

# **Med-e-Tel 2014**

*Electronic Proceedings*

*of*

*The International eHealth, Telemedicine and Health  
ICT Forum for Educational, Networking and  
Business*

Editors

Malina Jordanova, Frank Lievens

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**Electronic Proceedings: The International eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business**

**Editors: Malina Jordanova, Frank Lievens**

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## Preface

Dear Readers,

We are proud to present the Electronic Proceedings of Med-e-Tel 2014.

The 197 papers and abstracts from 52 countries, included in the Proceedings, were compiled for and presented at the Med-e-Tel 2014 (The International eHealth, Telemedicine and Health ICT Forum for Educational, Networking and Business, [www.medetel.eu](http://www.medetel.eu)). The event was held at Luxexpo, Luxembourg, Grand Duchy of Luxembourg April 9-11, 2014.

Med-e-Tel 2014 brought together participants from all over the world, networking among themselves and with representatives of international organizations, companies and project teams.

Please, when reading the Proceedings, be so kind and have in mind that:

- The sessions are listed in the order of their scheduling in the Preliminary Program on March 3<sup>th</sup>, 2014;
- Papers within the sessions are arranged in an alphabetical order of their titles;
- In the content, after the title of papers and abstracts, maximum of 3 to 4 co-authors are listed, while the remaining co-authors are marked as “et al.”;
- Last minute changes in the program, especially re-scheduling of presentations as a result of speakers’ requests, are not depicted in the organization of the Proceedings;
- Only texts that were submitted on time and were prepared according to the rules are included in the Proceedings;
- The papers have been peer reviewed by experienced researchers in the field of Telemedicine/ eHealth who are independent of the authors and the research. The papers were included for publication after receiving two positive reviews.

The Proceedings is a collective experience of colleagues from different continents and different cultures.

The aim of the this Proceedings is to permit those who are planning to introduce eHealth / Telemedicine applications in their regions or countries

to rely on experiences of others in order to avoid mistakes and to reduce potential problems.

We hope that anyone involved in eHealth/Telemedicine will find these Proceedings extremely interesting.

With the publication of this Electronic Proceedings as well as with the seventh book from the series “Global Telemedicine and eHealth Updates: Knowledge Resources”, Med-e-Tel strengthens its position as a widely recognized International Educational, Networking and Business Forum for eHealth, Telemedicine and Health ICT.

Enjoy your reading!

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# **Opening Session: Telemedicine and eHealth Update**

# European Junior Doctors and European Medical Students' Association Perspective on e-Health: A User Centered Approach and Engagement

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## Introduction

In 2013 the European Junior Doctors Permanent Working Group (EJD) launched a survey on e-health based on the observation that in order to increase e-health diffusion, a socio-technical and socio-cultural issue, [1-2] the e-health community should focus on usability and user centered design. The literature analysis allowed to discover that new generations, as generation Y, are considered a foremost variable in the development of functional e-health systems [3]. Literature analysis showed that Junior Doctors can be more critical than senior doctors about usability of e-health products (particularly electronic health records). This survey revealed that Junior Doctors would like to be implicated in the analysis, evaluation and development of e-Health as associations or as single doctors. For example a Junior Doctor recently developed an app to flag up problems and inefficiencies on hospital wards [4]. Nevertheless the majority of Junior Doctors is still not involved in e-health projects and a career in e-health does not seem a possible option for Junior Doctors.

The lack of careers in e-health for Junior Doctors suggests a deficiency in medical education on e-health since evidence suggests that there is a direct correlation between the core skills acquired through university education and the subsequent employability of University graduates [5]. The strengthening of education on e-health for medical students and Junior Doctors would probably increase the diffusion of e-health solutions in health systems, ameliorate the development of e-health solutions according to a user-centered design and improve the career opportunities of physicians inside e-health.

This work aim is to start the achievement of the following objectives:

1. Giving a wider insight on the new generations of doctors (Generation Y and X),
2. Helping to understand what is the European medical students' vision on UGT (undergraduate training) in e-health,
3. Creating a continuity between European JDs and medical students' visions that could facilitate the improvement of a common awareness on the following needs:
  - a) A user centered approach in e-health development able to ameliorate the work of young physicians,
  - b) A common vision on educational needs on e-health for new generations of doctors,
  - c) A common vision on the evolution of work scenery in e-health and on the involvement of doctors through careers and positions,
  - d) Offer a model able to explain to e-health stakeholders (like industries) what are the present requests of generation Y and X in e-health development

#### Methods

- Literature analysis of the following topics on PubMed and Google Scholar: UGT and e-health, PGT (post graduate training) and e-health, user centered design based on junior doctors and career opportunities in e-health for doctors.
- Survey filled by European Junior Doctors and European Medical Students focused on UGT and PGT, usability of electronic health records, and careers opportunities in e-health. The survey results will be examined as the survey questions will be answered by delegates and presented in Med-e-Tel 2014.

#### Results

Although there are obvious variations among specialties, physicians spend 25-30% of their time on administrative tasks that require the use of computers and other information technology devices [6].

For this and other reasons medical students consider e-health an important factor in the current and future health sector [7]. There are programs which can constitute an example in order to satisfy this request of e-health learning. In 2003, the Institute of Medicine's Health Professions Education Summit identified the utilization of informatics as one of the five domains of core competency for health care professionals [8]. Additionally, informatics also underpins the other four competency domains, which are to provide patient centered care, to work in interdisciplinary teams, to employ

evidence-based practice, and to apply quality improvement [9]. Today the Association of Faculties of Medicine of Canada (AFMC) has initiated a project on eHealth curriculum and eLearning [10].

After searching “e-health” and “doctors” on PubMed we obtained 1726 results which are reduced to 15, if we add the term “junior” to the research. None of these papers aim to analyze as main topic the potential role of junior doctors on e-health user centered design. One of these papers has engaged only Junior Doctors for a user-centered design paper on e-health [11].

The research of “e-health” and “doctors” and “career” show how the only career option foreseen by the papers is the telemedicine doctor in rural area. None of the papers propose positions for doctors as leaders in the strategic development of e-health products or services in public or private structures.

### Discussion

Although the basis for e-health learning and teaching has been posed, the real situation of medical education in e-health is still unclear and jeopardized. While Junior Doctors and medical students are trying to empower themselves through smartphone apps [12], some studies are proposing practicums in order to gain necessary skills in e-health applications and provide them with an opportunity to explore ways of using different e-health tools for the delivery of health care at a distance [13], other are suggesting to prepare directly “rural doctors” able to use communications technology and other distance education methods [14].

There is an emerging need to define the basic skills and knowledge for each level of the health care education and trans-border cooperation offers a unique opportunity for the establishment of common criteria for basic skills and knowledge, via joint discussions, collaborative thinking and concerted action.

Nevertheless there is no awareness on what are junior doctors potential careers in the world of e-health systems design and implementation.

A survey performed by an alliance of the association representing European Junior Doctors (EJD) and the association representing European Medical Students’ Association and Universities (EMSA) can help in creating the trans-border cooperation cited above. Moreover this cooperation can facilitate the creation a common vision between generations which are discussing in a user-centered manner about new ways of learning, using and developing e-health.

### Acknowledgment

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# How the Diplomatic Council Network Helps When It Comes to Healthcare

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The Diplomatic Council (DC) was established as a global Think Tank with the objective to build a bridge between diplomacy on the one side and economy and society including healthcare on the other side. Members committed to the Diplomatic Council strongly believe that Commercial Diplomacy including the healthcare sector is the foundation for international understanding and a more peaceful interaction amongst nations.

A thriving economy and healthcare industry bringing prosperity to mankind is one of the best guarantors of peace. This revelation was the motivation for the Diplomatic Council to turn its goal of promoting international understanding into an economic mandate. The methodology of a global business network is associated with the diplomatic communication level of the different nations.

In this respect, those healthcare experts and business leaders represented in the Diplomatic Council play a key role in consulting the ambassadors on how the economic principles can be transferred into the global diplomatic network. Vice versa the ambassadors shall use their diplomatic competency to warrant that the economic activities ultimately shall promote understanding amongst nations and safeguard peace. Against this background the Diplomatic Council welcomes those personalities from diplomacy, economy, society and especially healthcare who have a high acceptance, a high level of expertise and who share the same visions and values.

Thus, one of the Diplomatic Council's aim is to assist with global contacts including the healthcare sector. The Diplomatic Council is the publisher of the „Hospital directory for international patients“ series including the „DC Best hospitals of the world“ directory. The directories are distributed free of charge to embassies, consulates and international organizations all over the world to help them direct requests to the listed hospitals to make sure patients get the best treatment. In order to get included in the directory a hospital must conduct the self-assessment „DC Approved for international patients“ or qualify for the „DC Best hospitals of the world“ award. More than 150 hospitals have already successfully passed this process and have been awarded the certificate "Approved for

international Patients". All information provided will be perused on their plausibility and checked in random before the certificate is granted. As a first step many clinics start with the self-disclosure in order to qualify for the "Global Hospital". As a second step they will undergo the endurance test to belong to the "DC Best Hospitals of the World". For further details, please visit: [www.diplomatic-council.org/en/certificates/hospitals](http://www.diplomatic-council.org/en/certificates/hospitals).

„DC Best Hospitals of the World“ is the highest qualification standard and is awarded based on experts evaluation only. The “DC Best Hospitals of the World” certificate is granted to a hospital after extensive quality verification over a duration of several months by the experts of Temos International, a well-known certifier. Until now 31 hospitals located all over the world have been awarded this DC Best Hospitals of the World certificate. It is granted yearly at a conference organised by the international healthcare certification specialist Temos.

The Diplomatic Council Certification Program is designed for patients striving for more security and quality as well as for medical facilities seeking more international patients. These factors are especially important for the growing sector of medical tourism. People have travelled with the purpose to undergo medical treatment since ancient times. However, only since the 1980's, travelling for medical reasons has been recognised as a rapidly developing global market.

Furthermore people travelling for leisure expect medical treatment in emergency cases on a top level. Meanwhile this is a necessary precondition in order to attract tourists other than backpackers. These countries do not only need the facilities but also need to inform the tourists.

The increase in technological and medical research and developments, augmented product consciousness and globalisation are among the most influential trends that affect the medical industry. National health care systems, health insurance companies and hospitals urgently need to understand how medical travel is and will be affecting their national health care plans. There is a global deficit of information about medical tourism which hinders the industry's potential. The Diplomatic Council Global Healthcare Forum is taking measures to bridge this gap and to build a truly global platform to bring hospitals and patients together.

This includes the [hospitalscout.com](http://hospitalscout.com) platform supported by the Diplomatic Council. It is one of the most extensive Medical-Travel-Online-Comprisal with over 70,000 medical centers from more than 190 countries.

Interested parties can obtain the 210 pages Diplomatic Council report „Medical Tourism, Profit from the Global Health Care“ free of charge by sending an e-mail to the Diplomatic Council Secretary General Thi Thai Hang Nguyen ([nguyen@diplomatic-council.org](mailto:nguyen@diplomatic-council.org)).



Thi Thai Hang Nguyen has been the Secretary General of the Diplomatic Council (DC) since its foundation in The Hague. The born Vietnamese was nominated by the DC Founding President, His Excellency Ambassador Buddhi K. Athauda and unanimously elected by the Circle of Ambassadors to take over accountability of the DC Secretariate, one of the principal organs of the Diplomatic Council. She acts as a de facto spokesperson and leader of the organisation.

# Personal Health Systems Foresight: Visions on Innovations and Societal Demands

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Personal Health Systems (PHS) assist in the provision of continuous, quality controlled and personalised health services to empowered individuals regardless of location. PHS provides a horizontal development area across variety of patients, clinical specialties, technology fields and health services. The development of PHS requires and can mobilize the emergence of novel cross-disciplinary and -sectoral innovation partnerships.

Hence, we started a PHS Foresight project that expands across different PHS areas of application such as chronic disease management, life-style management, independent living and emergency services within and beyond the European Union up to 2030. With this project we want:

a) To achieve a deeper understanding of mismatches between the potential of PHS and current policy and innovation initiatives and framework conditions;

b) To support more mobilized and networked innovation communities, promoting PHS around jointly formulated issues which support pooling resources and streamlining diverse innovation initiatives;

c) To tackle future opportunities and alternative trajectories, aligning actor perspectives for the development of a joint strategic action plan, including recommendations for a possible new European Innovation Partnership (EIP);

d) To achieve a transparent, open and inclusive engagement of stakeholders, and targeted dissemination of results in society.

An online platform for launching a systematic online consultation process to generate and cluster visions on breakthrough innovations and societal demands has been deployed.

The ideas and online community activities are analysed not least, to identify partnerships for innovations. A comprehensive presentation of all the findings of this research can be found online (<http://www.phsforesight.eu/>). While we expect that the identified clusters of promising visions analysed from multiple perspectives will provide valuable support for the scenario and road mapping work of the PHS Foresight project and the development of policy-recommendations, we continue developing the online activities and engaging more stakeholders.

The evolving list of promising PHS visions will be maintained and updated constantly based on user assessments. The further assessment of PHS visions will support the identification of the most promising visions and will provide improved understanding of the PHS community preferences and future directions.

**Keywords:** Personal Health Systems

#### Presenters' Info



Robert Modre-Osprian received his MSc in technical physics and his PhD in biomedical engineering at the Graz University of Technology. He is a lecturer in Computational Medicine and a scientist at AIT Austrian Institute of Technology. He has comprehensive experiences in development, testing and validation of innovative mHealth and telemedicine solutions as well as eHealth closed-loop healthcare applications.

# **Smart Internet Teleconsults from Phones, Tablets and Browsers to Your EMR**

Pete Killcommons  
ATA Industry Council Chairman  
Board member American Telemedicine Association  
CEO Medweb

The Speaker will show how low cost Real time video telemedicine consults are now available on smart phones, tablets, and browsers, and can be integrated into the electronic medical record using standard HL7 and DICOM messages.

The Speaker will also address the convergence of both real-time (RTC) and web based telemedicine workflows with the electronic medical record and PACS system.

# **Telehealth – Next Stage Evolution: What will be Different, Important and Worth Looking out for?**

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Telehealth has shown strong positive results to date. These results have been repeated in many programs on a variety of countries around the globe. Technical evolution is accelerating. Early solutions were primitive, low volume and custom made, followed by gradual development of purpose built devices, designed for reasonable volume. We are now moving to ubiquitous platforms (smart phones, tablet, pads) this will change solutions in cost, deployment and the user experience. The application in health systems is also changing. What is next? Value will be demanded in all phases of these programs from planning to sales to deployment and then through use, support, effectiveness, acceptance, and outcomes. Effectiveness, acceptance and outcomes will depend on accuracy, the user experience and the real measure of quantified results. In the middle of all of this, the move toward ubiquitous platforms will homogenize the solutions that are available. These solutions will begin to look more and more alike. How will the buyer differentiate? What will be important? What will drive the difference between value and price? This presentation is from the perspective of leaders in this industry.

Keywords: Telehealth, technology, future

Mark VanderWerf is a recognized international thought leader in telemedicine and Telehealth as founder of AMD Telemedicine, AMD Telehealth and Telehealth Advisors as well as a founding Board Member of the International Society for Telemedicine and eHealth (ISfTeH) and as a Board Member and International SIG Chairman for the American Telemedicine Association.

## **TeleHealth – THE Patients’ Perspective (The Abstract of EPF’s Chain of Trust Project Presentation)**

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The “Chain of Trust”, 2011-2013 project entitled “Understanding patients’ and health professionals’ perspective on Telehealth and building confidence and acceptance”.

The main objective is to assess the perspective of the main end-users of Telehealth services across the EU, exploring whether and how views have evolved since the initial deployment of Telehealth, and what barriers still exist to building confidence in and acceptance of this type of service delivery. You can learn more about this project at [www.chainoftrust.eu](http://www.chainoftrust.eu).

The final report presents the main findings of the activities implemented by the Chain of Trust Consortium. These activities consisted of a literature review, an online survey and six national workshops, undertaken to gather information on the views and perceptions among patients and health professionals regarding the benefits of Telehealth services and their concerns. Four European Focus Groups were held to develop evidence-based policy recommendations to be carried forward at both European and national level.

The findings and recommendations have been presented and discussed at six national roundtables – in Greece, Latvia, Poland, Portugal, the Netherlands, and Norway (the same countries of the national workshops) – with a view to raising awareness among national stakeholders on the project findings and recommendations and promoting the integration of users’ perspective into their national Telehealth strategies and programs.

We are confident that project’s results covered in the final report will be useful to many of you working in the field of Telehealth and eHealth in your efforts to develop policies and services that meet the expectations of the end-users.

# **eHealth Applications in Surgery**

# **Cloud Teledermoscopy: System Development, Managing and Efficiency**

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## **Introduction**

Teledermoscopy is method of obtaining digital dermoscopic images with the technology provided by teledermatology.

Teledermoscopy is very convenient melanoma-screening tool, especially for the high risk patients in the remote settings, where they cannot receive qualified dermato-oncology service.

## **Aim**

The aim of this study was to assess the usability and quality of store-and-forward secure teledermoscopy system for pigmented skin lesions evaluation and further decision-making.

## **Method**

The doctors in the primary and secondary health centers created digital dermoscopic images and uploaded them to the secure online cloud system with all accompanying clinical data. Special questionnaire was developed that simplified and accelerated patient data entry and also providing power validation algorithm.

Within 24-hours 3 dermoscopy experts from pigmented lesions clinic evaluated macro- and dermoscopic images and filled in the report form.

## **Results and Conclusions**

A total 136 cases were evaluated in one month. Results were classified by the referral site, diagnosis and decision taken by the expert. From these 136 cases 21 were diagnosed as skin malignances and sent for further surgery to the nearest regional skin cancer center.

In conclusion: The web-based secure store-and-forward cloud teledermoscopy system is much faster and more convenient way of

dermatooncology service, especially in the remote settings. Significant improvement in the patient care and document flow was reached. Further analysis on the long-term results and costs effects will be performed.

**Keywords:** Teledermatology, Teledermoscopy, Cloud computing, Teleoncology



Anton Vladzmyrskyy, MD, PhD, professor and head of Telemedicine and eLearning Center at Donetsk National Medical University, President of Association for Ukrainian Telemedicine and E-health Development

# Design and Development of Workspaces for Surgical Skill Development

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## Introduction

Historically medical students were allowed to observe live surgical procedures from a gallery attached to the operation theatre (OT) separated by glass partition. Surgical postgraduates, however get access to live surgical procedures when they assist their mentors during the procedure. Special arrangements needs to be made to capture and distribute the live surgical images during surgical workshops held occasionally. This limitation of surgical training can be addressed by adopting advanced information & communication technology, multimedia, high definition capture and display tools to develop an integrated solution enabling capture, distribution and storage of live surgical data.

Surgical Telepresence is a relatively new concept and not being adopted in any academic medical institution in India. The utilisation of high bandwidth enabled distributed surgical telepresence can contribute significantly to the patient care and boost up surgical skills among medical staff. Thus telepresence evolves collaborative surgical workspace in which remotely located medical students can virtually interact in face to face meeting. Tele-presence projects are near to real image of the operative field to a remote site [1-3]. Surgical Tele-presence is a relatively new concept and not being adopted in any academic medical institution in the country. Telepresence surgery uses a computerized interface to transmit the surgeons actions at a surgical workstation to the operative site at the remote surgical unit, with haptic (force feedback) input to transmit to the surgeons the tactile environment of the operative field [4].

### *SGPGI Surgical Tele-presence Design, Engineering and Deployment*

The School of Telemedicine & Biomedical Informatics has identified Surgical Informatics as one of the thrust area of research under which a project “Surgiplex” is now being developed. Existing surgical video hub in

the OT complex was converted into surgical tele-presence suite for surgical skill education using tele-presence concept.

A. *Surgical Tele-presence System Consists of:*

1. **Display Devices:** Eight nos. of 46" high definition liquid format display (LFD) panels with a feature of digital video wall were installed with video controller hardware for large view of activities undertaken inside the operation theatre. Panels have 0.7mm bezel width. Panels are arranged over customized panel stand covered with wooden fixtures all around. Curvilinear sitting arrangements made inside the surgical telepresence where a video wall was erected using HD display monitors. External speakers and Taiden<sup>(R)</sup> conference mic along with mic controller was connected to Bosch<sup>(R)</sup> Amplifier. Matrox<sup>(R)</sup> video controller was connected to the video control of digital wall and audio was directly connected to external speakers and amplifier.
2. **Digital Wall controller:** It was hardware based controller. A multi-format video card along with Broadcam<sup>(R)</sup> streaming software was installed. Multiple video formats like s-video, composite video, HDMI, DVI, component and VGA was supported by the controller.
3. **Virtual Desktop Server:** Vspace<sup>(R)</sup> server was configured in IBM<sup>(R)</sup> Server loaded with windows multipoint server 2011. It was connected to 24 L300<sup>(R)</sup> desk top clients with a capability of initiating video call from each client using headphone and web camera.
4. **HD Monitors:** Samsung<sup>(R)</sup> full HD Monitors were used for display at each client with Keyboard & Mouse.
5. **Video Conferencing:** Polycom<sup>(R)</sup> HDX 9004 with Sony<sup>(R)</sup> PTZ as auxiliary camera mounted on the ceiling were used for organising interactive surgical workshop/ live surgical transmission with remote telemedicine centers.

B. *Modular Operation Theatre*

One of the Operation Theatre of Endocrine Surgery Department was converted to an integrated surgical digital operational theatre. Operation Theatre has multiple video sources like Ceiling mounted Sony<sup>(R)</sup> BRC 300 Pan Tilt Zoom (PTZ) camera, Wall Mounted Canon<sup>(R)</sup> camera, Stryker<sup>(R)</sup> in-light video camera fitted in the OT main light. Boom has add on panels for equipments like endoscopy camera, Ultrasound Camera, Head Mounted Camera, Patient Monitoring System , C-Arm and any analogue video signal.

Two 26" HD monitors were mounted in spring arms for surgical image visualization for surgeon and assistant along with two wall mounted 46" LCD panels. One LCD Panel showed remote partners and another LCD

panel shows local video. Surgical videos were captured through SDC-Ultra<sup>(R)</sup> in CD, DVD & External Flash Drive. Sometimes manual recording was done using Sony<sup>(R)</sup> PD170, Hi-Definition CAM PDW335 or Handy Cam from another operation theatre.

### C. *Hi-Speed Communication Bandwidth*

Surgical Telepresence room was connected to the School of Telemedicine & Biomedical Informatics (STBMI) for utilising hi-speed bandwidth from multiple service providers. A dedicated fibre optic link was established between surgical telepresence suite and the video hub located in the data centre. It was thus extended an option of archiving live surgery using Building4Media<sup>(R)</sup> (B4M) production suite for direct Hard Disk recording in the server located in STBMI and also it was shared with the audiences in the lecture theatre during Continuous Medical Education programme or shared during surgical skill development workshop. Various available bandwidth at telemedicine centres are Integrated Service Digital Network (ISDN), Satellite bandwidth from Indian Space Research Organisation (ISRO) Very Small Aperture Terminal (VSAT), National Knowledge Network 1G Bandwidth over Public IP, 100 Mbps Fibre to Home (FTTH). Network Bandwidth and Architecture designed and developed by STBMI has capability to utilise heterogeneous network with low latency and Quality of Service (QOS) and also extends the surgical telepresence network to other Government supported International Telemedicine Networks like South Asian Association for Regional Corporation (SAARC) Network & PAN African eNetwork. Doctors of other national and international collaborating partner institutions were also benefitted during educational programmes.

### Surgical Telepresence Work-Flow

Surgical Tele-Presence has multiple options for archiving the workflow of creating surgical videos includes video capture, editing of raw video, text, voice and graphics to improve educational value of the video & video archival or content delivery on CD/DVD or Flash disk. Video editing software like Final Cut Pro (FCP)<sup>(R)</sup>, Adobe Premiere<sup>(R)</sup> was used to edit video. Desktop packages like Adobe Creative Suite<sup>(R)</sup>, Maya<sup>(R)</sup> etc. plays an important role in improving the content by adding graphics, annotation and texts.

### Surgical Education Using Mobile Devices

Live surgical operations / procedures were available in mobile devices like iPhone, iPad and Mobile Clinical Assistant. Streaming server configured in the controller of the Digital video wall stream the entire procedure and was accessible in any of the internet enabled devices, kiosk

or desktop. Doctors can now view speciality surgical management procedures from doctor's duty room, OPD, Ward or from the residential complexes. Streamed content was riding over Hospital Information System (HIS) Network.

### Experience of Surgical Tele-presence For Enhancing Surgical Skill Transfer-SGPGI Case Studies

Endosurgery surgical procedures were transmitted from the Surgical Telepresence suite, SGPGIMS to the venue of Indian Science Congress - Bhubaneswar 04-Jan-2012. Ultrasound from Department of Maternal Reproductive Health was also transmitted. Quality of video and audio was found to be satisfactory. Live surgical skills from various Operation Theatres were thereafter transmitted remotely through multi-conferencing and streaming technology.



Figure 1: Snap shot showing panoramic view of Surgical Telepresence suite

#### Outcomes

- The medical students felt the experience was better than standard because of the enhanced learning secondary to the required verbal accuracy in describing the procedures.
- There was better visibility since the surgeon was not standing in the way.
- Sharing of Live surgical video during telemedicine session is the need of today's medical educational programmes like CME, workshop etc.
- Emergence of mHealth tools like iPhone, iPad along with streaming technologies help in disseminating medical knowledge all over the hospital
- Surgical tele-presence can be used to remotely mentor and enhance introductory surgical training for inexperienced medical students.

#### Future Scope

- With a clarity in the Audio/Video communication using HD technology and the availability of huge bandwidth on affordable cost, there is an Opportunity to do Tele-presence surgery.
- There is a scope of virtual simulation in telepresence surgical environment for education training and research.

## Conclusion

Surgical video hub in the OT complex at SGPGIMS was converted into surgical tele-presence suite for interactive surgical education using tele-presence concept. High definition videoconference with digital audio systems along with Digital Video wall was installed in the OT video hub where in 25 seats were designed with independent computer workstations. These nodes were networked with the video controller enabling personal visualization. Integrated Digital Operation Theatre was designed and deployed by networking multiple video feeds like room camera, in-light video, PTZ videoconference camera etc. through a video router. Surgical skills were shared with remote partners as well as local participants over IP video network technology. Entire surgical procedures were archived in storage systems at the data centre. This indigenous design and development of Surgical Telepresence suite, trademarked as Surgiplex<sup>(R)</sup> could cut down the cost of proprietary solutions.

