automatically stored in a database; if the data are complete, classification is performed. Seven criteria are important to be detected- Forced expiratory volume in 1 second (FEV1), fever, saturation of peripheral oxygen (SPO2) value, weight, breathlessness, general condition, and Sputum. These criteria are used to decide on the stability of the COPD patient. Criteria status which indicate referral are the decrease of measurements for FEV1, SPO2, and weight, increase in body temperature for fever, severe indication for breathlessness, deterioration of general conditions, and increased amount and change of colour for the sputum. If the number of positive criteria is greater than six then the patient should be referred to the hospital; otherwise, if the number of positive criteria is greater than four and any of the critical criteria (FEV1, SPO2, or Temperature) are positive then the patient will be referred to the hospital. On the other hand if the number of positive criteria is greater than four and none of the critical criteria is true the patient will not be referred and he will be recommended to stay at home.

Different types of failures may occur in the system. For example, with regards to the recommendations issued to the patient, the system may experience false negative or false positive errors. False negative error occurs when the system issued a recommendation for home treatment when a referral is required. False positive error occurs when a referral recommendation is issued when only home treatment is needed. There are various causes for each of these errors. Those causes need to be investigated and HiP-HOPS is used here to analyse the system and provide root causes of these errors. Of particular concern is the false negative error, which is deemed to present severe clinical risk. For the purpose of the analysis, the system has been modelled in the architecture of Fig.1.

The aim of the analysis is to identify the root causes of the scenario which has serious clinical risk, in this case, the false negative error. We present

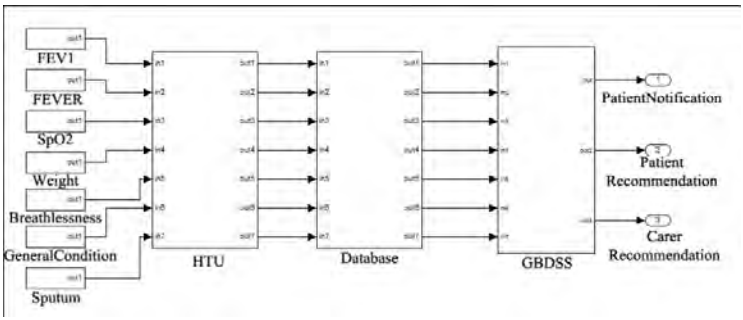


Fig.1: System Architecture

and discuss a scenario where five positive criteria are observed in the patient. Value failure refers to any deviation of value in a parameter, criteria, input or output. Internal malfunction for the components which relates to the criteria are represented by an affix of "V" behind the criteria name. For example, internal malfunction causing value failure in FEV1 is represented as "FEV1V" An internal malfunction (HTUV) may also occur in the HTU. For the Database, internal malfunctions may include software or hardware malfunctions, represented as DatabaseSW and DatabaseHW respectively. Similarly, the GBDSS component may experience software and hardware malfunction, which are represented as GBDSSSW and GBDSSHW. We have also included a condition of "ConditionNonCriticalC4" to represent the situation where non-critical criteria Weight, Breathlessness, GeneralCondition and Sputum are all positive.

Analysis Results

Once the components of the model have been annotated with the corresponding failure information, root cause analysis can be performed. HiP-HOPS synthesises and analyses the system fault tree and produces the Fault Tree Analysis (FTA) and Failure Mode and Effect Analysis (FMEA) results which shows how the value failure in criteria and the component failures (or their combinations) can lead to the false negative error. The necessary and sufficient combinations of these failures are called minimal cut-sets [1]. The following minimal cut-sets are produced from the system FTA: DatabaseHW, DatabaseSW, GBDSSSHW, GBDSSSW, HTUV, ConditionNonCriticalC4 AND FEV1V, ConditionNonCriticalC4 AND

SpO2V, ConditionNonCriticalC4 AND FeverV, 21 combinations of any two failures, e.g.: FEV1V AND FeverV, FEV1V AND SpO2V, FEV1V AND WeightV, FEV1V AND SputumV, FEV1V AND BreathlessnessV, SpO2V AND WeightV,

The resulting FMEA shows that the following component failures will directly affect the system failure (causing false negative error): DatabaseSW, DatabaseHW, GBDSSSW, GBDSSHW, and HTUV. It also shows the effects of the component failures in combination with other component failures. To summarize, the FTA and FMEA results show that in the discussed scenario, the following failures may lead to the false negative error:

- Any failure in the component HTU, Database and GBDSS;
- Combination of any two criteria failures - which causes the number of positive criteria to be smaller than 4 (C<4);
- In the case where four non-critical criteria are positive, any failure on one of the critical criteria.

The identification of these root causes allows greater understanding of the factors contributing to the undesired events leading to a serious clinical risk. This enables the identification of weak points in the system, which could then be effectively addressed and improved. The approach is generic and potentially can be used to analyse the impact of software, hardware, and human failures in a Telehealth application environment.

References

[1] W. E. Vesely, F. F. Goldberg, N. H. Roberts and D. F. Haasl. Fault Tree Handbook, Washington DC: US Nuclear Regulatory Commission, 1981.

[2] W. Gilchrist, Modelling Failure Modes and Effects Analysis, International Journal of Quality & Reliability Management (IJQRM), 10(5), 1993, pp. 16-23.

[3] N. Stathiakis, C. Chronaki, E. Skipenes et al, Risk Assessment of a Cardiology eHealth Service in HYGEIAnet., Proc Computers in Cardiology (CIC_2003), 2003, pp. 201–4.

[4] I. Maglogiannis, E. Zafiropoulos, .A Platis, C. Lambrinoudakis, Risk Analysis of a Patient Monitoring System Using Bayesian Networks, Biomedical Informatics, 39, 2006, 637-647.

[5] Y. Papadopoulos, J. McDermid. Hierarchically Performed Hazard Origin and Propagation Studies, Lecture Notes in Computer Science, 1698, 1999, pp. 139-152.

[6] M. Mohktar, J. Basilakis, S. Remond, N. Lovell. A Guideline-Based Decision Support System for Generating Referral Recommendations, IEEE conference on Engineering in Medicine and Biology Society (EMBS), IEEE, 2010, pp. 6166-6169.

Lamis Al-Qora'n is a PhD student in Computer Science Department at the University of Hull. She finished her masters from the same department in 2006. Currently she is a member of the Intelligent Systems Research Group with a research interest in safety analysis of clinical workflows and Telehealth applications. Lamis has a full scholarship from Philadelphia University – Jordan to complete her PhD.

Septavera Sharvia is a Post-Doctoral Researcher in Computer Science at the University of Hull. She is currently working on the safety assessments for dependable Telehealth systems. She completed her PhD in 2011, in which she investigated the combined application of traditional safety analysis techniques such as fault tree analysis with behavioural-based techniques such as model checking. She was previously a Research Associate at the University of York, working on the Early Safety Warning System for mid-air conflicts in the Air Traffic Management domain. Her research interests include HiP-HOPS, hazard assessment, fault tree analysis, verification and Complex Event Processing.

Dr Neil Gordon is a lecturer in Computer Science at the University of Hull, with research interests in formal systems and their applications, in particular to computer and information systems applications, including Health and education. Neil has published in the areas of codes and cryptography, dependable systems and intelligent systems.

Professor Yiannis Papadopoulos leads the Dependable Systems group in the University of Hull. He has pioneered a state-of-the-art method and tool for model-based dependability assessment and evolutionary optimisation of complex engineering systems known as HiP-HOPS. He has extensive collaborations with industry and is actively involved in two technical committees of IFAC (TC 1.3 & 5.1) on design and control of dependable systems.

TelMedHome System and High Signal Resolution Pulse Wave Method – Fast and Cheap Monitoring of the Patients with Cardiovascular Diseases

R. Krzyminiewski, B. Dobosz, A. Szymil
Medical Physisc Division, Faculty of Physics, Adam Mickiewicz University, rku@amu.edu.pl
Umultowska 85, 61-614 Poznan, Poland

Abstract: **The paper presents a new diagnostic method, High Signal Resolution Pulse Wave (HSR-PW) which is based on increasing the resolution of the pulse wave signal recorded during a standard test. The linear transformation method is used to increase resolution of the pulse wave. This procedure allows obtaining more detailed structure and analysis of received signal. The study involved twelve thousands patients in the age of 55 – 80 years. The standard pulse wave has been recorded, transferred by the Internet to the analytical server and the HSR-PW analysis has been performed. It was found about 20% records with disruptions caused by the patients mobility or technical errors. 41% of recorded pulse waves were correct and all parameters were located in standard range and 39% of obtained results were pathological.**

Introduction

A typical data recorded from pulse oximeter founded on patient's finger gives information how well the arterial blood is oxygenated and pulse rate value. The parameters of pulse wave, eventual pulse disturbances etc. are usually not analysed (Fig.1).

The study developed a computer analysis of recorded digital pulse waves by linear transformation method to enhance resolution of pulse wave signal (high signal resolution HSR) [1]. In previous work analyzed the usefulness of the method in the diagnosis of cardiovascular disease [2-3].

The aim of the study was to check how this new method can be useful in screening measurements older people.

Methods

The linear transformation method [1, 2] was used to increase resolution of the pulse wave. This procedure allows obtaining more detailed structure and

analysis of received signal. We named this high signal resolution pulse wave method as a HSR-PW. In contrast to the results of a standard measurement, HSR-PW allows to observe even minor changes in the circulatory system. The study involved twelve thousands patients in the age of 55 – 80 years. A standard CMS-50E digital pulse oximeter localized on the left hand index finger was used, which allows measurement of oxygen saturation in the range of 35%-99% with a resolution 1 % for SPO2 and registration of the standard pulse wave. The standard pulse wave has been recorded, transferred by the Internet to the analytical server and the HSR-PW analysis has been performed on-line.

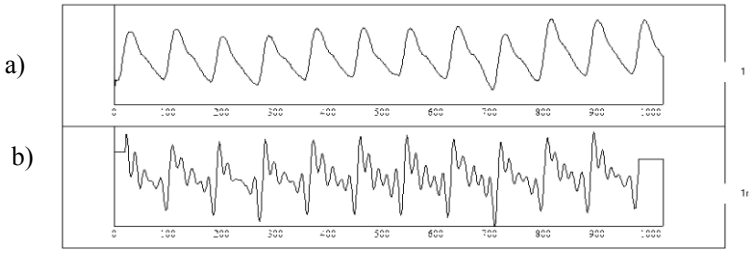


Fig.1. Pulse wave before a) and after b) high signal resolution processing

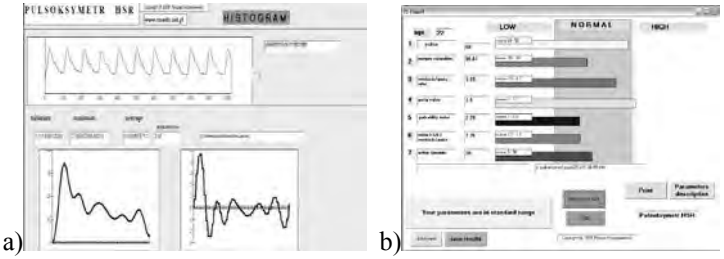


Fig.2. Pulse wave analysis result of HSR - PW a healthy person:
a) standard and HSR pulse wave, b) histogram of parameters.

HSR-PW can determine such parameters like: pulse rate, oxygen saturation, parameter describing ventricle/aorta volume ratio, pulsatility index, artery dynamic, index k1/k2 ventricle/aorta correlated with vascular resistance and much more (Fig.2b). Some of these parameters are sensitive indicators of cardiovascular abnormalities such as increased vascular resistance, atherosclerosis, arrhythmia, heart valve defects, etc. [2, 3]

Results

We studied 12000 healthy subjects and people with health problems.

The results of the pulse wave examinations we can divide into three groups: recorded technically properly with determined parameters in standard range of healthy people, recorded properly with parameters out of normal state and recorded technically incorrectly. It was found about 20% records with disruptions caused by the patients' mobility or technical errors. 41% of recorded pulse waves were correct and all parameters were located in standard range and 39% of obtained results were pathological. The system was able to detect arrhythmia (Fig.3), increased vascular resistance (Fig.4) and disadvantages of cardiac valve (Fig.5).

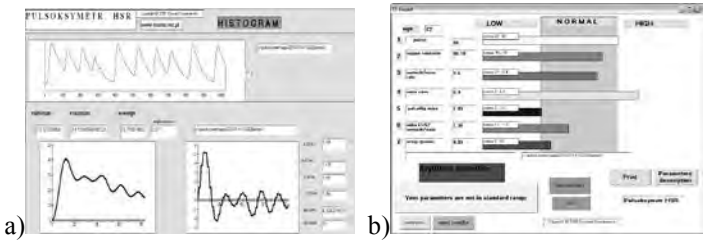


Fig.3. The case of arrhythmia: a) standard and HSR pulse wave, b) histogram of parameters

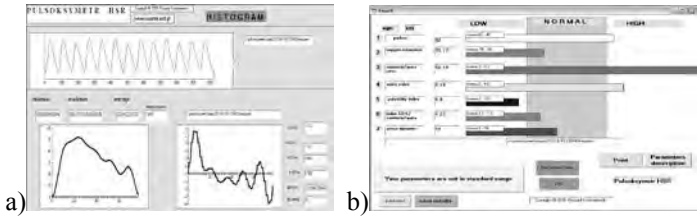


Fig. 4. Intermittent claudication: a) standard and HSR pulse wave, b) histogram of parameters

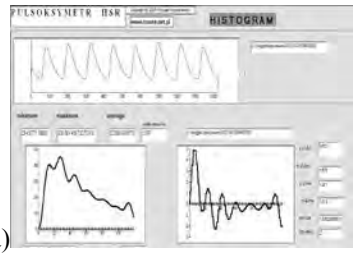
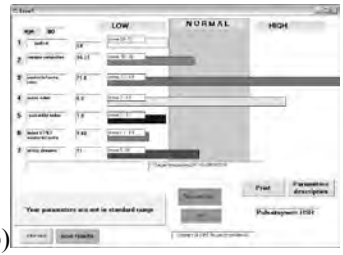
a)  b) 

Fig.5. Aortic stenosis: a) standard and HSR pulse wave, b) histogram of parameters

The results of the pulse oximetry records and analysis HSR-PW helped to detect in many people irregularities in the circulation system e.g. arrhythmia. Large part of them thanks to these examinations found the necessity to visit a doctor.

Conclusions

It was concluded that High Signal Resolution Pulse Wave (HSR-PW) and TelMedHome is a very good system to the early detection of low cardiovascular and the circulatory system abnormalities. The increased sensitivity of HSR-PW enables to observe a discrete pulse wave signal changes and therefore may increase their clinical utility.

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, TelMedHome – fast and cheap home care monitoring of the patients with cardiac diseases, In M. Jordanova and F. Lievens (Eds.) Global Telemedicine and eHealth Updates: Knowledge resources, Publ. ISfTeH, 2012, Luxemburg, Vol. 5, pp. 623-627.

Using a Touch Pad without Touching the Screen: Android Application for an Intuitive Increase of the Housing Environment

J. Gengo, T. Cardace, S. Jacquelet, L. Billonnet, J.-M. Dumas, C. Lesmarie
Université de Limoges, Limoges, France
laurent.billonnet@unilim.fr

Abstract: **Within the context of an ageing population, it is necessary to provide each and everyone with versatile widely-accepted applications for home control. We have started developing an intuitive pleasing application that can make life easier for persons with impaired mobility or conditions like Parkinson's disease. Home devices identified and displayed on a mobile interface (i.e. a smartphone or tablet with built-in camera) can benefit from augmented reality so as to make them controllable (via the gyroscope) by simple intuitive gestures without even requiring tactile interaction.**

Android's Present Position on the Market

Android currently enjoys a leading position on the tactile and mobile market and latest statics reveal their market share keeps growing. Android had 60% of the worldwide market share in 2012 while its Apple rival iOS only had 20% of the global market. Its open source model makes it a candidate of choice for persons with loss of autonomy who wish to stay at home while needing intuitive non intrusive low-pressure support.

Approach to and Aims of Proposed Applications

Our goal is to develop an application favouring the use of intuitive gestures to control home device switches (such as heating or lighting switches) in a natural way. This app makes use of the mobile interface built-in camera to recognize the labels which identify the type of switch and device currently targeted by the user. Once the device has been recognized, augmented reality displayed on the interface informs the user of the current state of the identified device (the current temperature in the room for instance, if it is a thermostat, or the on/off position of a distant light switch). Associated settings are also displayed. Simple motions applied to the interface (tilting it forward or backward, to the right or to the left) enable to slide the control up and down, thus increasing or decreasing the level of the corresponding device. Consequently, it is possible to expand this principle

and to generalize this type of application the meet the various needs of many different persons with decreasing autonomy.

As an experiment, a simple photomontage was done to simulate the interface functionalities we plan to implement. Figure 1 illustrates the intuitive control of automated roller shutters. When the user moves his tablet around his dwelling place, the application can be requested to recognize a device. This can be performed for example through QR codes. The QR code label will identify a specific device. Then, targeting the code will automatically display an augmented reality pictogram or graphic controller which will remotely inform of the state and functionalities of the device. Here, the logometry, i.e. the selected communication interface chosen for the shutters enables to understand naturally that the shutters are lowered 20%. The user can alternatively scroll the shutters up and down by using his finger, like with most tactile applications.

Fig. 1: Example illustrating the use of virtual reality to control roller shutters

As shown in Figure 2, the camera of the tablet detects the QR-code and recognizes the device which is being aimed at, as well as its current state. It also identifies or associates the available controls thanks to augmented reality. An additional type of interaction can even be designed and implemented. If the device is targeted for more than 3 seconds by the user without him actually interacting, the application can then offer a choice of available actions to be performed.

Fig. 2: Identification of a device and subsequent choice of actions on offer

As for persons suffering from Parkinson's disease, and in case shaking prevents them from operating the interface itself, QR-codes could alternatively be replaced by colour strips. Appropriate selection of a range of colours and shades would enable to locate and identify the object.