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# **Hardware and Software System to Transmit and Process 3D Visualization Data during Surgeries and Diagnostic Procedures**

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## **The Goal of the Project**

The strategic goal of the project was to develop hardware and software system for storing, processing and broadcasting stereoscopic image from surgeon's or diagnostician's helmet.

System is designed to be used in master classes, carried by leading surgeons, for novice surgeons' qualification improvement, by showing them the whole surgical field and the tiniest details, like surgical tool position e.g.

Another usage of the system is telecounseling, when teacher is able to control novice surgeon's course of action in online mode.

## **The System**

There has been developed a unique system for high definition (1080p) online broadcasting, storage and processing (editing) of stereoscopic visualization data received during surgeries. A stereo headpiece for the surgeon included in the system is certified for usage in operating theaters.

## **Partners**

Partners in this project are:

- Telemedical Department at Medical Dentist University named after A. Evdokimov;
- Posterior Eye Segment Diagnostics and Surgery Center;
- Camera Lab., LLC
- Russian Telemedicine Association;
- The Scientific Clinical Center of the Russian Railways.

## **Results**

The system is ready. The 12-month testing of the system took place at:

- The Department of Dental and Maxillofacial Surgery at Moscow State Medical Dentist University named after A. Evdokimov, headed by Professor A. Drobyshev;

- The 5th Department of Cancer (with use of laser medical technologies and photodynamic therapy), headed by Professor M. Stakhanov;
- The Cancer Center at the 2nd Central of the Russian Railways and the Department of Cancer at Moscow State Medical Dentist University named after A. Evdokimov, headed by Professor L. Velsher;
- The Center for Spinal Cord Pathology at the 1<sup>st</sup> Central Hospital of the Russian Railways, headed by Professor A. Baskov.

Currently we continue improving our system by developing new technologies in view of surgical and diagnostic specificity.

Partners firmly believe that this work could be a base for an international project.

# Medical Data Acquisition and Analyzes Using 3D Video and Images

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*Abstract:* The presented paper discusses results and analyzes obtained under investigation about possibilities to use autostereoscopic 3D live streaming and pre-created pictures and videos for 3D live video purposes. Methods: how to implement 3D live video are discussed. Additionally different methods for obtaining 3D images based on different technologies and their comparisons are presented.

*Keywords:* autostereoscopic 3D, 3D live video, remote diagnosis

## Introduction

Today is a normal practice to exchange images or videos for many different purposes. Medical applications do not stay away of this process. Video-conferencing or live-TV are usual technologies. For many reasons people start to look for 3D image exchange and 3D video-streaming. For the last several years (starting from the premiere of the AVATAR movie) 3D video technologies went from laboratories and became usual.

As we discussed in [1] two elements of current video communication technology have critical importance for medical remote applications: peripherals (sensors, devices) and video-audio-data transfer. Our tests and analyzes show that in many cases video-audio transfer is not the main problem for using new 3D vision technologies. Much more important for medical applications are the quality of the obtained images, the stream consistence and the depth of the stereo-images. Of course, color realism and quality is very important, too. The other element of the video-system, the visualization device, is of extreme importance as well.

In the presented paper we discuss some results of installed and investigated video-equipment for 3D video transfer, some comparison between autostereoscopic and glasses-based 3D monitors for medical imaging and devices for 3D image and video-capturing for the same purposes.

## Short Observation of 3D Visualization Devices and 3D Capturing Devices

Even the term "3D" is ubiquitously used today as one can find two types of displays/monitors on the market: stereoscopic and holographic.

- Stereoscopic (binocular) vision is the result of the fusion of the two images (an image per eye) in the brain. Convergence, focus and physiological diplopia are the three components of stereoscopic vision;
- Holographic displays have the ability to provide all four eye mechanisms [2]: binocular disparity, motion parallax, accommodation and convergence. Even volumetric displays that create light spots somewhere within their volume are called in many cases 'holographic'.

The most notable difference between these two types of stereo 3D displays is that when a stereoscopic display is used the observer lacks any freedom of head movement and the freedom to increase the amount of information about the 3D objects in the scene: holographic displays do not have this limitation but on the market the term "3D" is used to refer to stereoscopic 3D (dual 2D images as being "3D").

We compared two main versions of "3D" (stereoscopic) technology:

- Active Stereo 3D: Shutter glasses are used to produce the 3D effect for the user and actively separate the images seen by the left and right eye;
- Autostereoscopic 3D: This means that no glasses are required.

Holographic displays have not been investigated.

Devices for 3D image obtaining can be separated roughly to:

- 3D scanners;
- Linked 2D cameras;
- Stereoscopes cameras.

All those types of devices were tested under pre presented investigation.

### Test Cases and Analyses

Under our test were assembled and tested several 3D environments:

- Centralized system – one computer running both capturing and visualization devices;
- Distributed system – there were several variants
  - ❖ Linked 2D cameras and Active Stereo 3D or Autostereoscopic 3D display presenting live video;
  - ❖ Active Stereo 3D or Autostereoscopic 3D display presenting video-stream generated previously (off-line) both locally loaded or remotely sent;
  - ❖ 3D pictures obtained by different cameras (both stereo-camera and linked 2D cameras).

Video-streaming was tested for different image qualities (from 320×240 to 1920×1200) and at different frames per second frequency.

Starting from the simplest case – 3D picture obtained by different types of cameras we reached to unpredicted results. 3D monitors can present 3D pictures in different formats. All of them are multipicture. The simplest is side-by-side or half-side-by-side. These pictures attempt to present images in the way the eyes are sending information to our brain. On the 3D monitor pictures taken in that format are not very “3D”. If one will compare 2D image and the same scene as 3D image simultaneously on two identical as resolution displays positioned side-by-side he will feel the depth and stereoscopy but the only 3D images look plain.

If the same scene is taken using 5-image or 8-image technology the stereo-effect is clear and the depth is well-sensed. Additionally it can be controlled by the visualization software. The problem is that these types of stereo-pictures need different kind of equipment and environment. For medical purposes this environment is important because the stereo-quality is important. The limitation for implementation of this technology is that it is not convenient for mobile (and field) applications.

Presentation of off-line taken 3D videos has the same limitations. Side-by-side films are easily obtained in different manners but stereo effect is not very clear. We examined the following scenarios:

- 3D camera;
- Linked (paired) 2D cameras controlled simultaneously and taking synchronously their frames.

The 3D camera tested by us has distance between objectives equal to 50mm. The best result was received for objects at a 1200 mm distance in wide zoom setting. The subjective sense is for something better than plain 2D but not full 3D.

The paired cameras are better for test environment. We did the following tests:

- Connected them mechanically as it is recommended by the provider. In this case cameras are fully parallel and the distance between objectives was 45 mm (a);
- Connected them mechanically fully parallel with the distance between objectives of 70, 80 and 90 mm (b);
- Connected them mechanically with the distance between objectives of 70 mm and with angle between optical axes of 2 degrees (c).

Cameras are generating live video captured by video-capturing card. The video-capture can be controlled in different ways. Cameras are running in synchronous mode. They are producing a sequence of “left-right-left-right-...” pictures. Using cameras in the basic mode (a) we found the following effect. Stereo-effect (3D viewing) is best for objects staying at 1.2-1.5

meters. Even for them it makes feeling for “flat” pictures. In case (b) the worst result was for the distance of 90 mm between optical axes. We got 3D images but with low quality. For nearer objects the subjective sense is that one sees two overlapping objects.

For distance of 70 mm results were very good for objects staying at a distance of 2 to 3 meters. In case (c) the most clear 3D images but for a limited area between 1.5 and 2.5 meters.

On both types of displays videos looks similar. The 3D is seen but it is not with good depth.

At case of the live 3D video streaming we found another effect. The delay generated by the system varies and in some case is very significant. The first thought was that the network is the problem but experiment envisaged that this software delay in the chain “video capture-stream generation-networking”. The network generates small delays and was not a problem.

### Conclusion

Presented in the paper test and analyses can conclude to the following:

To use 3D images for diagnosis purposes and to provide full stereo-effect a hardware environment providing better than “side-by-side” picture capturing is needed. For telediagnosis paired 2D cameras with fast capturing and stream-generation software is enough. If the object (the patient) can stay in a fixed position the case (c) of hardware environment is the most useful.

More work and investigations are planned for the near future. We have to find/create a software platform which will guarantee small delays in all cases of live 3D video capturing. More work is needed to define rules for obtaining the best stereo effects for different scenarios. Last but not least is the work for suppression of artifacts generation.

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# Pseudo-Coloring Method for Computer-Assisted Diagnostics of Lung Diseases

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**Abstract:** The paper presents a new method for the pseudo-coloring of lung x-ray images. This will allow determining easier total lung volume and some structural changes needed for diagnosing many lung diseases. The presented method is a part of a computer assisted methods developed by our group to support work of pulmonary physicians.

Keywords: X-ray imaging, pseudo coloring, computer-assisted method

## Introduction

The interpretation errors of medical images are from the early days of the radiology. The medical problem after interpretation errors is reported for the first time by Garland in 1959. Regardless of changes, errors continue to be a major problem as they have the same distribution, i.e. in some cases, the errors are more frequent. This can best be seen in the diagnosis of disease in the initial stages, especially lung X-rays (around 20-50% missed diagnosis), and mammography (up to 75% fault diagnosis). Studies have shown that errors in the interpretation of images with confirmed diagnoses reached ~30%. At the same time, when images of healthy/sick patients are read by physician, the percentage of missed or incorrect diagnoses increased by another 4% [3, 4]. Errors in reading the X-rays are not only the result of the qualification of the physician, but also depend on the ability to see structures and details in the image.



Fig. 1. Examples of the color usage in medical images (source: [1, 7, 6]).

In essence, the process of ‘viewing’ is a very complex and includes anatomical, physiological, neuropsychological and psycho-emotional components. In such a complex process, possible errors are not a surprise, although not all of the images are equally complex [2]. In addition to this the examination of digital images on the display do not replicate in the fullness the

classical X-ray examination process due to the peculiarities of imaging systems and characteristics of human vision system. This determines the continued search for more effective ways and more accessible form of presenting information. An example of this is the use of color in the preview of PET or CT images (Fig. 1).

### Pseudo-Coloring Method of Lung X-Ray Images

The proposed method of X-ray images post-processing consists in pseudo-coloring by means of using specially defined color scheme upon grayscale images (fig. 2). The most popular method of pseudo-coloring is that of using Look-up tables [5]. This kind of tables is set in the computer tomography and positron-emission tomography aimed at improving the contrast of tissues under investigation. Unfortunately the direct application of this method when X-raying lungs aimed at pseudo-coloring proved to be non-applicable.

Experiments were conducted to assess the existing color scales investigation the importance of assigned colors gradient upon pixels within the investigated X-ray images according to their intensity and aiming at distinguishing sickly status of lungs.

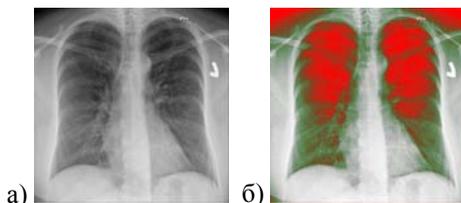


Fig. 2. X-ray image: a) an initial unprocessed image; b) an X-ray, processed with pseudo-color according the proposed method.

The ability of visual determination of densities in lung tissues is of special interest even in initial stage of healing and determining the vital lung volume of the patient. The carried-out references showed the lack of pseudo-coloring methods aimed at helping the diagnosis process – the existing methods are oriented to PET or CT images. This fact led to the necessity of investigating for application of methods used in other than lung treatments for the purpose of additional development of the proposed method.

The analysis of different color scales applications, used for medical purposes showed that the obtained X-ray images display very saturated colors (fig. 3). The latter fact contributes to an eye fatigue and brings obstacles to the diagnosis process. Such is the case of applying red color upon very large zones, as in JET and HSI in worm and color colors. At the same time in many zones the color is not a carrier of information; it even hampers the image analysis. Such critical zones are the ones around the bones, the heart, under the diaphragm, especially when the HSI scale in cold colors is applied. As example, in some of the cases the visualization quality of bronchus is significantly reduced (RAINBOW) or bronchi are being lost (HSI in worm colors and HSI in cold colors).

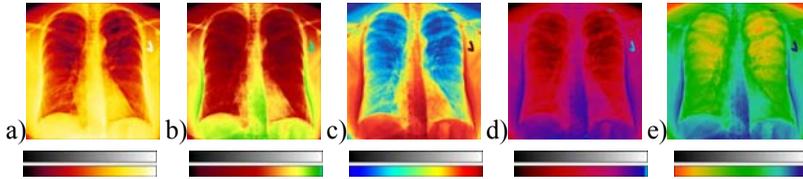


Fig. 3. Application of different color scales upon X-ray of lung: a) HOT; b) HSI in worm colors; c) JET; d) HSI in cold colors; e) RAINBOW.

In general the assessment of the existing scales in lung X-ray investigations shows that they cannot be applied directly and that a new way of presenting the information of lung X-ray images is to be looked about. The following peculiarities of the conducted experiments on the basis of the analysis of results have been determined:

- The direct application of a color scale that is used for other applications is not suitable because the lung visualization has its own specific features;
- Medically reliable X-rays cannot be achieved only by means of direct application of the gradient change of colors.

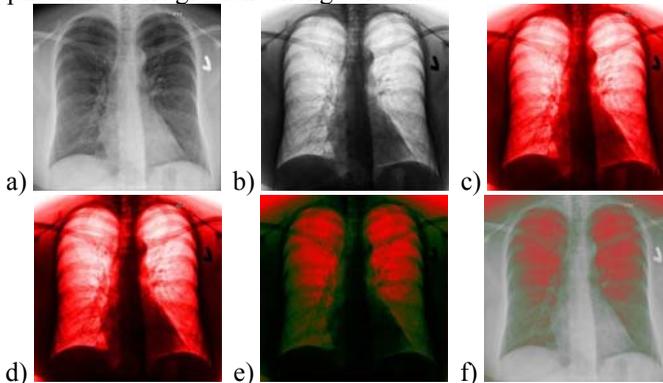


Fig. 4. Intermediate results of function application upon the X-ray image

The proposed method combines the visualization possibilities of two color scales - the greyscale used for visualization of X-rays and the color scale, which is used for visualization of lung tissues. The method consists of the following stages:

1. The image is transformed into a grayscale one;
2. The image is transformed into a negative one and its contrast is heightened by extending its histogram (fig. 4b);
3. The process filters are applied upon that negative image aiming the 'exfoliation' of the image in dependence of its X-ray density and integrating the chosen colors (fig. 4 c,d,e);

4. A function is applied aiming at restoration of the part of the image that is not of immediate interest - bones surrounding tissue (fig. 4 f);
5. Correction of brightness and contrast of the final image (fig. 2 b).

### Conclusion

The application of the suggested new method for X-ray pseudo-coloring aimed better visualization of local densities in lungs works when applied upon X-rays with normal quality. The processed images display clearly the normally functioning lungs as well as the heightened density zones within the lungs.

At the same time underexposed X-rays have excellent visualization quality after processing by the suggested method. To achieve the latter, during the last stage the brightness and contrast are corrected by maximum - extending the histogram and assigning the pixels a twice less value (after gamma-correction) in comparison with the standard one. (fig 6a).

When processing overexposed X-rays the lung vital volume is clearly visible while the intermediate level densities in the lung are not clearly displayed due to lack of information in the original image (fig. 6b).



Fig. 6. Processing underexposed X-ray images by the proposed method:  
a) underexposed X-ray image, b) an overexposed X-ray image

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# **Telemedicine as an Innovative Project-Study in Adherence Improvement after Living Kidney Transplantation**

## **(Design and First Results of a Prospective Ongoing Study at the Transplantation Center Freiburg, Germany)**

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### Introduction

The constant high number of patients on the German kidney waiting list and the permanent shortage of donor organs, forces some new solutions. One solution is to preserve the graft function as long as possible. For the possibly longest patient and graft survival, the successful operation is a key factor, but also to take care for the possibly best post-operative treatment. The Transplantation Center Freiburg has always been innovative and telemedicine has been an upcoming part of the German health care market. The benefit of telemedical support, e.g. for diseases like diabetes mellitus or heart failure, has been reported in many studies as in “Ref. [1, 2, 3]”. Concerning graft survival, deGeest et al provided evidence of a correlation between the rejection rate after kidney transplantation and missing adherence concerning the intake of immunosuppressive medication as in “Ref. [4]”. Butler et al confirmed in a meta-analysis a higher risk of rejection in non-adherent recipients as in “Ref. [5]”. An expert group with deGeest proved also: “The detrimental effect of non-adherence on short- and long-term transplant outcomes is substantial, with an estimated 15% to 60% of late acute rejections and 5% to 36% of graft losses associated with non-adherence” as in “Ref [6]”. Discovering all these facts, the responsible in Freiburg decided to initiate a project to evaluate the medical, psychosocial and economic wellbeing of living kidney recipients with a telemedical supported aftercare.

### Method

In July 2010, the project's evaluation was designed to draw comparisons. A repeated measure analysis of two groups with 25 patients each was planned over four time points. The limited sample size is determined by the yearly rate of living kidney-transplantations and a planned maximum length of data collection for 20 months. However, the focus in the design of this study is a high scientific quality. Therefore the evaluation has been carried out as prospective, randomized, controlled and open project-study. In September 2011, a random list for N=50 patients was computer-generated by the Institute of Medical Biometry and Medical Informatics Freiburg. Accordingly, two groups, each with 23 patients (2 dropouts/group), have been evaluated, one group with conventional aftercare as the control-group, the other as telemedicine group with conventional aftercare plus an additional telemedical support. Via an interactive web-based telemonitor, the telemedicine group enters at home daily data about their physical condition into a defined medical questionnaire. These data are checked daily by medical staff of the Transplantation Center Freiburg. In case of noticeable entries the medical staff contacts the patient by phone or video-conference to decide what should be done next. For the complete repeated measure analysis, both groups have been examined at four time points (0, 3, 6 and 12 months after transplantation) via medical reports and standardized Interviews/Questionnaires about the course of their medical condition, their adherence concerning the intake of immunosuppressive medication and about their psychosocial and economic factors. Table 1 shows that both groups have comparable characteristics.

Table 1: Overview of the patient's characteristics at time point 0 month after transplantation

CHARACTERISTICS	CONTROL-GROUP	TREATMENT-GROUP	p-value
Age in years: Median (Range)	51 (19-66)	46 (18-59)	*0.23
Sex, male	47,8%	60,9%	**0.55
Cumulative time on dialysis in months: Median (Range)	17 (0-134)	17 (0-134)	*0.85
ABO-incompatible Transplantation	26,1%	30,4%	**1.00
HLA-Mismatches $\leq$ 4	43,5%	47,8%	**1.00
First kidney transplantation	82,6%	82,6%	**0.83
Postoperative complications (SAE)	52,2%	47,8%	**1.00
Renal function after Transplantation / GFR in ml: Median (Range)	57,99 (13,60-82,92)	53,99 (38,48-81,95)	*0.98

\* Mann-Whitney-U-Test    \*\*Fischer-Exakt-Test

## Results

Table 2: Overview of statistical results at time point 0 month and time point 6 months after transplantation

OUTCOME MEASURES	p-value (time point 0 months after transplantation)	p-value (time point 6 months after transplantation)
Frequency of Unplanned Hospitalizations	Not applicable	*0,01
Duration of Unplanned Hospitalizations	Not applicable	*0,01
Composite Score of Adherence	*0,34	*0,03
Quality of Life: Cardiac & Renal Dysfunction	*0,38	*0,04
Employment Levels	**0,29	**0,05

\* Mann-Whitney-U-Test \*\* Fischer-Exakt-Test

Table 2 shows the complete and valid data sets at time point 6 months after transplantation reveal significant differences between the control-group and the telemedicine group. In the telemedicine group, at the onset of diseases, serious complications can usually be avoided because of an early diagnosis of acute renal failure and infections. This reduces significantly the frequency and duration of unplanned hospital-readmissions in the first 6 months after transplantation. The medical benefits for the recipients of telemedical support include also positive economic effects in the form of time- and cost-savings for the German health facilities and Insurance companies. Further, the telemedicine group scores significantly higher in adherence to immunosuppressant medication, which may suggest that they act more reliable while handling their daily duties in regard to their physical conditions. They report a higher quality of life and have managed their return to work earlier. Measured outcomes for timepoint 12 months after living kidney transplantation also confirm significantly positive effects of telemedical supported aftercare after living kidney transplantation.

## Conclusion

It is validated, that recipients' medical and psycho-social benefit is being substantially assisted with telemedical supported aftercare after living kidney transplantation. The results confirm that the telemedical supported patients experience longer periods of being healthy during the first year after the living kidney transplantation, which creates a win-win-situation. There are time- and cost- savings for German health facilities and Insurance companies without any restriction in the quality of supply. Due to the positive effects, in July 2013 a follow-up study has started to evaluate the transferability of the results to patients after kidney transplantation from deceased donors.

## Acknowledgment

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# **The Application of Telemedicine in the Follow-Up of Lung Transplantation in a Patient with Cystic Fibrosis**

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## **Introduction**

The Cystic Fibrosis Unit of Children's Hospital Bambino Gesù in Rome has more than 25 year experience in diagnosis and treatment of Cystic Fibrosis (CF) patients. It represents a support centre in central and southern Italy for critical cases and for Cystic Fibrosis Transmembrane Regulator (CFTR) related diseases.

The CF Unit actively collaborates with the Transplantation Division for the follow-up of patients with CF who undergo lung transplantation, performed in our Unit since 1991, and it is a reference centre for lung transplantation for pediatric and young adults patients in Italy.

In the CF Unit at Children's Hospital Bambino Gesù in Rome, THC was introduced in 2001 for the homecare of patients with the aim to early recognize the relapse phases of pulmonary infections.

In the past years, we used, for Telemonitoring, mostly instrumentation able to send information about respiratory parameters (Oxitel®, Spirotel®): spirometry with determination and recording of FVC, FEV1, FEV1%, PEF, FEF 25-75, FET, flow-volume and volume-time curves; pulse oximetry with registration of oxygen saturation (SaO<sub>2</sub>) and heart rate also in 24 hours recordings with regard to desaturation events.

Recently we started using a new equipment that, in addition to the parameters of respiratory function, it also provides information on other organs and systems, useful for monitoring other aspects of chronic multi organ, especially in special situations such as pregnancy and lung transplantation, or monitor other concomitant chronic diseases, such as hypertension.

## **Methods**

The CF diagnosis is performed in our FC Centre using the sweat test and the CFTR Gene Mutation Analysis according to current criteria [1].

Parents are in charge of monitoring, managing, and supporting a complex home-based treatment. A decrease of FEV1 >10% is considered a significant sign of infectious pulmonary relapse [2].

The treatment of CF is performed by a multidisciplinary team, having a specific experience in this disease. In our Unit, more than 200 patients are followed and, on the average, 15 new diagnoses are performed every year.

For the follow-up at a distance, we currently use an instrumentation called the Intel ® Health Guide. This is a complete telemedicine device of the latest generation. This is a monitoring solution that integrates a remote device for home care, the Intel ® Health Guide PHS6000 with the Intel ® Health Care Management Suite, an online interface that allows clinicians to monitor patients and manage their care at a distance. In a recent study we described and discussed the workflow we use in the daily practice, developed and improved over the years [3].

### Clinical Case

S.D., 19 years old, Female, Cystic Fibrosis (G542X/N1303K) and severe respiratory and pancreatic insufficiency. Chronic pulmonary colonization with *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Stenotrophomonas maltophilia*. Clinical course characterized by low average FEV1 (33% of expected) and frequent episodes of respiratory exacerbation with Oxygen-dependence with repeated cycles of intravenous antibiotic therapy practiced. 1 year ago evidence of atypical mycobacteria in sputum for which D. S. has carried out specific therapy. Chest Tc: important and widespread lung injury. During the first year of recordings, in the pre-transplant, we found a number of tests similar to the previous period, an increase of DH compared to hospitalizations. The reason for this change was the early recognition of exacerbations, which has prevented hospitalizations by i.v. antibiotic therapy. In May 2013 D. has undergone dual lung transplantation. We continued the follow-up with the remote monitoring.

D.S. has had during the post transplant 2 hospitalizations for pulmonary exacerbations, effectively highlighted by early changes. In the first one she had to do a course of intravenous antibiotic therapy. About 3 months after transplantation it is detected at home, by telemedicine, an acute reduction of FEV1 (-13%) in an apparent well-being state (Fig.1). In the phone contact following the transmission agitation and dyspnea were reported, thus giving indication for hospitalization. In Intensive Care Unit the patient is treated with oxygen therapy, non-invasive ventilation, sedation and antibiotics. Discharged after about 3 weeks with a diagnosis of acute respiratory failure, acute rejection, noncompliance to immunosuppressive therapy, lung

transplantation, D. S. has continued the follow-up at home by telemonitoring.

### Discussion

In the lung transplant the main adverse effects are infection and rejection, which often manifests itself in the form of bronchial obstructive pulmonary disease [4].

Spirometry, with the determination of FEV1, has long been considered a sensitive method for the systematic search of such complications [5].

It is now universally accepted the recommendation that the follow-up of lung transplant recipients should include the measurement of FEV1 at home by means of a portable spirometer [6].

In our case the telemonitoring has highlighted early at home a crisis of pulmonary relapse and rejection, allowing medical équipe to make a timely and appropriate therapeutic approach.

Some factors may influence the effectiveness of telemonitoring: first of all understanding by the patient and his collaboration in order to ensure optimal adherence to the recommendations of the treatment team and timeliness to intervene in the presence of significant alterations. Secondly, because the transplant team does not have direct access to the data as a rule, these are not readily available for a daily review [7].

In our case, some data appear significant.

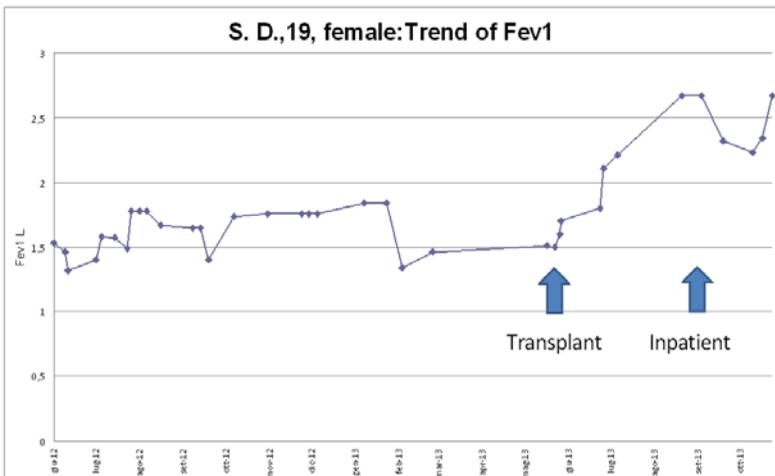


Fig.1: Trend of Fev1 before and after lung transplantation

During clinical episode of rejection, the precocity of recognition has avoided the permanent lung damage and therefore the total recovery of lung function until the current value corresponding to approximately 85% of the expected value, as in the pre-transplant period.

Clinical stability during the year preceding the transplant was facilitated by the use of telemedicine, which has also allowed greater sharing of clinical data by the entire treatment team, which is essential for the success of the transplant.

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# **eLearning**

# **An International Telemedicine Curriculum?**

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*Abstract:* Several member countries have asked the ISfTe H for assistance in providing education and training in telemedicine. Currently few medical schools or nursing colleges offer such education or training, other than in specialties like radiology and ophthalmology which have integrated aspects of telemedicine into routine practice. Telemedicine courses do exist in several countries - USA, Norway, Russia, South Africa, and these mostly are aimed at practicing healthcare professionals. Also, the IS fTeH has developed and run a structured 2 - 3 day awareness and training course for healthcare professionals.

Several disciplines have also developed clinical and operational guidelines for the practice of telemedicine - but these set standards for the provision of care and do not constitute education or training. Further accreditation, proposed by some, would be an obstacle and counterproductive to the uptake and use of telemedicine, especially in the developing world with its extreme shortage of doctors and nurses. So what is needed? Several issues must be considered. It is necessary to differentiate between: formal education in telemedicine leading to an academic qualification (MSc, PhD); training in the use of specific technologies, devices and services, with possible certification; and raising awareness of telemedicine. All are important, but have different objectives, outcomes, and audiences (health professionals, administrators, technicians, and the patient community). Without such capacity building there will be little consumer demand for telemedicine. What is being sought is a generic, hybrid, model of awareness, training and education that covers the needs of health professionals, administrators, and decision-makers. The generic programme must be flexible enough to be readily adapted to local and regional differences in clinical practice, regulation, telemedicine services, and infrastructural and human resource circumstances. Device or service specific training must be developed and offered locally.

The ISfTeH Education Workgroup is working towards developing this hybrid curriculum by adapting and refining existing offerings.

Introduction

The Education Working Group of the International Society for Telemedicine and eHealth (ISfTeH) was formed at Med-e-Tel in 2007 and was the first ISfTeH working group. The rationale behind its formation was several fold: there is great need for telemedicine, especially in the developing world; uptake of telemedicine in the developing world is low; lack of training in and awareness of telemedicine have been cited as the reasons for limited use of free humanitarian telemedicine services in the developing world; most developing world services and programmes were enthusiast driven; there is limited human capacity to maintain and grow these programmes; and there is little in the way of telemedicine capacity development programmes [1,2].

### *Vision*

The stated vision of the Education Working Group is “To develop a workforce with a basic practical knowledge of telemedicine and competence in the ethical use of telemedicine and tele-education.” The vision statement did not confine the activities to the developing World nor to formal academic education which leads to recognized qualifications but includes raising awareness of telemedicine and training in certain activities.

Its first task was to develop a basic telemedicine training programme for health workers and support staff that can be used anywhere in the world. A basic introductory course was designed based on sound pedagogical principles. It was modular in design and can be run over two days for those with prior computing experience and over three days for the computer novice. The modules have been used in some African countries [3]. There are several existing and long running telemedicine training and education programmes around the world including those in Norway, Russia, Australia, the USA and South Africa in addition to vendor and device specific training. This introductory course was not intended to compete or match these programmes but rather to raise initial awareness and provide limited skills.

### *Generic International Curriculum*

Over the past 2 years there have been a number of requests from member nations of the ISfTeH for a generic telemedicine curriculum as they feel that the basic introductory course does not meet their needs. This raises the following questions, why the need and what is needed? It is clear that people see the potential benefits of telemedicine and understand that to achieve these there needs to be an adequate and trained workforce that can conduct telemedicine consultations and that also understands the legal, ethical, management and organizational issues related to telemedicine. Until

telemedicine is an integral part of the practice of medicine, it is unlikely that aspects of it will be taught at medical schools and nursing colleges.

### *Issues*

What then are the issues that have to be addressed? There are different aspects to the request and various possible solutions as there are differences between raising awareness of telemedicine, training people to do certain things, and educating people. Is there need to find individual solutions to awareness, training and education? How will a solution take into account local needs, local infrastructure and local service requirements?

### *Awareness*

Who needs to be made aware of telemedicine? The intuitive answer is that it is the health professionals and trainees but it is also the policy makers and administrators who will need to budget for and support telemedicine services. The most important group is the end user, the patients, as they are the beneficiaries of telemedicine services. This is the group we should be focussing on because they can drive demand for telemedicine services when they perceive the benefit to themselves. But this is beyond the scope of the current remit. While there may be some commonality in what is required to raise awareness in these groups, there are different requirements depending on the infrastructure, services offered, maturity of telemedicine initiatives and government or institutional awareness and support.

### *Training*

The same holds for training. While there are generic skills in which people can be trained such as photography, email encryption, use of videoconferencing equipment, etc and generic issues such as legal and ethical issues there is also specific training that is required. This again is specific to local services offered, the devices used and local infrastructure. Training is also required for those providing support services, technicians, site co-ordinators and administrative staff. Again, they have different needs and requirements.

### *Education*

What of education? Who should receive formal academic education on telemedicine, when and why? The issue becomes, why are we educating people and what are we educating them for? In an ideal setting where telemedicine is an integral part of routine medical services there would be no need for telemedicine activity as it would be part of the routine undergraduate curriculum as students would see it in use in everyday

practice. While some countries may have integrated telemedicine in specific specialties such as radiology and ophthalmology, it is far from the norm. The analogy is the telephone: doctors and nurses may be taught about the legal and ethical issues related to the use of the phone but they are not educated or trained on how to operate a phone. Further education should be aimed at future managers and planners of telemedicine programmes and the question then becomes, is it necessary to offer Masters and PhD programmes [4]?

### *The Way Forward?*

What are the outcomes of the three options? Raising awareness does not lead to any qualification. In those environments where attendance at courses leads to promotion a certificate of attendance can be offered.

Training can lead to a certificate of competence. The thorny issue of training leading to accreditation and licensure then arises. Certainly people need to use technology safely, competently and responsibly but is this required for licensure and accreditation? To do so places yet another barrier in the way of the use and growth of telemedicine. Accreditation is not required to use other information and communication technologies such as telephones or fax machines in the provision of health services. In most countries education leads to a formal qualification such as a university degree, diploma or a certificate from a regulatory authority. Unless there are career paths for people completing such education, should we be offering it?

So what is the solution? Based on analysis of existing offerings and expressed need a hybrid model that incorporates awareness and training, and that is based on sound educational principles is required. Being hybrid it will also have to take into account both generic and specific local issues and factors. Such a hybrid model can also be a module in a degree programme. Whatever is developed should be in a modular format to facilitate presentation to working professional.

Ideally telemedicine awareness and training should be incorporated into undergraduate programmes or professional qualifications. We must remember that we must not forget the end user, the patients and awareness programmes need to be developed locally to address this.

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# Telehealth to Provide Support and Promote Continued Education for Primary Care Practitioners in Minas Gerais, Brazil

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**Abstract:** Our aim is to assess the teleconsultations performed by the Telehealth Network of Minas Gerais, Brazil, in order to demonstrate the importance of the telehealth to support the healthcare professionals who work in remote cities and promote continued education. All teleconsultations performed from April 2007 to December 2013 were assessed; those performed from January to March 2012 were analyzed based on the type of query. Throughout the study, 57,619 teleconsultations were performed. Family physicians/internal medicine physicians (33.0%), dermatologists (18.7%) and nurses (12.6%) answered most queries. From January to March 2012 (n=2027), 77.7% of teleconsultations were related to patient's assistance and 22.3% were general doubts. The most frequent queries were about etiology (33.3%), pharmacological treatment (24.8%) and non-pharmacological treatment (22.3%). Skin and subcutaneous tissue diseases (15.4%) followed by infectious and parasitic diseases (10.8%) comprehended most queries. In conclusion, this study shows the telehealth potential to provide support and promote continued education for the primary care practitioners in remote cities.

## Introduction

Brazil is a continental country that has cultural, economic, geographic and infrastructural contrasts, with concentration of healthcare professionals and resources in the largest cities [1]. Telehealth was implemented to reduce this inequality in healthcare by improving the access of small and remote cities to specialized care, reducing unnecessary referrals and professional isolation, and thus helping to keep healthcare professionals in those cities [2].

Minas Gerais is a Brazilian province with 853 cities and an area equivalent to France. In 2005, the state government sponsored the creation of the Telehealth Network of Minas Gerais (TNMG) to connect 6 university hospitals with municipal health departments of remote cities. Since 2007, the network has been performing teleconsultations (second opinion) for a broad range of medical and non-medical specialties [3]. Nowadays, it attends primary care practitioners of 660 cities.

The objective of this study is to assess the teleconsultations performed by the TNMG, Brazil, in order to demonstrate the importance of the telehealth to support these healthcare professionals and promote continued education.

### Methods

In this retrospective observational study, all teleconsultations performed between April 2007 and December 2013 were evaluated and classified according to the professional who requested and the specialist who answered them. The teleconsultations performed between January and March 2012 were analyzed based on the type of query and the ICD-10 chapter.

### Results

During the study period, 57,619 teleconsultations were performed. The healthcare professionals who requested the highest number of teleconsultations are shown in Table 1. Family physicians/internal medicine physicians (33.0%), dermatologists (18.7%), nurses (12.6%), obstetricians and gynecologists (10.3%), pediatricians (6.7%), dentists (3.5%) and physiotherapists (2.0%) answered most queries. Subspecialists (other than dermatologists) answered less than 10% of the queries.

Table 1. Healthcare professionals who requested teleconsultations between April 2007 and December 2013 (n=57,619)

<b>Specialty</b>	<b>Frequency - N (%)</b>
Nurses	30,180 (52.4)
Physicians	20,359 (35.3)
Dentists	1,917 (3.3)
Physiotherapists	986 (1.7)
Pharmacists	877 (1.5)
Nutritionists	555 (1.0)
Psychologists	445 (0.8)
Audiologists	267 (0.5)
Other	2,005 (3.5)

From January to March 2012 (n=2,027), 77.7% of doubts were related to patients' assistance and 22.3% were general doubts. The most frequent queries were about etiology (33.3%), pharmacologic treatment (24.8%) and non-pharmacologic treatment (22.3%). Table 2 shows the types of queries among physicians and nurses. According to the ICD-10 classification (Table 3), the areas in which the healthcare professionals had more doubts were: skin and subcutaneous tissue diseases (15.4%), infectious and parasitic diseases (10.8%), digestive (7.8%) and genitourinary (7.1%) diseases.

Table 2. Type of query according to professional who request the teleconsultation, from January to March 2012

<b>Type of query</b>	<b>Physicians (N=666) %*</b>	<b>Nurses (N=1264) %*</b>
Etiology	37.9	34.1
Pharmacological treatment	36.6	20.3
Propaedeutic	31.8	13.5
Non pharmacological treatment	18.3	21.3
Patient follow-up	12.4	14.7
Medical or nurse advice	10.8	17.2
Surgical treatment	6.5	5.7
Assistance to pregnancy	4.5	5.1
Prognosis	1.7	2.4
Vaccination	1.2	8.6
Cervical cytology	0.6	4.2
Growth and development	0.2	0.6
No specific doubt	4.0	5.0

\*The sum is higher than 100%, as each teleconsultation could contain more than one query.

## Discussion

This study, of a large scale telehealth service integrated to primary care of 660 cities in Brazil, highlighted the potential of telehealth to provide support for primary care practitioners and to promote continued education for these professionals who are isolated from education centers, by promoting clinical case discussions based on doubts from their practice. It is already known that knowledge is retained more frequently when it is obtained from solving concrete problems and challenges or when the acquired knowledge can be immediately used on daily practices [4]. Thus, it contributes to reduce the sensation of professional isolation and helps improving the quality of healthcare.

Table 3. Type of query according to ICD-10 classification among teleconsultations performed from January to March 2012 (n=2027)

ICD Category		N (%)
I.	Certain infectious and parasitic diseases	217 (10.8)
II.	Neoplasms	45 (2.2)
III.	Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	16 (0.8)
IV.	Endocrine, nutritional and metabolic diseases	101 (5.0)
V.	Mental and behavioral disorders	42 (2.1)
VI.	Diseases of the nervous system	24 (1.2)
VII.	Diseases of the eye and adnexa	14 (0.7)
VIII.	Diseases of the ear and mastoid process	8 (0.4)
IX.	Diseases of the circulatory system	106 (5.2)
X.	Diseases of the respiratory system	17 (0.8)
XI.	Diseases of the digestive system	152 (7.8)
XII.	Diseases of the skin and subcutaneous tissue	310 (15.4)
XIII.	Diseases of the musculoskeletal system and connective tissue	65 (3.2)
XIV.	Diseases of the genitourinary system	144 (7.1)
XV.	Pregnancy, childbirth and the puerperium	26 (1.3)
XVI.	Certain conditions originating in the perinatal period	16 (0.8)
XVII.	Congenital malformations, deformations and chromosomal abnormalities	12 (0.6)
XVIII.	Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified	309 (15.4)
XIX.	Injury, poisoning and certain other consequences of external causes	50 (2.5)
XX.	External causes of morbidity and mortality	42 (2.1)
XXI.	Factors influencing health status and contact with health services	295 (14.6)

The study revealed that professionals of basic areas (family physicians, nurses, obstetricians and gynecologists and pediatricians) answered most queries, and that most queries were about etiology, pharmacological treatment and non-pharmacological treatment, and the topics with higher demand were skin and subcutaneous tissue diseases, infectious and parasitic diseases, digestive and genitourinary diseases. This information is very useful to develop focused training strategies.

## Conclusion

The large number of teleconsultations shows that the service has already been incorporated into the healthcare system, offering assistance to healthcare professionals, mainly nurses and physicians, in remote municipalities. Also, this study shows the telehealth potential to provide support and promote continued education for the primary care practitioners in remote cities, in addition to improving the access of the population to specialized care.

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# **Telemedicine as a Support for the Discipline of Radiology from the Faculty of Medical Sciences**

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## **Purpose**

The Discipline of Radiology from the Faculty of Medical School is developing telemedicine activities for integration over the Internet with other national and international universities and centers of excellence, in order to provide qualification for the training of students at graduation. The objective of this paper is to present the positive results of the use of teleconferencing as a means of interactive communication among the groups.

## **Materials and Methods**

From March 2005 to June 2013, monthly teleconferences, video and web conferencing were collected, with the target audience of undergraduate medical students, general practitioners, pediatricians, and radiologists. All virtual meetings were recorded and are available for free reuse in the collaborative platform of UERJ Telehealth Center.

## **Results**

77 teleconferences, with an average of 435 participants were conducted: 29 clinicopathological telesessions, 45 distance classes and 3 themed webinars.

All Brazilian states have participated in reliance of the topic presented.

Other countries that have presented and/or participated: Canada, USA, Germany, Chile, Bolivia, Colombia, Argentina, Guatemala, Spain, Panama and Australia (Figure 1).

## **Conclusion**

The use of new technologies in medicine has led to continued integration between the undergraduate students who try on the experiences of other institutions.

**Keywords:** telemedicine, telehealth, e-education



Figure 1- Coverage map of the Discipline of Radiology, Medical School, Rio de Janeiro State University Brazil

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# Telemedicine Use as a Learning Resource for Monitoring and Discussing Surgeries: The Perception of Brazilian Medical Students

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## Introduction

Telemedicine is receiving more attention as it can facilitate access to health services, whilst at the same time greater discussion is required as to how Telemedicine solutions can be integrated in with traditional medicine.

Telemedicine solutions have been used for many years since the 1960s and from that time, there have been cycles of greater or lesser interest in the subject [3]. A possible application of Telemedicine is Telesurgery, which involves the real-time transmission of a surgical procedure to an audience that is physically located away from the operating theatre [1].

Telesurgery can be an important academic tool used in the classroom with the aim of complementing theoretical and practical educational activities. According to Dekastle [4], meeting the needs of students and giving them a beneficial experience is a challenge when that teaching involves the surgery theatre. For him, Telesurgery allows the students to observe the surgical procedure without causing scheduling, supervision, or patient care problems.

In this context, the aim of this paper was to analyse the perception of students from a Brazilian medical school in regards to the use of Telemedicine, specifically in relation to the transmission of surgical procedures from an operating theatre to the classroom as a learning resource tool.

The motivation for this study is to understand the possibilities regarding the use of Telemedicine as a teaching resource, including an evaluation of the positive and negative aspects. It is well known that health services are very specialised, usually expensive, and concentrated in certain regions of a country. As a result, it is difficult and costly to provide high quality face-to-face health services [2]. Similarly, providing high quality lectures for medical students is complicated and embodies a series of potential impacts, such as: a) the need for a surgical procedure to be underway and performed with

high quality (for the achievement of the educational goal of the lecture); b) the need for surgery to occur at the same time as the lecture; c) the consideration of possible negative impacts on the comfort, safety and privacy of the patient. Therefore, the use of Telemedicine as a complementary teaching resource becomes very important.

## Methods

The research was conducted using a structured questionnaire with open and closed responses. Students evaluated technical and educational aspects of the use of Telemedicine using a scale from 0 to 5 for the objective responses. The respondents were all students from the School of Medicine of the Pontifical Catholic University of Rio Grande do Sul (PUCRS), Porto Alegre, Brazil, enrolled in two disciplines (Approach to Medical Practice and Practice of Adult and Elderly Health from the 3rd and 7th semesters, respectively). The data collected represented the perception of these students regarding the applicability of Telemedicine as a complementary teaching resource.

Students received the questionnaire upon completion of the teletransmission of the surgical procedure. A total of 59 surgeries were carried out between 2009 and 2013 involving 37 different procedure types from 14 specialties. These were teletransmitted from the surgical block of the Hospital São Lucas/PUCRS to the classroom. Students completed 798 questionnaires, with 257 being from the Approach to Medical Practice unit and 440 from the Practice of Adult and Elderly Health unit.

Students participating in the data collection were all Brazilian, however, students and professors from other countries were invited on many occasions to remotely watch and discuss the surgeries.

The data was analysed with the use of descriptive statistics for the objective responses and the grouping of similar responses for the open questions.

## Results

The mean ( $\pm$ SD) for the technical aspects evaluated were 4.4 ( $\pm$  0.7) for the quality of image and 4.0 ( $\pm$  0.9) for the sound. In relation to educational data, the mean ( $\pm$  SD) was 4.8 ( $\pm$  0.5) for its relevance, 4.8 ( $\pm$  0.4) for its teaching method, and 4.7 ( $\pm$  0.5) for its content.

These findings show the importance given by the students to the use of Telemedicine as a teaching resource. In order to better understand these result, a series of statistical analyses were performed with the intention of identifying the relationship between the variables studied. Table 1 features the technical and educational aspects in relation to the level of medical education of the students, considering the 3<sup>rd</sup> and 7<sup>th</sup> semesters of the

course. It is possible to see from this table the mean for each topic evaluated by the questionnaire, respecting the scale from 1 to 5.

Table 1. Evaluation of technical and educational aspects of the use of telemedicine as a didactic tool, considering the level of medical education of the students

Mean for the aspects evaluated  Discipline (semester - respondents)	Technical		Educational		
	Image quality	Sound quality	Relevance	Teaching	Content
Approach to Medical Practice (3 <sup>o</sup> - 357)	4.43*	3.92	4.61	4.53	4.49
Practice of Adult and Elderly Health (7 <sup>o</sup> - 440)	4.41*	4.05	4.80**	4.82**	4.74**
<b>Total (797)</b>	4.42	3.99	4.71	4.69	4.63

*Significant difference ( $p \leq 0.05$ ) between technical aspects (\*) and educational ones when the two groups of students were compared (\*\*).*

These findings corroborate the idea that a better evaluation was given by students from the course in the 7th semester in relation to the educational aspects of the surgery teletransmissions. The current stage of the research still does not allow the identification of other possible variables that can be affecting these findings, other than these students being 4 semesters ahead in their medical education. In terms of the evaluation of technical aspects (image and sound quality), no significant difference was found between the two groups of students, although for both groups the image quality received a better evaluation than that of the sound. It is reasonable to consider that a student from a more advanced semester of the course can provide a better understanding of the surgery being transmitted. This aspect can be impacting on the results of the study since it is expected that these students would be more prepared than those from an earlier stage of the course. This may indicate that students towards the end of their medical school education could be better candidates for the use of Telemedicine as a teaching resource.

In terms of the qualitative opinion regarding the Telemedicine experience, analysis of the open questions (total of 764) allows them to be grouped into six categories:

- a) A better visualisation of the procedure in comparison to actual participation in the operating theatre, since viewing is more limited in the theatre;
- b) A better understanding of the surgical plan, the anatomical structures involved and the clinical history and prognosis of the patient, with detail provided by a professor situated in the classroom alongside the students;
- c) The possibility of exchanging experiences with students and professors from different countries, providing even greater understanding of the surgical procedure and the patient clinical case;
- d) Increasing the possibility of seeing a larger variety of surgical procedures;
- e) Better conditions for the surgeons performing the operation and for the patient due to there being fewer people in the surgery theatre;
- f) A better understanding of the possibilities of the use of Telemedicine.

An expected response was not expressed by the students, which relates to the potential reduction in risk to the surgery itself due to not having students in the theatre, thus reducing disturbances that could affect the concentration of the surgeon during the procedure.

### Conclusion

This study clearly shows the importance given by students to the use of Telesurgery as a teaching resource. It contributes to a better understanding of Telemedicine as a complementary teaching tool, something that is still of little used in Brazil. Telemedicine can be used as a way to substitute with quality the participation of students in an operating theatre during surgical procedures, while at the same time enhancing the student experience and potentially reducing risks during the procedure.

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# **The Post-Course Dilemma: Teaching A Student How to “Fish” Versus Offering Him / Her “A Fish”**

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The aim of this presentation is to describe how the Institute of Tropical Medicine (ITM) in Antwerp has designed an electronic short course with the aim of training health care professionals dealing with HIV/AIDS patients in low resource settings in making evidence-based medical decisions.

Initially our distance-learning course was designed to provide the latest information on how to treat HIV patients. However, in the medical field information (and evidence) changes rapidly, due to the most recent research results, and evidence in medicine might become obsolete after a short time. As a solution, many training centers opted to organize continuous post-course programs updates. It is questionable whether this is the optimal strategy to enable students in accessing new information or if a different approach is needed to promote sustainable lifelong learning.

From our experience, we believe students should be appropriately trained in order to be able to select, discriminate and analyze the vast amount of information available in literature and make medical decisions evidence-based.

With this goal in mind, we revised our distance learning course and introduced the following adaptations:

- Different eLearning activities, emphasizing the 21<sup>st</sup> century skills (such as promoting critical thinking, collaborative problem solving and identifying useful and reliable information using Information Communication Technologies) were introduced. All these generic skills are essential to improve a core competency in the medical field, such as clinical decision-making.
- A specific training for tutors/facilitators was designed and implemented with the aim of improving the quality of the online tutoring. This has ensured that students are well directed and guided during the overall length of the course.
- Standardization of the assessments and increased transparency in evaluating the students has been granted with the introduction of rubrics.

Teaching students how to catch fish by training them on evidence-based medicine and clinical decision making might be more effective and sustainable than passively pass through post-course digested notions.

**Keywords:** Lifelong learning; medical education; eLearning; critical thinking; empower; evidence based medicine; capacity building.

# Training of Health Professionals Using Telemedicine Technologies

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Currently, the Department of Health "Russian Railways", together with the Department of telemedicine Moscow State Medical and Dental University named after A.I. Evdokimov actively implemented training of health workers on the basis of telemedicine technologies.

The purpose is to transfer of practical experience, and improve the quality of education of health workers as well as improving their theoretical knowledge and the formation of a conscious approach to treatment; improving quality of care; providing training at the workplace without departure. Least but not last - the economic feasibility of training is also a goal.

We conducted a series of lectures based on videoconferencing. The thematic schools were organized by chief specialists of the Department of Health "Russian Railways".

The cycles consist not only of lectures and analysis of specific clinical events. As a part of the certification process, conducted by the Department of Cardiology, Family Medicine First Moscow State Medical University named after I. M. Sechenov, cadets were trained without departing from the regions, at work and got standard form documents/ certificates.

As a result, students were trained and completed knowledge, the ability to get answers to their questions and put them into practice, which in turn is an indicator of the effectiveness of training.

Analyzing the results of these cycles, we have concluded that the traditional "face to face" lectures and modern videoconferencing courses have certain differences. However, despite the limitations due to the lack of nonverbal communication components, unusual forms of communication, emotional distress contacts and some other features, videoconferencing courses do make learning more complicated.

In conclusion we would like to underline that the use of telemedicine technologies in training of health workers have several advantages over full-time education, which can greatly reduce the cost of institutions in training the staff, reduce time away from work, etc. As a result of video training employees can gain the knowledge and skills which can radically change the way they work in a better way.

# Capacity Building through Education, Research and Collaboration: AFRICA BUILD, an eHealth Case Study



# Capacity Building through Education, Research and Collaboration: AFRICA BUILD, an eHealth Case-Study

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## Introduction

AFRICA BUILD (AB) is a Coordination Action project under the 7th European Framework Programme (the list of partners is available in the footnote).

Partners in the project are:

1. Universidad Politecnica de Madrid;
2. Ministry of Communications and Information Technology (CIT), Egypt;
3. Faculté de Médecine de Pharmacie et d'Odontologie (FMPOS) de Bamako, Mali;

4. University of Geneva; 5. Institute of Tropical Medicine (ITM), Antwerp (Belgium);
5. 6. World Health Organization, Department of Reproductive Health and Research;
6. 7. Faculty of Medicine and Biomedical Sciences (FMSB) University of Yaoundé;
7. 8. University of Ghana, School of Public Health

It aims to improve the capacities for health research and education in Africa through Information and Communication Technologies (ICT). Since



Figure 1. AFRICA BUILD, project aim

its launch in 2012, the AB project has promoted health research, education and evidence-based practice in selected countries in Africa by attempting to create centers of excellence through the use of ICT, “know-how”, eLearning and knowledge sharing and through Web-enabled virtual communities [Fig. 1].