Technological and Sociological Parameters

In technological terms, the habitat itself should meet the technical requirements needed so as to have its various devices controlled by a central system. State-of-the-art products, particularly in the field of home automation, are available on the market. Wired and wireless technologies are available to transmit command signals. Re-inventing home appliances or the way they are connected is definitely not the point. The novelty of our approach lies in the fact that the interface is, for the user, the entry point into the whole system, that is to say the entire environment he lives in. As regards ethics and sociology, ubiquity is a crucial aspect for the user to perceive his assistance as a natural extension of his gestures and way of life [1-2]. Non-intrusive low-pressure features are essential parameters when it comes to appropriation and pleasurableness of the system. In addition, our application does not put in the shade all the other uses of a mobile tactile interface, i.e. the potential opportunities to browse the web, communicate, maintain social bonds or use games and applications that bring about material and psychological benefits on a daily basis.

Perspectives

The prospects of such a research project are twofold. A first aspect consists in studying the natural psychological effect of the colours put forward in the interface. This will enable to develop codes and sets of colours dedicated to specific conditions and disabilities as well as specific psychological or mental states among users [3].

Then, with a view to adjusting the interface to accommodate the majority, we are working on an extension of the research presented in [4]. The aim of the study is to offer several ways of controlling the home through a single interface. A further development of the application presented in this article will consist in being able to control home comfort devices and settings in distant rooms, i.e. without requiring the user to be present in that room. Thanks to the interface, he can access the map of his house and select the room he wants to monitor (lighting or current temperature for example). On the same general principle as in this article, identifying controllers on a blueprint or a photo of the room saved on the tablet enables to take control of the corresponding devices (like those presented above). A mock-up has been created and is presented in [4]. A version is being developed in which the remote control will be identified on a 360° photo panorama of the distant room. Thanks to this virtual view the user will be able to "navigate" into his house, as if he was walking around naturally. The originality of the approach is that the user will be offered the opportunity to interact thanks to natural intuitive motions of the tablet, rather than tactile interaction.

References

[1] N. Pignier, D. Tsala-Effa, L. Billonnet, A. Geslin-Beyaert and J.-M. Dumas, “On the semiotic appropriation of ICT tools for people in loss of autonomy”, Invited paper, 23rd Digiworld Summit, Montpellier, France, 2011.

[2] B. Bourdillon, L. Parizot, J. Vincent, E. Desbordes, N. Pignier, L. Billonnet and J.-M. Dumas, “Applications of tactile interfaces to home automation for people in loss of autonomy: training for memory gestures”, In M. Jordanova and F. Lievens (Eds.) Global telemedicine and eHealth Updates: Knowledge Resources, Publ. ISfTeH, Luxembourg, Vol. 4, 2011, pp. 126-129.

[3] M. Delvigne, L. Billonnet and J.-M. Dumas, “Using color codes through ICT and home automation technologies in the housing environment context for people in loss of autonomy”, 9th International Conference on Smart Homes and Health Telematics, pp. 200-204, Montreal, Canada, 2011.

[4] F. Mas, A. Remondière, P-A. Cochereau, E. Rouleau, P. Dartoux, L. Billonnet, Ch. Aupetit-Berthelemot, J-M. Dumas, "ePatient and eNurses Tools Based on Tactile Interfaces Applications for Nursing Home Residents and Nurse Team Support", eTELEMED 2013, The Fifth International Conference on eHealth, Telemedicine, and Social Medicine, Nice, 24 février au 1er mars 2013. www.marsouin.org, 2010

	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 focuse on AAL, smart interfaces, home automation and ICT for people in loss of autonomy. He is the Director of the BSc "Home automation for elderly and disabled people" and the international MSc "Auton'Hom-e [otɔnɔmi]"
	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

Validation of Wi-Fi Communication between Multiparametric Patient Monitor and eHealth Management Platform: A Case Study

R. Ferreira, J. Rosario, M. Much, I. Scheffler, E. Velasquez, T. Russomano
Scientific Department, Toth Technology and LIFEMED
contato@tothtecnologia.com.br
Av. Ipiranga, 6681, Predio 99ª, 13° Andar, Porto Alegre, 90619-900 Brazil

Abstract: **eHealth applications have enabled the provision of better care to hospitalized patients. However, its use in medical devices has brought with it new challenges for ensuring the quality and reliability of data management. The aims of this study were: (1) to validate the Wi-Fi communication between a multiparametric patient monitor and an eHealth Management Platform in a hospital environment; (2) to determine the best protocols and technologies to be used for data exchange with minimum connection problems and packet loss. A comparative study analyzed the data exchange performance using different equipment configurations between a multiparametric patient monitor and an eHealth Management Platform connected via Wi-Fi. The study demonstrated a reduction in connection problems and packet loss when using Wi-Fi communication at an 802.11G standard. In addition, the data exchange quality was improved by using TCP protocol instead of UDP protocol, and with selection of the channel with the lowest concurrent networks. The proposed configuration enabled the correct visualization of patient physiological information at the Central eHealth Management Platform, with minor flat line events due to connection problems or packet loss.**

Introduction

Cost reductions and a friendlier interface for wireless technologies have allowed them to become widely used for health application, driven also by the need of health care professionals to give the most appropriate care to patients in a timely manner and suitable location [1]. These advances have led to significant changes to inpatient and outpatient care [2], creating an innovative background for e-health and wellness application development. New system use context models have been designed, evolving from hospital to home, generating new challenges for communication interoperability and standardization [3].

A growing variety of medical devices have become cable free, aiming to increase hospital productivity, capacity and patient service [1, 3], and enabling information to be virtually accessed by health care professionals [4]. However, it is fundamental for solutions to be delivered that implement the most appropriate technologies for equipment use in each scenario and to ensure the correct selection and configuration of communication protocols [3].

Objectives

The aims of this study were: (1) to validate the Wi-Fi communication between a multiparametric patient monitor and an eHealth Management Platform in a hospital environment; (2) to determine the best protocols and technologies to be used for data exchange with minimum connection problems and packet loss.

Methods

The validation process was divided between a hospital environment evaluation, which took place at PUCRS University Hospital, Porto Alegre, RS, Brazil, and communication performance tests. Initially, the number of concurrent local Wi-Fi networks was evaluated in the intensive care units and recovery and emergency rooms using the inSSIDer 2.1 software loaded on a notebook with Wi-Fi capability. Wi-Fi equipment placement was also assessed. In view of these findings, a comparative study analyzed the data exchange performance between a LIFEMED Lifetouch10 multiparametric patient monitor and a LIFEMED eHealth Management Platform connected via a Linksys WRT102N Wi-Fi router (Figure 1) using two sets of equipment configuration (Table 1). The monitor was positioned in a laboratory environment and placed 5 meters apart from the access point. No physical obstructions lay between them and the Wi-Fi networks operated concurrently. The data exchange was analyzed using the WireShark® software. Packet size was set to 255 bytes.

Fig.1: Equipment arrangement used for the laboratory based comparative study

Table I: Equipment configuration used during the comparative study

Configurations	Set 1	Set 2
Network communication protocol of the multiparametric monitor	User Datagram Protocol (UDP)	Transmission Control Protocol (TCP)
Wi-Fi technology selection of the access point	Automatic	Set to 802.11G.
Wi-Fi channel selection of the access point	Automatic	Less active channel selected
Windows Operational System Delayed Ack configuration	activated	deactivated

Monitor software was designed to always transmit all patient physiological variables (ECG, respiration rate, EtCO2, SpO2, temperature, non-invasive and invasive blood pressure) due to hardware limitations.

Results

The hospital environment evaluation found a maximum of 14 concurrent Wi-Fi networks in the departments assessed. It was decided, however, to broaden the application of the proposed study by testing 19 concurrent networks.

The comparative study between configuration set 1 (Figure 2) and configuration set 2 (Figure 3) demonstrated an increase in connection speed and stability and reduction in packet retransmission when using configuration set 2.

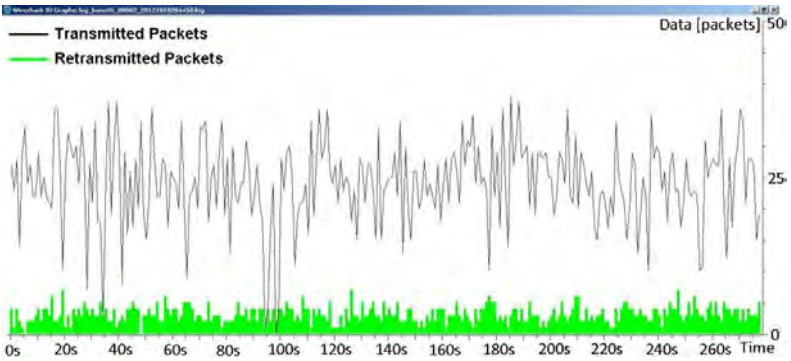


Fig.2: Data exchange analysis performed by the WireShark software when using configuration set 1

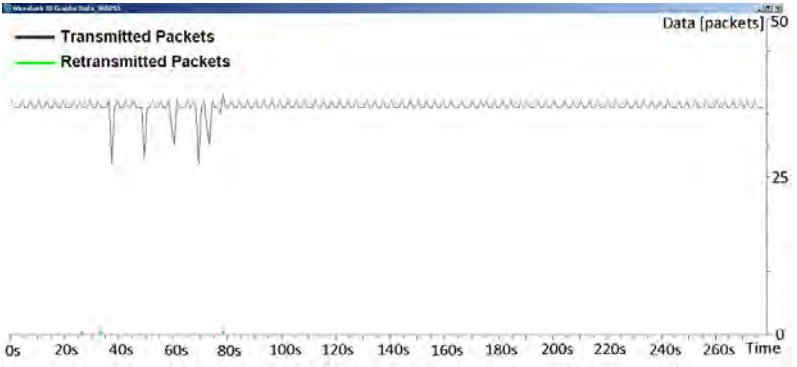


Fig.3: Data exchange analysis performed by the WireShark software when using configuration set 2

Conclusion

This study validated the Wi-Fi communication between the proposed equipment and was able to define a configuration that enabled the correct visualization of patient physiological information at the Central eHealth Management Platform, with minor flat line events due to connection problems or packet loss.

This study also demonstrated the positive impact of the reevaluation of equipment configuration for medical system performance and reliability, potentially avoiding the unnecessary expense of acquiring more powerful equipment.

References

[1]. P. Yu, M. X. Wu, H. Yu and G. Q. Xiao, "The Challenges for The Adoption of M-Health," in IEEE International Conference on Service Operations and Logistics, and Informatics, Shanghai, 2006

[2]. D. Donnelly, R. Harper, J. McCAnderson, D. Branagh, A. Kennedy, M. Caulfield and J. McLaughlin, "Development of a ubiquitous clinical monitoring solution to improve patient safety and outcomes," in Engineering in Medicine and Biology Society (EMBC), 2012 Annual International Conference of the IEEE, San Diego, 2012

[3]. Aragüés, J. Escayola, I. Martínez, P. del Valle, P. Muñoz, J. D. Trigo and J. García, "Trends and Challenges of the Emerging Technologies toward Interoperability and Standardization in e-Health Communications," IEEE Communications Magazine, pp. 182-188, 2011

[4]. R. Harper, N. Donnelly, I. McCullough, J. Francey, J. Anderson, J. A. McLaughlin e P. A. Catherwood, “Evaluation of a CE Approved Ambulatory Patient Monitoring Device in a General Medical Ward,” em 32nd Annual International Conference of the IEEE EMBS, Buenos Aires, 2010

Telenursing

BEIP – Happy, Healthy and at Home Medication Management via Video

M. Tyler, C. Towers, T. Coyne and S. Vido
Royal District Nursing Service ltd., 31 Alma Road, St Kilda, Victoria 3181, Australia
mtyler@rdns.com.au; ctowers@rdns.com.au; tcoyne@rdns.com.au; svido@rdns.com.au

Abstract: **An ageing population places pressure on the capacity of community care organisations to meet service demand. TeleHealth offers opportunities to bridge some of that gap between demand and supply. In this paper, the project being presented explores videoconferencing to deliver nursing visits to clients requiring assistance with management of their medication. The nurse visit is delivered via an Intel® Health Guide device and the clients care is supplemented on a weekly basis with a traditional home visit by the nurse. Initial indications are positive with favourable feedback from clients and staff. The ongoing challenge will be the incorporation of this TeleHealth service model into mainstream service delivery supported by a sustainable business model.**

Royal District Nursing Service (RDNS)

RDNS is Australia's largest provider of home nursing, home support and related healthcare services.

Employing 1,900 staff, more than 1,200 registered nurses, enrolled nurses, community carers, physiotherapists and social workers, RDNS delivers care and support to over 40,000 clients in their homes each year in Australia and New Zealand [1].

Around 80% of all RDNS' clients are older persons, reflecting an ageing population with an independent spirit and a desire to remain in their homes [2]. RDNS provides person and family centred care that enables older people to:

1. Remain living in their own home for longer
2. Minimise avoidable hospital admissions and
3. Care confidently for others.

Many of our increasingly aged population find themselves in need of support in their role as a carer, in addition to having health needs of their own.

RDNS provides both general and specialist nursing care including: breast cancer management, complex technical care, such as intravenous antibiotic therapy or chemotherapy, continence care, cystic fibrosis management, diabetes management, haemophilia care, HIV/AIDS care, holistic healthcare for people experiencing homelessness, hospital liaison nurses working with discharge planning, medication management, personal care delivered by health carers, stomal therapy and wound care.

The RDNS Customer Service Centre (CSC) is a 24/7 telephone service staffed by registered nurses is available to provide advice and information to clients, as well as support to staff working after hours. The CSC handles over half a million calls per annum and is the operational hub for RDNS' TeleHealth initiatives.

The Medication Management Challenge

RDNS is caring for an increasingly ageing client population who typically experience the impact of ageing, as well as chronic conditions. In addition, clients require complex care from RDNS to enable them to remain in the home instead of being admitted to hospital or be burdened with costly specialist care.

Medication management is a significant focus of in home services provided by RDNS. RDNS visits data shows that in 2011, nearly 538,000 home visits involved a component of medication management. Each home visit involves an RDNS nurse travelling in an RDNS car to a client's home in an increasingly congested urban environment. An RDNS nurse can spend up to a quarter of her/his day travelling in a car from client to client.

In 2011, the Australian Productivity Commission projected a commensurate threefold increase in the size of the Australian aged care workforce by 2051 – to 980,000 people.

The Commission concluded that – "Given the inherent uncertainty of projecting demand and supply over a long time horizon, there is a need for either an ongoing or periodic evaluation of the key demand and supply factors, including the models of care employed or technological developments" [3].

RDNS has also recognised the need to trial alternative service models and test technology to respond to the challenge of significantly increased demand for services. One area of focus has been medication management.

Happy, Healthy and at Home

The Happy, Healthy and at Home initiative is focussed on trialling the delivery of medication management visits to clients in their home by a registered nurse via a videoconference call. The initiative, which is known

within RDNS as *the Broadband Enabled Innovation Project (BEIP),* is designed to test the acceptability, efficacy, operability and sustainability of a service model built around a significant proportion of the nurse-client interaction being via video rather than the traditional physical face to face.

RDNS embraces the 're-enablement' or 'restorative' approach to community care (referred to as 'active service model" [4]) and BEIP is seen as consistent with that approach providing support for client management of their own medication needs.

BEIP has been made possible by a sizeable grant from the Victorian State Government (through the Department of Business and Innovation) and the support of our partners – Telstra, Care Innovation, Healthe and La Trobe University. The RDNS Human Research Ethics Committee has reviewed and approved the project.

The Project

BEIP has been operational for nine months. To date, nearly eighty clients have been assessed for inclusion to the programme and the total number having been enrolled to the programme is 34 clients. The target is to enrol fifty clients, who will be receiving services by April 2013.

To establish the programme, detailed preparatory work was done in the areas of clinical governance, service protocols, service delivery and technical setup. This required involvement from a range of staff and consultants to ensure project delivery.

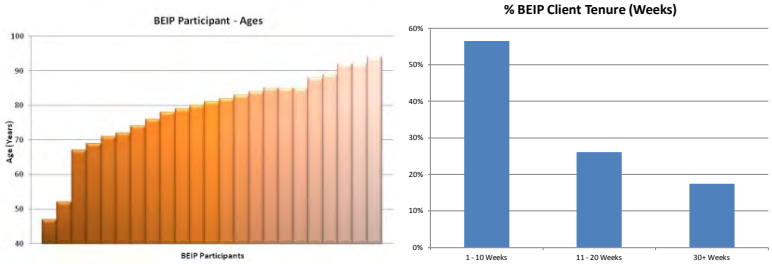
Key pre delivery work that was undertaken included the drafting of client inclusion criteria to determine who would be suitable for service delivery of this kind; development of a clinical governance framework and protocols to ensure client safety was not compromised; service delivery 'set-up' at the CSC to ensure client confidence that their privacy was being respected. This included nursing staff education.

Service delivery typically comprises a daily videoconference call from the nurse to the client at an agreed time (videoconferencing minimises the uncertainty inherent in delivering a home visit at a specific time, given traffic congestion and delays caused by unexpected client issues). The client is prompted and/or supervised through the self administration of their medication. All visits are recorded in note form in RDNS' client data management system. Typically, the client also receives one home visit per week which enables the nurse to make an ongoing assessment of the client's circumstances and to complement those conducted via a video link. When required, multiple daily calls are made for clients who require assistance several times per day.

Clients are surveyed when they enter and exit the programme and are also surveyed on a weekly basis whilst enrolled. Nursing staff are also being surveyed about their experience with this service model. It was not originally intended to survey carers (typically family members) but this will now occur as, anecdotally, they have often been a source of resistance to a client's participation – despite the client's willingness.

The evaluation of the project will focus on clinical efficacy and outcomes, client and staff satisfaction and cost benefit.

Interestingly, age does not appear to be a barrier to enrolment in the project with the oldest client currently enrolled being ninety-four years of age. Length of stay in the project is being measured although it is too early to draw any conclusions. Please see the following charts:



Next Steps

The pilot phase of the initiative will conclude in June 2013 and the BEIP Project will formally conclude in September 2013. A formal evaluation will be completed by then. While there is general consensus that BEIP is demonstrating the value of videoconferencing as part of RDNS' service delivery mix, the formal evaluation will test that perspective.