One essential step in the project has been to develop an innovative Web portal that enables capacity building through eLearning and allows African health researchers to get in touch with peers and share knowledge and their work [1]. Building such virtual communities requires a user-friendly and customizable interface in 4 languages and allowing the integration of

numerous applications. As educational activities and knowledge-sharing applications were developed for this interface, the portal was adapted to the educational and other needs of the users visiting the portal to access educational resources or the knowledge-sharing applications.

At Med-e-Tel 2014 we propose a skills-building workshop to showcase what we have learned in the process of developing the portal. We believe our experience will of interest for IT developers, educational workers, health-care researchers and other health - care professionals with an interest in eLearning as part of continued medical education. Topics covered in the workshop are outlined below:

1. The AB project and objectives of the AFRICA BUILD portal (ABP);
2. Case-studies of ABP development and discussion
  - Technical aspects and architecture of ABP;
  - Scientific news widget on the ABP: development of a search tool for scientific information;
  - DUDAL webcasting: the past, the present and the future of the webcasting tool and the technical issues overcome when integrating it in the ABP;
3. Closing session: the lessons learnt from the use of the ABP and its eLearning courses and the next steps ahead

*1. The AB project and the purpose of developing the AFRICA BUILD portal (ABP)*

Over the past decade, the EU has supported many initiatives that involve IT and health. However, none of the projects to date have involved significant transfer of expertise in research in health informatics, use of IT in health and the IT tools that have been used to countries in Africa. The AB project aimed to analyse the state of the art in health research and education in Africa and implement an IT-enabled, open and collaborative infrastructure for education, training and knowledge-sharing for health researchers in English-, French- and Arabic-speaking African countries, developing virtual communities of practice. The web-based hub created for this exchange was the Africa Build Portal (ABP).

A large number of e-learning courses validated learning resources and methodologies are currently being offered through the ABP. These learning resources aim to improve the education capacities of selected centres of excellence in the field of health research in Africa. Through researchers' mobility and participation in local and international meetings, the knowledge-sharing was taken even further than would have been possible through web-based exchanges alone.

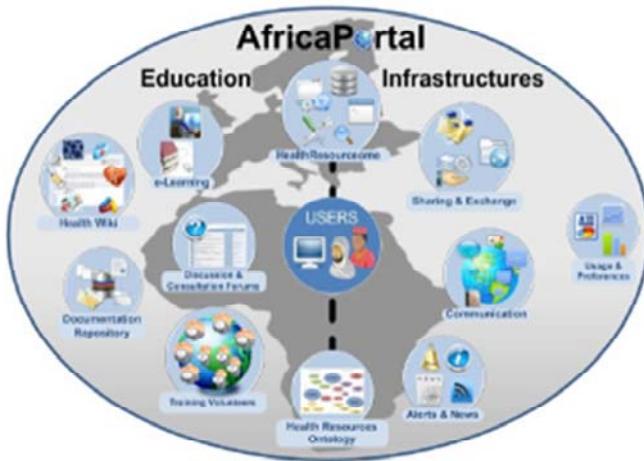


Figure 2. A representation of the AFRICA BUILD Portal

## 2. Case-studies of the ABP development and discussion

Built on the Social and Semantic Web platform (Web 2.0 and Web 3.0, respectively), ABP supports networking and allows access to a wide variety of open-source informatics tools for health. It also allows the creation of new virtual communities of health researchers, biomedical informatics developers and users, facilitating the exchanges of methods, tools, knowledge and expertise with international subject matter experts.

With the final aim of embedding distance-learning and remote ICT expertise tools in ABP, several facilities were included in the portal, such as:

- a) A social kernel, powered by Elgg. This is a social networking engine, delivering the building blocks that enable businesses, schools, universities and associations to create their own fully-featured social networks. This feature allows African researchers to connect with others researchers to share knowledge and collaborate.
- b) A method to plug-in Moodle instances to make their courses immediately accessible and reuse them in a social context.
- c) A research interface called the eLaboratory. This is a Widget-based environment that integrates different research resources

such as PubMed Central, BioMed Central, AJOL, WHO news, a Research Projects GIS and an African Educational catalog and Cochrane Reviews. [*Cochrane Reviews are systematic reviews of primary research in human health care and health policy and are internationally recognized as the highest standard in evidence-based health care. They investigate the effects of interventions for prevention, treatment and rehabilitation also the main source content for the WHO Reproductive Health Library (RHL)*].

- d) A “Scientific News” widget accessible from the eLaboratory, allowing users to find information and news on these various databases and websites. The search criteria are parameterizable: the source of information and keyword need to be selected and can be saved. Also searching the users’ profile information is possible.
- e) A “Projects widget” accessible from the eLaboratory, collecting a wide scope of projects in Africa related to Healthcare with a focus on eHealth. Projects are sought according to topics and/or countries, and the results are retrieved on a geographical map.
- f) A "Survey Widget" offering to build and disseminate surveys among the AFRICA BUILD portal community. The aim of this widget is to foster collaboration and research among the African researchers and communities of practice.
- g) A Mobility Brokerage Service designed to help African researchers to find training opportunities, jobs or mobility opportunities.
- h) DUDAL— a video webcasting tool for lectures or tutorials. This tool makes it easy to record and embed courses in ABP. It also facilitates streaming or downloading of webcasts. This user-friendly software has already been tested in Africa by the RAFT telemedicine network to work in “infrastructure-deficient environments”, in particular when faced with low-bandwidth and unstable Internet connectivity [2].

In addition to the above tools or facilities, the “Social” Web 2.0 and the “intelligent” or “semantic” Web 3.0 facilities have granted the possibility for collaborative work within the project consortium. AFRICA BUILD has created networks and virtual communities in health research and biomedical informatics, where professionals can exchange wide-ranging materials and knowledge [3-4].

3. *Closing session: lessons learnt from the use of the ABP and its Learning courses and the next steps ahead. The experience at the University of Ghana, School of Public Health*

The experience gained in developing the ABP, and using it to train African colleagues in bio-informatics and health research, will be used to improve know-how, research and technological capacities at selected African institutions or so-called “centres of excellence”.

The next steps will be to sustain the resources and knowledge resulting from building the ABP and the bio-informatics and health research courses and transfer them to other bio-informatics and health research initiatives. Health educators and researchers will continue to develop courses and content relevant to the African health and research landscape to ensure sustainability of the portal. The knowledge is there, on the ABP and at the partners, now there is a need to apply it further in health research.

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**eMedic:  
Telemedicine Initiatives in Baltic Sea Region**



*Developing New Practices for Teleconsultation and Diabetes*

# **Integration of Home-monitoring Data and PHR, EMR**

Peeter Ross

Tallinn University of Technology, Estonia

While much attention has been paid to the implementation of electronic patient records (EPR), electronic medical records (EMR) and integration of them into one region- or nation-wide health information exchange (HIE) platforms, less has been discussed about the integration of personal health records (PHR) consisting of health data with EPR, EMR or HIE.

This presentation discusses implementation of new medical data exchange standards to integrate personal health data collected by using home monitoring devices or entered manually by the citizen with PHR and HIE. As an example of the personal health data exchange platform Estonian nation-wide health information system (EHIS) is used. EHIS is a secure internet based data exchange platform provided by the state and functional since the end of 2008. It aims to connect different health related databases in Estonia and providing on-line access to medical professionals and patients if they are entitled to do so.

# **PrimCareIT - Counteracting Brain Drain and Professional Isolation of Health Professionals in Remote Primary Health Care through Tele-Consultation and Tele-Mentoring**

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The overall aim of PrimCareIT project is to raise the attractiveness of remote primary health care for medical professionals by the means of tele-consultation and tele-mentoring, and thereby to counteract brain drain and professional isolation of health care professionals.

PrimCareIT Project Objectives Are:

- To assess the needs, opportunities and barriers of tele-consultation and tele-mentoring;
- To motivate health care professionals to work in rural areas;
- To promote equal access to health services;
- To eliminate barriers of distance and thereby to counteract professional isolation;
- To offer experience and support through tele-mentoring;
- To foster sustainability of telemedicine;
- To raise eHealth awareness among policy makers.

## **Background**

At the background of the project is the problem of ageing population in Europe, which causes new challenges for our society. Demand for primary health care services is rising. With the retirement of older professionals and unwillingness amongst younger professionals to relocate to remote areas, there is a shortage of physicians, especially in rural areas.

PrimCareIT meets these challenges through promoting and developing technical support among health care workers in rural areas. Tele-mentoring supports continuing medical education and tele-consultation provides technical support for communication and networking between professionals.

## **Conclusions**

During the PrimCareIT project we found out that differences and challenges between Baltic Sea Region countries are largely similar. Some

countries have started using eHealth solutions earlier and therefore use eHealth more than others. However challenges between countries are similar. In order to develop eHealth solutions it is necessary to develop also work processes and to change health care professionals' attitudes.

One observation from the project pilots was that using tele-consultation and tele-mentoring together with changes in work processes can reduce professional isolation and brain drain in remote primary Health Care.

Key words: eHealth, tele-consultation, tele-mentoring, professional isolation, brain drain

# **eMedic: Remote Control of Diabetes in Patients on Insulin Treatment: eMedic Pilot Results from Latvia**

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## **Objectives**

Care and treatment of patients with diabetes mellitus is a growing burden for economy. Quality of care in treatment of diabetes is of crucial importance. However, long waiting time for endocrinologist or diabetologist visit interferes with efficient diabetes care process. “eMedic – Developing New Practices for Teleconsultation and Diabetes” (eMedic) is a project funded by the Central Baltic INTERREG IV A programme 2007-2013. The objective of the project is to develop new practices for virtual consultation in medicine.

The aim of eMedic pilot study in Latvia is to implement methods of remote diabetes monitoring into diabetes treatment and to compare it with conventional diabetes care strategies.

## **Methodology**

The pilot study with 53 patients had been carried out from January 2013 till December 2013. 29 patients were enrolled into diabetes remote monitoring group, 24 patients – into conventional care group.

In the conventional care group, patients had onsite visits with an endocrinologist and diabetes nurse every 3 months. In the diabetes remote monitoring group, patients were supplied with special glycometers and mobile phones, which enable data transfer about glycaemia to a web portal PHRBOX. Treatment plans had been constructed by doctors in PHRBOX portal. Further, during virtual visit, patient’s data were analyzed by doctors in the PHRBOX portal and if necessary, treatment plans are corrected. PHRBOX portal was used also for communication with a patient. Onsite visits were planned at 6 and 12 months after beginning of the study.

## Results

Several sets of data are being collected and evaluated: data about patients' compliance, clinical data about diabetes compensation, frequency of hypoglycemia, number of unplanned visits to the doctor, sick leaves and hospitalizations because of diabetes, life quality assessment. In order to evaluate the technology, patient and medical personnel were asked to fill in special questionnaires (system usability score, modified Kaplan 4C). Recommendations about improvement and implementation of the tested solutions into everyday care of diabetic patients will be elaborated.

## Conclusions

The preliminary results show that applied techniques can be used in order to improve quality of care for diabetic patients with the help of the virtual visits. However, implementation of e-medicine solutions in Latvia requires specific education for medical personnel and patients.

# Sustainability Planning in eHealth Projects

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## Introduction

Health care systems around the world work under pressure to become more effective and more patient-centred. The use of electronic health services, referred in this document as electronic health (eHealth), has offered great possibilities to overcome these challenges. The term *eHealth* refers to all kinds of information and communication technologies used for supporting health care and promoting a sense of well-being. Currently, numerous eHealth pilots worldwide struggle and many fail to survive beyond the pilot phase. Despite the large number of eHealth projects today and the positive outcomes of evaluation studies, the actual take-up of eHealth services is lower than expected [1].

Many projects fail to survive beyond the pilot phase and studies that investigate the effectiveness of eHealth applications most often do not show any long-term effects. In general, three types of difficulties with the uptake of eHealth have emerged:

- *Slow diffusion*: eHealth technology is not available to, or desired by, everyone (potential users do not have the resources (access), or the need, to use the technology)
- *Low acceptance*: eHealth technology is not satisfying (early adopters do not have their needs satisfied)
- *Low adherence*, also referred to as non-usage attrition: eHealth technology is not used persistently (e.g., online therapy is not finished) [2].

Current frameworks for eHealth development suffer from a lack of fitting infrastructures, the inability to find funding, complications with scalability, and uncertainties regarding effectiveness and sustainability [3]. Therefore, in the case of any eHealth pilots, holistic sustainability planning and implementation should be conducted. This article presents a process for how to build a sustainability plan and discusses how sustainability planning should be included in eHealth pilots from the very beginning of project design.

## What is Sustainability Planning?

In the context of eHealth projects, the word *sustainability* can be defined as *a system which has passed the pilot phase and is now fully operating* [4]. Moreover, in this document the important difference between pilot phase eHealth and sustainable eHealth lies in the financing: a sustainable eHealth service will no longer be financed by external funds (e.g. project funding). However, being financially sustainable is not the only important issue for a project. Besides, a project should attain institutional sustainability, political sustainability and technological sustainability [5]. Sustainability does not necessarily mean that the project is a success since a project can be sustainable without attaining its major goals. However, if a project is not sustainable, it is likely to be a failure [6].

The literature suggests a strong stakeholder analysis and participation with a solid business model are key factors to sustainability planning [3]. This assumption is supported also by eHealth Initiative where a good, comprehensive tool kit to build a sustainability plan in the eHealth context was found. This toolkit consists of integrated steps to build a sustainability plan: Stakeholder analysis, Research and Analysis, Business Model, Risk Migration, Stakeholder Testing and Modifications and Adoption and Implementation. Another approach suggests the elements of a sustainability analysis to be:

- Relevancy
- Acceptability
- Economic and Financial Viability
- Environmental Sustainability
- Implementation and Monitoring Strategy
- Post-implementation operations and maintenance

This approach gives emphasis also to the post-implementation period. [7]

### Sustainability Planning as a Part of Project Design in eHealth Pilots in the EU

Sustainability planning has been under discussion for decades at the project, organisation, consortium, theme and geography levels. The European Union has tried to steer sustainability planning through its seven-year programme and project funding periods, regulations that emphasise long-term planning and implementation and by launching, for example, the Networks of Excellence (NoE) already in 2002. Sustainability effects have been effectively addressed in Project Cycle Management (PCM) Guidelines. The factors promoting sustainability are threaded throughout the attributes of Relevance, Feasibility and Effective & Well-managed [8].

Sustainability planning should be a solid part of the whole project cycle. Project Cycle Management in the EU draws attention to feeding the information from the evaluation phase back to the programming phase. In general, project results should have a stronger steering effect on regional, national and international decision making. The lack of sustainability has been seen as a serious problem, especially in projects in developing countries. Recommendations on how sustainability could be improved are many. Most of the literature on this matter emphasises the importance of taking sustainability into focus as early as possible. Factors affecting sustainability should be articulated and incorporated already in the project design stage. Later, these factors should be followed up through monitoring [7].

Based on the experiences of the eMedic project, the following aspects in particular are recommended for consideration in each project design phase:

- Sustainability planning is teamwork and work division should support it;
- A preliminary but precise stakeholder analysis should be performed already when planning eHealth pilots;
- Financial sustainability planning of eHealth pilots takes time in international network projects and critical paths can be avoided only by making project timetables anticipatory enough;
- Indicators and information which are the basis for proceeding with a pilot or a part of it to implementation have to be defined and described clearly in an early phase;
- The sustainability process needs to be monitored and evaluated throughout the pilot phase.

## Discussion

The reasons for making pilot phase eHealth a sustainable and long-term solution should be clearly discussed and indicators defined. A sustainability plan is always a hypothesis and contextual. Social, economic and political changes affect the issue of sustainability and the research results might change the path of the sustainability plan. A project worth sustaining in the project design phase may not be worth sustaining by the end of the project [7].

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# Teleconsultation Practices and Foot Ulcer Care in HDSWF

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The target of the eMedic project is to develop new practices for virtual consultation in medicine. Turku University Hospital (plastic surgery, internal medicine) participates in the eMedic project by assessing the feasibility of remote management of diabetic foot ulcer patients through communication within primary health care and between specialised and primary care facilities.

The objective of the pilot study for teleconsultations for diabetic foot ulcer patients is to decrease patient visits, to enable a faster referral process and to improve the quality of care. Increasing the knowledge of correct diabetes foot ulcer treatment at primary care units is also of interest.

Teleconsultation pilots were carried out between February and November 2013. A set-up consisting of a mobile camera connected to a telecommunication system was used to transfer clinical images and online communication between the nurse making house calls and the diabetes care general practitioner or specialised outpatient clinics.

The general practitioner could also contact a consulting plastic surgeon or endocrinologist and the treatment could be decided during teleconsultation.

Diabetic foot ulcer treatment pathways were evaluated in the piloting organisations. Education in technology, wound care and diabetes care were given prior to the pilot period. Wound care practices were synchronised in the participating municipalities

Compared to the time prior to the project in terms of medical and economic aspects, teleconsultations may reduce, in a clinically equivalent way, the number of visits to a specialised clinic, decrease wound healing time, while still maintaining high standards of wound care. Synchronised protocols with defined intervention points are required.

Key words: eMedic, telekonsultation, wound care

# **What Patients Expect from Mobile Device?**

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The limitless penetration of mobile technology in everyday life has great potential to widen the spectrum of tools used for home monitoring of patients' health condition. However, the change of patients' habits to register their home monitoring data in mobile device instead of paper diaries seems to be quite a challenge.

The paramount condition of health data collection for the citizen is simplicity. Measuring of the blood glucose, blood pressure or pulse rate and writing the results on the paper diary is the golden standard for the patients with diabetes already for decades. It is a simple process and easily achievable. Planning, implementation and operation of mobile devices for home monitoring should follow the same principles – patients with chronic conditions assume that modern technology will not interfering their daily routines but would make data acquiring and communication with healthcare professionals simpler.

This presentation gives an overview of patients' expectations and opinions of using mobile devices for medical data collection based on the one year experience of home monitoring pilot (eMedic) of diabetic patients. The data are collected using questionnaire based on Kaplan 4C framework and SUS (System Usability Scale).

# **Telecardiology**

# **A Fast, Android Based Dietary Logging Application to Support the Life Style Change of Cardio-Metabolic Patients**

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## Introduction

The increased burden of chronic diseases in the health care of modern societies is well known. It is clear that old methods to cover the health supply demand of the society are insufficient, so services utilising modern info-communication technologies are taking over a part of classic workflows of the chronic disease management [1, 2]. The majority of these chronic diseases root, however, in a life style deviation, so systems supporting only the remote measurement of physiological are insufficient, because they miss the very important intervention possibilities of life style modification. The correction of life style deviations is one of the most human effort intensive procedures in the health care. However, it can also be supported by modern info-communication technologies. The use of a dietary log application to support later dietary counselling is a typical function where apps of mobile devices can be very effective.

The basis of most computerized services available for dietary logging is a Food Composition Database (FCDB) containing the nutrient content for a wide range of common foods. Nutrients are the basic carbohydrates, proteins, minerals, vitamins etc. and foods are either ingredients of dishes (like white flour or olive oil) or they are consumed alone like apple or red wine. Some FCDB's, like the USDA SR FCDB are free for download [3]. In order to compute the nutrient content of the user's meals, the dietary database must also contain a highly culture-specific set of recipes as well. There are several web-based or mobile applications that provide an interface for the logging of the user's meal and various services related to the analysis of the log like daily/weekly overview charts, support for losing or gaining weight etc. The Calorie Counter android application boasts with the biggest recipe database of more than half a million [4], a large part of which was contributed by the users. Similar applications, with a smaller database, are the My Diet Diary and Tracker 2 Go [5, 6]. Our research group at the University of Pannonia, Hungary, earlier developed an android based

dietary logging application called “Lavinia”. In a previous study we have already tested the ability of this system to cover the diet of an inpatient cardiac rehabilitation facility working with five parallel arrays of menu for a three week rehabilitation treatment [7].

### Objective

The purpose of the current study is to test the time demand that the users need for dietary logging with the “Lavinia lifestyle mirror” application.

### Short Depiction of the Lavinia Logging Application

The Lavinia dietary logging application was developed at the Medical Informatics R&D Centre at the University of Pannonia, Veszprem, Hungary, to support dietary logging on mobile interfaces, dietary log analysis, and also personalized menu generation using a dietary database specialized for the Hungarian culture. Its data base currently stores 9500 food items along with their nutrient contents and 1373 dishes composed from the foods, but on the android user interface we show only the most important 299 dishes and 360 foods, organized in 195 sets, to simplify the search and thus preserve user motivation. The system supports a hierarchical set-based search (see Fig. 1) as well as the usual keyword based search. We also allow to log generalized dish sets (like ‘pasta’) when the user does not find an exact match. If such a set is logged, we use the averaged nutrient contents of the set members in the analysis.

### Methods

This study was performed using the dietary data of a medical institution, the Cardiac Rehabilitation Center of the Military Hospital, Balatonfüred, Hungary. In the current, preclinical phase only staff members were included to perform a final test before the planned clinical test of the system, in which typical patients treated in the institution will take part. The test period was 22 days long, for 5 different, manually compiled regular hospital menus, so in total we processed the meals for 110 days, with 3 meals per day, with Lavinia. The full list contained 1179 logged items with 156 different dishes and 38 foods (total 194). Some items occurred quite frequently, but there were also dishes specifically designed for a certain diet.

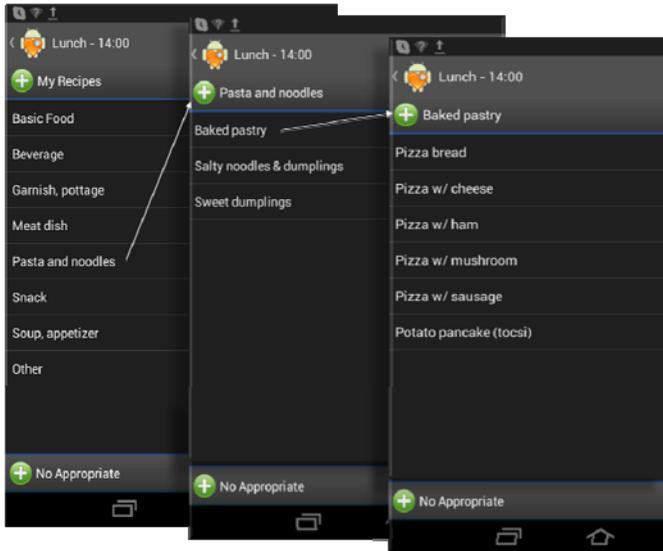


Figure 1. Screen shots of a “set-based” search procedure in the Lavinia mobile application

The time expenditure of the mobile phone based logging procedure was measured using these 1179 items. Five persons, familiar with mobile phone usage, but new to our set based dietary logging user interface received a short (3 to 5 minutes) introduction to the operations in the Lavinia system. Then they entered the list in the Lavinia system. The activity of the test subjects was logged and time stamped by the application from the start of any new item entry to the completion of the process. The switch from the set based search to the free text based search was allowed at any point for the subjects. We measured the average time spent for an item at the beginning and end of the process. The application start up time was not considered, assuming continuous stand by position for the investigated application in the background on the android system.

## Results

The five persons recorded the institutional menus in Lavinia for the investigated 22 days with an average of 12.0 items per day. The average net time consumption for entering a single item decreased considerably from 25.60 sec on the first day to 12.45 sec on the last, with a typical logarithmical learning curve ( $\text{time} = -4,06 * \ln(\text{days}) + 26,95$ ,  $R^2 = 0.60$ ). This decrease was dominated by the acceleration of the set based recording from

24.89 sec to 12.00 sec ( $\text{time} = -3,52 * \ln(\text{days}) + 22,71$ ,  $R^2 = 0.75$ ), while neither the frequency nor the time consumption of keyword based search was changed during this short period (13,4%, extra 22.15 sec.). The overall result is that the average total daily time consumption of dietary logging decreased from 6.80 min to 2.61 min ( $\text{time} = -0,86 * \ln(\text{days}) + 5,49$ ,  $R^2 = 0.65$ ).

### Conclusion

The set based dietary logging application is a viable system to generate a nutrition mirror for the users. The daily total time consumption of dietary logging is highly acceptable. Users possibly need longer practice to reduce the extra efforts connected with keyword based search

### Acknowledgment

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# **An Educational and Motivational Bridge between Hospital and Home for Infarction Patients**

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## Introduction

Cardiovascular diseases are one of the main causes of death worldwide, including Slovenia. The incidence and progression of these diseases is highly dependent on lifestyle. Lifestyle change is therefore a central aim in prevention and rehabilitation [1].

Patients that have had an infarction have an increased risk of cardiovascular problems. They are a risk group for which adopting a healthy lifestyle is crucial. In Slovenia, the optimal time when the patient has the greatest motivation for change has not been adequately exploited.

For example, patients may have an infarction and remain in the hospital for several days. There they receive much information from the medical team about what this disease means for their lives. However, when they are released from the hospital they return home, where they find that they have forgotten most of the information received (up to 85%).

It is during this period (the first few weeks) that patients, their partners, and their families are most motivated to make lifestyle changes.

Recent reports support the hypothesis that the internet is developing into an important source of health-related information. The use of the internet for acquiring health-related information is constantly increasing [2]. The drawback concerning medical information on the internet is that it may be inaccurate, and especially that it is often not specific to the patient. Information acquired from the internet can therefore be deceptive and also harmful to those seeking medical information. There is a need for better design and delivery of health information literacy programs for e-patients [3].

In Slovenia, the use of the internet grew steadily from 2004 to 2011 (Figure 1).

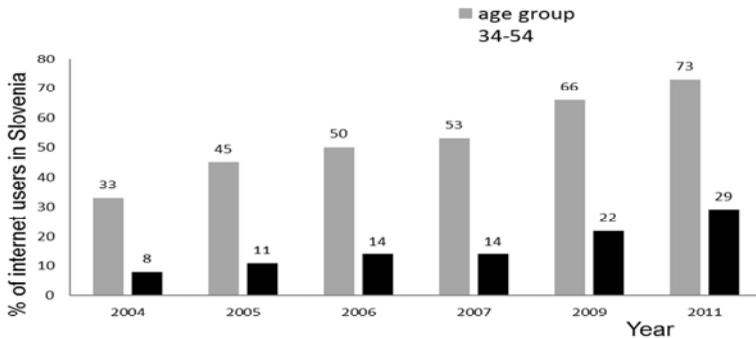


Figure 1. Internet use from 2004 to 2011 in Slovenia for two age groups: 35–54 years and 55–74 years.

We propose a solution in which an internet platform for educational and motivational support increases adherence to healthier lifestyles and raises awareness of the importance of organized cardiac rehabilitation programs. Patients are provided with an anonymous internet access code upon release from the hospital. The instructions match the diagnosis and are conveyed using best practice in internet education and motivation approaches.

#### Platform Application Benefits

Overall, it is expected that the platform will benefit a quarter of the members of the risk group. It has been shown previously [4] that proper education of patients reduces 30-day readmission to the hospital by 25%. Additional potential benefits are long-term cost reductions, positive influences of knowledge penetrating into patients' society, increased patient empowerment, and greater satisfaction with medical service.

The aims of the study are to determine the percentage of patients that are actively using the service and to ascertain their learning patterns, duration of interest in learning, users' relation to the patient, and their experience using the service.

#### Study Design

A team of experts carefully prepares the content of the internet service in advance. It is of paramount importance to carefully select the topics and the way the material is presented to the patient.

Upon leaving the hospital, patients receive an internet access code that enables them to access material on the internet from home. The code provides complete anonymity. At the same time, it allows us to measure the internet behavior characteristics of the code user.

At the core of the educational and motivational internet tool are short educational units. They were developed by Primarius© and include videos, texts, and quizzes in line with best practice examples of human interaction with the internet and multimedia.

It has been shown that patients highly value peer information. It is easier for patients to adopt other patients' lifestyle habits than to analytically understand why these habits are good for them. As social-cognitive learning theory has shown [5], a complex behavior can be learned by watching others.

The study will include 1,200 infarction patients per year. Over the 2-year duration of the study, 2,400 patients will have access to the service. We expect 50% of the patients to be younger than 69, which is our target group of 1,200 patients. The expected rate of voucher delivery is 50 per month during the 24 months of the study.

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# **Blood Pressure Telemonitoring Integration in a Public Hospital's High Blood Pressure Ambulatory Care Program**

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## **Introduction**

The high prevalence of hypertension in a population and the need to have good blood pressure control to reduce the complications related do high blood pressure imposes the need to implement adequate programs [1]. It's well known the need to improve the actual rate of blood pressure control [2]. As a clinically silent situation it has been proved that most of the patients need to be stimulated to take blood pressure measures and to take their medications, traditionally that is done with repeated face to face episodes with the patient and a health care professional. This kind of solution is very human resource consuming, has low efficiency and doesn't provide an organized solution in case of hypertension decompensation. The Centro Hospitalar Cova da Beira Hypertension control program in partnership with the University of Beira Interior and AIT - Austrian Institute of Technology developed a yearlong proof of concept project, the PADISTUBI, to try to demonstrate the use and feasibility of telemonitoring in the context of a public hospital's High Blood Pressure Ambulatory Care Program. At the end of the project the data was analyzed and demonstrated the feasibility and the interest in the use of telemonitoring to improve hypertension control in Centro Hospitalar Cova da Beira's High Blood Pressure Ambulatory Care Program in selected patients. Most of the patients that used the system felt comfortable and in connection with the team.

## **Material and Methods**

The PADISTUBI study was approved by the Hospital Ethical Committee and all patients consented to be enrolled.

Twenty patients were selected from the Centro Hospitalar Cova da Beira's High Blood Pressure Ambulatory Care Program to be included in the program that was intended to have year duration. During the program the doctors received the alarms activated by SMS and could access the web portal to see all the patient information. At the end of the study, graphics obtained were incorporated in the hospital electronic health record.

Concerning the IT infrastructure, the system was divided in two main parts: (1) an RDMS database, a web portal and a GSM gateway; and (2) the equipment sets distributed to the patients (smartphone, blood pressure monitor and digital scale).

(1) The **database** and **web portal** were developed and hosted at the Austrian Institute of Technology (AIT) at Graz (Austria). The translation of the web portal to Portuguese was made by the IT staff at the Health Science Faculty of the Universidade da Beira Interior (UBI) at Covilhã (Portugal) with the collaboration of specialized physicians from the hospital (CHCB). The web portal had two types of user access profiles: *physician* and *helpdesk*. These profiles had different roles and levels of access to the patients' data. The *physicians* were responsible for creating the patients records and prescribing/adjusting the drugs using the web portal. They also had access to statistics and charts of the blood pressure, heart rate and body weight of each one of the patient included in the study. The *helpdesk* staff was responsible for managing the patient's equipment set and for assigning it to the corresponding personal record in the database via web portal.

The **GSM gateway** was also at the AIT facilities during the study. The role of this part of the system was to receive the SMS containing the data with the readings from the smartphones at Portugal and insert it at the corresponding place in the database. All the communications were made using the general purpose GSM mobile network. The mobile operator at Portugal was Optimus Telecommunications who also kindly provided the SIM cards for the smartphones.

(2) The **patients' equipment sets** were composed by a NFC capable Samsung smartphone, an RFID card, a NFC capable A&D blood pressure monitor, and a NFC capable A&D digital scale.

The **smartphone** Java application used by the system was developed by the AIT and, as happened with the web portal, it was also translated to Portuguese by the IT staff at the UBI. To make the system more *user-friendly*, the application starts just by the proximity of the **RFID card** of the patient.

The patient measures his/her blood pressure as usual and transmits the readings data directly to the smartphone application just by approximating it to the **blood pressure monitor**. The transmission is made via Near Field

Communication (NFC) eliminating the probability of human error. The patient's body weight is also transmitted from the **digital scale** to the smartphone application via NFC.

The only human interaction of the patient is made to express his/her level of wellbeing and to inform if he/she took the prescribed medication.

Finally, to transmit the data to the GSM gateway via SMS and close the application the patient just needed to approximate his/her personal RFID card to the smartphone back.

## Results

Twenty two patients were included in the study. Patients were selected by the Centro Hospitalar Cova da Beira's High Blood Pressure Ambulatory Care Program physician after an explanation of the project. The IT technician was responsible for giving to the patient the equipment pack (blood pressure monitor, weight scale, smartphone, RFID card, instructions leaflets and contacts), and to give instructions on the use of the system. During the process, patients received alarms if there were missing measures. Physician received alarms if confirmed high or low pressures occurred.

Patients continued to be followed according to the health care plan independently of being participating in the project.

Patients used the system for a mean period of 4.5 months (8 patients for less than a month, 8 between 1 and 5 months, 3 between 6 and 11 months, 2

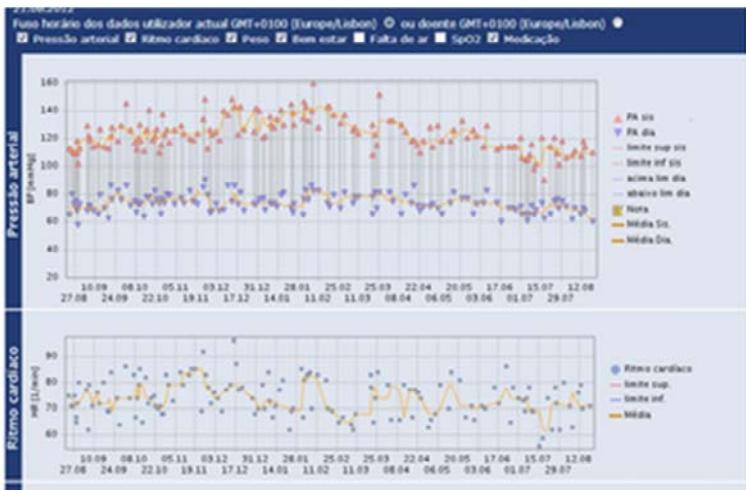


Figure 1 – Example of the telemonitoring record obtained using the PADISTUBI project

for a whole year and 1 for two years) 2991 sets of data were collected.

Drop outs occurred, mainly because of difficulty in using the smartphone interface.

In Figure 1 we can see an example of the graphic information generated in real time gathering data received from patient auto-telemonitoring.

In this study, data was incorporated manually into the hospital electronic health record. Actually we are developing a system to automatic incorporation.

### Conclusions

Long term blood pressure telemonitoring as part of a public hospital blood pressure control program is feasible and provides, in selected patients, a solution to be considered in the care planning. Both patients and physicians felt comfortable and safe.

### Acknowledgment

We would like to express our thanks to OPTIMUS for providing the SIM cards and supporting the database traffic for the study

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Robert Modre received his MSc in technical physics and his PhD in biomedical engineering at the Graz University of Technology. He is a lecturer in Computational Medicine and a scientist at AIT. He has comprehensive experiences in development, testing and validation of innovative mHealth and telemedicine solutions as well as eHealth closed-loop healthcare applications.

# **Comparison of Diagnosis Efficacy of Arrhythmias with Cardiac Telemetry versus Holter Monitoring- Telemarc Project® - Initial Results**

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## Introduction

Cardiac arrhythmias occur in all age groups, starting with the fetal period until old age, however the type and frequency of occurring arrhythmias are different among all age groups. Supraventricular tachycardia is the most frequently observed arrhythmia in children. In adult population it is atrial fibrillation. Its incidents increase with age, exceeding 7% in the population 70 and older. The efficacy of pharmacological treatment is low (<15-30%). Treatment with catheter ablation increases the efficacy to 70-80%, however the accessibility of such treatment in Poland is very low.

Given the above, early and reliable diagnosis of patients with dangerous arrhythmias is extremely important, regardless of the age group. Such early and accurate diagnosis is likely to result in selection of proper and most effective treatment.

New Technologies recently emerging on the market create the opportunity for long-term, remote monitoring of heart rhythm while offering automatic detection and classification of arrhythmia and facilitating tele-consultations. Non-invasive methods enabling long-term ECG monitoring in patients with paroxysmal symptoms, such as tachycardia or palpitations increases the probability of detecting and reporting infrequent but dangerous events with profound clinical significance.

The ability to transmit the entire ECG signal over GSM networks along with its remote consultations over the Internet increases patient access to specialized medical consultations. It can lead to shortening of time-to-diagnosis and result in most appropriate treatment – invasive as well as non-invasive.

Atrial fibrillation is very common but its paroxysmal character cause that large percentage of the episodes are symptomless. Conventional diagnosis process, most common in Poland and Europe is a – 24- hour Holter monitoring. Long term telemetry monitoring 14 days, using intelligent

automated technology might shorten the time to diagnosis and has a potential of higher diagnosis accuracy.

#### Aim of the Study

- The aim of the study was to compare the efficiency of diagnosis of arrhythmia detection in heart rhythm Holter monitoring vs. long term cardiac telemetry.
- Optimization of diagnostics and therapy of arrhythmias and syncope with innovative telemetric solutions.

#### Material and Methods

Patients referred to arrhythmia treatment center according to schedule were monitored for 14 days using the intelligent telemetric system prior to treatment. Following the analysis of the diagnostic session each patient was prescribed a treatment. Upon reaching a stable anti-arrhythmic drug dosage or upon patient stabilization following an invasive procedure the patients were subjected to a second telemetric monitoring session in order to assess the treatment efficacy.

Material consists of 648 randomized patients age 19-90 to the up to 3 Holter monitoring group vs. up to 14 days long term cardiac telemetry. The PocketECG® system was used in telemetric examinations in Telemarc Project®. The data were collected and interpreted by the device and transmitted to the Monitoring Center with annotations and assessed by specialist. System automatically recognizes and qualifies the heart beats.

#### Results

The results of the study revealed that in 14 days long term telemetry correct diagnosis of arrhythmia was established in 98.4% patients and in normal 3 times Holter monitoring only in 42.5% of patients. The 38,2% of diagnosis in long term telemetry was established in first 3 days and rest (60,2%) was established in next days of monitoring.

#### Conclusions

Presented study reveals that long term monitoring is much better in diagnosis making of arrhythmia than traditional Holter examination what means that faster diagnosis goes to faster therapy. Less visits equals better economic impact. At a conclusion long term cardiac telemetry is more efficient diagnostic tool to establish the diagnosis of palpitations than Holter monitoring.

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# Early and Non-Invasive Detection of Lower Limb Ischemic Disease in Rural Areas with Telemedicine

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## 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 symptoms or clinical evidence. Early stage diagnosis, obtained through non-invasive strategies has been proposed as a means of diagnosing incipient vascular occlusion. Since 2012, as a result of public private partnership between a regional hospital in Zdar nad Sazavou (22 000 inhabitants, central Czech Republic, one of the highest incidence of diabetes mellitus, diabetic foot and related lower limb amputations) and a private company Advanced Medical Solutions a preventive telemedical program was prepared, implemented and put into operation with the below defined objectives and results.

## Objectives

### *Generic objectives:*

1. To analyze the applicability of a noninvasive diagnostic strategy for the early detection of arterial flow reduction in a rural population;
2. To introduce an innovative telemedicine platform allowing data storage and transmission for specialized second opinion;
3. To introduce a long term sustainable preventive program;
4. To promote technical qualification of remote professionals of health sector in the field of new technologies.

### *Specific Objectives:*

Evaluate a population of more than 1000 adults from the region with specific focus on the following target groups and priorities:

- Elderly populations;
- Diabetes mellitus + other major metabolic risk factors;
- Family medicine.

This initiative will allow us to:

1. Introduce an innovative telemedicine platform allowing data collection, transmission and storage for subsequent analysis and report by specialists and, when needed, specialized second opinion;
2. Investigate the applicability of a systematic, well-structured and non-invasive screening to support the early identification of atherosclerosis, peripheral arterial flow reduction and diabetic foot;
3. Encourage and promote technical qualification of local health professionals supported remotely by specialists – angiologists, diabetologists and cardiologists - in the investigated areas enabling an effective screening using these new technologies.

The screening techniques used in this study will also be evaluated in terms of specificity and sensitivity to stratify the patients that need further evaluation leaving the others, with no sign of subclinical disease, outside the health system, reducing the waiting lists and demanding pressure for healthcare services in times of scarce resources.

## Methods

The applied methods and equipment are focused on Peripheral Artery Disease (PAD) screening using Computer aided occlusion Pletysmography to evaluate the onset of PAD avoiding premature amputation of toes and lower limbs. The device is designed for the screening and evaluation of the quality of perfusion on the periphery, based on lower limbs. The system allows a complete arterial and venous diagnostics based on proven protocols elaborated in accordance to applicable guidelines. The conception of the system allows an easy and automated procedure to be effected by a nurse or basically trained healthcare personnel without the presence of expert angiologist or doctor. The preventive program is based on the following procedure:

1. Measurement: Patients were measured by a nurse without the presence of doctor using the Computer aided plethysmography developed by Advanced Medical Solutions. The results of the measurement were sent together with the basic anamnesis to the Telemedical center for evaluation;

2. Evaluation: The evaluation of the data was effected by expert angiologists who provided also the indication for further procedure and divided the patients into the following groups:
  - a) Patients with physiological parameters without detected pathology;
  - b) Patients with border values or detected risk factors however without immediate risk;
  - c) Patients with pathological values or detected immediate risks requiring acute further procedure.

Currently the nurse is already able to recognize the pathological alterations and her informal evaluation is in tune with the expert evaluation made by angiologists.

- 1) Verification with golden standard method - ultrasound:

All patients with identified alterations and pathologies based on defined measurement were indicated for deeper evaluation based on ultrasound which as a golden standard allowed evaluating the sensitivity and specificity of the methodology.

In September 2012, the system was installed at the regional health center in Zdar nad Sazavou. After an initial pilot project and training a long term preventive was started on a sustainable basis. 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 preventive program was successfully implemented in Zdar nad Sazavou and is currently operated on a sustainable basis with the capacity of 10 patients a day per measurement spot. After the initial setup and training there were diagnosed 1791 patients, 962 women and 829 men. The basic characteristics of the patients are provided below. Based on the anamnesis the patients were divided into the following groups:

- 1) Healthy without symptoms
- 2) Diabetes Melitus I
- 3) Diabetes Melitus II
- 4) Symptomatic patients, e.g. suffering from pain while walking

Group	Age	Healthy	DM-I	DM-II	Symptom
Women	17-92	35	0	245	682
Men	12-91	42	5	356	426

Table 1  
103

(table 1).

The results of the Computer aided plethysmography diagnosis are given in the table 2. Patients were divided into 3 major groups:

- 1) Healthy – 148 patients = 56 women + 92 men
- 2) Suspicion – 1419 patients = 807 women + 612 men
- 3) Pathology – 224 patients = 180 women + 44 men

Risk factors detected with the plethysmography diagnosis - evidenced as “abnormal peripheral perfusion indicators, e.g. arterial capacity and altered arterial waves” - were detected in slightly above 79% and pathological values above 12%. This relatively high incidence of detected suspicion and pathology is influenced by the group of patients with high presence of diabetes and symptoms. 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.

Group	Healthy	Suspicion	Patology
Women	56	807	180
Men	92	612	44

Table 2

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ral perfusion was detected in 12% of all patients with an indication for immediate intensive therapy. In this group of acute patients there are 3% with immediate risk of limb loss which was avoided thanks to the program.

Based on the statistical evaluation of the data the sensitivity exceeded 92% for the peripheral arterial disease.

In addition to the limb loss avoidance the program also allowed the application of non-invasive and less burdening physiotherapies designed for the application in the rural areas without presence of expert doctor.

Currently we evaluate the potential of using micro-invasive therapies based on stem cell procedures that would allow providing a new level of therapies available in rural areas.

## 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 program 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 computer aided 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. During the program there were also identified several non-invasive and micro-invasive therapies which might be used in rural areas with the aim to assure a comparable level of care to major health centers.



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Co-operating on start-up and implementation of telemedical programmes designed for early and non-invasive diagnostics of peripheral perfusion for patients with cardio-metabolic risk factors, like diabetes melitus II



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Tomas Bohrn, Master in Material Science, Engineering, Technical University in Brno, Czech Republic  
Working experience in Investments and Funding  
Co-founder of a Telemedical center with specific focus on early and non-invasive diagnostics of peripheral perfusion for patients with cardio-metabolic risk factors, like diabetes melitus II

# Early Detection and Prevention of Complications Related To Cardio-Metabolic Risk Factors with Telemedicine

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**Abstract:** Cardio-metabolic risk factors are growing worldwide at an unbearable pace and Diabetes Mellitus (DM) is becoming the most serious chronic disease in a global scale. The estimates from the International Diabetes Federation (IDF) state that approximately 382 million people are currently living with diabetes with 46 % undiagnosed. The projected values for 2035 show a 55% raising the global burden to 592 million people around the world. The main objective of our work is to build a screening approach to identify people at risk for DM and to further stratify those with early signs of the most important DM complications – Cardiac and Cerebrovascular disease, Peripheral Artery disease and Diabetic Retinopathy.

## Introduction

With the advances in Information and communications technology (ICT) it's becoming easier to perform remote diagnosis and health assessments of predefined groups of population that could be at risk for determined pathologies. One widely accepted diabetes risk prediction score, which has been used outside the original country, is the Finnish Diabetes Risk Score (FINDRISC)<sup>1</sup> that was adopted by the Portuguese Directorate-General of Health (DGS). This score was the basis of our population stratification and for those with age between 40 and 65 years of age, the Systematic Coronary Risk Evaluation low cardiovascular Risk Charts, based on gender, age, total cholesterol, systolic blood pressure and smoking status was also used.

## Objectives

Evaluate a population of approximately 1.200 apparently healthy adults from the Lawyers and Solicitors Retirement Fund.

This initiative will allow us to:

1. Introduce an innovative telemedicine platform allowing data collection, transmission and storage for subsequent analysis and report by specialists and, when needed, specialized second opinion;
2. Investigate the applicability of a systematic, well structured and non-invasive screening combining different methods to support the early identification of atherosclerosis, peripheral arterial flow reduction and retinal diseases;
3. Encourage and promote technical qualification of local health professionals supported remotely by specialists – ophthalmologists, radiologists, cardiologists - in the investigated areas enabling an effective screening using these new technologies.

The screening techniques used in this study will also be evaluated in terms of specificity and sensitivity to stratify the patients that need further evaluation leaving the others, with no sign of subclinical disease, outside the health system, reducing the waiting lists and demanding pressure for healthcare services in times of scarce resources.

## Methods

The DM complications that we have determined to evaluate were - Atherosclerotic Disease, Diabetic Retinopathy and Peripheral Artery Disease (PAD). For the early diagnosis of these pathologies some methods are widely accepted and allow remote evaluation by doctors if performed on site by trained healthcare professionals. The techniques that we've used were the following:

1. Carotid Intima-media Thickness (CIMT) is regarded as a surrogate marker of the systemic atherosclerosis, including coronary and cerebrovascular atherosclerosis. Atherosclerosis detection with CIMT is performed using a portable ultrasound to carry out the echography of the carotid arteries and measure the Intima-media layer to compare the results with data from selected studies [2]. This test is approved for cardiovascular screening in several international guidelines [3] with a level of evidence IIa. When the CIMT is above the 50% percentile it's widely accepted that this patient as a vascular age above the biological age and therefore that individual is at higher risk of Myocardial Infarction and/or Stroke. It was decided that all CIMT exams should also investigate heterogeneity of the thyroid gland.
2. Diabetic retinopathy screening using digital non-mydratiac fundus photography and a telemedicine platform is a widely accepted [4] method as an easy way to obtain good quality images of the retina with no need for pupil dilatation that would require a recovery period after the exam. With the same image other pathologies can be found like

Glaucoma and Age Related Macular Degeneration giving this way a chance for special follow-up near any ophthalmology service.

3. Peripheral Artery Disease screening using Computer aided occlusion Pletysmography [5] and Ankle Brachial Index [6] to evaluate the onset of PAD avoiding premature amputation of toes and lower limbs. These methods allow a simple and practical way. The device is designed for the screening and evaluation of the quality of perfusion on the periphery, based on lower limbs. The system allows a complete arterial and venous diagnostics based on proven protocols elaborated in accordance to applicable guidelines. The conception of the system allows an easy and automated procedure to be effected by trained healthcare personnel.

### Results

During this initiative more than 1.077 adults, with the following age and gender distribution:

Age group	<=30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	>70
<b>Female</b>	35	49	95	104	92	71	23	20	7	10
<b>Male</b>	7	29	38	63	60	64	71	89	74	76
<b>Total</b>	<b>42</b>	<b>78</b>	<b>133</b>	<b>167</b>	<b>152</b>	<b>135</b>	<b>94</b>	<b>109</b>	<b>81</b>	<b>86</b>

The FINnish Diabetes Risk SCcore was applied to all participants with the following results:

<b>FINDRISC</b>	<b>Female</b>	<b>Male</b>	<b>Total</b>
Low	245	155	<b>400</b>
Slightly elevated	173	235	<b>408</b>
Moderate	55	88	<b>143</b>
High	29	83	<b>112</b>
Very high	4	10	<b>14</b>

To all the participants with diabetic Moderate, High or Very high risk the other tests were performed with an incidence of pathologic exams that showed some variability.

1. For ocular screening we've found that 130 exams were pathologic. This value represents approximately 12% of all the population and 48% of the risk group.
2. For cardiovascular screening we've found that 265 exams showed atherosclerotic plaque or were above the 75th percentile. This value

represents approximately 25% of all the population and 96% of the risk group.

3. For Peripheral Artery Disease we've found similar values to the ones we've identify with elevated cardiovascular risk with identifiable atherosclerotic carotid plaque or CIMT over the 75th percentile.

### Conclusion

The conclusions that we can pull out from this initiative show that implementing risk-stratified screening can identify in cascade the participants that should be present to further tests allowing restratification and a personalized medical intervention aiming to correct modifiable risk factors.

With this approach, that is viable with small resources and low investment, some serious asymptomatic diseases can be found at an early stage giving the individual a change for appropriate treatment at the right time with better chances of cure.

In one of the participants that underwent the CIMT test a papillary thyroid carcinoma was found and treated with thyroidectomy with a very favorable prognostic.

For this finding I consider already that this initiative was a god one!

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# **ECG Platform: From Idea to User- Driven Development and First Public Measurements**

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## Introduction

Cardiovascular prevention programs include preventive electrocardiogram (ECG) measurements. They serve to facilitate early detection of pathological changes and to create a reference for early detection of such changes in the future.

ECG measurement requires a highly skilled doctor and/or a sophisticated computer program to extract any medically relevant information, but at the same time the measurement itself can be taken by a nurse, medical technician, or skilled individual.

One of the goals of preventive measurements is also to take advantage of the event to provide education about cardiovascular diseases and their risk factors. With ECG measurements, this poses a problem because the data measured are too complicated for the patient to be able to visualize the heart function, and so the educational component is difficult to convey.

In order to facilitate and take advantage of preventive ECG measurements, an initiative was raised to develop an internet platform. The ECG platform enables a nurse or skilled individual to make recordings at given location. Then the data are uploaded onto an internet platform and are readily available for viewing and processing by users or doctors regardless of their physical location. In addition, the platform would enable attractive education using the patient's own data to visualize cardiac function, storing past recordings, and continuously developing advanced automated analyses.

The drawbacks of the internet platform are that the users must have an e-mail address and must be willing to share it with the platform operator in order to receive their results. Using the platform also requires basic computer and internet literacy.

A series of public measurements were conceived to study how different user segments respond to the novel concept of preventive measurements and to study the obstacles they face when using them.

The platform developed is suitable only for preventive situations. Personal data protection is achieved by assuring anonymity at each stage of the process.

## Methods

Three hundred preventive 12-lead ECGs were recorded at six different public events: a local marathon, a spa, an office, a professional cycling marathon, a running club, and festival for the elderly.

The screenshot shows the user interface of the 'spoznaj svoje srce' website. At the top, there is a navigation bar with a logo (a heart inside a circle) and the text 'spoznaj svoje srce'. Below the logo, there are links for 'Dobrodošli! bonut', 'Moj profil', 'Moje meritve', and 'Odljava'. On the right, there is information about the user's account: 'Uporabniški paket: Napredni', 'Veljaven do: Neomejeno', 'Število datotek: 6', and 'Prostor na voljo: 49848 KB'.