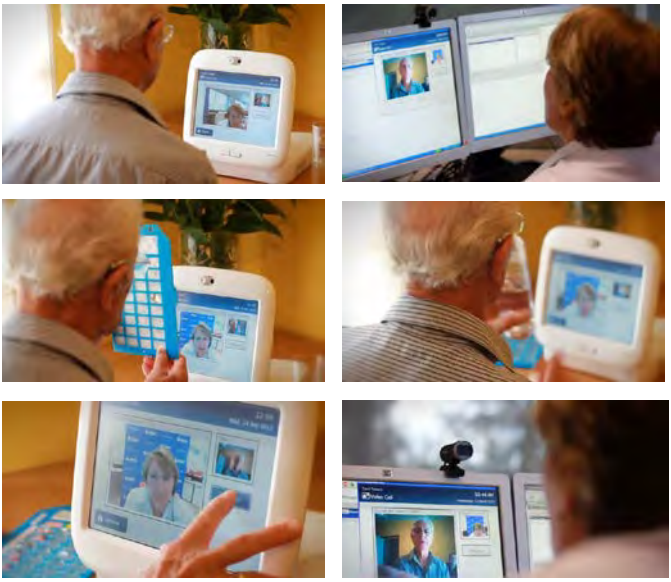
To date most of the early technical issues that are normally inherent with the introduction of emerging technologies, have been satisfactorily resolved. The service delivery 'routine' has been established, clinical risk appears to be well managed and stakeholders are expressing general satisfaction (with the caveat above regarding carers).

The cost benefit of the service model will also be assessed. TeleHealth service models in community care are not generally supported by funding arrangements in Australia. This is being increasingly recognised at a policy level as a constraint on the sector's capacity to invest and innovate in response to the pressure of an ageing and increasingly chronically ill population.

The formal evaluation of the project will be published in late 2013.

Images

The following images demonstrate BEIP's operation at RDNS' CSC as well as in the client's home.



References

[1] RDNS Annual Report 2012: p. 3-31.
[2] RDNS Annual Report 2012: p. 28.
[3] Productivity Commission, Caring for Older Australians, Productivity Commission Inquiry Report, Volume 2, 2011: p. 355.
[4] Victorian HACC Active Service Model Discussion Paper, Rural and Regional Health and Aged Care Services Division, Victorian Government Department of Human Services, Melbourne Victoria Australia, May 2008: p. 4-5 and p. 9-13.

Acknowledgements

RDNS would like to acknowledge the primary funding source of the BEIP Project; Victorian State Government, through the Department of Business and Innovation.

Home and Community Care (HACC) services provided by RDNS are jointly funded by the Victorian and Australian Governments B and MBA.

Stelvio Vido is RDNS Executive General Manager Projects and Business Development.
Stelvio has been with RDNS for over ten years and has over 25 years of executive level experience in the private sector, local government, and the not-for-profit sector. Stelvio's portfolio includes business development, executive support for the RDNS New Zealand operation, and development of RDNS' TeleHealth capability. He also manages the RDNS Portfolio Management Office, which supports the implementation of new business opportunities and service contracts.
Qualifications: University of Melbourne – B. Com., LL

Mat Tyler is a Prince2 Qualified Project Manager who has managed successful projects within a number of industries in Australia and the United Kingdom. Mat has worked in the UK with Transport for London and Plymouth City Council, managing successful large-scale organisational change projects. Appointed to the role of RDNS TeleHealth Project Manager, Mat is focused on delivering commercially viable outcomes and customer focussed results within the TeleHealth arena. Qualifications: Certified Prince2 PM Practitioner, Cert IV TAE, Cert IV QMA.

Carol Towers has worked with the RDNS as a Registered Nurse in various roles since 1987. Over the last 6 years she has developed an interest in working with clients to improve their medication management. She played a pivotal role in developing the Hospital Admission Risk Programme (HARP); Medication Management Service within Northern Health and RDNS. Carol is an integral member of the RDNS TeleHealth activities and acts as Clinical Nurse Lead for RDNS' Telehealth initiatives. Qualifications: RN, BApSc Advance Nursing, Cert IV TAE.

Theresa Coyne has worked with RDNS in pivotal roles since 1996. Since 2001 she was employed as Centre Lead for the rollout of mobile devices and laptops to all RDNS Field Staff, worked as a Support Centre Officer providing 1st and 2nd level IT phone support and was appointed Project Officer to oversee the deployment of Mobile Computing Devices. Theresa is focused on providing technological outcomes and delivering sound results via her pivotal role as Logistics & Technical Lead for RDNS' TeleHealth activities. Qualifications: Cert IV TAE, Cert III BM, Cert III IT, A+ Hardware.

Effect of Presence and Distance Teaching Methods on Nurses' Knowledge about Pressure Ulcer

P. A. L.Cavalcanti[1], E. M. L. R.Andrade[1], J. M. M. Neto[2], A. K. C. Monteiro[1], A. K. C. Monteiro[1], I. A. C. Mendes[3]
[1]Department of Nursing of the Health Sciences Center at the Federal University of Piauí, Brazil
[2]Department of Quimica of the Nature Sciences Center at the Federal University of Piauí, Brazil
[3]University of Sao Paulo at Ribeirao Preto College of Nursing, WHO Collaborating Centre for Nursing Research Development, Brazil
patriciaazevedolc@yahoo.com.br, elrangel@ufpi.edu.br, jmoita@uol.com.br, karinemonteiro2006@hotmail.com, karolmonteiro2006@hotmail.com, iamendes@eerp.usp.br

Introduction

There is no consensus about what kind of education would be better to increase nurses' knowledge of Pressure Ulcer (PU) (1-3). Thus, this study aimed to verify the effect of on-site and distance teaching methods on knowledge of nurses about PU.

Methodology

The experimental research with posttest control group was performed at a large-sized public hospital in Brazil, from January to April 2012. The sample of 43 nurses was randomly divided into Control Group (n=20), who had on-site classes, and Experimental Group (n=23), with distance learning. The research project was approved by the Ethics Committee. For data collection, Pieper and Moot's (1995) knowledge test was applied.

Results and Discussion

The mean score on the knowledge test for the on-site learning participants was 34.0 (SD=3.3) and for participants of the distance learning was 36.2 (SD=2.7). The mean difference between groups was statistically significant ($p=0.019$) (Table 1).

Table 1 – Comparison of the average knowledge on PU after training with on-site and distance teaching

Knowledge on PU after training			
Teaching method	$\bar{x}$	*sd*	***p value***
On-site	34,0	3,3	**0,019**[4]
Distance	36,2	2,7	

$\bar{x}$ - average *sd* - standard deviation [4]*t* test

The effect of distance education methods on nurses' knowledge of PU was higher than the one of on-site teaching. Distance Education (DE) seems to be an effective strategy for lifelong learning as it is practical, interactive and enable nurses who are in clinical practice to decide on the best time and place to access the content (4-5).

Final considerations

Improving nurses' knowledge of PU is essential to promote nursing interventions pertinent to the Guidelines for prevention and treatment of PU.

Acknowledgment

Statistical analysis was supported by Professor PhD José Machado Moita Neto (Department of Chemistry of the Nature Sciences Center at the Federal University of Piauí, Brazil).

References

[1] J. B. Costa; H. H. C. Peres, N. M. B. Rogenski, C. M. C. Baptista. Proposta educacional on-line sobre úlcera por pressão para alunos e profissionais de enfermagem. Acta Paul Enferm, v.22, n.5, p.607-11, 2009.

[2] J. R. Cox, S. Wynen; E. V.J Cox, S. Roche, E. V. Wynen. The effects of various instructional methods on retention of knowledge about pressure ulcer among critical care and medical-surgical nurses. The journal of continuing education in nursing, v.42, n.2, p.71-8, fev, 2011.

[3] M. L. Jones. E-learning in wound care: developing pressure ulcer prevention education. Br J Nurs, v.16, n.15, p. 26-31, 2007.

[4] S. Horiuchi, Y. Yaju, M. Koyo, Y. Sakyo, K. Nakayama. Evaluation of a web-based graduate continuing nursing education program in Japan: A randomized controlled trial. Nurse Education Today, v. 29, pp.140-149, 2009.

[5] M. G. Moore, G. Kearsley. Educação a distância: uma visão integrada. Tradução Roberto Galman. São Paulo: Thomson Learning, 2007.

Indirect Blood Pressure Measurement: Assessment of a Continuing Education Program Offered on Mobile Device

S. H. Tognoli[1], I. A. C. Mendes[1], S. Godoy[1], E. M. L. Range[2], C. A. Seixas[1]
L. B. de Paula[1]
[1]University of São Paulo at Ribeirão Preto College of Nursing (EERP-USP)
sitognoli@eerp.usp.br, iamendes@usp.br, sig@eerp.usp.br,
leonardo.brussolo@gmail.com
Avenida dos Bandeirantes 3900, 14040-902, Ribeirão Preto, SP, Brazil
[2]Federal University of Piaui, Brazil, elairgel@gmail.com

Abstract: **The course on indirect blood pressure measurement was ministered using mobile technology and was offered to nursing professionals from three Basic Health Units of the Western District of the city of Ribeirão Preto. This exploratory and descriptive study had the participation of 11 nursing auxiliaries who were monitored in four different phases: diagnostic, procedural and summative assessments and use of mobile technology and theoretical and practical evaluation. Results indicate gaps in knowledge related to aspects that involve indirect blood pressure measurement, when evaluating the educational activities in the procession phase. Most professionals had a good performance on accomplishing the procedure after the course. All 11 (100.0%) positively evaluated the use of the mobile device (Tablet) in continuing education at service, indicating they would like to participate in other activities using the resource. It was concluded that the study has limitations due to the small number of participants and the rules established by the service as to the custody of devices. Thus, further studies should be proposed in order to better scale the aspects identified by this study as limiting.**

Introduction

Studies show that hypertension, a major risk factor for cardiovascular diseases, has emerged as a major non-communicable disease (NCD) in the Brazilian and global scenario. Control of NCDs is therefore one of the main challenges in health care in the coming decades. Data from 2003 show that hypertension affects 50 million people in the United States and approximately 1 billion people worldwide [1].

In this context, the correct determination of blood pressure is a key factor in establishing the diagnosis of hypertension and imperative for safe decision making in the prevention and treatment of this chronic non-communicable condition [2].

The procedure of measuring blood pressure must be careful with the purpose of ensuring the accuracy of the values obtained [2].

Thus, health care professionals responsible for their execution need to provide care conditions free of errors that could jeopardize not only the diagnosis of hypertension but also promote the early detection, treatment and control of the disease.

Thus, using mobile technology, an updating course on indirect blood pressure measurement was offered for nursing professionals from three Basic Health Units of a city in the interior of the state of São Paulo, Brazil.

Method

Descriptive and exploratory study with the participation of 11 nursing auxiliaries who were monitored in four different assessment phases:

a) Diagnostic (pre-test),
b) Procedural (during the access to the course),
   Aiming to collaborate with the orientation process of professionals' learning, the course was structured with nine modules and five activities in the form of interactive exercises.
   The procedural assessment referred to the activities proposed in modules 2, 3, 6 and 8.
c) Summative (post-test)
d) Use of the mobile technology and theoretical-practical.

Results

Results indicate gaps in knowledge concerning some aspects involving indirect blood pressure measurement, when evaluating educational activities in the procedural stage.

The comparison of the performance of professionals at pre and post-test identified that even after accomplishing the course, gaps remained in knowledge regarding: devices used in indirect blood pressure measurement with oscillometric technique; importance of determining the maximum level of inflation of the rubber bag; sequence of steps for indirect blood pressure measurement.

It is emphasized that most professionals had good performance on the procedure after the course.

All 11 (100%) positively evaluated the use of the mobile device (Tablet) in continuing education at service, indicating that they would like to participate in other experiences using the resource.

Discussion

Similar data regarding the performance of health professionals in relation to theoretical knowledge about blood pressure measurement and evaluation of the use of the mobile device in continuing education at service was found. [3-7].

Conclusions

It is pointed out that this study has limitations due to the reduced number of participants. Thus, new studies aimed at better scaling limiting aspects identified by the study are recommended.

The importance of the use of mobile technology as a resource to be explored in continuing health education is evidenced.

References

[1] A. V. Chobanian et al. The seventh report of joint national committee on prevention, detection, evaluation and treatment of high blood pressure: the JNC 7 report. JAMA, 2003; 289: 2560-72.

[2] Sociedade Brasileira de Hipertensão, Sociedade Brasileira de Cardiologia, Sociedade Brasileira de Nefrologia. Diretrizes brasileiras de hipertensão arterial. 6, Arq.Bras Cardiol, 2010; 95(suplemento1): 51 p.

[3] C.C.P. Rabello; A.M.G. Pierin, D. Mion Júnior. O conhecimento insatisfatório de profissionais da área de saúde sobre a medida da pressão arterial. Rev. Esc. Enferm. USP. 2004; 38(2):127-34

[4] C.R.F. Araújo et al. Avaliação dos procedimentos para medida indireta da pressão arterial em uma unidade de terapia intensiva por profissionais de saúde. Rev. Soc. Cardiol. Estado São Paulo. 2006, 1:1-8.

[5] L.T. Lima, L.M. Gusmão. Conhecimento teórico e prático de auxiliares de enfermagem sobre medida da pressão arterial. Rev. Saúde.2008,2(1):12-16.

[6] J.J. González-López et al. Knowledge of correct blood pressure measurement procedures among medical and nursing students. Rev.Esp. Cardiol. 2009, 62(5):568-71.

[7] M.A.S. Ribeiro. O desafio da elaboração, aplicação e avaliação de um curso a distancia sobre tratamento de feridas. 2004. Dissertação (Mestrado) – Universidade Estadual de Campinas. Faculdade de Ciências Médicas, Campinas – SP. 2004, 273p.

Silvia Helena Tognoli is MSc by the Fundamental Nursing Graduate Program at the University of São Paulo at Ribeirão Preto College of Nursing – EERP/USP (2012). BSN in Nursing by EERP/USP (2005), specialist in ICU and emergency care by the University of Ribeirão Preto (2009), Hospital Administration (2012) and Training in DLO (2012). Works as a researcher and member of the Studies and Research in Communication in the Nursing Process Group – GEPECOPEn at EERP/USP.

Isabel Amélia Costa Mendes has a Bachelor of Nursing (1968) and Public Health Nursing (1969) from the University of São Paulo at Ribeirão Preto College of Nursing (EERP-USP); MSc in Nursing at UFRJ (1975); PhD (1986) and Full Lectureship in Nursing (1989) at EERP/USP. She has been Full Professor at EERP/USP since 1991 and Researcher 1A at CNPq. Vice-director (1990-1994) and is also Director of the WHO Collaborating Centre for Nursing Research Development.

Simone de Godoy is a Professor Doutor na mesma instituição e pesquisadora do Grupo de Estudos e Pesquisas em Comunicação no Processo de Enfermagem (GEPECOPEn). RN (1994), licensed nurse (1995), MSc by the Fundamental Nursing Graduate Program (2002) and a PhD in Science (2010) by the University of São Paulo at Ribeirão Preto College of Nursing (EERP/USP) - WHO Collaborating Centre for Nursing Research Development, Brazil. Faculty member at the same institution and researcher at the Studies and Research in Communication in the Nursing Process Group – GEPECOPEn.

Elaine Maria Leite Rangel - Faculty, Department of Nursing at the Health Sciences Center at the Federal University of Piauí, Brazil

Carlos Alberto Seixas - Computer Sciences degree by the Federal University of São Carlos (1993), PhD by the University of São Paulo, with the thesis “Structure and Dynamics of a Course in Virtual Learning Environment” (2011). Is the author of “E-Learning and Distance Education: Practical Guide for implementation and use of open systems”, Atlas, 2006. Currently works as IT analyst at the University of São Paulo and professor of the IT Bachelor program at UNIESP-RP. Has experience in Computer Science, with emphasis in Computer Systems Architecture, acting on the following themes: distance education, virtual learning environments, video conferencing, information systems, telenursing, health communication, health information systems and health informatics.

Leonardo Brussolo de Paula - Computer Sciences degree by UNISEB COC (2007). Specialist in Web Application Development by the Federal University of São Carlos (2010). Member of the Studies and Research in Communication in the Nursing Process Group – GEPECOPEn at EERP/USP. Has experience in Computer Science with emphasis on Development and Analysis of Web Applications

Telehealth and Person-Centered Care: Exploring the Possibilities

C. C. Bartz
International Council of Nurses, cbartz@uwm.edu
3 place Jean-Marteau, Geneva, Switzerland

***Abstract*: This paper describes an analysis of telehealth research reports concerning people with diabetes for the application of principles of person-centered care: respect, benefit and fairness. The study methods and results were greatly variable. From a person-centered care view, greater use of qualitative or mixed methods research designs for telehealth studies with people with diabetes may help the people being studied to be more actively involved throughout the study and to benefit more substantially from the study findings.**

Introduction

eHealth, the application of information and communication technologies (ICT) to health [1] is omnipresent today. Used by countless specialties, telehealth provides health information and services over distances, mediated by ICT. Given that telehealth means distance care, retaining the person-hood of all care recipients and research subjects seems warranted.

Using the Helsinki Declaration [2] and the Belmont Report [3], three ethical principles can be identified that should underlie the conduct of human research. These are respect for persons, beneficence and justice. Respect means at least polite tolerance. Beneficence means that persons are treated ethically and without harm, and with some benefit. Justice is used here in the sense of fairness in distribution. While the principles were articulated to underlie research involving people, we suggest that they can serve as well for principles of person-centered care.

Person-Centered Care

Person-centered care is a provider-recipient partnership, where health care is rendered while fully considering the recipient throughout. The provider considers care recipients' mental and physical health, beliefs and values, and socio-economic realities, while also integrating the relevant science and clinical expertise for the needs, risks or problems presented.

The description of person-centered care given here differs slightly from person-centered medicine and patient-centered care. Person-centered medicine has recently been re-invigorated, with substantive philosophical

and theoretical arguments for returning to a medicine of, for, by and with the person in an empowering manner through a partnership of patient, family and clinicians [4, 5]. Patient-centered care is focused primarily on diagnosis and treatment of illness or injury.