The main content area is divided into several sections. On the left, there is a 'Dobrodošli!' section with a 'Izberite poročilo' dropdown menu and a 'Včlanite se danes!' button. Below this are five red buttons: 'Srce', 'EKG slika', 'Ritem', 'Utrip', 'Rezultati', and 'Kardiolog'. The 'Rezultati' button is highlighted.

The 'Rezultati' section is titled 'Poročilo o delovanju Vašega srca' and 'Rezultati'. It contains the following text: 'EKG meritev vašega srca je pokazala: ANALIZIRANO S PROGRAMOM SEMIP 1.5, EDAN Inc. Diagnosis Sinus Rhythm \*\*\*\*\*Normal ECG\*\*\*\*\*'. Below this is a section titled 'Vaši rezultati' with a sub-header '»Veliko nas ima EKG s fitnimi nepravilnostmi, ki niso specifične. So značilnost osebe podobno kot podpis. Dobro jih je poznati za primer, če se kaj spremeni v prihodnosti.«'. There are three main results displayed in graphics:

- 1. Frekvenca srca | angl. HR - Heart rate** 75. Število utripov v minuti. The graphic shows a horizontal bar with a scale from 60 to 90. A black dot is positioned at 75.
- 2. Trajanje vala P | angl. P duration** 107 ms. Čas potreben, da se začne krčiti cela mišica levega in desnega preddorja. The graphic shows a horizontal bar with a scale from 80 ms to 120 ms. A black dot is positioned at 107 ms.
- 3. P-R interval | angl. PR interval** 159 ms. Čas med začetkom krčenja preddorov in začetkom krčenja prekatov. The graphic shows a horizontal bar with a scale from 120 ms to 200 ms. A black dot is positioned at 159 ms.

On the right side of the page, there is a 'Moje meritve' section with a table of ECG measurements:

Ime datoteke	Datum
jk010811_7-Resting ECG	19.10.2011
SB R10_1-Resting ECG	02.08.2011
jk010811_7.R10	01.08.2011
bt	18.04.2011
201104180001_1-Resting ECG	18.04.2011
bonut-201007190002-1-Resting ECG	10.03.2011

Below the table are buttons for 'več' and 'naloži'. At the bottom right, there is a 'Urejanje strani' section with links for 'Urejanje uporabnikov', 'Urejanje člankov in novic', 'Urejanje lektov', and 'Urejanje kategorij člankov in novic'.

Figure 1. Layout of one page with results explained in graphics (Slovenian only). The platform can be accessed at [www.qsecg.com](http://www.qsecg.com) (username: guest, password: guest).

Within their accounts, users could view the standard ECG slip, the results of the automated ECG analyses presented in graphics, and explanatory videos. The education was divided into the following sections: Heart, ECG Image, Rhythm, Beat, and Results. Each section contained the results of an individual ECG with video, graphic, and written explanations.

## Results

Public preventive ECG measurements were well accepted. Across the age range from 18–83 years, 90% of all potential subjects had an e-mail address and were willing to share it. Of the e-mail addresses given, 3% were incorrect, and 40% of the subjects measured never accessed their ECG internet accounts. There was little if any confusion regarding opening the web account among the younger population (< 60 years), but 9% of the older population reported a high level of frustration trying to access the internet platform.

## Conclusion

Users generally understood the concept of measuring ECG away from home and viewing the results on the internet platform at home. We propose that this be integrated with other measurements within cardiovascular disease prevention programs. This technique makes it possible to integrate preventive ECG measurements with patient education using their personal measured data as a reference.

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# Tele-Cardiology Program Implementation: Saipem Approach & Experience

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## Introduction

Saipem launched a flagship program called tele-cardiology with the objective of expanding access to quality health care. Traditionally, remote located worksites and camps are high risk difficult to access [1]. Cardiovascular disease (CVD) prevention, cardiac emergency and rehabilitation are now fully integrated into the Saipem health prevention program and tele-cardiology has very important role to play. Its capabilities in the diagnosis, treatment and follow up of cardiovascular disease have extended the possibilities of providing the kind of care required by Saipem employees and of lowering health care costs considerably.

The application of tele-cardiology has shown the following area of focus:

1. Early interventions, monitoring & management of acute cardiovascular cases;
2. Cardiovascular disease screening, surveillance and risk assessment;
3. Prevention efforts through behavior change to decrease CVD risk among high-risk employees.

Even though the tele-cardiology has been practiced for years, a burst of communication of technologies in recent years has greatly enhanced its capacity and quality [2]. The advantage of tele-cardiology in remote communities such as SAIPEM operating units is especially important because of its capability of overcoming the obstacle of the large distances that would have to be covered in order to access quality medical assistance. As such, hazardous and even unnecessary transportation of critically ill patients for the purpose of diagnosis can be avoided by remote expert counseling.

Tele-cardiology in Saipem enables the remote exchange of data between company physicians and specialized cardiologists based in TelBios cardio Centre, Milan to facilitate diagnosis, monitoring, and management advice on treatment of Saipem employees [1, 5]. In 2006 Saipem medical management in agreement with TelBios have developed a service for assistance in cardiovascular pathology in remote area to be used both in emergency cases and for prevention of cardiovascular disease among

employees [3]. It provides real time communication, around the clock between company physicians in a remote location and cardiology specialist, to include phone interactions and online communications [4].

### Facilitating Seal the Gaps

The capabilities of the primary care in company clinics at the peripheral and remotely located sites are restricted in terms of specialized diagnosis and treatment. They are armored to deal mostly with primary care issues and some emergencies but they are not trained to provide specialized care in case of heart attack or stroke, nor do they have enhanced equipment to give echocardiography or round the clock cardio monitoring.

Ever since the launch of tele-cardiology program in Saipem, it enables to seal the gaps. It allows the remote exchange of data between company physicians from 45 worksites and specialist cardiologist based in Milan to facilitate diagnosis, monitoring, and management of challenging cardiovascular conditions.

### Telecardiology Process Description

The telecardiology program process is divided in two phases by and large [6]:

- *Recording and Preprocessing Phase*

The system is available 24/7 hours 365 days in both real time “online” and store and forward “offline” format [8].

Data Collection: Company physicians on duty take the ECGs of the employees/patients, using a high reliability trans telephone telbios ECG recorder of small size. This device records and transmits 1/12 ECG derivations.

Transmission: When required, ECG is recorded at the company clinic in periphery and data is then transmitted using wireless technology in conjunction with a landline phone or mobile phone available in the clinic. The company physicians have to identify themselves stating code of telbios machine to the operator in telbios center who will automatically involve specialist cardiologist [7,8].

- *Reporting, Consultation between Company Physicians & Cardiologist Specialists and Storage*

Reports: After the cardiologist’s interpretation the report is sent back to the company physician in a pdf format. If a patient indicates the need for immediate action, alerts can be generated and sent to the company physician on duty. The results are immediately sent to involved responsible entity (1. physician on duty, 2. Program coordinator, corporate based and 3. GIPSI electronic data base system for automatic archive in employee file).

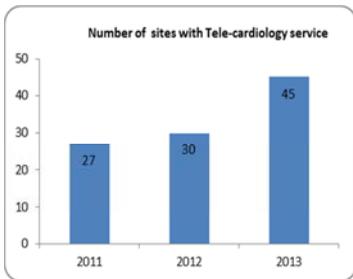


Aerotel HeartView P12/12L

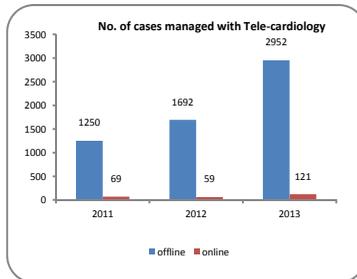
The company physician utilizes this information putting diagnosis and treatment.

### Statistical Analysis

The Tele-cardiology implementation since its inception in 2007 demonstrates significant improvements in the quality of care as well as huge potential cost savings. In the year 2013, there were additions of new worksites with telecardiology implementation making it a total of 45 worksites as shown in Graph 1. Out of that, at least 17 had successfully accomplished their annual target of minimum 90 ECG transmissions to telbios Cardio center. The remaining sites were also very efficient implementing this program on respective sites. In the year alone, a total of 3073 ECGs were transmitted to Tel-Bios for specialist interpretation and out of these 121 ECG's were sent in "ONLINE" mode. These 121 cases have been considered at that time potential cardiac emergencies or were related to a certain cardio-vascular disease. A number of 8 cases out of 121 emergencies marked ECG's have been considered MEDEVAC worthy. Thanks to Tele-cardiology, a total of 113 cases have been managed onsite. The remaining 2952 cases were part of constant monitoring and follow up

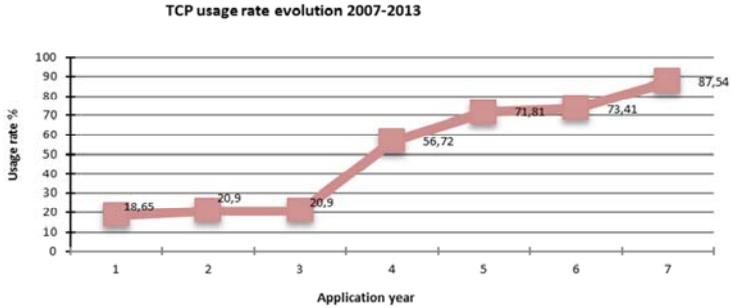


Graph1



Graph2

under cardiovascular disease prevention program (CVDPP).

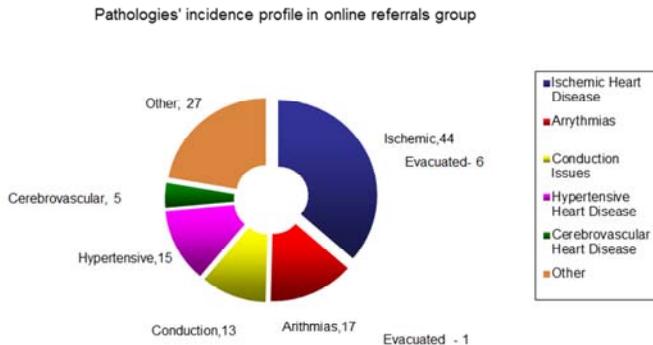


Graph 3

These statistics point out a rise in trend of number of cases managed with tele-cardiology implementation as shown in Graph 2. This year, there is an increment of 75.5% in total number cases referred to Tele-Cardiology Service (2012 – 1751 cases, 2013 – 3073 cases). Although this result is expected since the number of worksites involved increases, an efficient monitoring and management of the program played an important role on this achievement.

### I. Usage rate

As in the previous years the usage rate target was set to 90 ECG transmittals per device per year for the sites applying the tele-cardiology program. The average telecardiology program usage rate in year 2013 was 87.54 %. This shows a significant incremental growth in respect of the 2012 usage rate (8.68 percentage points) and a sustained implementation if



Graph 4

compared with the previous years of its implementation.

## *II. Pathologies Incidence Profile in Online ECG Transmission (Graph 4)*

### *A. Cardiovascular Disease Prevention in Primary Care Settings: Role of TelBios*

In the year 2013, 2952 (96.07%) of ECG transmissions were carried out in non-urgent, in “Offline mode” and were sent to Telbios, Milan, for specialist interpretation and suggestion. These 2952 cases were part of constant monitoring and follow up under CVDP program. Tele-cardiology case management models tested in several randomized trials of secondary prevention have shown significant improvements in risk factors along with decreases in cardiac events and mortality and improved patient perception of health compared with usual care. In Saipem primary care settings, tele-cardiology systems are most commonly used with patients suffering from coronary heart diseases (acute MI), Arrhythmia, hypertension, pacemaker keepers as well as with patients suffering from chronic heart failure. Seen from a medical point of view, it is paramount to judge the clinical situation without delay as well as to take necessary therapeutic measures timely and to control their efficiency over a long period of time. Consequently, tele-cardiology program include the establishment of a nonstop monitoring of patients with increased or high risk of cardiovascular incidents.

### *B. Estimating the Economic Benefits of Tele-cardiology Program*

The analysis considers an average amount per medical evacuation of 10000 Euro. This sum includes so called direct costs of the services accessed during an emergency medical evacuation: transport by helicopter, ambulance services, third party medical personnel involved in evacuation costs, specialized medical attention ashore and specialized examinations and eventual hospitalization expenses. Apart from these direct costs, we have to considered additional financial losses that are not clearly or immediate visible. These include but are not limited to: loss of productivity, recruitment of new personnel, additional mobilization and logistic expenses, eventual legal disputes, etc. It is estimated that these costs, with their “iceberg” effect increase the cost of one single evacuation 8 to 36 times. Thus we can presume that all 121 online (emergency) referrals, representing the same number of cases candidates for evacuation, would have implied a total cost of 1210000 Euro. As per the data presented above, only 8 cases have been finally considered “evacuation worthy”. Following this simple math assessment, the telecardiology has managed to save in 2013 expenses for medical attention worth 1130 000 Euro. If we consider that the complete telecardiology service cost in 2013 was 105 000 Euro, it has brought clear and net optimization of 1025 000 Euro. Additional “savings” results in

better outcome of an acute event due to immediate recognition of the problem and early application of appropriate treatment.

#### *C. Barriers to Tele-Cardiology Program Implementation and Achieving Target*

Improved awareness of use of Tele-cardiology program is needed in employees. Perceived individual benefit is a key driver for employees.

Bigger approach towards the program and deeper understanding of potential benefits in monitoring, cardiac emergency prevention and CVD risk factors by physicians are needed and foreseen particularly on some worksites.

#### *D. Conclusions and Future Directions*

In this paper, the recently introduced tele-cardiology program assisted to company physician was presented. This is one of the most successful examples of innovative technology practice and has resulted in substantial quality of life gains for employees with cardiovascular pathology. The company physicians and employees alike were positive about the induction of telecardiology service in primary care clinics [7]. It also became evident that as medical staff gained confidence in the new technology it became an important tool for supporting clinical decision making to the extent that inappropriate MEDEVACs were being minimized.

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# Telecardiology Project of Rio Grande do Sul State, Brazil: Mistakes and Lessons from the First Five Years

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**Abstract:** Since 2008, a public telecardiology project started in southern Brazil, under the coordination of the Instituto de Cardiologia do Rio Grande do Sul (ICFUC-RS). Currently involving 37 remote villages and a telecardiology central unit, it consists of: Tele-ECG diagnosis on a 24/7 basis; medical counselling via videoconferencing facilities, and; a telecardiology training program (presence mode and periodic webconferencing lectures). This paper reports major obstacles encountered and mistakes made during both the implementation and operational phases of the Telecardiology project. Also, some technical alternatives and potential solutions to the identified barriers are described.

## Introduction

Cardiovascular diseases impose major risks to human health, with coronary arteries stenosis and occlusion being responsible for a large number of deaths and physical disabilities. The immediate electrocardiographic (ECG) diagnosis, a key to successful treatment of heart attacks [1], is not available in small towns, remote or rural communities, particularly in countries characterized by large territorial areas or who exhibit low socio-economic condition. Since 2008, the implementation of a public telecardiology project (Tele-ECG RS Project) started in the state of Rio Grande do Sul (RS), the southern Brazilian state - 11 million inhabitants, under the coordination of the Instituto de Cardiologia do Rio Grande do Sul (ICFUC-RS) [2]. The project is financially supported by both the Brazilian federal and RS state government. The method consists of: immediate Tele-ECG diagnosis on a 24/7 basis; medical counselling via videoconferencing facilities (second opinion in cardiology), and a telecardiology training program (presence mode activities and periodic webconferencing lectures). Currently the Tele-ECG RS Project (Phase II - Mar 2011-Nov 2013) includes 37 remote villages and a telecardiology Unit, from where 48.873 Tele-ECGs were analysed. In the course of this project, it was necessary to promote technical and operational adjustments as well as

of overcoming obstacles of various natures, whose main facts and solutions are described in this article.

### Objectives

This study aims to: 1) Report major mistakes made during both the implementation and operational phases of the telecardiology project; 2) Describe some solutions and technical alternatives to the identified barriers, including the adoption of new strategies for the upcoming expansion of the project, which includes 120 new remote institutions.

### Methods

The staff of the Tele-ECG RS Project - nurses, medical doctors, IT experts and administrative personnel - was in charge of reporting all issues that could somehow jeopardize the smooth progress of the project, at the same time providing some input about potential solutions and alternatives to the identified barriers and mistakes. Aspects related to the Tele-ECG equipment (computers, Internet access, local room facilities, ECG operation), methodology of qualifying sessions (face-to-face and multiseat web-based sessions), videoconsultation method and administrative issues were targeted.

### Results

During Phase II, 48.873 Tele-ECGs were analyzed, including 25.609 males (52,40%), representing 4496 acute cases (9,20%), 27174 chronic/nonspecific (55,60%), 16421 normal (33,60%) and 782 cases with technical interference (1,60%). In that period, several relevant technical, administrative, operational issues and obstacles were identified. Together with respective potential solutions (PS), these aspects are listed hereunder in accordance with its technical characteristics:

1) Delay in equipment acquisition and installation, resulting from bureaucratic and local administrative difficulties. PS: Maintaining frequent contact with local health authorities, following in advance the process of acquisition of all required equipment. Thus, the training phase only happens when institutions are fully equipped, thereby allowing remote professionals to receive in due time the final training session - full module - in their own health institution.

2) Technical issues related to ECG patient's connecting cable. PS: Acquiring an additional ECG cable for the connection between the patient and the digital ECG machine, avoiding prolonged interruptions when necessary to make technical repair. This is important because this component of the ECG machine suffers damage to its structure due to

frequent handling in the emergency room. It is recommended to provide 2 ECG cables as part of the initial budget of the Tele-ECG project.

3) Inadequate local infrastructure in the ECG room, including the unavailability of stable access to the Internet. PS: It is recommended the adoption of a standard contract through which the local health authority confirms that minimum technical requirements are available for installing and for operating the TeleECG system at a local level, in accordance with the technical standardization of the project. It should mention the provision of stable Internet access, the availability of protective tool against electrical discharges as well as no-break devices.

4) A lack of skills concerning telemedicine standards and Tele-ECG systems utilization. PS: Considering that this was the first public telecardiology project in RS state, training activities - face-to-face and webbased - included basic lessons on the theme of telemedicine and eHealth. Specific training activities towards the utilization of the Tele-ECG method included: adequacy of room environment (temperature, comfort of the patient in the exam room), proper placement of electrodes, basic skills on tele-ECG software operation and dealing with simple digital technical issues and, identifying and prioritizing transmission of urgent exams as a means to accelerate the delivery of urgent reports.

5) Performing a single training session in remote health institution did not result in providing adequate training. PS: The initial training of remote teams was expanded to two sessions, including an initial class held at the headquarters of the ICFUC-RS (in the state capital), also maintaining a second round of training activities conducted in the remote town. Moreover, it has become mandatory the presence of doctors (2 or more), nurses (2 or more) and IT experts (1 or more) of each municipality, with individual sessions organized for each institution. This strategy, applied since 2011, ensures that professionals receive at least 8 hours of training activities, becoming informed about the entire concept of the telecardiology project.

6) Busy staff and insufficient motivation to attend training sessions. PS: The shortage of health professionals in remote institutions is a limiting factor for attending periodic web-based training activities, so that those webconferencing sessions initially conducted every 21 days, have been rescheduled as monthly sessions. Besides, a new platform that allows recording the webinars - PPT files plus respective audio - was incorporated to the program, making it possible to retrieve its whole content. Monthly sessions transmitted via multipoint webconferencing were readapted so that to include themes relevant to the practice in cardiology as well as to other health issues of interest, also addressing topics suggested by the professionals of remote institutions like: influenza, infectious diseases,

diabetes therapy, stroke, atrial fibrillation, acute myocardial infarction, as well as classes on administrative and regulatory aspects related to the Tele-ECG RS Project (reports, filling out standard forms, etc.).

7) Low utilization of videoconsultation method (second opinion), with preference for phone calls. PS: The videoconsultation method was considered a more complex tool, with preference being given to the use of mobile phones that are now part of everyone's life, available to all team members even inside the emergency rooms. The videoconsultation tool is being modified so that it becomes easier to use, turning it accessible on the computer screen immediately after each urgent ECG analysis.

### Discussion

Identifying and dealing with major obstacles to the operation of the telecardiology project of RS/Brazil is expected to contribute to the adoption of appropriate strategies towards the upcoming project expansion to additional 120 institutions. In spite of performing some technical adjustments that included rebuilding the videoconsultation platform and managing administrative issues, giving special emphasis to the improvement of the educational program is a priority [3]. Focusing in the provision of a specific and detailed training program as part of the implementation phase seems to be a key component regarding eHealth project's successful operation and sustainability [4]. Long distances, absence of local long term educational programs, economic restrictions and, particularly, the importance of keeping in close contact with remote professionals of health sector are all relevant aspects that justify conducting a long term web-based educational program bound to eHealth and telemedicine initiatives [5].

### Conclusions

The implementation and sustainability of innovative eHealth and telemedicine projects imposes the need to tackle and overcome unexpected barriers, as well as being able to learn from our own mistakes. Identifying, reporting major issues and presenting these results to the scientific community can be of great value, thus contributing to a better walk without the need to reinvent the wheel. In our view, investing in continuous education of remote professionals deserves occupying a chair in the first row as a key element for the sustainability of eHealth services, mainly when developing countries and huge territorial areas are part of the scenario.

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# Telehealth for Patients with Heart Failure: A Comparison between Telehealth Systems

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## Introduction

Heart failure (HF) is considered one of the most common diseases in Western Europe, with more than 10% of the people older than 75 year suffering from it. Furthermore, HF is recognized as a costly and disabling condition that threatens social and economical systems [1]. Therefore, the Recap (Regional Care Portals) project emerged as an initiative to develop innovative tools to promote and improve the implementation of telehealth systems [2]. This project involves transnational cooperation between thirteen partners from the North West Europe region that work towards the application of new financial, organizational, legal and technological solutions to the telemonitoring of HF patients. These new solutions aim to improve the diagnosis, therapy and remote monitoring of HF, by optimizing the communication between patients and care givers, and educating the patients to self-manage their condition. One of the partners involved in this project is the North East London NHS Foundation Trust (NELFT) in the UK, which is in charge of the recruitment of patients into the telehealth study, and of the follow up of their condition. Currently, as a part of the Recap project, two telehealth platforms are being deployed to the patients, namely, the Docobo unit and the Motiva platform provided by Philips. Fig. 1 shows these two platforms, and their characteristics are listed in Table 1.

The main difference between these two platforms is the user interface, which in the case of Philips contains more educational material, and a more interactive environment that allows the patients to follow the evolution of their disease closely. The comparison between these two systems is part of the Recap project, and one of the goals is to identify if there are advantages of the education provided by Philips on the compliance of the patients in the

telehealth system. In this paper, two populations are studied, one with Docobo system, and another one with the Motiva platform. The goal is to identify if the patients with the Philips system show any difference with respect to the population with Docobo units. This comparison will give some indications of the characteristics that a telehealth system should have.



Fig. 1. Telehealth platforms used in the Recap project

Table 1. Characteristics of the telehealth platforms

<b>Docobo</b>	<b>Philips</b>
Stand-alone unit	Interactive telehealth platform
No video streaming	Personal healthcare channel
No educational information	Educational information to control and understand the condition
Blood pressure (systolic/diastolic)	Blood pressure (systolic/diastolic)
Pulse rate	Pulse rate
Oxygen saturation (SpO <sub>2</sub> )	Oxygen saturation (SpO <sub>2</sub> )
Body weight	Body weight

## Methodology

### Data

The dataset collected in this study consists of 212 HF patients (mean age  $69 \pm 12$  years, 70 females, 142 males) referred to NELFT, and monitored in 2013. These patients were selected after evaluating the following inclusion and exclusion criteria.

Inclusion criteria: *a)* Older than 18 years, *b)* Valid diagnosis of LVSD (left ventricular systolic dysfunction) supported by a positive ECG, *c)* And must present any ONE of the following: Sudden increase in weight > 1.5kg in 24 hours; Blood Pressure < 90 systolic; Sudden increase in shortness of breath; Episodes of palpitation/tachycardia without collapse; Change of medication within 48 hours of discharge from acute; High Hospital Anxiety Depression Self Assessment (HADS) score.

If any of the following criteria applied, the patient was excluded from the study: Unconfirmed diagnosis (without ECG); Clinically stable – NYHA I

to II classification (New York Heart Association); Patient is normotensive (120/80); Nil Oedema; Patient is end of life – NYHA > II; Insufficient cognitive understanding to use the telehealth equipment/complete questionnaires.

Once the patient was selected to be part of the study, one telehealth hub, either a Docobo or a Philips system, was randomly allocated. During the first days of the monitoring period, the patient was trained to measure twice a day, on a daily basis, 5 physiological parameters: blood pressure (systolic and diastolic), heart rate, oxygen saturation (SpO<sub>2</sub>), and weight. After 42 days, the telehealth hub returned to NELFT, and it was allocated to a different patient.

### Data analysis

In order to determine whether there is an influence of the system on the evolution of the patients, three different approaches were followed. First, linear regression was used to compute the slope of each physiological parameter. For this, the 42 days of measurement were used and each patient parameter was then characterized by the slope  $m$  (see Fig. 2). The slopes of all patients were then compared. For the second and third approaches, the amount of times the patients measured themselves during the day, and the amount of missing data on each telehealth hub, were compared. All comparisons were evaluated using the Kruskal-Wallis test with a 95% confidence interval.

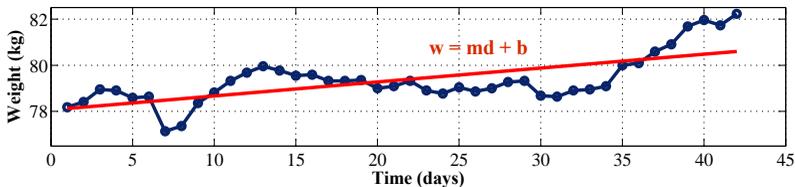


Fig. 2. Linear regression of the physiological parameters. Each parameter is characterized by the slope  $m$ .  $w$  represents the weight,  $d$  the day, and  $b$  the bias term.

## Results and Discussion

After comparing the trends of each physiological parameter, using the slopes after linear regression, no significant differences were found between the telehealth systems. This is not a surprise, since the follow up of patients used in both systems was exactly the same. However, when looking at the amount of times the patients with the Philips system measured themselves in one day, significant differences ( $p < 0.05$ ) were found on all parameters. Patients with this system seem to comply much better with the telehealth

study (see **Fig. 3a**). This can be explained by the fact that the interface offered by Philips is more user friendly and it offers educational videos and a more interactive environment. This can also be observed in the amount of days the patients with the Docobo system forgot, or did not use the system (see **Fig. 3b**). An important factor that needs to be taken into account in future studies is that patients seem to forget more often to take weight measurements, and this represents a big limitation, since it is one of the most informative parameters to predict HF.