Person-centered care delivery should integrate patient and family goals for health and recovery from illness [6]. The recipient may or may not be a patient and providers are from various disciplines. Multidisciplinary capabilities are gaining importance with the increased use of mHealth. Nurses or community workers, e.g., are able to provide care to people in the community who do not have access to physicians or tertiary care facilities. In keeping with the aim of universal coverage or fairness [7], peoples' health needs may be more equitably met with person-centered care.

The purpose of this paper is to describe a narrative analysis in telehealth research for evidence that the principles of person-centered care were applied.

Methods

This exploratory review used 12 randomly selected research reports that met the criteria of telehealth research involving people with diabetes and published in 2012. Diabetes is a worldwide problem; estimates are that by 2030 about 340 million people will have diabetes [8].

The most common research design in the 12 papers was a randomized controlled trial. Buetow's framework for person-centered research [9] shows a hierarchy of person-centered study designs. With participant on the *y* axis and researcher on the *x* axis, intervention studies, such as randomized trials, were on the lowest end while ethnography, case and single subject designs were on the high end.

Findings

Two of the sources were review articles [10, 11] that analyzed 13 and 27 randomized controlled trials, respectively, with behavioural interventions usually showing improved control of glycemia and improved self-care outcomes. The reviews noted that intervention technology was sometimes difficult for the elderly but many subjects benefited from saved travel time and clinic waiting time. Assessing respect shown to subjects in each study was difficult. Evidence of fairness was found in one review's recommendation that recruitment of subjects should be expanded to the community.

The 10 remaining individual reports showed the great variability in telehealth interventions used. About half the papers noted ethics committee approval. Three studies were pilots [12-14]. Three studies [15-17] assessed

telephonic interventions effects on glycemic control; two of these had comparison groups. Two were retrospective studies [18, 19], using electronic health record data. One study [20] assessed knowledge, self-efficacy, adherence, and perceptions of technology. One study [21] retrospectively analyzed 5,703 telephone consultations to identify common call reasons and responses.

Considering the wide diversity of this small set of studies, discovering respect for and fairness with subjects was difficult. We might assume that all studies were reviewed for human subjects protection, given the prevalence of ethics review requirements and the concern for litigation.

Most of the studies indicated at least some benefit to most of the subjects. People in control groups receiving usual care are probably attended to more than non-study individuals. Two studies used self-efficacy, one as a theoretical framework [13] and one as a variable [20].

It may be useful to add qualitative designs to telehealth studies (these were lacking in the sources reviewed) so that all of the persons being studied can relate their experiences and the data can contribute to knowledge for care delivery. Also, as EHRs generate large data sets, it will be important to consider the principles of respect, fairness and benefit to the person/patient from whom the data were drawn [22, 23].

Conclusion

The abundance of published research that used telehealth strategies with people with diabetes is slowly contributing to the body of knowledge about diabetes care. For the most part, however, the studies have small samples or are unique without replication, or both. Increased emphasis on person-centeredness in diabetes research, with qualitative research methods used to learn from those people with diabetes what they need to have and know in order to cope with their diabetes, may be a useful avenue for continued research. This could mean a decreased emphasis on randomized controlled trials which, given the variability of interventions and measured outcomes across research groups, do not lend themselves to meta-analysis for building knowledge.

References

[1] http://www.who.int/topics/ehealth/en/

[2] http://www.wma.net/en/30publications/10policies/b3/index.html

[3] http://www.hhs.gov/ohrp/policy/belmont.html

[4] A Miles and J E Mezzich. The care of the patient and the soul of the clinic: person-centered medicine as an emergent model of modern clinical practice. *Int J Pers Cent Med* 1(2), pp 207-222, 2011.

[5] A. Miles and J E Mezzich. The patient, the illness, the doctor, the decision: negotiating a 'new way' through person-centered medicine. *Int J Pers Cent Med* 1(4), pp 637-640, 2011.
[6] K. A. Daley. Person-centered care – what does it actually mean? *The American Nurse* 44(6), p3, 2012.
[7] http://www.who.int/dg/speeches/2012/wha_20120523/en/index.html#
[8] S. Buetow. A framework for doing person-centered health research. *Int J Pers Cent Med* 1(2), pp 358-361, 2011.
[9] S. Wild, G. Roglic, A. Green, et al. Global prevalence of diabetes. *Diabetes Care* 27(5), pp 1047-1053, 2004.
[10] M. Cassimatis, D. J. Kavanagh. Effects of type 2 diabetes behavioural telehealth interventions on glycaemic control and adherence: a systematic review. *J Telemed Telecare* 18, pp 447-450, 2012.
[11] L. S. A. N. Siriwardena, W. A. S. Wickramasinghe, K. L. D. Perera et al. A review of telemedicine interventions in diabetes care. *J Telemed Telecare* 18, pp 164-168, 2012.
[12] L. G. MacLean, J. R. White, S. Broughton, et al. Telephone coaching to improve diabetes self-management for rural residents. *Clinical Diabetes* 30(1), pp 13-16, 2012.
[13] J. Chiung-Jung, A. M. Chang, M. Courtney, M-A. Ramis. Using user-friendly telecommunications to improve cardiac and diabetes self-management programme: a pilot study. *Journal of Evaluation in Clinical Practice* 18, pp 695-697, 2012.
[14] S. A. Mulvaney, S Anders, A. K. Smith, et al. A pilot test of a tailored mobile and web-based diabetes messaging system for adolescents. *J Telemed Telecare* 18, 115-118, 2012.
[15] C. B. Schechter, H. W. Cohen, C. Shmukler, E. A. Walker. Intervention costs and cost-effectiveness of a successful telephonic intervention to promote diabetes control. *Diabetes Care* 35, pp 2156-2160, 2012.
[16] R. A. Stone et al. The Diabetes Telemonitoring Study Extension: an exploratory randomized comparison of alternative interventions to maintain glycemic control after withdrawal of diabetes home telemonitoring. *JAMIA* 19(6), 973-979, 2012.
[17] I. Gonzalez-Molero, M Dominguez-Lopec, M Guerrero, et al. Use of telemedicine in subjects with type 1 diabetes equipped with an insulin pump and real-time continuous glucose monitoring. *J Telemed Telecare* 18, pp 328-332, 2012.
[18] J. Kesavadev, A. Shankar, P. B. Pillai et al. Cost-effective use of telemedicine and self-monitoring of blood glucose via Diabetes Telemanagement System (DTMS) to achieve target glycosylated hemoglobin values without serious symptomatic hypoglycemia – a retrospective study. *Diabetes Technology & Therapeutics* 14(9), pp 772-776, 2012.
[19] A. Ferrara, M. M. Hedderson, J. Ching, et al. Referral to telephonic nurse management improves outcomes in women with gestational diabetes. *American Journal of Obstetrics & Gynecology* 206, pp 491.e1-5, 2012.
[20] J. B. Wakefield, J. E. Holman, A. Ray, et al. Outcomes of a home telehealth intervention for patients with diabetes and hypertension. *Telemed J E Health* 18(8), pp 575-579, 2012.
[21] N. R. Evans, L. S. Richardson, K. K. Dhatariya, M. J. Sampson. Diabetes specialist nurse telemedicine: admissions avoidance, costs and casemix. *European Diabetes Nursing* 9(1), pp 17-21, 2012.
[22] A. Miles. Person-centered medicine – at the intersection of science, ethics and humanism. *Int J Pers Cent Med* 2(3), pp 329-333, 2012.
[23] C. Weng, P. Appelbaum, G. Hripcsak, et al. Using EHRs to integrate research with patient care: promises and challenges. *JAMIA* 19(5), pp 684-687, 2012.

Claudia C. Bartz, PhD, RN, FAAN is the Coordinator for the International Council of Nurses eHealth Programme. Dr Bartz has her Bachelor of Science in Nursing from the University of Wisconsin-Madison, USA; her Master's in Nursing from the University of Washington, USA; and her Doctor of Philosophy in Nursing University of Arizona, USA. Dr Bartz is a Fellow in the American Academy of Nursing. She lives in Wisconsin, USA.

Telenursing: Advancing Care Delivery, Education and Research

Claudia C. Bartz
International Council of Nurses, cbartz@uwm.edu
3 place Jean-Marteau, Geneva, Switzerland

***Abstract*: Nurses worldwide are using telehealth strategies and technologies to support and advance health care. Care delivery is enhanced through the ability to reach people with care needs that range from health promotion to disease management. Telenursing education offerings and programmes are supporting learning needs of providers, patients and healthy populations. Nursing research is adding to our knowledge of what telehealth strategies are optimal for various age groups and various disease categories. Nurses are making significant contributions to the rapid advancement of telehealth for improved health care and client outcomes. The ISfTeH Telenursing Working Group and the ICN Telenursing Network members exemplify leadership in telehealth nursing in many countries of the world.**

The Rockefeller Foundation recently published a list of 10 top trends impacting the next 100 years of global health [1]. Three of the top trends are especially relevant to telehealth and telenursing: 'technology races ahead,' 'game-changing advances in science,' and 'new ways of learning.' Every day, new eHealth technologies are developed and moved toward implementation. The science of telehealth, as evidenced by continually expanding knowledge, supports the ability to describe, predict and control health interventions that have been shown to result in positive outcomes for individuals, groups and communities. And, as with every new field, providers and recipients alike are able to integrate new ways of learning about ideas as well as about materials and methods, and new ways of applying that learning for optimal care recipient outcomes.

Today, a substantial amount of telehealth research is available from many different specialties and subspecialties, in many different care environments. Telehealth research maybe especially enhanced or advanced because data are either an inherent part of telehealth systems (for example, home monitoring data collection) or a part of the culture of information and communication technology applications, which are almost always data driven and data dependent. Review articles and meta-analyses are beginning to provide evidence that the body of knowledge about telehealth is growing,

although common findings include small and diverse samples and great variability in intervention strategies. Theoretical, hoped-for benefits of telehealth, such as improved access and care outcomes, equity of care, and decreased costs are beginning to be more tangible as the science underlying telehealth continues to advance.

The purpose of this paper is to describe themes and contexts inherent in telenursing, considering nurses themselves, their professional interdisciplinary colleagues, and, of course, the recipients of nursing care. We know that nurses are involved with development, implementation and policy development for telenursing and telehealth. Two small groups of nurses, considering the more than 13 million nurses worldwide, demonstrate the scope of telenursing and also the intense interest in learning from and supporting one another. The International Society for Telemedicine and eHealth Telenursing Working Group has 42 members representing 18 countries. The range of nursing practice for this group includes NGOs, ministries of health, universities, health care systems, specialty services, vendors, consultants and entrepreneurs. A key value of the Working Group is its access to and integration with the interdisciplinary and worldwide context, communications and conferences offered by the ISfTeH. The International Council of Nurses Telenursing Network has more than 250 members, representing 61 countries. In reviewing the areas of interest indicated by the membership, nearly every specialty, age group, socio-economic strata are of interest, as are educational endeavors and research topics. The Network shares education and professional development resources for telenursing and supports access to ICN's wide range of information, communications and resources supporting nursing and health worldwide

Nurses contribute to the science of telehealth in a variety of ways. One of the first documented examples of telenursing comes from the early 1970's when Quinn assisted physicians in seeing patients via telehealth in a hospital-based telemedicine centre in Boston [2]. The land-line telephone continues to serve an important purpose in telenursing in, for example, telephone triage, telephone advice centers, or telephone counselling systems. For nurses worldwide, the integration of new health-related technology into care delivery, education and research has become an important aspect of professional telenursing practice.

Care Delivery

Telenursing in care delivery holds great promise for improved access such as with mobile devices in populations in remote and rural areas and in underserved urban areas. The number of smart phones and tablets is

estimated between 1.5 and 1.8 billion units in 2013 and increasing to between 2.7 and 3.0 billion units in 2015 [3]. Nurses use mobile devices in all aspects of care delivery, from assessment to interventions to outcomes evaluation. The capacity for care delivery via mobile phone services is only limited by the imagination of the nurse and the care recipient, with available features such as short message services (SMS), multimedia messaging services (MMS), internet access, camera, video, Bluetooth technologies and global positioning systems.

Another rapidly expanding care delivery setting involving telenursing is found in intensive care units which have remote, and often multi-facility, monitoring centers and systems. Tele-ICUs are a multidisciplinary endeavour, requiring trusting professional relationships while bringing the necessary experts virtually to the bedside of critically ill patients attended by nurses, physicians and other care providers [4, 5, 6]. As noted above, data are part of the telehealth culture and this is readily exemplified in tele-ICU research capability. A study of sepsis screening and management [7] used 89,921 screens on 36,353 ICU admissions to 161 ICU beds across 500 miles. In a two year period, 5,437 patients were identified as meeting the criteria for severe sepsis. Confidence in the findings from large data sets such as this one can indeed help to change practice.

Education

Nurses have a strong commitment to educating individuals, groups and communities who have health care needs. One tenet of the ICN Code of Ethics for Nursing states that "the nurse ensures that the individual receives accurate, sufficient and timely information in a culturally appropriate manner on which to base consent for care and related treatments" [8, p.3]. Telehealth strategies can support nurses well-beyond face-to-face education encounters. Adolescents with diabetes responded favourably to tailored mobile and web-based messages designed to motivate and remind them about diabetes self-care tasks [9]. It cannot be assumed, however, that tele-education is always better for the client. In a study of delivering education about strokes to elderly individuals over distance versus in-person stroke prevention education, no differences were found in recipients' satisfaction with delivery method or in post-education knowledge [10].

In the Draft Report of the Global Thematic Consultation on Health [11], a number of variables are noted to be linked to health, among them education. The report states that education, and especially of girls and women, has a critical role in improving health (p.14). Nurses aiming to find methods to improve breastfeeding support used structured telephonic counselling in a pilot study [12]. Breast feeding rates were higher with the structured

counselling compared to conventional counselling. In a pilot study of using videoconferencing [13], the 10 participants strongly agreed that they were comfortable talking about breastfeeding concerns using home videoconferencing. Both of these studies warrant further research to confirm the findings among women who are, or could be, breastfeeding.

Research

Telenursing research designs range from qualitative studies to randomized, controlled trials. In a qualitative study of encouragement for physical activity using mobile phones and pedometers, 41 sedentary women were asked about the use of these devices as means to improve their health [14]. The women were interviewed and the data were analysed for themes. The three themes are presented in a way that is useful to all telenurses and researchers: monitor me, motivate me, and mobilize me. This triad of study findings provides a very useful way to frame, for example, a larger, more controlled study of adherence to treatment that uses personal devices.

Other examples of telenursing research include examining telephone-based telehealth in self-care for people with chronic conditions [15], teleconsultation with spinal cord injured people [16], and a study of nurses themselves as they staff telephone-advice systems [17]. The results of these descriptive studies were mixed, with none of them of themselves signalling a need to change practice immediately. As is so often the case with telehealth research, more study is needed to understand whether what seems intuitive (eg, offering phone consultation to people with SCI or seeing indicators of stress among telephone advice nurses) can be found in the evidence.

Summary

Telehealth in all of its specialties and settings is an exciting field for health care providers. Its proliferation encourages the anticipation of improvements and advances in health care delivery worldwide. This paper has briefly described telenursing as it is operationalized, using care delivery, education and research as areas of consideration. The areas are rather artificial, in that nearly all nurses use one or more kind of telehealth technology every day. Successful nurses can readily deal with new technology and with integrating substantive research findings into their practice. Nurses welcome the ability to deliver safe, efficient and effective care to all people.

Health care delivery continues to be a major challenge for all health care providers, in view of continuing socio-economic and political uncertainty, poor sanitation and inadequate water supplies, and insufficient access to

care. Further challenges include the changing demographics worldwide to include more elderly people (to include nurses themselves), more overweight and obese people, and more people with non-infectious chronic diseases. Telehealth has great promise for addressing many of these challenges. We only have to see the way and pursue the solutions.

References

[1] http://centennial.rockefellerfoundation.org/events/entry/top-trends Accessed 14 February 2013.

[2] E. E. Quinn. Teleconsultation: Exciting new dimension for nurses. RN 37 (2), 36, 38, 40, 42. 1974.

[3] T. Standage. Live and unplugged. *The Economist-The World in 2013.* 125-126.

[4] L-M. Williams et al. Telenursing in the intensive care unit: transforming nursing practice. *Critical Care Nurse* 32(6), 62-69, 2012.

[5] M. Nielsen, J Saracino. Telemedicine in the intensive care unit. *Critical Care Nursing Clinics of North America* 24, 491-500, 2012.

[6] C. Ruesch et al. Using nursing expertise and telemedicine to increase nursing collaboration and improve patient outcomes. *Telemedicine and eHealth* 18(8), 591-595, 2012.

[7] T. A. Rincon, G. Bourke, A. Seiver. Standardizing sepsis screening and management via a tele-ICU program improves patient care. *Telemedicine and eHealth* 17(7), 560-564, 2011.

[8] http://www.icn.ch/about-icn/code-of-ethics-for-nurses/ Accessed 22 February 2013.

[9] S. A. Mulvaney et al. A pilot test of a tailored mobile and web-based diabetes messaging system for adolescents. *Journal of Telemedicine and Telecare* 18, 115-118, 2012.

[10 P. A. Schweickert et al. Telehealth stroke education for rural elderly Virginians. *Telemedicine and eHealth* 17(10), 784-788, 2012.

[11]http://gallery.mailchimp.com/56558b804f7cf78f0ba8ab5a5/files/For_comments_draft_report_health_in_the_post_2015_development_agenda.pdf Accessed 22 February 2013.

[12] V. Simonetti et al. A structured telephonic counselling to promote the exclusive breastfeeding of healthy babies aged zero to six months: A pilot study. *International Journal of Nursing Practice* 18, 289-294, 2012.

[13] W. Rojjanasrirat, E-L. Nelson, K. A. Wambach. A pilot study of home-based videoconferencing for breastfeeding support. *Journal of Human Lactation* 28(4), 464-467.

[14] Y. Fukuoka, T. Lindgren, S. Jong. Qualitative exploration of the acceptability of a mobile phone and pedometer-based physical activity program in a diverse sample of sedentary women. *Public Health Nursing* 29(3), 232-240, 2012.

[15] K. Shea, B. Chamoff. Telehomecare communication and self0care in chronic conditions: Moving toward a shared understanding. *Worldviews on Evidence-Based Nursing*, Second Quarter, 109-116, 2012.

[16] S. Young-Hughes, L. A. Simbartl. Spinal cord injury/disorder teleconsultation outcome study. *Rehabilitation Nursing* 36(4), 153-172, 2011.

[17] B. Farquharson et al. Stress amongst nurses working in a healthcare telephone-advice service: relationship with job satisfaction, intention to leave, sickness absence and performance. *Journal of Advanced Nursing* 68(7), 1624-1635, 2012.

Claudia C. Bartz, PhD, RN, FAAN is the Coordinator for the International Council of Nurses eHealth Programme. Dr Bartz has her Bachelor of Science in Nursing from the University of

Wisconsin-Madison, USA; her Master's in Nursing from the University of Washington, USA; and her Doctor of Philosophy in Nursing University of Arizona, USA. Dr Bartz is a Fellow in the American Academy of Nursing. She lives in Wisconsin, USA.

Telenursing as a Health Promotion Strategy

V. D. Souza Júnior, I. A. C. Mendes, A. Mazzo, S. Godoy
University of São Paulo at Ribeirão Preto College of Nursing - EERP-USP/Brazil valtuirduarte@usp.br, iamendes@usp.br, amazzo@eerp.usp.br, sig@eerp.usp.br

Abstract: **Telenursing uses technological resources to broaden nursing care possibilities. An integrative literature review was undertaken of studies with telenursing interventions for which strong clinical evidence is provided. Studies show the increased use of telenursing and its evidences for health promotion purposes.**

Introduction

Telenursing, as a part of the telehealth system, refers to the use of technological resources and communication systems, including telephone, computers and the Internet to develop nursing care [1]. It can reach patients in the form of education and care management or opinion consulting for educational purposes.

Telenursing is currently expanding, according to different international studies, mainly as a resource that permits nursing care and teaching, in view of geographical, material and qualified human resource barriers, aiming for the qualitative enhancement of health services [1-3].

This study was developed as the preliminary part of an ongoing research on the use of telenursing in care delivery to neurogenic bladder patients attended at a rehabilitation center.

Aim: to identify research with stronger clinical evidence in the literature, developed through telenursing interventions.

Method

An integrative review was undertaken in the databases Medical Literature Analysis and Retrieval System on line (MEDLINE), *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (LILACS) and Web of Science, using the descriptors telenursing, nursing care and communication means, in the attempt to answer the question what interventions are used in telenursing research, with the strongest clinical evidence level (2 and 3) according to Stetler's classification [4]. The review covered papers published in the last ten years, whose full version was available in Portuguese, English or Spanish, and which answered the research question. After reading the titles and abstracts to apply the inclusion criteria, out of

144 papers published, 16 articles were selected as a sample for analysis. The studies were analyzed according to Ursi's framework [5], observing the identification data of the publication, the method used, the country where the study was undertaken, the technology and strategy adopted in the interventions, the activity area, subjects and main results.

Results

The distribution of the publications per year was as follows: 18.75% in 2011, 6.25% in 2010, 25% in 2009, 31.25% in 2008, 12.5% in 2004 and 6.25% in 2001. Among the countries where the studies were developed, 43.75% came from the USA, 18.75% from the United Kingdom, 12.5% from Sweden, and 6.25% each from Chile, Norway, Japan and China.

As regards the method used, in 11 publications, interventions were compared with control groups, five of which were randomized controlled clinical trials, two pre and post-test evaluations, two involved intervention and monitoring of patients' clinical evolution and one was a case-control study.

In terms of the technology used, eight papers used telephone interventions, one associated with videophone (for video calls) and one associated with a monitoring system; three used a website, one associated with videophone (for video calls), two with mobile telephony associated with symptom monitoring and one with its own video call system. One of the studies was undertaken in a teaching context and the remainder in clinical contexts. Among the research subjects of the papers analyzed, 25% suffered from type II Diabetes, 12.5% from cancer and the remainder belonged to the general population: hypertensive patients, post-stroke patients, patients under treatment for Parkinson, psychiatric patients, elderly, women in a remote community, wounded patients, nurses and nursing students, corresponding to 6.25% each.

Discussion

Telenursing is growing, as illustrated by the increased number of publications, although this increase is not progressive per year; the presence in different countries and the existence of strong evidence and benefits of its use. In different studies, strong evidence was offered for the use of telenursing as a health practice.

Among the technologies used, the telephone was the most frequent. This may be due to its large-scale dissemination in the population and its simple and easy functioning. Care delivery through audio-calls demands further competency development for the nurses to hold interviews, who also lose the possibility of using visual assessment for decision-making [6]. The use

of mobile telephony also offers the possibility of information exchange through text messages and, in some cases, image exchange [7].

The dissemination of computers and the Internet makes the technologies used feasible, as computers permit associating the use of websites, video calls, videoconferencing, audio calls and text messages. Until recently, this demanded specific equipment for each system used; technological evolution entails unlimited possibilities to use telenursing in daily reality [8].

Among the types of patients, the use of telenursing was most evident with diabetic patients, as the system is focused on health promotion, and this disease comes with great instability concerning patients' information level, demanding constant monitoring [9]. In some studies, cognitive-behavioral and motivational theories and techniques were used to assess patients' perception about their health conditions and support their coping, besides addressing communication skills, so as not to restrict information exchange actions and permit therapeutic dialogue [8-10].

Conclusions

Telenursing is an efficient tool to help countries to overcome barriers and bring health care information to the population, promoting basic care and favoring rehabilitation and health maintenance processes. In all papers analyzed, the goal of using telenursing was to complement and enhance the integration among health systems and health care, without any claim on replacing traditional activities.

References

[1] College of Registered Nurses of Nova Scotia. Telenursing Practice Guidelines. Vancouver, BC, 2008.

[2] International Council of Nurses (ICN). International Competencies for Telenursing. Geneva Switzerland: International Council of Nurses, 2007.

[3] I. A. C. Mendes, S. Godoy, C. A. Seixas, M. S. Nogueira, M. A. Trevizan, L. M. M. Alves et al. Telenursing: Current Scenario and Challenges for Brazilian Nursing. In: Sajeesh K, Helen S. (Org.). Telenursing. New York: SpringerLink, 2011, v. 1, p. 17-27.

[4] C. B. Stetler, D. Morsi, S. Rucki, S. Broughton, B. Corrigan, J. Fitzgerald et al. Clinical methods: utilization-focused integrative reviews in a nursing service. Appl Nurs Res 1998 November; 11(4):195-206.

[5] E. S. Ursi, C. M. Galvão. Prevenção de lesões de pele no perioperatório: revisão integrativa da literatura. Revista Latinoam Enferm. 2006: 14(1): 124- 31.

[6] L. Fincher, C. Ward, V. Dawkins, V. Magee, P. Willson. Using telehealth to educate Parkinson's disease patients about complicated medication regimens. J Gerontol Nurs. 2009 2009/03/;35(2):16-24.

[7] L. McCann, R. Maguire, M. Miller, N. Kearney. Patients' perceptions and experiences of using a mobile phone-based advanced symptom management system (ASyMS) to monitor and manage chemotherapy related toxicity. Eur J Cancer Care (Engl). 2009 2009/03/;18(2):156-64.

[8] J. Dale, I. Caramlau, J. Sturt, T. Friede, R. Walker. Telephone peer-delivered intervention for diabetes motivation and support: the telecare exploratory RCT. Patient Educ Couns. 2009 2009/03/;75(1):91-8.
[9] I. Lange, S. Campos, M. Urrutia, C. Bustamante, C. Alcayaga, A. Tellez et al. Effect of a tele-care model on self-management and metabolic control among patients with type 2 diabetes in primary care centers in Santiago, Chile. Revista Medica De Chile. 2010 Jun;138(6):729-37. PubMed PMID: WOS:000280179200010.
[10] E. Amoako, A. H. Skelly, E. K. Rossen. Outcomes of an intervention to reduce uncertainty among African American women with diabetes. West J Nurs Res. 2008 2008/11/;30(8):928-42.

Valtuir Duarte de Souza Júnior
BSN in Nursing by the University of Uberaba (2009), specialization in ICU with emphasis on emergency care (2011). Master's student at the Fundamental Nursing Program at the University of São Paulo at Ribeirão Preto College of Nursing. Member of the Studies and Research in Communication in the Nursing Process Group – GEPECOPEn.

Isabel Amélia Costa Mendes

Has a Bachelor of Nursing (1968) and Public Health Nursing (1969) from the University of São Paulo at Ribeirão Preto College of Nursing (EERP-USP); MSc in Nursing at UFRJ (1975); PhD (1986) and Full Lectureship in Nursing (1989) at EERP/USP. She has been Full Professor at EERP/USP since 1991 and Researcher 1A at CNPq. She was Dean at EERP/USP for 2 terms (1994-1998 and 2002-2006), Vice-director (1990-1994) and is also Director of the WHO Collaborating Centre for Nursing Research Development.

Alessandra Mazzo - Professor and Assistant Technical Director II at EERP-USP, assisting in projects for the modernization and implementation of simulation labs. She has experience in care and teaching in Nursing and is a member of the Studies and Research in Communication in the Nursing Process Group – GEPECOPEn. Member of the Brazilian Society of Communication in Nursing (SOBRACEn). President of the Teaching Laboratories Committee at EERP-USP.

Simone de Godoy - Brazil. Professor Doutor na mesma instituição e pesquisadora do Grupo de Estudos e Pesquisas em Comunicação no Processo de Enfermagem (GEPECOPEn). RN (1994), licensed nurse (1995), MSc by the Fundamental Nursing Graduate Program (2002) and a PhD in Science (2010) by the University of São Paulo at Ribeirão Preto College of Nursing (EERP/USP) - WHO Collaborating Centre for Nursing Research Development, Brazil.

Teleoncology

An Awareness System for Follow-Up Care after Breast Cancer Treatment

B. Karimzad Sharifi[1], S. Massah[2]
[1]Department of IT Management, Electronic Branch, Islamic Azad University, Tehran, Iran, b.karimzad@gmail.com
[2]University College of Nabi Akram, Tabriz, Iran, solmaz.massah@gmail.com

Abstract: **Patient empowerment is a new IT approach to the process of treating patients. The patients suffering from cancer are in need of more help due to the special circumstances of the disease and long treatment period. This is a report on a project in progress which aims to improve the efficiency of breast cancer treatment by informing and educating the patients and reminding them of the treatment steps. The need for such a system was felt by the authors having dealt with such a patient for 6 years, and it is believed that this system can play a realistic role in the treatment process of these patients.**

Introduction

Usually, people suffering from major diseases like cancer and their families are primarily reluctant to accept the presence of the disease and they prefer to think that what is happening is not real. Similarly, after the treatment, they want the illness to be over as soon as possible and try to forget about it. Although such spirits can be effective in the treatment process, it should be noted that careful pursuing of the follow-up steps for permanent recovery is more effective than merely forgetting it.

Problem

Treating breast cancer takes a long time and due to a variety of therapeutic activities, more physicians are involved in the treatment process. Since patient information is not usually recorded in a standard and uniform format, the therapeutic activities are likely to fall apart and some important information may be forgotten or not recorded in a patient's file properly. In some cases, new scientific findings change or modify the treatment processes. Sometimes, it is necessary to redo some previously done tests with newer techniques so as to prescribe newer medications accordingly.

Patient Empowerment as a Solution

Patient empowerment in the health care context means to promote autonomous self-regulation so that the individual's potential for health and wellness is maximized. Patient empowerment begins with information and education and includes seeking out information about one's own illness or condition, and actively participating in treatment decisions [1]. The patient empowerment movement started in the early 1970s, advocating the rights of the patient. The goal of patient empowerment is to build up the capacity of patients to help them to become active partners in their own care, to enable them to share in clinical decision making, and to contribute to a wider perspective in the health care system [1].

Patient empowerment is a process of helping people to assert control over factors that affect their health [1].

In this research, we are designing and executing a system which reminds, raises awareness and educates the patients about further treatment steps and required tests by using information and communication technology. While the early years of health ICT development and policies concentrated on technologies to be used by health professionals, ICT aiming at patient users is now prioritized area [2].

Collaborative Awareness System: A Health 2.0 Approach

Electronic reminder systems have been available for decades, yet medication adherence remains poor. Most systems rely on simple alarms and do not address other determinants of health-related behavior [3]. Establishing an efficient and dynamic informative system requires co-presence of the individuals who are specialized in different technical and medical fields. Such co-presence can be made possible through the technology of Web 2.0, which is regarded as Health 2.0 in health system.

Health 2.0 or Medicine2.0 is the use of a specific set of Web tools (blogs, Podcasts, tagging, search, wikis, etc.) by actors in health care including doctors, patients, and scientists, using principles of open source and generation of content by users, and the power of networks in order to personalize health care, collaborate, and promote health education [4].

Working Team and Pilot Stage

Since the purpose of this system is to inform, educate, and remind, and focuses on remote medical suggestions and not treatment, it can be defined independent of all the other health systems.

In order to pilot the first phase of the project, the cooperating physicians and residents were selected from the lists of friends on social networks like

Facebook. Once they were identified, their profiles were investigated in terms of reliability, and an invitation to cooperation message was sent to them. Then, the rest of project has been pursued in more specialized networks, i.e. Wiggio. In the following step, some of the people diagnosed with diseases who are willing to take part in this program will be registered in person. Then, their medical records will be received and, according to the kind of disease and its severity, further steps will be reminded. They will be asked to enter the latest results of their tests and diagnoses into the system.

In this step, physicians and the residents with relevant expertise analyze the data manually. Then, they get in touch with the patients through phone calls, text messaging, or internet.

Final Implementation

In the next step, by using the experience gained in the pilot phase, a web-based software application will be developed and these services will be offered in higher speed, and larger scope and size .That is, the technical data related to the disease will be entered into the patient's file in the system and the processing operation will take place more automatically at this phase. Finally, upon their approval by the cooperating physicians, the patients or their family will be informed about the results of this processing.

Conclusion

Unofficial and volunteer activities can both promote health conditions in a society as well as direct the current culture towards using the facilities more efficiently. This can be true especially for the societies in which the health system is not concentrated and integrated. The primary idea of this project derives from the authors' personal experience dealing with such a patient, and it is hoped that, by attracting more attention and support, this project can take effective steps in this regard.

References

[1] D. H. Lau, "Patient empowerment—a patient-centred approach to improve care", Hong Kong Med J Vol 8 No 5 October 2002, pp. 372-374,

[2] H. K. Andreassen. "Patient–oriented ICT: Policy and practice" A dissertation for the degree of Philosophiae Doctor, University of Tromsø, May 2011, pp. 2–10.

[3] J. O. Moore, H. Hardy, P. R. Skolnik, F. H. Moss. "A collaborative awareness system for chronic disease medication adherence applied to HIV infection" Conf Proc IEEE Eng Med Biol Soc. 2011.

[4] S. Hughes, I. Joshi, J. Wareham. "Health 2.0 and Medicine 2.0: Tensions and Controversies in the Field" Journal of Medical Internet Research, [Online] Available: http://www.jmir.org/2008/3/e23/

Solmaz Massah has received her B.S. in electronic engineering from Azad University of Lahijan and her M.S. in industrial engineering, system and productivity management, from Tarbiat Modares University of Tehran, Iran. She is interested in e-Health, Telecommunication, CRM and Business Models. She is now working as a GSM expert in telecommunication industry and also teaching Systems Analysis and Design, Management Information Systems and Industrial Relations in University College of Nabi Akram, Tabriz, Iran.

Behzad Karimzad Sharifi has done his B.S. in mechanical engineering at University of Tabriz, Iran. Currently, he is doing his Master's thesis in IT Management, advanced information systems, entitled: "A System Architecture for Small Clinics CRM (PRM) in Iran" at Electronic Branch, Islamic Azad University, Tehran, Iran. His areas of interest include Developing Businesses using IT, e-Health, CRM, Decision Support Systems, Expert Systems and also Pump Industry. He is now working as head of sales engineering section in Pumpiran Company, Tabriz, Iran.

CANSCREEN – Early Stage Cancer Screening Based on Analysis of Blood Proteins, Evaluated by Special Cluster Analysis

J. Jansa, M. Cesal
Immobiliser Central Europe, Ltd., Prague, Czech Republic
BIOCONS, Ltd., Trencin, Slovak Republic

Abstract: **Early diagnosis or screening is the objective of rational clinical and biochemical cancer diagnostics. During the last twenty years, clinical research has been focused on finding tumour markers (followed by commercial production of corresponding diagnostic kits), which are mainly specific organ enzymes and tumour antigens. On the other hand, non-specific proteins (proteins of the acute phase), which are found by various methods (polarography, electrophoresis of proteins, etc.) are lately criticised just like less valid "markers of the fifties". Scientific experimental studies, however, recently confirm significant changes in occurrence of several protein components in blood serum when examined before macroscopic finding of an induced tumour. The main principle of CANSCREEN is a complex analysis of blood proteins and its goal is a low-cost method for cancer screening. Electrophoresis and coulometry were chosen as measurement methods. After several years of clinical testing, new expert system was developed. The basic idea of this system is an application of cluster analysis of measured parameters, first of all of different blood proteins. In the first version of the proposed method, a set of globulins was used, especially alpha-1, alpha-2, beta and gamma globulins. The unique feature of the proposed medical expert system lies in the optimal algorithm for the most effective classification of unknown object (patient) into the appropriate diagnostic group accordingly to his state of health**

The importance of glycoproteins for determination of inflammatory reactions of the organism has been investigated for many years. Winzler et al. [1] discovered that an increase in quantity of glycoproteins in blood serum is accompanied by an increase in polarography current.

The increase of glycoproteins in serum as the organism reaction to pathological changes has not been properly investigated yet. Grafova et al. [2] have also dealt with application of glycoprotein determination to oncological research.