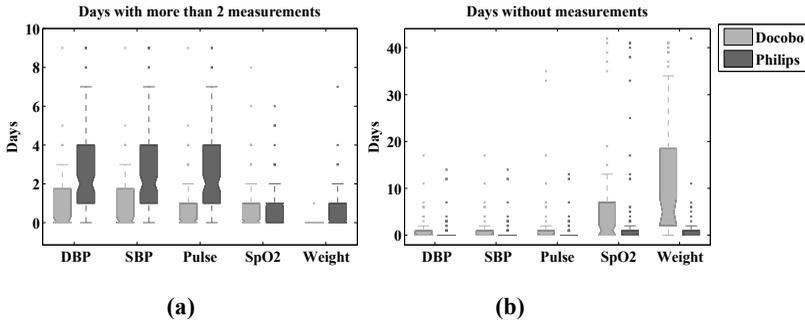


Fig. 3. Comparison between telehealth systems. Note that the patients with Philips system seem to comply significantly better ( $p < 0.05$ ) than the patients with Docobo units. (a) Number of days when the patients measured themselves more than required. (b) Amount of days without any measurement.

### Conclusions

Early observations indicate some differences between both systems, however further data will be analysed during the course of the project to further verify this. The fact that patients with Philips systems measure themselves significantly more times a day than patients with Docobo units seems to indicate that there is an apparent effect of the user friendliness provided by Philips. Patients with Philips technology may feel more comfortable with the system and comply much better than others, though equally clinicians are conscious that patients would not be encouraged to 'over monitor' i.e. take measurements more than the recommended times per day. As the project develops and more data is analysed, the findings can help telemonitoring projects like Recap to increase the benefits obtained by such systems, as patient compliance is an important aspect to any telehealth research.

The initial findings need to be confirmed with a quality of life questionnaire. Therefore, the European Heart Failure Self-Care Behaviour

Scale questionnaire is currently implemented in the system, to be able to confirm the effect of education and user friendliness on telehealth.

### Acknowledgments

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### Authors' Info



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Jan Minter has over 30years of nursing and managerial experience within the NHS , currently working as part of North East London NHS Foundation Trust (NELFT) as a Cardiac Nurse Consultant, she has been instrumental in developing and redesigning Cardiac and Respiratory services, in order to ensure they are 'fit for purpose'. Jan is clinical lead for a range of specialist services made up of heart failure, COPD, epilepsy and Parkinson's, developing and implementing these services across the sub-economy, by encouraging innovative and new ways of working. Cardiology has long been a field of practice where the concept of innovation and change has been taken on board and Jan has used this influence to implement new concepts of care. Jan has some previous clinical experience of using Telehealth within the arena of Heart Failure, using this technology to provide quality care, and motivate both staff and patients to believe and be confident in the use of new technology.



Michelle Stapleton joined NHS South West Essex Community Services, now part of North East London NHS Foundation Trust (NELFT), in September 2008. Since joining the organisation she has welcomed the challenge of redesigning our community specialist services, in order to ensure they are 'fit for purpose'. Michelle has more than 15 years experience of working in cancer and palliative care services as a senior nurse and manager and is currently the NELFT Integrated Care Director for Thurrock. Michelle is responsible for adult services, children's services, sexual health services and a wide range of specialist teams including end of life, COPD, heart failure and diabetes. Michelle proactively supports innovation and practice development and has successfully led her existing teams to be practice development units (PDU) since 2000.

Stuart Thomson joined Health Enterprise East (HEE), the NHS Innovation Hub, after



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Siegfried Jaecques received a PhD in Materials Engineering from KU Leuven University in 1995. Until 2008 he did research on implant fixation and hard tissue restoration, [working in the Materials Engineering department, the division of Biomechanics and Engineering Design and the BIOMAT research cluster of the Dental School of KU Leuven]. From 2009 on, he coordinates the Leuven Medical Technology Centre (L-MTC), a research centre within K.U.Leuven, fostering inter-disciplinary research bridging the groups of Science & Technology and Biomedical Sciences. LMTC is also embedded within [K.U.Leuven Research & Development (LRD)], the technology transfer office of K.U.Leuven.



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Sabine Van Huffel received the MD in computer science engineering in June 1981, the MD in Biomedical engineering in July 1985 and the Ph.D in electrical engineering in June 1987, all from KU Leuven, Belgium. She is full professor at the department of Electrical Engineering from the Katholieke Universiteit Leuven, Leuven, Belgium. In April 2013 she received an honorary doctorate from Eindhoven University of Technology, together with an appointment as a Distinguished professor from January 1, 2014 to January 1, 2018. She is heading the Biomedical Data Processing Research Group (BIOMED) within the Stadius Center for Dynamical Systems, Signal Processing and Data Analytics.

# Telemonitoring of Patients with Cardiovascular Disorders by a Pulse High Resolution Oximetry Method

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**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 standard pulse wave has been recorded, transferred by the Internet to the analytical server and the HSR-PW analysis has been performed.

## Introduction

A typical data recorded from pulse oximeter founded on patient's finger and ear gives information how well the arterial blood is oxygenated and pulse rate value. But the parameters of pulse wave, eventual pulse disturbances etc. are usually not analysed. 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-PW) (Fig.1) [1]. In previous works the usefulness of the method in the diagnosis of cardiovascular disease was analyzed [2-3].

Also ear pulse wave sensor was tested to measure the state of neck arteries. The aim of the study was to check how this new method can be useful in detection abnormalities of the circulation system patient stay at home.

## 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 (Fig.1-2). In contrast to the results of a standard measurement, HSR-PW allows to observe even minor changes in the circulatory system. The study involved twenty-four patients with hypertension and fifteen healthy people as a control group. Registration of

pulse wave involve a standard CMS-50E digital pulse oximeter, placed on the left hand index finger which allows measurement of oxygen saturation in the range of 35%-99% with a resolution 1 % for SPO<sub>2</sub>. The performed tests, FMD (flow – mediated dilatation) and NID (nitroglycerin-induced dilatation), describe temporary changes in the blood vessels.

The wireless OEM Pulse Oximeter model 3150 Nonin also has been tested with finger sensor and an ear clip sensor to compare results of HSR-PW from finger and ear pulse wave.

The standard pulse wave has been recorded, transferred by the Internet to the analytical medical server and the HSR-PW analysis has been performed. Computation time did not exceed 15 seconds so practically analyses were done online.

## Results

The analysis showed that changes of the shape of the pulse wave in HSR-PW took place in both groups conducting the FMD and NID tests. The HSR- PW method proved to be more sensitive to changes in the body then the standard pulse oximeter. Comparison high resolution pulse wave recorded on the finger and ear shows a similar structure in the case of healthy peoples (Fig.4) and big differences in the case persons with arteries problem. The received record of the pulse wave after the HSR-PW analysis showed significant changes, which could not be observed by the use of the standard pulse oximeter. The new HSR-PW method helped to distinguish people with hypertension from healthy people. The applied modeling satisfactorily allows describing the changes of the vessel resistance. The obtained results provide a good basis for further tests, which may introduce an important element into the complex diagnostics of the circulatory system.

HSR-PW can determine such parameters like: pulse rate, oxygen saturation, parameter describing ventricle/aorta volume ratio, pulsatility index, artery dynamic, index  $k_1/k_2$  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]

The system was able to detect arrhythmia, increased vascular resistance, aortic stenosis (Fig.2) and influence of drug on HSR pulse wave parameters (Fig. 3).

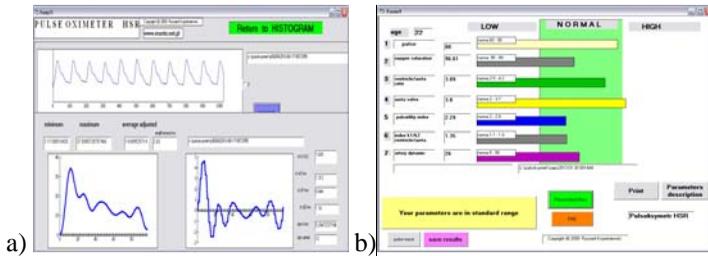


Fig.1. Pulse wave analysis result of HSR - PW a healthy person:  
 a) Standard and HSR pulse wave, b) Histogram of parameters.

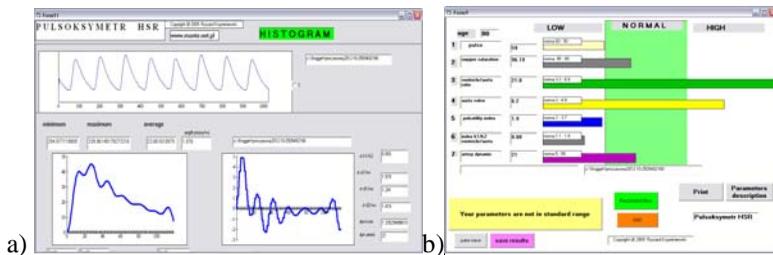


Fig.2. Aortic stenosis:  
 a) Standard and HSR pulse wave, b) Histogram of parameters.

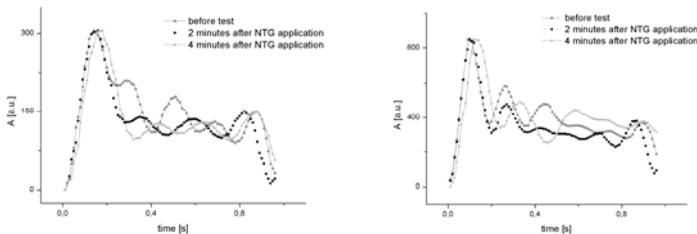


Figure 3. Pulse wave after HSR-PW analysis in the NID test:  
 a) Patients with arterial hypertension, b) Control group

We also tested HSR-PW analysis of an ear sensor of the pulse wave and compare results of this sensor to finger sensor. It was used wireless OEM Pulse Oximeter model 3150 Nonin. It was check for control group of the healthy people that the structure of HSR-PW signal from finger and an ear

sensor is the same (Fig.4) and the ear sensor can be very useful to detect abnormalities of the neck artery.

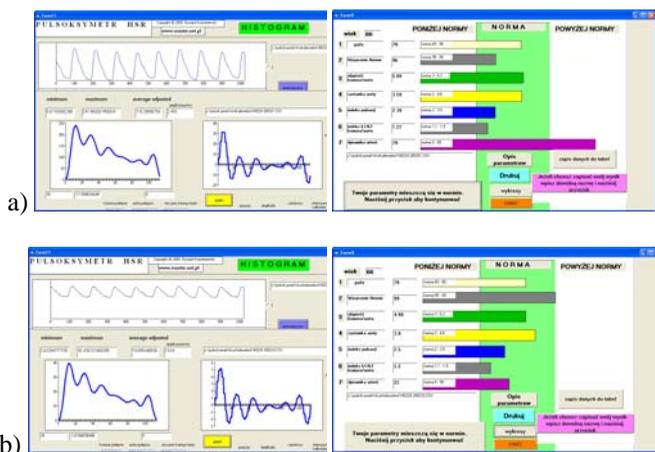


Fig. 4. HSR-PW of the healthy people recorded on a) finger sensor and an b) ear sensor.

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.

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# Utilization of a Web-Based Electronic Medical File to Improve Case Management and Continuity of Care in the Remote Areas of Mongolia

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## Background

Mongolia, located in the heart of central Asia, occupies a vast territory of 1.6 million km<sup>2</sup>. One third of its 3 million inhabitants reside in the capital city, leaving the rest of the country's area scarcely populated. Under the country harsh climate, the temperature varies from -30°C to +40°C.

Cardiovascular diseases, largely caused by the traditional fatty diet, have been a major health concern and the leading cause of mortality for the past 20 years, with a constant increase every year. The semi-nomadic way of life of people moving from one place to another makes it difficult to ensure proper follow-up of patients with chronic heart disease. The huge gap in terms of equipment, medical education and human resources between the provincial and the central hospitals makes the physicians feel isolated and helpless, and results in high patients flow, referred or not, from the remote areas to the center.

Under these conditions, telemedicine was a means to bridge the distances. It was initially meant to create a communication network between doctors disseminated throughout the country and to make the central specialized expertise available to the distant provinces. First steps began in 2001 through regular telephone lines. Despite limited bandwidth and desperately slow transmissions a strong team spirit emerged among the physicians from 8 provinces out of 21 who pioneered telemedicine in Mongolia. Advising and exchange of experience between the provinces and the center, as well as between provinces, were soon facilitated by a specialized website. The visible result of this phase was a substantial drop of unnecessary referrals to the central hospital.

As telecommunication means developed in Mongolia, high speed Internet connection became available throughout the country. It was then possible to build, for every patient, a personal medical file accessible from any place where the patient would show up for medical care.

## Objective

The next phase of the project began with the objective to build an individual electronic medical file serving multiple purposes and meeting the needs of various concerned parties: the patients, the health professionals, the hospital managers and the health authorities. The potential benefits include proper follow up of treatment, surveillance of symptoms, avoidance of repeated investigations [4], easy tele-advising, limited and appropriate referrals, activity based management of hospitals and clinics, sound statistics and HIS/MIS systems [5].

Meeting this objective implies that the medical file become a routine tool for the physicians, hence that it meet their needs and facilitate their work.

## Material and Method

After the first phase that used emails with attached documents, and the first half of the second phase during which several formats were tested, the choice was to develop a simple structured electronic medical file with the following characteristics:

- Free software components
- Web-based
- Robust
- Flexible and modular
- Ensuring interoperability, security and confidentiality.

A French IT company was selected to develop a specific product based on a platform meeting these requirements. Although the product is tailored for cardiovascular diseases, and consequently named “MnCardio”, the aim was to come up with an architecture allowing the interface to be configured to suit any specialty, while maintaining the common architecture and structure.

The developed software has three major functions:

- It collects simple clinical information from the patients and constitutes an individual medical file;
- It provides the doctors with a space to discuss difficult cases and seek advice from peers and from the reference center. Cases are easily illustrated and documented with data extracted from the patient’s file;
- It contributes to the building of a clinical database and produces activity and morbidity statistics.

The individual medical file primarily allows patient care and continuity of care. The doctors retrieve the patient’s file from the central dedicated servers and update it with today findings and results. Part of these data is stored anonymously in a database for activity, management, or epidemiology statistics.

The personal medical files are protected and accessible only to authorized health professionals. An authorized physician can read and update the file from any location where the patient shows up, be it during a nomadic move or due to prescribed referral.

When a case requires advice from colleagues or from more specialized levels, the doctors can flag that patient file for later use without disrupting his/her activity. Later s/he can prepare a “ticket” with all necessary information (clinical, lab test, imaging investigations with attached images and video files) and post it in the forum section where it becomes visible to the authorized doctors of the network. It is the physician who initiated the discussion who closes it when s/he considers all necessary information is obtained.

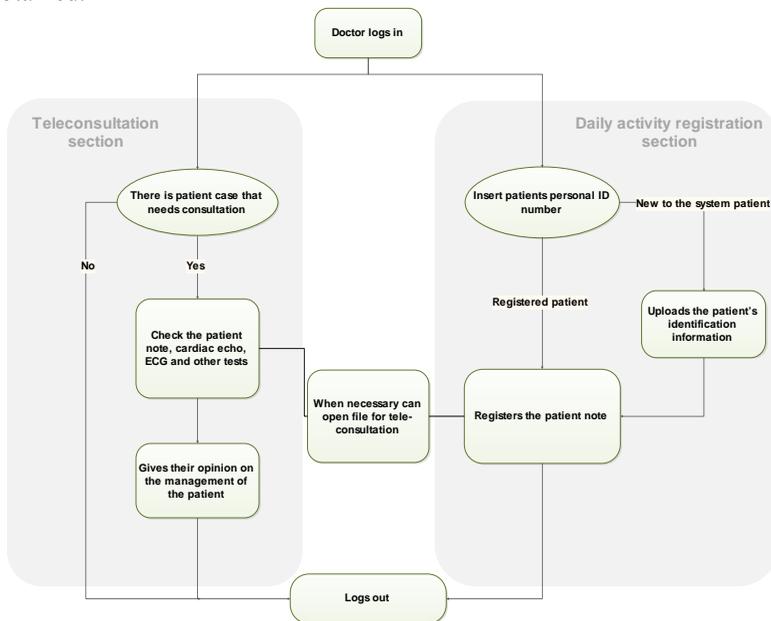


Figure 1. The general functioning of the system

During its early stage of utilization, the system was installed at the Shastin central hospital and in the 8 provincial hospitals where the project was initiated. The server was temporarily hosted at the developers’ headquarters in Paris. Since 2012, as the third phase of the project began, new servers were installed in Mongolia, at the MoH and at the Centre for Health Development, and the system was progressively extended to the 13 remaining provinces and to the 9 urban districts of Ulaanbaatar.

## Results

Between 2009 and 2011, only the outpatients clinics of the initial 8 provinces were connected. Since the beginning of the project's third phase the coverage was extended to be completed by the end of 2013. Currently 83 doctors are using the software. The database now contains 54,528 registered patients totaling 65,134 visits. 7,224 patients (13.2%) account for the 10,606 excess visits (16.3%) with an average of 2.4 visits per patients for those who came repeatedly.

Item\Year	2009	2010	2011	2012	2013
Number of registered patients	248	104	1409	8973	43794
Number of follow-up visits	0	0	23	1454	9129

Table 1. Distribution of patients' registration per year

Tele-consultation was requested in 355 cases that generated from 1 up to 17 answers per question, with an average of 3 answers per request.

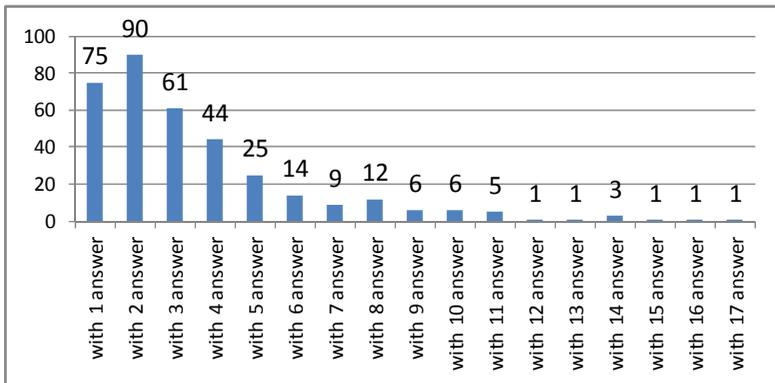


Figure 2. Distribution of answers per request of tele-consultation

Only 27 (32.5%) of the participating doctors regularly use the system, meanwhile 56 (67.5%) do not. A survey among the inactive doctors indicates that the time they can spend per visit is limited, due to the great number of patients. Excessive workload is the first reason put forward for not using the system, except when they are in need of advice. The second reason is a slow or occasional loss of the Internet connection. Interrupted connection may be due to the late payment of the subscription. Requests are frequently submitted to the local health authority for higher speed connection or for uninterrupted subscription, but not all of them make it a priority.

	<b>Number of project doctors</b>	<b>Number of doctors using MnCardio</b>	<b>% of active doctors</b>	<b>Average number of visits/ doctors</b>
8 provinces	15	8	53%	1822 / 8 = 228
9 urban districts	26	12	46%	5209 / 12 = 434

Comparing the activity of the physicians from the provinces and from the urban districts shows that the number of patients seen probably does not explain the utilization or the non-utilization of MnCardio.

### Discussion

Developing a network based on the patient’s medical file represents a major step forward from the initial development of the “medico-social” network that resulted from the first phases of the project. Meanwhile it continues to link the physicians together through its central tele-consultation/ tele-advising feature, it constitutes an individual medical file that benefits to every recipient and actor of the health system.

First beneficiary, the patient, may be treated appropriately from any place in the country. This is of utmost importance for those who will benefit from cardiac surgery, as strict follow-up and fine-tuning of their treatment will be required.

The doctors, whatever they may feel at first, will ultimately save a lot of time as a number of tasks may be automated, such as the printing of the patient’s health booklet, or the activity statistics that are required by the MoH’s services and departments.

The managers of health institutions, as well as the politicians/decision makers, need activity-based information and sound figures to prepare meaningful aggregated statistics, to make appropriate strategic choices, and to fairly distribute the resources.

More generally, this project is following its baseline principle that is, from the very first days, to rely on the physicians activity. The aim is now to provide them with a routine tool that facilitates their task and improves the quality of service. Unnecessary referrals to the central hospitals should continue to decrease, and the doctor’s follow-ups of the patients should be simplified as well, since previous e-medical record of any patient attending any clinic will be instantly accessible.

The results obtained after only a few months of full deployment clearly show that there is a problem of acceptance. Two major causes may be considered:

- Either the proposed system does not meet the needs of the physicians and is a real additional burden;
- Or the whereabouts and the benefits that can be derived from its utilization are not understood.

Objective measurements of the time actually spent to fill an individual file show that it may save time for the physician, provided that there is no duplication of tasks. Eliminating redundancies may require some reorganization and may involve the managers of the clinics. Meeting the needs means that the user interface be kept simple and convenient, and that innovative components and solutions be imagined and worked out.

Introducing an electronic medical file requires first that the concept of individual file be understood. It is not yet the case for all physicians. Then, it is a matter of education that must be shared between the health authorities and supported by the project. The fact that the MoH requested that the servers be installed within its premises, and that the system be extended, indicates that there is a will to pursue the experience.

Those issues must therefore be addressed with the health authorities, keeping in mind that there are plans to establish a national health and management information system, and that it opens an opportunity to build on real-time activity of the health delivery institutions. Developing the system as a web application permits to reach its users directly when modifications and updates are necessary. Properly trained IT engineers will ensure local sustainability to further develop the system in other fields of telemedicine within a common architecture.

### Conclusion

The telemedicine model developed in Mongolia is designed to build an individual medical file allowing the doctors to care for a nomadic population, and to allow peer to peer as well as province to center tele-advising. Simultaneously, it can feed a national HIS/MIS with real time activity and morbidity data.

Although provincial and central hospitals have Internet connection and despite a simple, user friendly interface, less than one third of the doctors routinely use the software as a medical record. Nevertheless, preliminary results show the benefits that can be derived from wider utilization: the patients can access specialized consultation without undertaking difficult and costly travel throughout the country; unnecessary and costly referrals decrease, allowing more effective referrals; appropriate follow up contributes to better case management; routine data collection generates sound reporting for decision making.

Wider utilization calls for the training of IT engineers who will further develop the product and for clear support from the health institutions to modify the attitudes and help incorporate new concepts in practices.

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## **Posters**

# A Roadmap for Mobile Mental Health in Denmark

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In partnership with the Danish Mental Health Foundation, the Danish Technological Institute is establishing a national collaborative on mobile technologies supporting mental health treatment and prevention in Denmark in partnership with public provider organizations, research, businesses and NGOs.

Our main objectives are: To identify opportunities for practical application of mHealth technologies in mental health promotion as well as assessment, monitoring and treatment of mental disorders; To engage with and discuss mobile mental health research and development trajectories in Denmark and abroad with a view to capacity building among Danish technology suppliers and public health care providers; To facilitate opportunities for further research and development, in partnership with the industry, health care sectors and civil society.

A first task is to conduct a technology roadmap pointing out future directions for prevention, treatment and recovery using ICTs in a Danish context.

The Med-e-Tel presentation will present the results of the road mapping and discuss possibilities and challenges related to the use of ICTs in mental health promotion using case studies from Denmark.

Keywords: Mobile mental health, prevention, self-management

# Assessment of an Educative Program on “Hand Washing and Gloves Use” Through a Mobile Device for Nursing Professionals

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## Introduction

Mobile learning (M-learning) has been employed as a tool to facilitate the teaching-learning process. In nursing, we are aware of the importance and need to offer continuing education (CE) to these professionals, but this activity remains a challenge. Nursing professionals have used mobile devices in their work environment for different activities, such as: communication, evidence-based collaborative practice and learning support in the work environment [1, 2, 3]. Thus, new types of learning emerge that involve this technology, such as “learning here and now”, characterized by information access anywhere and anytime, favoring significant learning [4]. In Nursing, m-learning has favored the approximation of instructors and students with the theoretical and practical contents, during clinical practice, in real time. This possibility has contributed to safe care delivery, as it is based on real-time evidence-based care [4, 5]. Hence, this tool has stimulated nursing teaching [6]. Based on the above, the objective in this study was to assess an educative program on “Hand washing and glove use” offered through a mobile device (tablet).

## Method

Cross-sectional, exploratory and descriptive survey: The data were collected at a small secondary public hospital in an interior city in São Paulo State, Brazil. Participation in the educative program took place during

the work shift and involved daily accesses to the units of each course module on hand washing. The professionals assessed the educative program through a mobile device (Galaxy Tab Wi-Fi, operating system Google Android, model P1010, with a seven-inch touch screen and 16-gigabyte internal memory), with the help of a Likert questionnaire with 26 questions, ranging from “I strongly agree to I strongly disagree”. Forty-seven nursing professionals participated in the study (auxiliary and baccalaureate nurses), with one case of missing data at the moment of the evaluation, as the professional was on holiday. All ethical aspects were strictly complied with to execute the research. For the data analysis, descriptive statistics were used with the help of SAS/STAT<sup>®</sup> (2003).

### Results

Among the 47 nursing professionals who participated in the research, female professionals (82.98%) were predominant, between 31 and 41 years of age (46.81%), mostly (78.72%) auxiliary nurses from the medical and surgical clinics (59.57%). Thirty-one (36.05%) professionals had worked in the area between five and ten years. As regards the mastery of the mobile device, 22 (47.83%) participants mentioned beginner skills, 19 (41.30%) intermediary and five (10.87%) advanced skills.

The use of the mobile technology helped the professionals to develop technology-handling skills according to 41 (89.13%) participants, while three (6.52%) were indecisive and two (4.35%) disagreed (Table 1, question 1). As regards the professionals’ motivation to take the course through a mobile device, 30 (65.22%) agreed, six (13.04%) were indecisive and 10 (21.74%) indicated that the mobile device did not motivate their learning (Table 1, question 2). The characteristics of the course through a mobile device (tablet), such as flexible times, convenience and learning at one’s own pace facilitated the learning process for 32 professionals (69.57%), six (13.04%) were indecisive and eight (17.39%) did not agree (Table 1, question 8). Thus, 41 (89.13%) professionals mentioned that they were able to develop the course at their own pace and convenience, while four (8.69%) did not agree and one (2.17%) professional was indecisive (Table 1, question 11).