These scientists have found that an increase in glycoproteins is seen in all processes related to tissue degeneration and decomposition, even in malignant growth. They point out that there are no significant differences in glycoprotein totals of various stages of tumour growth but that they increase at all stages. Through fractionation they have discovered significant increase in alpha-1 and alpha-2 fractions and a reduction in beta glycoproteins. They do not consider the changes to be specific. The scientists quoted here believe that the monitoring of glycoprotein totals is sufficient for diagnostic purposes and they see its greatest advantage in the evaluation of post-operative progress.

In 1984, Cesal et al. [3] published a method for separation of serum glycoproteins by means of ion exchange chromatography. Based on a comparison between a group of people suffering from acute and chronic inflammations and tumours and a group of healthy people, the conclusion was drawn that serum glycoproteins can be separated into several fractions. Determination of glycoprotein concentrations in two fractions taken together offers greater diagnostic possibilities than a determination of glycoprotein totals. Their sensitivity and selectivity amount to some 50% - 60%.

Remarkable progress has been achieved by Cesal, Jansa et al. [4-6], who have introduced a new method based on separation of serum glycoproteins, where the evaluation of glycoprotein concentrations in fractions is carried out by means of an original cluster analysis method named BioAnalyst. In most cases, the sensitivity and selectivity of the method is higher than 80%, regardless of the tumour type. A special software module for Monte Carlo modelling of results is at the core of this method.

Alpha-1 antitrypsin (A1AT), alpha-1 acid glycoprotein (A1AG), and haptoglobin (HpG) were discovered to be the major components of acid-resistant fraction of serum used for separation and subsequently for polarography and photometry.

These proteins anchor in alpha 1, alpha 2 and beta globulin areas during the electrophoresis separation predominantly. Obviously, their quantitative changes will manifest themselves in the change of relative ratio of fractions in the globulin area, improving the resulting information also by an immunity component (gamma globulin). Up to now, the diagnostic capability was only utilized by registering quantitative changes in individual fractions and specific electrophoresis recordings would be attributed to so-called types, e.g. inflammatory, nephrotic, etc. Although human brain is able to register and classify changes of protein spectrum composition, it is not able to evaluate their mutual relation and “movements”. This is where cluster analysis can be used.

The sensitivity of the decision-making algorithm in the clusters interface is very important to the classification (diagnosing) of the subject under observation (the patient) into a particular cluster, as this is the area where most of the clinically uncertain cases will occur. An unsuitable method can cause the diagnosis to fall wide of the mark. BioAnalyst helps the skilled practitioner to classify the subject into one of the clusters and simultaneously calculates the probability with which the patient has been classified into this particular cluster (fuzzy approach).

As the next step, the authors have improved the above mentioned expert system BioAnalyst and tested it on several combinations of protein-like blood parameters. Between 2006 and 2010 this research was paid from governmental grants of the Academy of Sciences of the Czech Republic.

Proceeding from the results of the above mentioned research work, Cesal and Jansa have proposed a new system for early stage cancer screening based on the following principles:

(1) Recommended parameters to be measured first are blood plasma globulins, especially alpha-1, alpha-2, beta and gamma globulins;
(2) For evaluation of results, a special expert system BioAnalyst based on unique cluster analysis should be used;
(3) All new protein-like recommended parameters to be used potentially for cancer screening can be chosen by Monte Carlo modelling from their pathological intervals and confirmed diagnosis, without any expensive clinical studies.

Conclusion

Although the results achieved are very promising, a complex clinical study is necessary for confirmation of possible standard use of this low-cost reliable biochemical test for early stage cancer screening applicable for vast majority of population. Although we present this problem as a model study, the results indicate possible diagnostic utilization of this proposal for differential diagnostics of tumorous diseases, naturally after some "refinement" of the electrophoresis technique or use of coulometry technique.

References

[1] R. J. Winzler, I. M.Smyth, „Plasma Mucoprotein Levels in Cancer Patient", J. Clin. Invest. 27, 1948
[2] Grafova et al., Zmeny serovych glykoproteinů u plicní rakoviny", Cas. Lek. Ces., 11, 1977
[3] Cesal et al., Czech patent No. 238 020
[4] Cesal et al., Urceni mukoproteinoveho vektoru", Czech patent No.262 663, 1989
[5] Jansa et al., „Method for determination of Mucoprotein Vector", US patent No:4,900,447, 1990
[6] Jansa et al., Disease detection", EP 033665 A1, 1991

Jaroslav Jansa received his master's degree in Control Engineering from the Institute of Chemical Technology (VSCHT) Prague in 1967 and his doctor's degree in Physical Chemistry from the Institute of Macromolecular Chemistry of the Czechoslovak Academy of Sciences in 1978. He has been working for more than 40 years in the field of wireless communications, eHealth and security. Jansa was awarded European prizes GALILEO Masters from the European Space Agency in 2008, 2009, and 2010. Currently, he is an expert for Space and Security of the Research European Agency in Brussels and EUROSTARS expert of the European Commission. Jansa is author of 30 Czech, EU and US patents. He published more than 100 scientific and technical papers in Europe and USA. His current scientific interests are focused on telemedicine and computer assisted biomedical research.

Milan Cesal received his master's degree in Biochemistry from the Technical University (SVST) Bratislava in 1975 and his doctor's degree in Pharmacy from the Pharmaceutical Faculty of Comenius University Bratislava in 2004. He has been working for more than 30 years in the field of biomedical engineering, eHealth and pharmacy. Cesal is author of 20 Czech, EU and US patents. He published more than 50 scientific and technical papers in Europe. His current scientific interests are focused on pharmacy, telemedicine and biomedical research.

Improving Breast and Cervical Cancer Screening in Developing Countries Using Telemedicine

A. E. Schmaus-Klughammer
Klughammer GmbH
Ulrichsbergerstrasse 17, 94469 Deggendorf, Germany

Abstract: **Breast and cervical cancer are important causes of mortality in women in developing countries. Cervical cancer is the second deadliest cancer - after breast cancer, especially in Africa. But in developing countries exams are often not available. Especially in rural areas hardly any examinations are done. Examining breast cells by fine needle aspiration biopsy (FNA) or from a woman's cervix (VIA or pap smear) changes can be detected. Remote evaluation using a web-based telediagnostic platform delivers diagnoses to women in rural areas within the same day. In cases where no expert doctor is available and the next hospital is far away, telemedicine is very useful. Often screening, diagnose and treatment can be done at the same visit. This saves time and money as there is no need to wait for diagnoses and no need to come back to see the doctor. A national screening project includes evaluation of the actual situation in a country. It has to be found out which locations will be suitable for starting a screening project. Expert doctors will teach the local health workers and local medical doctors on site. Necessary equipment will be installed and training will be provided. Doctors will return regularly to repeat training until the local medical doctors know how to do it independently.**

Introduction

Breast cancer is the top cancer in women both in the developed and the developing world. The incidence of breast cancer is increasing in the developing world due to increase life expectancy; increase urbanization and adoption of western lifestyles. Although some risk reduction might be achieved with prevention, these strategies cannot eliminate the majority of breast cancers that develop in low- and middle-income countries where breast cancer is diagnosed in very late stages. Therefore, early detection in order to improve breast cancer outcome and survival remains the cornerstone of breast cancer control [1].

Cervical cancer ranks as the 2nd most frequent cancer among women

between 15 and 44 years of age in the world. New estimates of worldwide and regional cancer incidence and mortality published by the World Health Organization confirm the prediction that the numbers for cervical cancer would continue to climb, especially in developing countries. The sooner the infection is identified the better women are sheltered from cervical cancer.

Materials and Methods

Screening General

Screening is testing of all women at risk of cervical cancer, most of who will be without symptoms. Screening aims to detect precancerous changes, which, if not treated, may lead to cancer. Women who are found to have abnormalities on screening need follow-up, diagnosis and possibly treatment, in order to prevent the development of cancer or to treat cancer at an early stage.

In most developing countries there is neither breast cancer nor cervical cancer screening programs. So it makes sense to do screening of both cancers during the same examination. The women do not have to come for a screening twice. It is time and cost-effective.

Breast Cancer Screening

A clinical or self-breast exam involves feeling the breast for lumps or other abnormalities. Mammography is a common screening method, for women over 40. There is considerable variation in interpreting the images. One X-ray image may be declared normal by one radiologist and suspicious by another. Although the primary method of screening for breast cancer is radiological rather than pathological technique, the quality of pathology services is of crucial importance as the definitive diagnosis of cancer is almost invariably made by pathologists [2].

Cervical Cancer Screening

Several tests can be used in screening for cervical cancer. Tissue may be easily taken by women at home, or in a hospital. This tissue can be used for HPV (Human Papillomavirus) tests, which became more effective and more affordable than a few years ago. Women who have a high risk HPV can be detected through the tests. Next Step may be the Pap smear test and cytological diagnoses. This is a test that has been used in large. It reduced cervical cancer incidence and mortality populations in the developed world. Regardless of the test used, the key to an effective programme is to reach the largest proportion of women at risk with quality screening and treatment.

In order to avoid overtreatment of patients with false positive results and inadequate treatment of advanced cervical intraepithelial neoplasia or early

cancer, it is important to use colposcopy as a final diagnosis instrument.

Telemedicine

Telemedicine allows health care professionals to connect to each other and to evaluate, diagnose and treat patients in remote locations using telecommunications technology. Telemedicine allows patients in remote locations to access medical expertise quickly, efficiently and without travel.

Cancer screening projects using telemedicine software benefit from different aspects. Screening programs in developing countries will be carried out in the cities but also in the rural areas where hardly any expert pathologist, cytologist, oncologist or radiologist is available. Large image series like X-ray or ultrasound images, cytology and histopathology images will be stored on a database within a patient case. The images are viewed by the entire medical personal that has permission to login. These images will not be downloaded but are available as thumbnails and can be enlarged if necessary. A slow internet bandwidth is sufficient. Non-expert doctors receive diagnoses within short time.

The non-expert doctors not only need a telediagnostic software but they also need appropriate hardware. Hardware packages that comprise TelePathology, TeleHospital, TeleTeaching and TeleUltrasound are available.

But not only is the hardware necessary it is also important to be able to collect the necessary tissue, to prepare the slides and to exchange life videos for diagnoses. Body fluid from the cervix can be collected by a special test kit at home. The collected fluid may be used for an easy-to-proceed HPV test. The result looks similar to a pregnancy test. This result may be added to the patient case on the telediagnostic platform. The same fluid may be used for cytology. The fluid may be stained by Giemsa. For this staining no expensive laboratory equipment is necessary. The staining is not temperature sensitive and no extra cooling is necessary. Women who bring the fluid for diagnoses to the hospital will receive the results within hours. The women do not have to return to the hospital for receiving the results. In case of cervical cancer screening an outpatient procedure may be performed the same day.

In case of a biopsy, which may be necessary, to obtain further information in case of suspicion of an invasive cervical cancer or of a breast cancer tissue may also be collected and prepared and images of the slides are captured with a microscope camera. They are uploaded to the patient case for further diagnoses through the expert doctors. Doctors from different places can share a live colposcopy. During the live colposcopy they can

discuss the diagnoses and they can assist during the treatment. This support improves the quality of treatment in rural areas.

Practical Example from the Millennium Challenging Account

Since August 2012 the MCA does breast and cervical cancer screening in the rural areas in Mongolia. Until today 600 unclear cases were stored and discussed on the web-based telediagnostic platform CampusMedicus from Klughammer, Germany www.klughammer.com. Forms are filled out and added to the patient cases for epidemiology. Live teaching sessions are held by Mongolian expert doctors from the Cancer Center Hospital and the Mother & Child Hospital in Ulaanbaatar. CampusMedicus resulted to be a sustainable telemedicine platform in Mongolia.

Results and Future Outcomes

The use of telemedicine in cancer screening improves the cancer screening, diagnoses and treatment in developing countries. The provision of telemedicine services assuredly meets an important social need to extend health care to remote and rural areas in developing countries.[3]

References

[1] http://www.who.int
[2] Professor Ulrich Bonk, Breast Cancer
[3] D. Wright. The sustainability of telemedicine projects

Ms. Anna E. Schmaus-Klughammer is the Chief Executive Officer of Klughammer GmbH in Germany. The company develops web-based telemedicine, telediagnostics and telesurvey software and also assembles hardware for telemedical projects. Ms. Schmaus-Klughammer holds a degree in law (LLB hons from Trent University, Nottingham, UK) and has 25 years of management experience. She specializes in telepathology with focus on breast and cervical cancer screening. Globally, she has negotiated telemedicine projects with Ministers of Health in Mongolia, Armenia, Malawi, Zimbabwe and Ethiopia and has been directly involved in the implementation with local hospitals. Ms. Schmaus-Klughammer is also president of the NGO "One World Medical Network". German is her mother tongue. She speaks English and French fluently and has basic knowledge of Italian.

Melanoma Screening Using Telemedicine & eHealth: How an Organized Service Worked in an Effective Way

M. Barreiros[1], S. Nunes[1], M. Barbosa[2]
[1]Life Beat Centro de Diagnostico Avançado, S.A., Lisboa, Portugal
[2]Fraunhofer Portugal Research Center for Assistive Information and Communication Solutions (FhP-AICOS), Porto, Portugal

Abstract: **Malignant Melanoma (MM) is the deadliest form of skin cancer and, since it has an asymptomatic evolution, makes it a good candidate for early detection trough noninvasive screening methods that can seamlessly analyze skin lesions in regions where dermatologists aren't available. Using a combination of mHealth and Telemedicine we are trying to instruct people to recognize what can be a suspicious skin lesion and then submit them to a Teledermatology analysis that allows a remote examination of that lesion by a group of certified dermatologists.**

Introduction

Early diagnosis of MM is extremely important not only because success rates of recovering from MM are very high if detected during the early stages of its development [1], as well as because a melanoma in an advanced stage of development is approximately 2200 percent more expensive to diagnose and treat than an early in situ melanoma [2]. Thus it is widely accepted that the best way to deal with MM is trough prevention.

Follow protection rules regarding sun exposition and self-observation of skin lesions and moles are actions that would unquestionably protect people from this deadly form of skin cancer.

The two major challenges are:

- Educate people to recognize skin lesions, moles and growths that might be suspicious for skin cancer;
- Organize a network of Teledermatology sites to evaluate suspicious moles and refer those situations for further investigation or removal by certified dermatologists;

To help people on that analysis a mnemonic called the ABCDE test, as been proposed by the dermatologists and it consists of analyzing the following characteristics:

A - Asymmetry
B - Borders (irregular)
C - Color (variegated)
D - Diameter (greater than 6 mm (0.24 in), about the size of a pencil eraser)
E - Evolving over time.

Objectives

There is a clear potential for providing a Teledermatology Service to deliver dermatologic expertise in underserved regions due to the uneven regional distribution of dermatologists.

We propose a service business model that combines mHealth – through the "Melanoma Detection App", a smartphone-based complementary tool for monitoring of skin lesions through the ABCDE test – and Tele Medicine through the screening of suspicious moles using a dermatology system known as Spectrophotometric Intracutaneous Analysis (SIAscopy)

Besides the clear potential to empower and motivate the users to actively manage their own skin health status, this approach will also offer the opportunity to refer suspicious skin lesions to dermatology centers for removal and further investigation.

Smartphones appear as a very interesting tool to be used in digital monitoring of skin lesions due to its increasingly better quality in image acquisition, portability and easy data transmission. Skin lesion evaluation can be optimized with a mobile application that allows the user to collect process and store information of skin lesions through its automatic classification using the ABCD test.

The Melanoma Detection App prototype, developed at Fraunhofer Portugal AICOS consists on an Android application that allows taking and/or loading photos of skin lesions and sending them to a server for risk assessment purposes according to the ABCDE test. We also extract the differential structures feature, which is an important additional characteristic in dermoscopy clinical practice. The classification of the images is based on a random trees classifier which uses a dataset of 504 skin lesion images manually classified by dermatologists (214 suspicious lesions and 290 benign lesions).

Screening of suspicious moles is then performed using a dermatology system known as Spectrophotometric Intracutaneous Analysis (SIAscopy) [3].

Due to the multi-layered structure of the skin, and because the most prominent chromophores have slowly varying spectral properties, it is possible to generate models which can predict the method of light transport

within skin. This allows analyzing the skin using broadband spectrophotometric techniques.

Four different primary wavelengths of light are shone into the skin in turn. An imaging chip is then used to record the light remitted from the skin at each pixel, giving an image representing the amount of light leaving the skin for each of the four wavelengths used. Cross polarisers are used to remove any scattering from the surface of the skin.

These images are fed into the SIAscopy algorithms which compare them to a mathematical model of the skin. The outputs of this algorithm are 4 images depicting the concentration of haemoglobin, melanin, collagen and dermal melanin within the area of skin imaged.

The Dermatologist will then be able to analyze the skin lesion in a high resolution color image and also evaluate the approximate composition of the mole showing the concentration of haemoglobin, melanin, collagen and dermal melanin within the area of skin imaged.

Results

Preliminary results for the mobile monitoring of screen lesions supported by the Melanoma Detection App, achieved 72 % of sensibility and 70 % of specificity using a leave-one-out cross validation method.

We are currently tuning the machine learning parameters in order to find the classifiers that best fits for each feature, as well as studying the relevance of the extracted features to represent each one of those characteristics, so we believe that better classification performances can be achieved without major changes in our algorithm.

Next steps include a 1st phase validation (MD's will test it in real patients and input if they agree with the automatic analysis), algorithms improvements (based on the 1st phase validation report, application improvements and developments in the backend server, and 2nd phase validation (field trials involving patients with clinical or family history of skin cancer and their MDs)

The Teledermatology supported by the SIAscopy system was developed by Screencancer and its being used in Norway within the Boots pharmacy network since 2010.

In Lisbon we have started a pilot that enrolled 72 individuals with skin lesions. From these base 116 moles where analyzed but only 91 where according to the ABCDE rule. From this sample 5 moles where considered potentially malignant and referred for removal. All of them where Malignant Melanomas in early stage!

Individuals had no previous knowledge of the way to perform self-analysis and it was only at the moment of testing that they get acquainted with the ABCDE method.

Conclusion

The main objective is to establish a combination of techniques to fight MM.

The data gathered on the Lisbon site lead us to conclude that people need some help to understand which are the dangerous skin lesions that require immediate attention from the other that don't show malignant characteristics.

The combination of these two techniques will therefore enable a wide utilization of a mobile tool that can be used in any Smartphone with a camera that performs a first evaluation.

The result will then prompt for subsequent action. If the mole is suspicious then a referral for Teledermatology is done allowing easy access to a Dermatologist analysis and further management.

References

[1] H. P. Soyer, J. Smolle, H. Kerl and H. Stettnre. "Early diagnosis of malignant melanoma by surface microscopy", Lancet, 1987, Vol. 2.

[2] D. T. Alexandrescu. Melanoma costs: a dynamic model comparing estimated overall costs of various clinical stages. Dermatol Online J. 2009;15(11).

[3] Clinical Investigations - Spectrophotometric intracutaneous analysis: a new technique for imaging pigmented skin lesions British Journal of Dermatology 2002; 146: 448–457.

Miguel Alexandre da Silva Ramos Barreiros

With a background education in Mechanical Engineering, the last 18 years working in the healthcare sector.

In the Healthcare area most of the expertise comes from preventive and occupational health services and also medical imaging projects for the early diagnosis of asymptomatic diseases.

Sílvia Gonçalves Nunes

Cardiac and Respiratory Physiologist. Is now working in several projects in Life Beat – Centro de Diagnóstico Avançado, Lisbon - including: ScreenCancer – Skin Cancer Screening; VitalJacket – Wearable EKG T-shirt, 24 to 96 hours continuing EKG record; Vacumed/Vacusport – Intermittent Vacuum Therapy, lower limbs disorders treatment.

Miguel Barbosa has an MSc in Electrotechnical and Computers Engineering by the University of Porto and an MBA by the EGP-UPBS University of Porto Business School. With several years of professional experience in technology commercialization, strategic business development, corporate development and financial planning and analysis, currently is Executive Director at Fraunhofer Portugal and invited assistant professor at the Faculty of Engineering of the University of Porto, teaching “Business Plan Development” at the Master in Innovation and Technological Entrepreneurship (Post-Graduate Program).

Telesurgery & Woundcare

Impact of Telewound Monitoring on the Quality of life of Out-patients in Federal Medical Centre, Owerri, Nigeria

A. N. Ogini[1], H. C. Nwuke [2]
[1] Telemedicine unit/Nursing Services Department, Federal Medical Centre, Owerri, PMB 1010 Imo state, Nigeria
[2] Pharmacy Department, Federal Medical Centre, Owerri, PMB 1010, Imo state, Nigeria

Abstract: **Background: Mismanaged wounds have social, economic and clinical implications in the life of patients. Chronic wounds are wound that does not heal within 30 days. It is a known fact that most mismanaged bruises could exacerbate to a more serious chronic wound. In developing countries, with limited health facilities and bed spaces, there is a tendency to forcefully discharge the patient on slightest recovery; this trend has drastic implication in the quality of life (QoL) of the patient and most times, lead to wound breakdown. This study is to assess the impact of telewound monitoring in improving the quality of life of patients: pain and the healing time of the wound. Method: 20 patients of Telewound monitored group against the 19 of control group that visit clinic as scheduled were examined (Every 2 weeks). Biatain pain scale and healing time were used to assess the impact of chronic wound on quality of life of the patients. Result: 37% reduction in healing time for telewound monitoring against control group. There is 29% reduction in pain in telewound monitored against 16% reduction in pain the control. Conclusion: follow up of chronic wound care, facilitate healing time and reduce associated pain thereby improving the quality of life of patient.**

Introduction

Assessing the levels of pain in patients with chronic wounds is important to understand that it is of biopsychosocial concepts; they are comprised of complex interactions between biological, psychological and social components. This will need to be considered to obtain a holistic understanding of the patient's experience, and to guide the administration of the most suitable treatments [1]. Pain, a common cause of distress in patients

with acute and chronic wounds, can have a significant impact upon quality of life (QoL) [2].

It has been suggested that the negative psychological impact of pain can impair wound healing [3, 4] and can restrict activities detrimental to QoL[5]. Therefore, effective assessment, management and monitoring of wound pain could facilitate an improvement in healing rates and overall QoL.

Chronic pain can occur from tissue damage caused by different types of wounds (nociceptive pain), as well as the potential nerve damage as a result of the wound (neuropathic pain). Nociceptive and neuropathic pain can be present between wound treatments as a persistent background pain, [6] which may lead to psychological problems if not managed adequately(1). While background pain can be influenced by clinicians, the focus of this review is on wound-treatment related pain, for example, at cleansing and dressing change [7, 8]. If patients perceive such treatments to be particularly painful, this could result in distress and avoidance behaviour due to the anticipation of pain.

If patients develop anticipatory pain before wound treatments such as a dressing change, then this can affect QoL as much as the pain experienced as a result of the treatment itself [9]. Hyland et al. [10] demonstrated that the level of pain experienced by patients suffering from leg ulcers was positively correlated with amount of sleep loss, time spent thinking about the ulcer, stress and general reductions in QoL. This suggests that more pain, sleep loss and time spent thinking about the ulcer were associated with poor coping, which could have a detrimental effect on wound healing and overall QoL. Similarly, research [11] revealed that pain was a key factor in reduced physical activity of patients with venous or mixed leg ulcers. In addition, many of the patients experienced pain-associated sleep problems, which can contribute to fatigue, worry and a sense of reduced wellbeing [1] therefore, need for proper wound assessment to ameliorate the painful stress of the patient.

Wound assessment will define the status of the wound and begin to identify impediments to the healing process. It is not an exact science, but requires the skills and assessment of trained professionals. The following need to be assessed and carefully recorded at each dressing change:

• Cause: determine etiology;

• Local wound characteristics: Location, Size (length x width x depth), Wound bed (black, yellow, red, pink, undermined), Exudate (copious, moderate, mild, none), Wound edge (callus and scale, maceration, erythema, oedema), Odour (absent, present).

• Patient concerns: pain (persistent, temporary)

• Condition of surrounding skin (normal, oedema, warmth, and erythema)

• Clinical signs of critical colonisation/local infection and extended infection.

Assessment of the wound is a prerequisite to the selection of an appropriate dressing [12].

The entire wound healing process is a complex series of events that begins at the moment of injury and can continue for months to years. This overview will help in identifying the various stages of wound healing. I. Inflammatory Phase, II. Proliferative Phase and III. Remodeling Phase.

Chronic wounds are wound that does not heal within 30 days. It is a known fact that most mismanaged bruises could exacerbate to a more serious chronic wound. In developing countries, with limited health facilities and bed spaces, there is tendency to forcefully discharge the patient on slightest recovery; this trend has drastic implication in the quality of life (QoL) of the patient and most times, lead to wound breakdown. There are limited researches on the impact of monitoring on chronic wound management.

In the light of above, this necessitated the clarion call to assess the impact of telewound monitoring on the quality of life via assessing reduction in pain and healing time of the wound.

Method

39 patients where co-opted into the research from consultants' out-patient department of the hospital, after signing patients' consent form and meeting the criteria for the research. Of which, 20 patients of Telewound-monitored group against the 19 of control group that visit clinic as scheduled were examined (Every 2 weeks). The research lasted for 1 year or upon complete healing of the wound. The telemonitored group was counseled on the proper wound dressing process and was monitored via mobile phone (telemonitoring) or visit at home every week, while they were told to dress the wound daily or every other day depending on the stage of wound. The control was assessed at usual hospital out-patient wound dressing unit, on schedule.

Assessment of pain (Biatain pain scale) Scoring over time is an effective way to optimise chronic pain management. Biatain pain scale involves the use of both the Visual Analogue Scale (VAS) and Numerical rating scale (NRS).

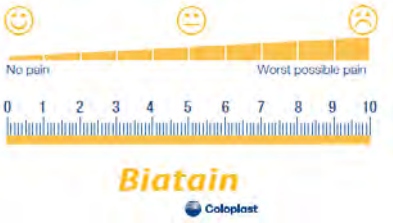


Fig.1: Biatain pain scale.

VAS is rated based on visual concept “no pain- to- worst possible pain” and asked the patient to pick a point on the continuum that best reflects how she/he is feeling. While NRS is the use of numerical from 0 to 10, 0 is ‘no pain’ to 10 is ‘worst possible pain’ and the patient was asked to choose a number that best reflects his/ her present level of pain [12]. The average signifies the pain measurement. Healing time was used to assess the general wellbeing of the patient, and assessed based on the overall physical and physiological assessment of the wound, that is, the depth and diameter (length and width) of wound was used to measure the healing process.

Conclusion

Follow up of wound management after certain degree of healing aid in fastening healing process and reduce wound breakdown. Reduction in pain has great impact in the overall wellbeing of the patient thereby, improving the patient’s quality of life.

References

[1] K. Solowiej, V. Mason, D. Upton, Psychological stress and pain in wound care, part 2, A review of pain and stress assessment tools, J. of Wound Care, 19:3., 2010.

[2] K. Soon, C. Acton, Pain-induced stress: a barrier to wound healing, Wounds UK, 2: 4, 92-101, 2006.

[3] K. Solowiej, V. Mason, D. Upton, Review of the relationship between stress and wound healing, part 1, J Wound Care, 18: 9, 357-366. 2009.

[4] Kiecolt-Glaser, J.K., Marucha, P.T., Malarkey, W.B., et al., Slowing of wound healing by psychological stress. Lancet, 364, 1194-1196, 1995.

[5] K. Woo, G. Sibbald,, K. Fogh et al., Assessment and management of persistent (chronic) and total wound pain, Inter Wound J, 5: 2, 205-215, 2008.

[6] K. Y. Woo, R.G. Sibbald, The improvement of wound-associated pain and healing trajectory with a comprehensive foot and leg ulcer care model, J Wound, Ostomy Continence Nurs, 36: 2, 184-191, 2009.

[7] G. Kammerlander, T. Eberlein, Nurses’ views about pain and trauma at dressing changes: a central European perspective, J. Wound Care, 11: 2, 76-79, 2002.

[8] P.E. Price, H. Fagervik-Morton, E.J., Mudge, et al., Dressing-related pain in patients with chronic wounds: an international patient perspective, Inter Wound J.

[9] H. Hollinworth, Pain at wound dressing-related procedures: a template for assessment. http://www.worldwidewounds.com/2005/august/Hollinworth/Framework-Assessing-Pain-Wound-Dressing-Related.html (accessed 13 Jan 2013).

[10] M. E. Hyland, A. Ley, B. Thomson, Quality of life of leg ulcer patients: questionnaire and preliminary findings, J. Wound Care, 3: 6, 294-298, 1994.

[11] M. M. Heinen, A.W.M. Evers, C.J.T. Van Uden, et al., Sedentary patients with venous or mixed leg ulcers: determinants of physical activity, J. Adv. Nurs., 60, 50-57, 2007.

[12] F. Gottrup, R. Kirsner, S. Meaume, C. Münter, G. Sibbald, Clinical Wound Assessment: a Pocket guide, Denmark, Coloplast A/S, 2000. www.coloplast.com.

	Ogini Augustina N. is an assistant Director of Nursing service in-charge of the Obstetric and Gynaecological area. The multidisciplinary team coordinator of the telemedicine unit, F.M.C Owerri, with MPH, MSc IsPm, B. NSc, B.Sc. have been involved in telemedicine practices since 2007 and special interest in research work in eHealth.
	Nwuke Henry C, Presently working in the capacity of a clinical pharmacist 1, in federal medical centre Owerri. Nigeria with 5 year post-qualification experience. A B.Pharm,M.Pharm degree holder in pharmacology ang toxicology university of Nigeria Nsukka, with special interest in anti-inflammatory, patient adherence improvement, and a pharmaceutical counselor . e-mail dumohen @yahoo.com

Tailored Patient Information Using a Database System: Increasing Patient Compliance in a Day Surgery Setting

J. Grode[1], U. Steinsøe[2], D. Skarregaard[2], K. Håsum[2], L. Grode[2]
[1]ICT Engineering, VIA University College, jegr@viauc.dk
Chr. M. Oestergaards Vej 4, 8700 Horsens, Denmark
[2]Department of Anaesthesiology, Regional Hospital Horsens, Sundvej 30, 8700 Horsens, Denmark
ullastei@rm.dk; dorthe.skarregaard@horsens.rm.dk; Kirsten.Haasum@horsens.rm.dk; Louise.Grode@horsens.rm.dk

Abstract: **Patient compliance is key to successful treatment of patients in day surgery, as noncompliance will put the patient at risk and is costly. Observing health literacy amongst patients at an individual level is essential to patient empowerment and thus the increase of patient compliance overall. The hospital is responsible for providing the patients with accurate information empowering patients to prepare for surgery. The contribution of this work is the analysis and implementation of a Health Information System that allows staff at the day surgery setting to tailor patient information at an individual, situation-dependent and linguistically relevant level, utilizing a common set of health literate text blocks, images and tables.**

Introduction

Patient compliance is key to successful treatment of patients in day surgery. Noncompliance can put the patient at risk and is costly. To increase patient compliance, patient empowerment is essential. Patients having day surgery are responsible for preparing them self for surgery and postoperative rehabilitation. The hospital is responsible for providing the patients with accurate information enabling the patient to prepare for surgery. It is also essential to avoid overloading patients with irrelevant, uncoordinated information, letters and leaflets. Various studies support these considerations. A review of patient adherence to treatment demonstrates the importance of patient compliance / adherence to treatment, albeit the paper also points out the lack of high quality studies at the time of writing (2001) to get additional insight in the consequences of non-adherence [1]. However, later research clearly document poor compliance

[2] and correlation between unintentional non-compliance and inadequate or marginal health literacy [3, 4]. From literature, it is evident that health literacy must be addressed in all information provided to patients, be it written, verbal, electronic or otherwise. It is also obvious that it is the health professionals who must address this issue by providing proper text based information material addressing various levels of health literacy [5, 6]. In order to address health literacy at an individual level and with efficiency, systems to produce such information material must be designed, developed and implemented.

Project Methodology

The project was carried out primarily between Regional Hospital Horsens who provided the clinical setting, and VIA University College, Horsens, being the implementer of the system. During the project, an anthropological study using questionnaires and interviews was carried out. The target groups were staff and patients in the day surgery setting. The study was carried out to further support system requirement analysis that can be derived from literature. The development of the system was carried out using an agile software development to ensure focus on most important features, and to ensure a high level of user-driven innovation from sprint review sessions, etc. During the project execution, quality assurance was monitored by an external consultant (DELTA) and workshops on certification of medical devices were carried out to further support the proper development of the system. The project ran over 8 months from August 2012 to April 2013, and is illustrated in Fig. [1].

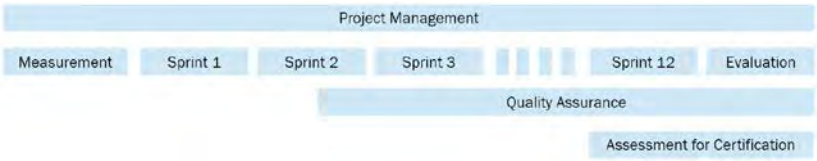


Figure 1: Project schedule

Requirement Analysis

The outcome of the anthropological study in combination with literature studies was a number of key areas that the system should support to facilitate the production of patient information letters. These key areas were described in a number of User Stories. At a high level, the most important ones can be summarized as follows:

Figure 3: Sample letter

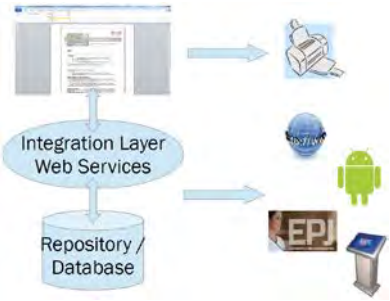


Figure 2: System Architecture

- Content for patient information letters must be adaptable to various types of treatment (anaesthetics, surgery, fasting regimes, etc.);
- Information letters must be easily adaptable to each patient scenario (health literacy, patient scenario, etc.);
- The system must support translation to foreign languages and an easy way to adapt an information letter to such language the patient require;
- The system must support the documentation into relevant Electronic Health Record system of which information material has been handed out (legal requirement);
- The system must support a template based approach, ensuring high efficiency while maintaining the adaptability of each letter;
- The system must provide for a "define once, use many" approach such that common information material used across many templates and information letters can be maintained as a single object but be used for many purposes;
- The system must cater for future extensions to electronic media, portable devices and information kiosks.

System Implementation

To support the requirements, a three tier software architecture was established. A relational database system holds all information pieces in a granular, structured form. Each individual piece of information can be joined with other pieces thus supporting the tailoring of information. A web service layer caters for integration with output systems/media (word processing engines, web, mobile apps, and information kiosks). To lower

the adoption bar of the system, an MS Word user interface was integrated with the web service layer, and information can now quickly be categorized and grouped according to purpose of use, users can quickly setup information letter templates, generate information material based on existing templates and support translation of content. An example of a letter generated by the system is shown in Fig. 2. The system architecture is illustrated in Fig. 3.

Conclusion

Based on existing research and anthropological studies, we have derived requirements for a system to maintain and tailor patient information letters to improve compliance by addressing marginal or inadequate health literacy. We have illustrated the development and implementation of this system. Statistics on compliance taken prior to system introduction will be compared to post-system introduction statistics to confirm that the system efficiently supports the requirements, resulting in overall improved compliance and adherence to instructions given to patients in the day surgery setting.

Acknowledgement

This project was sponsored by TrygFonden smba, Lyngby Hovedgade 4, 2.sal, DK-2800 Kgs. Lyngby, Denmark.

References

[1] E. Vermeire, H. Hearnshaw, P. Van Royen, J. Denekens. “Patient adherence to treatment: three decades of research. A comprehensive review”. Journal of Clinical Phramacy and Therapeutics (2001), vol. 26, pp. 331-342

[2] C. J. C. Cheng, I. Smith, B. J. Watson. “A multicentre telephone survey of compliance with postoperative instructions”. Journal of the Association of Anaesthetists of Great Britain and Ireland”, Vol. 57, Issue 8, pp 778-817, August 2002

[3] S. G. Smith et al. “The Influence of Health Literacy on Comprehension of a Colonoscopy Preparation Information Leaflet”. Diseases of the Colon & Rectum Volume 55: 10 (2012), pp. 1074-1080

[4] Lee A. Lindquist et al. “Relationship of Health Literacy to Intentional and Unintentional Non-Adherence of Hospital Discharge Medications”. J Gen Intern Med 27(2):173–178

[5] S. Stableford, W. Mettger. “Plain Language: A Strategic Response to the Health Literacy Challenge”. Journal of Public Health Policy 2007, 28, 71–93

[6] U.S. Department of Health and Human Services. ”Quick Guide to Health Literacy”.

Jesper Grode holds a Ph. D. in Computer Science from Technical University of Denmark, 1999. As Assistant Professor at VIA University College, Jesper teaches advanced database systems, computer architecture and programmable logic. In addition, Jesper devotes energy and time for research and development in health care IT and to project execution with public institutions and private companies

within the health care sector. In his previous career, Jesper worked as developer, manager and project director for a big internationally oriented company, developing, supplying and supporting Master Data Management solutions.

Ulla Steinsøe is registered nurse since 1996. Ulla is working in a day surgery center at Hospitalsenheden Horsens, Denmark. Ulla is devoted to high quality in care and information for the patients in order to educate the patients for best possible compliance. Prior to day surgery, Ulla has 11 years of experience in intensive care and cardiology nursing.

Dorthe Skarregaard is registered nurse since 1987. She has worked in intensive care unit and with cardiac patients. In 1999 trained as a nurse anesthetist and has anesthetized both inpatients and day surgery patients. Since 2004, Dorthe has examined patients before anesthesia. She operates the anesthesia clinic at Hospitalsenheden Horsens and is therefore also responsible of the written patient information.

Kirsten Haasum became a nurse in 1989, and since then worked in clinical practice; since 2008 at the Hospital in Horsens, Denmark at the department for Day Surgery. Kirsten has worked in several departments and has often been involved in projects where development of documentation and patient information has been the focus. Kirsten holds a Diploma of Health; health education/communication and clinical education in 2006. Kirsten has a function of Practice-responsible Nurse, teaching nursing students in clinical practice.

Louise Grode, RN, BA, MScPH. Clinical Development Nurse, Department of Anaesthesiology, Horsens Regional Hospital, Denmark.Current fields of special interest: Quality improvement in clinical nursing, Patient safety, enhanced recovery after surgery

Virtual Reality Platform for Simulate Bariatric Surgery and Predict Patient Evolution

A. Cervera[1], J. Benseny[1], J. Benavent[1], D. Gutierrez[2], E.M Targarona[3]
J.C. Pernas[3], C. Balague[3]
[1]i2Cat Foundation, andrea.cervera@i2cat.net
C\ Gran Capità 2-4, Nexus I Building, office 203, 08034 Barcelona, Spain
[2]T-systems, david.gutierrez@t-systems.es, C\ Sancho de Avila, 110, 08018 Barcelona, Spain
[2]Sant Pau Hospital, etargarona@santpau.cat, C\ Sant Antoni Maria Claret, 167 08025, Barcelona, Spain

Abstract: **Obesity is one of leading cause of death worldwide and could lead to the development of several comorbidities. This project aims to develop a Virtual Reality Platform to support surgeons to prepare and perform the surgery as well as estimate patient's evolution. The system is being designed and executed by healthcare professionals and e-Health researchers.**

Introduction

Obesity (BMI>30) is a metabolic disorder with a higher rate of prevalence in the world and is considerate the first cause of death after smoking causes. Obesity could lead to the development of comorbidities such as diabetes, hypertension, heart disease, osteoarthritis, gout, hyperlipidemia, choleithiasis and sleep apnoea. When it comes to Morbid Obesity (BMI>40), complications are more severe; they occur in a shorter period of time and come associated with a decrease in the quality of life [1].

Medical treatment combines dietary, pharmacological or psychotherapeutic techniques; but in the vast majority of cases with Morbid Obesity, surgery is the most recommended treatment. Nowadays, the most accepted techniques are Gastric Bypass, Duodenal Switch (SD), Gastric Band (BD) and Sleeve Gastrectomy (GT) [2]. It is estimated that 400,000 bariatric surgeries are performed every year in the world [3].

The Bariatric Surgery Project [4] aims to develop a Virtual Reality Platform to generate a 3D model of the patient's stomach and simulate the surgery over the 3D, allowing the surgeons to plan, evaluate and choose the best surgery option for the patient. Furthermore, the system will also allow estimating patient's weight loss after the surgery, based on patient's physiological characteristics and information of previous Bariatric Surgery

interventions.

Problem

Using Bariatric Surgery techniques the patients normally can lose around the 70% of their weight excess in one year from the surgery. However the weight loss depends of several factors such as the type of surgery technique and patient`s habits and genetics. From these factors the most controllable is the surgery, but it is very difficult compare the same surgery technique because the same procedure cannot be easily reproduced.

Nowadays, various Virtual Reality platforms are applied in several medicine specialities. However, these platforms usually provide clinicians with a generic model of the organ they desire to interact with and do not allow real reconstruction of patient's organs from clinical images. On the other hand, already existing simulation platforms that allow simulating real organs are not specifically designed for Bariatric Surgery.

The 3D model of the patient's stomach and the surgery simulation has a high interest for the clinical evaluation of the surgery, allowing comparing them more precisely.

Bariatric Surgery System

The Bariatric Surgery Project is a multidisciplinary initiative designed and executed by healthcare professionals (surgeons and radiologist) and e-Health researchers. It aims to develop a Virtual Reality platform to support surgeons in prepare and perform the surgery, as well as, estimate patient's evolution.

The system will retrieve the patient's abdominal TACs from the Picture Archiving and Communication System (PACS) available at the hospital. From these TACS the system will generate a real 3D representation of the patient's stomach. The platform will allow the physicians to interact with the 3D model, zoom it, decompose it and finally plan the real surgery simulating it over the 3D model. Also, the platform will incorporate heuristic models providing a prediction of the patient's weight loss.

After the Surgery will be possible generate news3D representation of the patient's stomach, allowing the physicians study the result of the surgery, and preventing post-surgery complications or not expected outcomes.

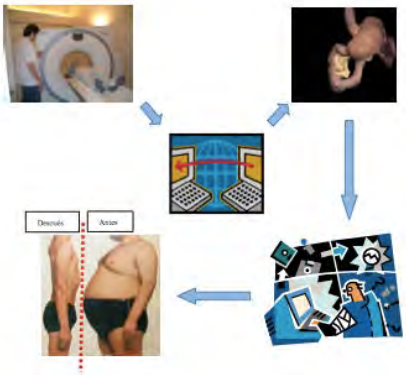


Fig. 1 Bariatric Surgery Process

The system will be integrated with the Hospital information system, allowing retrieving DICOM TACs, the storage of the 3D patient's stomach model from the PACS and the sending of the patient's information into his electronic health record (EHR) using HL7 standards.

In addition, Bariatric Surgery project includes a predictive model, which based on previous data from similar surgeries and combined with data of the patient will be able to estimate the evolution.

Expected Outcomes

Is expected that the use of the Bariatric Surgery system will provide necessary tools for surgeons to develop their work easily and more efficiently, allowing them to simulate the real Surgery and helping to choose the best technique for each patient, based on the simulation of the surgery and the prediction the patient's weight loss.

It's also expected to improve the patient care, providing more information about the surgery and their evolution, and thus an increase in quality assistance.

Current State

Currently we are working on collect patients data from previous bariatric surgery interventions for the study, a first prototype of 3D stomach reconstruction, which has been designed and will be tested by using real TACs, and the development of a especial data base for the project and its integration with the Hospital Information Systems.

Acknowledgment

This project is partially funded by the Spanish Government; on the

research and innovation plan “INNPACTO 2011”. It is collaborative initiative with three Spanish institutions, T-Systems which develops the Virtual Reality Platforms, Sant Pau Hospital which validate Clinically the Platform and i2CAT Foundation which implement the interoperability with healthcare systems. And it

References

[1] H. Buchwald; Y. Avidor, E. Braunwald, M. D. Jensen, W. Pories, K. Fahrbach, K. Schoelles. “Bariatric Surgery. A Systematic Review and Meta-analysis”. Available at: http://jama.jamanetwork.com/article.aspx?articleid=199587

[2] Bariatric Surgery for Severe Obesity. NIDDKhe National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). Available at: http://win.niddk.nih.gov/publications/gastric.htm#whataresurg

[3] H. Buchwald; D. M. Oien. “Metabolic/Bariatric Surgery Worldwide 2008”. Available at: http://wlsvitagarten.com/wp-content/uploads/2009/11/2008-surgery-type-percentage.pdf

[4] Bariatric Surgery homepage. Available at: http://bariatric-surgery.i2cat.net

Andrea Cervera Forner has a B.Sc. in Telecommunications from Technical University of Catalonia (UPC) and currently is studying a M.Sc. in Telemedicine from the Open University of Catalonia (UOC). She is involved in several European Funded projects like HIPERMED and National funded Projects like Bariatric Surgery or i2HealthSantPau LivingLab. She holds HL7-CDA certification and extensive DICOM and SNOMED knowledge

Jaume Benseny received his MS degree in Telecommunications Engineering from the Technical University of Catalonia (UPC) in 2007. He works as Project Manager in various national and international projects like the Catalan Tele-Stroke Network, the i2HealthSantPau LivingLab. He has a strong multidisciplinary expertise on networking and e-health technologies and long experience in real and open-innovation environments. He holds CCNA and HL7 certifications and has extensive DICOM knowledge

Josep Benavent Marco has a B Sc. in Telecommunications and a M. Sc. in Telecommunications Engineering (MASTEAM) both by Universitat Politècnia de Catalunya (UPC). Nowadays, he is a PhD student at Fundació i2CAT. His research interest is focused on co-creation techniques and stakeholders’ involvement environments in order to develop multidisciplinary IT projects

Winner
of the 2012
ISfTeH Student Videoconference Session

Validation of Physiological Data Transmission System

R. Ferreira, J. C. Rosario, M. Much, I. V. Scheffler, T. Russomano
Scientific Department, Toth Technology, jeferson@tothtecnologia.com.br
Av. Ipiranga, 6681, Predio 99ª, 13° Andar, Porto Alegre, 90619-900, Brazil

Abstract: **Patient physiological information has been of great importance in diagnosis and treatment of disease since the beginning of health care development. Telecommunication systems advances made over the last two decades have enabled secure and reliable high speed data transmission, giving health care professionals virtual access to patient information. This study aimed to validate data transmission between a multi-parametric monitor and a central management Server. Initially, a 4000 sample wave form composed of square pulses and a sinusoid component was defined using MATLAB®. The wave was then generated in a continuous loop by the NI USB-6221® module of National Instruments, at a rate of 1000 samples per second. The generated analogical wave was connected to a Lifetouch10 monitor, which digitalized and divided it into Ethernet packets, sending them through a computer network to a central visualization desk. Received data was stored and converted to ASCII coding, enabling performance of a comparative analysis between the generated and received data. A synchronized graph comparison of both waves demonstrated an acceptable data loss of less than 0.01 samples per second. The graph analysis verified the strength of the communication protocols used to transmit data from the Lifetouch10 monitor to the visualization desk, confirming the reliable representation of the monitored physiological signs.**

Introduction

Improvements in health care systems have guided new developments in telemedicine and e-health. Applications based on GSM, Bluetooth and Wi-Fi, among others, have improved not only the remote health care assistance, but also the efficiency and accuracy of such applications [1-3]. Along with these improvements has come the necessity to develop new protocols to enable secure and reliable high speed data transmission, giving health care professionals virtual access to patient information. Communication protocols for medical use demand a deep analysis of the network to be used,

considering bandwidth, amount of data transfer per patient and the necessity for real-time applications [4].

In line with these advances and as part of a joint innovation project to develop a cardioverter/defibrillator, the Brazilian companies LIFEMED and Toth Technology together with the Pontifical Catholic University of Rio Grande do Sul conducted a research project to evaluate network communication protocol reliability between patient vital signs health monitors and a central Server with the aim of ensuring data consistency.

This remote monitoring system is able to manage and centralize patient physiological information, permitting the supervision of variables, such as ECG, SpO_2 and $EtCO_2$, among others. The communication protocol allows data recording for several patients to be centralized in a monitoring workstation, improving health care.

Objective

This study aimed to validate data transmission between a multi-parametric monitor and a central management Server.

Methods

A test environment composed of a LifeTouch10 multi-parametric monitor, a TCP/IP network and a data management and storage Server was set up in order to simulate the network and data transmission load characteristics found in a hospital.

Tool Development

A 4000 point wave form was created at MATLAB® (Fig. 1), in order to enable data validation. Square pulses were inserted to its shape allowing synchronization, when comparing transmitted and received waves. A sinusoid component permitted evaluation of information loss.

The National Instruments module NI USB-6221® generated the analogic wave at a rate of 1000 samples a second in a continuous loop, resulting in 4 second cyclic waves.

Performance Tests

The NI USB-6221® module was connected to a LifeTouch-10 monitor that digitalized the received signal and divided it into Ethernet packets, sending them through the network to the Server (Fig. 2). A 10 min recorded period of received data was stored and converted to ASCII coding, enabling a comparative analysis between the generated and received data.

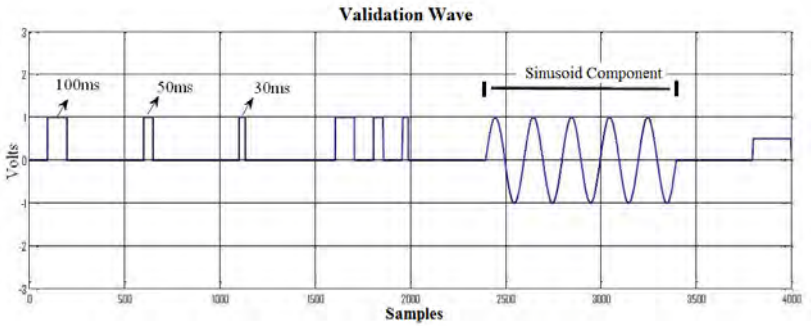


Fig. 1: A 4000 point validation wave created at MATLAB®

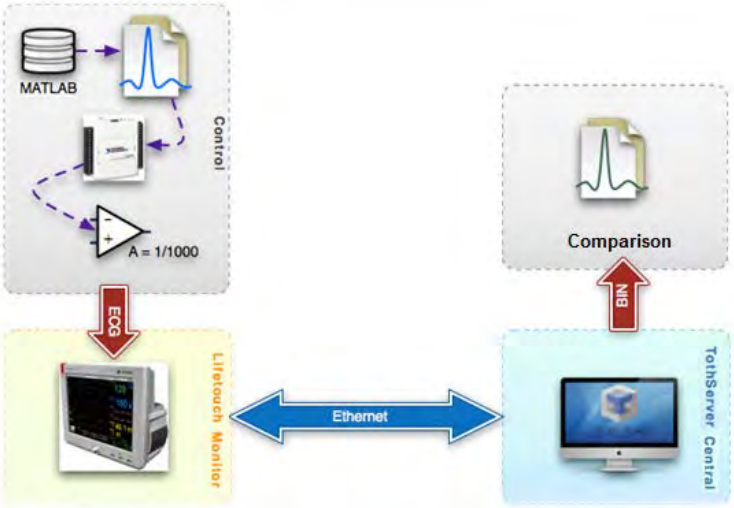


Fig. 2: Schematic view of the system

Results

A comparison was made between the last cycle from the 10 min recording of the original wave generated by MATLAB® with the corresponding last received wave. It demonstrated that the sample loss was inferior to 0.01 samples per second (Fig 3), allowing the correspondence of the two waves. This loss is considered acceptable as a greater one would generate a discrepancy in the synchronization between the two waves.

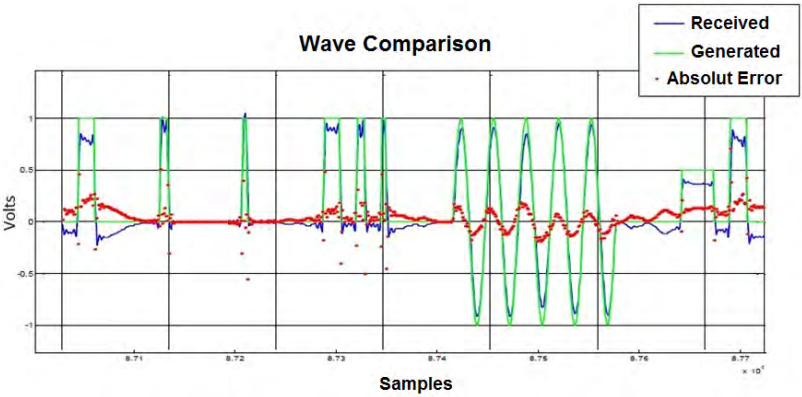


Fig. 3: A wave comparison between generated and received signals.

Conclusions

The comparative analysis of the two wave forms verified the strength of the communication protocols used to transmit acquired signal samples from the LifeTouch-10 monitor to the Server. An evaluation of data quality should be considered in future studies.

References

[1]. E. Kyriacou, S. Pavlopoulos, A. Berler, M. Neophytou, A. Bourka, A. Georgoulas, A. Anagnostaki, D. Karayiannis, C. Schizas, C. Pattichis, A. Andreou, D. Koutsouris. Multi-purpose HealthCare Telemedicine Systems with mobile communication link support. Biomedical Engineering Online. v.2, n.7, 2003 - doi:10.1186/1475-925X-2-7

[2]. S. Khoor, K. Nieberl, K. Fugedi, E. Kail. Telemedicine ECG-telemetry with Bluetooth technology. IEEE Computers in Cardiology, v.28, p.585-588, 23-26 Sept. 2001

[3]. H. S. Ng, M. L. Sim, C. M. Tan, C. C. Wong. Wireless technologies for telemedicine. BT Technology Journal, v.24, n.2, p.130-137, Apr. 2006

[4]. I. Martínez, J. Salvador, J. Fernández, J. García. Traffic Requirements Evaluation for a Telemedicine Network. In Proceedings of the 1st International Congress on Computational Bioengineering (ICCB '03), pp. 389–394, Zaragoza, Spain, September 2003.