Table 1 – Distribution of response frequencies related to the professionals’ opinion (N=47) about positive aspects of the “Hand washing” course. Ribeirão Preto, 2014.

Question	Answer					
	Favorable		Neutral		Unfavorable	
	N	%	N	%	N	%
<b>1</b>	41	89.13	3	6.52	2	4.35
<b>2</b>	30	65.22	6	13.04	10	21.74
<b>8</b>	32	69.57	6	13.04	8	17.39
<b>11</b>	41	89.13	1	2.17	4	8.69

Missing=1

The results indicate that 36 (78.26%) professionals considered the device as a good continuing education means, while 10 (21.74%) professionals did not find it was a good CE means. Their justifications included: lack of skills to manipulate the device, making the process tiresome and discouraging, the size of the display made it difficult to see the text and the touch system was bad for people who experience difficulties with this kind of system. On the other hand, the professionals who considered the technology a good means for CE: practical transportation of the equipment, ideal size, as it does not need much room and easy manipulation of the equipment because of the intuitive manner.

### Conclusion

The use of a mobile device showed to be an efficient continuing education tool. The m-learning offers an opportunity for connectivity in real time, granting the professionals more significant and motivating learning. Thus, this technology can be employed in the context of nursing practice, as it enhances the professionals' trust and confidence in their practice.

### Acknowledgment

The researchers are grateful to the Brazilian National Scientific and Technological Development Council (CNPq) for funding.

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# **Brazilian Journal of Telehealth (JBT)**

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## **Introduction and Aim**

Brazil is dramatically implementing projects in telemedicine and telehealth. Thus, a journal is the mirror in the international technical community for these advances in research, health education, in teleconsulting and in remote diagnosis. For this purpose, the staff of UERJ Telehealth Center [1] has developed the Brazilian Journal of Telehealth [2], an exclusively online journal for the dissemination of scientific papers in the areas of telemedicine and telehealth.

## **Material and Methods**

Bilingual system (Portuguese/English) developed in PHP software (CodeIgniter Framework), Javascript, HTML, CSS and the use of PostGreSQL database, allowing, through registration made by an online form, the quarterly submission and publication of papers in relevant scientific areas. These papers are organized by title, author(s), edition, year and volume. The material submitted by the author is forwarded to the editors who make an initial review on the subject, standards and technical standards. Then the material is subjected to peer review, anonymously. The entire process is made by the system itself through sending emails and assignments of roles to users (author, editor, reviewer, designer). Despite being an exclusively digital magazine, there are several categories of publishing similar to a print magazine, namely: Editorial, Letter to the Editor, Original Article, Review Article, Experience Report and Summary of Thesis. Once approved by the editorial board, the paper is available in the following edition, in PDF format.

## **Results**

From August 2012 to November 2013, 6 issues of the journal and one supplement were published, with 17,190 accessions of the public – Brazilians and foreigners.

## Conclusion

There is a great interest on the part of the scientific and technical community in telemedicine and telehealth area.



**Jornal Brasileiro de TeleSaúde**  
Brazilian Journal of Telehealth

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The Brazilian Journal of Telehealth (Jornal Brasileiro de TeleSaúde) is an official journal of Rio de Janeiro State University. Contributions from around the world are accepted to provide a tool to share on how different countries are using new technology in health care. Sections within the journal include editorials, original articles, reviewing articles and theses abstracts related to research at post-graduate in university programs. A subscription to this journal will help you to stay in touch with Brazilian e-health initiatives and to the fast moving and growing of telehealth solutions and applications. Brazil is now engaged to national and regional e-health programs, including from primary health care to specialized telediagnosis. The Journal is published quarterly in the months of March, June, September and December.

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Figure 1- Brazilian Journal of Telehealth website

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- [2] Brazilian Journal of Telehealth. Access available in [www.jbtelessaude.com.br/jornal/](http://www.jbtelessaude.com.br/jornal/)



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# Confirmation of Proper Endotracheal Tube Placement Using Telemedical Technology: a Technique to Improve Far Forward Airway Management

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## Introduction

For the critically injured patient, establishing the airway is a priority. In battlefield situations, airway management including intubation is often performed by non-physician healthcare providers. These providers require initial training as well as skills maintenance, but these learning opportunities are limited by availability of instructors and location of learners at distant and sometimes front line sites. Several studies have demonstrated the feasibility of telemedicine as a training tool for these situations [1-3]. This investigation demonstrates the use of telemedicine technology to train distant site medical personnel in video laryngoscopy and to confirm proper endotracheal tube placement by tele-bronchoscopy.

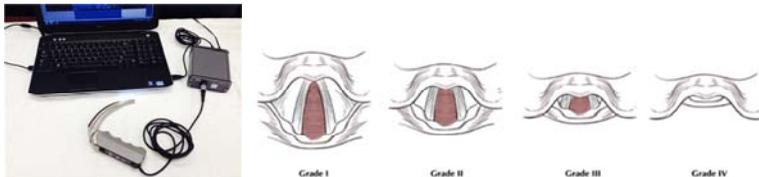


Fig. 1. Video laryngoscope connected to a Karl Storz C- Hub, which transmits images using an Internet based adobe connect videoconferencing program.

Fig. 2. Cormack, Lehane views of the glottic opening as seen during laryngoscopy

## Methods

After IRB approval, advanced practice nursing students at the University of Nebraska Medical Center Simulation Center, Omaha, NE were instructed in how to perform an intubation by an anesthesiologist at Walter Reed National Medical Center using an Adobe Connect video conferencing program. After receiving intubation instruction, each student performed two intubations using a Karl Storz video laryngoscope with a #3 Macintosh blade. During one intubation, the video-viewing monitor was turned away from the student's view so that the instrument functioned as a standard direct laryngoscope. A second video laryngoscopic intubation was performed with the student viewing the monitor. Visualization of each intubation was transmitted to the distant tele-mentoring site by linking the video laryngoscope to a Karl Storz C-HUB which transmitted the images through a standard internet connection using adobe connect (Fig. 1). During intubation, students reported the Cormack, Lehane (C/L) view they observed [4] (Fig. 2). After intubation, a bronchoscope connected to a C-CAM, which linked the video images through the C-HUB allowing transmission to the distant site was passed through the endotracheal lumen by the student under tele-mentoring from the distant site anesthesiologist (Fig. 3). Using visualization of the carina, the distant site anesthesiologist confirmed proper endotracheal tube placement. This was also observed and confirmed by the proximal site instructor.

## Results

Fifteen advanced practice nursing students learning intubation participated in this study. During direct line of vision intubation the average C/L score was 2.5 compared to 1.4 when using video laryngoscopy (Fig. 4). Students were successful in direct intubation 67% of the time compared to 100% successful intubations when using video laryngoscopy (Fig. 5). Students reported a confidence level of performing successful intubation 5.7 compared to



Fig. 3. This picture shows a bronchoscope connected to the C- HUB with a C-CAM. This device transmits the image from the bronchoscope over the Internet using Adobe Connect

8.0 when using video laryngoscopy as reported on a scale of 0 (no confidence) to 10 (high confidence) (Fig. 6).

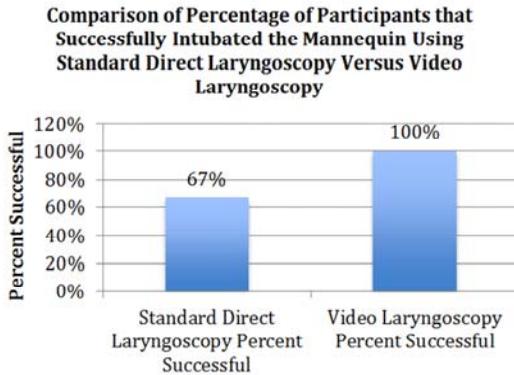


Fig. 4. Comparison of C/L Grade Using Standard Direct Laryngoscopy versus Video Laryngoscopy

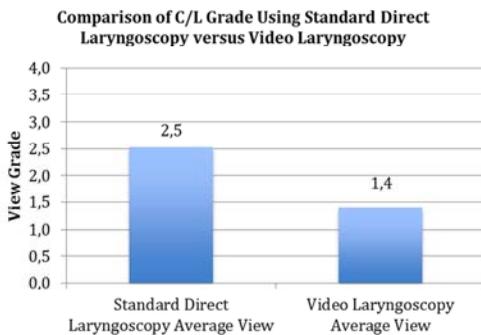


Fig. 5. Comparison of Percentage of Participants that Successfully Intubated the Mannequin Using Standard Direct Laryngoscopy versus Video Laryngoscopy

## Discussion

This study demonstrated that students could be successfully taught to intubate from a distant site via tele-mentoring.

Video laryngoscopy was shown to provide an improved view of the glottic opening during intubation. Success of intubation was improved when using video laryngoscopy. This could be significant when a far forward provider is intubating a difficult airway or when the provider does not routinely intubate patients.

Tele bronchoscopy was demonstrated to allow a distant site anesthesia provider to confirm proper endotracheal tube placement. This procedure has significant potential to confirm proper endotracheal tube placement when intubations are performed in an out of operating room or field situation. This technique can be used to confirm proper endotracheal tube placements prior to transport of a patient, as when confirming proper placement at an air head before a long transport flight. Tele-bronchoscopy as demonstrated here, could be used to

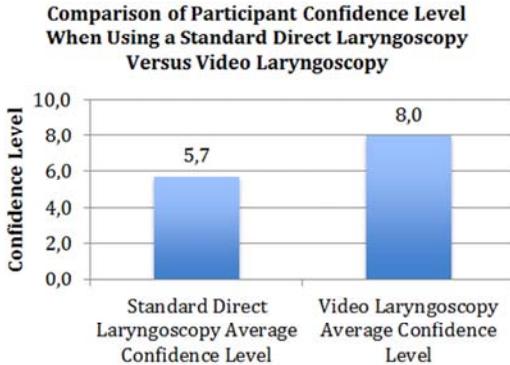


Fig. 6. Comparison of Participant Confidence Level When Using a Standard Direct Laryngoscopy versus Video Laryngoscopy

verify or adjust endotracheal tube placement during a transport, such as a flight, when auscultation is not reliable due to aircraft noise. It could also allow an airway management expert to confirm the proper placement.

In summary, the telemedicine methods used in this study can be used to improve far forward airway management. Tele-mentoring using a video conferencing program such as Adobe Connect can allow an instructor to train medical personnel in a remote area to learn new airway management skills or provide maintenance training. Tele-bronchoscopy can be used to confirm proper endotracheal tube placement in situations such as confirmation at an air head before transport out of a military theatre of operations.

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# **Consumer Perception and Needs of Home Telehealth Services among Dwelling Adults in Taipei**

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## **Introduction**

As medical services and scientific technologies advance, people's average life expectancy has been greatly increased, and population aging has become a global phenomenon. Corresponding with the population ages, prevalences of chronic diseases and disabilities will also increase. In most developed countries, approximately 80% of adults over age 65 years have at least one chronic disease. Of these, 30% have three or more chronic conditions [1-2]. In Taiwan, the elderly population reached 11.2% in 2014 and is expected to rise to 20% by 2025 [3]. Approximately 65% of older adults have at least one chronic disease [4]. The cost of health care will soar because of this trend. Medical expenditures of the National Health Insurance for the elderly population reached 43.6%, which was seven times the cost of all other age groups combined [5]. These changes suggest a need for new care-delivery mechanisms [6-7]. Home telehealth care, using advanced information and communication technologies, has become a mainstream trend in health care for this situation [8-9].

Home telehealth care is defined as remote care delivery or monitoring between a healthcare provider and a patient outside of a clinical health facility, most often in their place of residence [10]. By supporting home telehealth care, it is possible to effectively manage the endemic numbers of people living with chronic diseases, improve access to care, increase work efficiency, and handle clinician shortages, especially of underserved populations [11]. However, some researchers think that telehealth care still has organizational, ethical, design, cost-effectiveness and usability problems, as well as other matters that need to be resolved and innovated [12-14]. Hence, it is not completely accepted in most societies. In case of Taiwan, the Department of Health commissioned a Telecare project in 2007 to manage long-term care needs by utilizing information technologies. Unlike health care systems of western countries, the single-payer, compulsory National Health Insurance system enabled the Taiwanese nearly equal financial access to comprehensive health services and provides all citizens

with financial risk protection from large medical expenses. At the same time, it gives patients the right to freely choose their providers and doctor shopping with minor conditions and multiple physician visits have been resulted. Since telehealth care system with the potential to improve patients' disease management and decrease health care cost, Taiwan's government has therefore initiated the pilot project to enhance citizens' health. The project has been launched in Taipei since 2009. Since the implementation of home telehealth care is still in the pilot testing stage, before it can become a fully implemented effective and efficient alternative care model, consumers' perspectives should be explored. The purpose of this study was to investigate the general public's perception and needs for home telehealth services.

### Methods

A cross-sectional telephone interview was used for research design. The stratified random sampling method using the district's proportion of population over the age of 20 was applied (table 1). Random Digit Dialing was used to select 5,944 households listed in the Taipei telephone directory. A total of 545 adults completed the survey (successful reaching rate=9.20%).

The self-developed survey questionnaire contained four parts with acceptable reliability ( $\alpha = 0.70\sim 0.90$ ) and content validity ( $CVI \geq 0.86$ ). The "Need for home telehealth service" contains 6 items. Each item of the instrument was scored on a 5-point Likert type scale. The mean scores were calculated; a higher score indicates higher perceived needs. The Acceptance of home telehealth service contains five of nominal type items. Finally eleven 3Cs facility items were developed to evaluate subjects' information literacy and age, gender and educational level were used as demographic variables.

Table 1: Sampling distribution structure: District representatives (N=545)

District	Population (%)	Stratified sample size (%)	Sample collected (%)
SongShan	161666 (7.5%)	33 (6.6%)	40 (7.3%)
XinYi	190509 (8.9%)	42 (8.4%)	42 (7.7%)
DaAn	214604 (10.0%)	47 (9.4%)	47 (8.6%)
ZhongShan	178475 (8.3%)	36 (7.2%)	40 (7.3%)
ZhongZheng	112554 (5.3%)	29 (5.8%)	40 (7.3%)
DaTong	105502 (4.9%)	30 (6.0%)	40 (7.3%)
WanHua	168682 (7.9%)	41 (8.2%)	41 (7.5%)
WenShan	205505 (9.6%)	54 (10.8%)	54 (9.9%)

NanGang	104366 (4.9%)	27 (5.4%)	40 (7.3%)
NeiHu	233062 (10.9%)	54 (10.8%)	54 (9.9%)
ShiLiu	250393 (11.7%)	57 (11.4%)	57 (10.5%)
BeiTou	216482 (10.1%)	50 (10.0%)	50 (9.2%)
Total	2141800 (100%)	500 (100%)	545 (100%)

## Results

Subjects in this study were 20-85 years old with a higher representation of female (60.7%). 282 subjects (51.7%) had a college or higher educational preparation, and 138 (25.3%) had received a high school level of education. In surveying subjects' acceptance of home telehealth service, 182 (33.4%) indicated that they had heard of such a service before and 340 (62.4%) represented that this service would make them feel more secure in health. Even though 353 (64.8%) felt the service would be convenient to access and 374 (68.6%) said it will enhance their self-management behavior; on the other hand, 328 (60.2%) indicated they would have concerns in private data protection (table 2).

Table 2 Consumers' Acceptance for Home Telehealth services

Variables	n	%
Do you ever hear of such a service before?		
Yes	182	33.4
No	363	66.6
Do you think this service might make your health more secure?		
Yes	340	62.4
No	107	19.6
It depends	53	9.7
Don't know	44	8.1
Do you think this service can allow you to more easily get care?		
Yes	353	64.8
No	106	19.4
It depends	54	9.9
Don't know	30	5.5
Do you think the service will let your private data not be protected?		
Yes	328	60.2
No	147	27.0
It depends	46	8.4
Don't know	22	4.0
Do you think this service can increase your opportunities for physicians or other health professionals contact you?		

Yes	374	68.6
No	99	18.2
It depends	39	7.2
Don't know	30	5.5

Regarding computer and information literacy, subjects in Taipei have certain standard in the informational equipment and capability. In “Will you feel any difficulty in calling out or receiving call using mobile phone?” 473 (86.79%) expressed no difficulty at all. 512 (93.9%) owned computer equipment at home; 390 (71.6%) said that they can operate the computer by themselves. Up to 279 (51.2%) said that they used 3Cs products daily and 115 (21.1%) was “occasionally used”. Those said that they used it for more than 1 hour daily had reached 55.6%. 318 (58.3%) said that they sometimes use internet search for health and medical information. 397 (72.8%) felt it was important to know how to search for the information. 237 (43.5%) known how to search for useful health information through internet and up to 368 (67.5%) had ever used the internet to register and access to the health service.

Table 3 illustrated majority of subjects agreed with the services provided, with the highest need in daily biomesurements and feedback and health education. Most people (91%) stated that they would not feel the need to use this service currently, but 65% said that they might use it in the future. In terms of willingness to pay, only 192 (35.2%) agreed to pay for 101-500 NTD and 176 (32.3%) agreed to pay less than 100 NTD.

Table 3 Consumers' Needs for Home Telehealth services

Variables	n	%	Mean	SD
Home telehealth service needs to allow you upload blood pressure and blood sugar result as needed?	545		3.72	.97
Strongly agree	85	15.6		
Agree	330	60.6		
Neutral point	32	5.9		
Disagree	89	16.3		
Strongly disagree	9	1.7		
Home telehealth service needs to remind you any abnormal findings in biomeasurements results?			3.95	.90
Strongly agree	545			
Agree	131	24.0		
Neutral point	325	59.6		
Disagree	30	5.5		

Strongly disagree	51	9.4		
	8	1.5		
Home telehealth service needs to provide you with health education?	545		3.86	.90
Strongly agree	99	18.2		
Agree	348	63.9		
Neutral point	27	5.0		
Disagree	63	11.6		
Strongly disagree	8	1.5		
Home telehealth service needs to make health records easily to be downloaded?	545		3.70	1.01
Strongly agree	86	15.8		
Agree	328	60.2		
Neutral point	26	4.8		
Disagree	90	16.5		
Strongly disagree	15	2.8		
Home telehealth service needs to provide consumer health consultation?	545		3.85	.94
Strongly agree	114	20.9		
Agree	323	59.3		
Neutral point	27	5.0		
Disagree	73	13.4		
Strongly disagree	7	1.3		
Home telehealth service needs to notify you community activities?	545		3.76	.93
Strongly agree	82	15.0		
Agree	343	62.9		
Neutral point	32	5.9		
Disagree	81	14.9		
Strongly disagree	7	1.3		
Home telehealth service needs to provide you distanced visit?	545		3.76	.99
Strongly agree	106	19.4		
Agree	309	56.7		
Neutral point	29	5.3		
Disagree	95	17.4		
Strongly disagree	6	1.1		

### Conclusion

The success of home telehealth services implementation depend upon consumers' acceptance of the program. The results of this analysis offer further insights into dwelling adults in Taipei. This survey demonstrated that general publics agree with the concept and potential benefits of home telehealth services when they have information about them. However, few

people are willing to pay out of their own pocket unless the service is very inexpensive. With the high capability of computer literacy, result of this study shows that the largest barrier to the development of home telehealth services is cost. Policy makers and product development of industries should consider results of this study for future implication.

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# **Creating a Business Modelling Tool for Collaboration between Public and Private Partners in a Telemedicine Ecosystem**

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A national initiative, the Telemed.nu project is a collaboration between four Danish Research and Technology Organizations to develop a common national platform for development of open source telemedicine solutions based on international standards.

The telemedicine ecosystem enables interaction between various health IT systems from different companies and across sectors. Through multiple measures Telemed.nu initiates a dialogue between public and private stakeholders to provide a common framework for successful adoption and implementation of telemedicine solutions.

Key challenges identified in the project are the organizational and economical barriers for implementation of new digital health solutions. Making discussions about cost and benefit open are key in creating a platform where incentives and organisational challenges, such as new divisions of roles and responsibilities can be addressed.

Research in this project uses business model generation theory from other industries to create a tool for collaboration and business model development, where partners can discuss investments and revenue structures for development and deployment of telemedicine solutions. The tool is currently being tested with stakeholders, divided into five main categories: regional government (hospital sector), municipal community care, medical device vendors, large EHR system vendors and ICT infrastructure distributors.

The tool will be adjusted to accommodate the stakeholders' different needs in an iterative inclusive process.

The goal of this research is to create a model for business model development, customised to the needs of the different stakeholders but where the main focus is to create innovative value-adding solutions for citizens with chronic conditions.

The Med-E-TEL presentation will present ongoing work with the business modelling tool and discuss relevant tools, techniques and

methodologies in measuring and mapping (inter) organisational cost/benefit in telemedicine.

**Keywords:** Business modelling in telemedicine, ecosystem

# **eDiazorg: Telecommunication to Improve Diabetes Self-Management and Care**

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## Introduction

In Belgium, 8 % of the population has diabetes type 2 [1]. This chronic disease has a large impact on the quality of life of the patient, the healthcare system and budget. Diabetes requires sufficient self-management and ongoing support by a healthcare team. The Belgian government organizes diabetes care in the community by diabetes care paths involving nurses, educators, dieticians and MDs. Consequently, a decent communication, cooperation and task description between all involved health care providers is mandatory [2,3]. However, and in addition to communication problems, health care providers also complain about not knowing the stage of motivation a patient has towards a specific health behavior and the (administrative) paperwork introduced by the care paths. At the patient side, questionnaires sent out to them revealed their need for proper information concerning their disease and the prescribed (oral) medication schema.

The aim of the performed study is to improve the healthcare organization for diabetes patients, their self-management and the quality of life using telecommunication. In addition, improved self-management is at the basis of the beneficiary application of telecare protocols, that are to be supported by the governmental e-health (sub)platforms (both eHealth and VitaLink/InterMed in Belgium).

## Study Setup

This longitudinal single center action research study used interviews and focus groups with diabetes patients and their healthcare workers and explored difficulties in 1) the organization of the diabetes care and 2) the self-management of the patients. A self-management tool for patients based on the trans theoretical model of change [4] (cf. infra) and a communication tool for the healthcare workers and patients was developed by informatics students. Both (digital) tools were pilot tested by diabetes patients and the above mentioned categories of health care providers.

## Results

With respect to diabetes type II patients, one expects that they do understand their disease and cure sufficiently well enough to make them change their behavior themselves [5]. To support and determine the stage of self-management, either by themselves or by a health care provider, the five stages of behavior as defined by Prochaska, DiClemente and Norcross [4] are used: not motivated at all, slightly motivated, moderately motivated, motivated, and determined (in a routine manner). In fact a sixth stage exists as well: it is the complete fallback of the patient, which consequently coincides with the first/second stage.

To overcome the issues mentioned in the introduction, a protocol has been worked out (and implemented by IT students) for the health care providers to a) determine the stage of motivation a patient has towards a specific health behavior, b) how the health care provider has to interact with the patient at that stage, and c) which actions the health care provider can use at the given stage.

The developed protocol defines a set of actions that can be undertaken by either the health care provider using, e.g., motivational interviews with the patients [6] or by the patient him-/herself to proceed from as given stage to the next one. Within this study/defined protocol, we focused on five different health behaviors. They are all typical for patients with diabetes type II, but also useful for other chronic diseases as well (literally or illustrative):

- a. To improve activity (doing sports, walking, ...)
- b. To improve healthy food intake
- c. To improve adherence with oral medication
- d. To improve adherence with insulin or incretinemimeticum injection
- e. To improve monitoring of blood glucose

Specific questionnaires (in Dutch) for each of the stages have been defined to achieve the goals set forward. For obvious reasons we will not list them here in full detail but simply give the next example. The developed protocol advises two actions with respect to activity for the first stage: giving neutral information about their disease and telling them the pros and contras of activity with respect to (the evolution to be expected of) their disease. Finally, the protocol was implemented and used in small pilot groups existing of both health care providers and patients.

#### Remarks/Conclusions

Healthcare providers experienced 1) a lack of time and knowledge to support self-management, 2) a high need to share data between each other and the patient to optimize care and 3) a lack of a platform to share those

data. Diabetes patients experienced a lack of information and support by the healthcare workers.

All respondents, either health care providers or patients, acknowledged the value of both digital tools, i.e. the self-management tool and the communication tool. However the tools need improvement in usability and linkage with the electronic medical and electronic nursing file.

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# e-Prevention in Latin America and the Caribbean

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## Introduction

There are major health inequities in Latin America and the Caribbean (LAC). A number of factors limit access to timely, high-quality medical care. These include lack of human resources, infrastructure, equipment and medications; physical distance and cultural gaps between public health services and the population requiring them; and low family incomes. Income level, location and ethnic origin can lead to the vulnerability and exclusion of millions of the region's households. In addition, the demand structure is changing with the rapid ageing of the population and with the growth of urban areas, particularly medium-sized cities.

This is a joint project from the Care Challenge, connecting nurses, Millennia2025 Foundation in Paris, France, Institute Tropical Medicine Alexander von Humboldt University Peruvian Cayetano Heredia and Pan American Health Organization, Lima, Peru. We hereby present the information and communication technology (ICT) 'revolution' has been hailed as the enabling force for developing countries to become more active participants in the global economy. Developed countries are concern about how to address the dramatic changes in development, urbanization, ageing environmental shifts that are modifying in the diseases for a continuing education in health program.

e-Prevention's goal is to accelerate technology development, deployment, and implementation for sustainability and widespread public health impact. As explained in relation to the remedy of health, there are in turn a series of problems: health professionals concentrated in urban areas and high concentration of resources at all levels of assistance, usually distant from the neediest populations and neglected. Similarly, in remote locations, where a large number of vulnerable people, are presented group of health professionals who need assistance, support and accompaniment in the handling of cases of health problems of the population that will attend , also require a set of actions leading to continuing education, which will allow



Health classes

them to be at a level appropriate to upgrade, to interact with other health professionals and community, for the purpose of providing solutions to the health problems that exist in these populations.



Ministry of Education in the Jungle

### Empowerment Woman and Children

For inhabitants of rural areas, access to medical specialists is problematic, since it requires travel to urban centres where these doctors are located. Such travel is often costly and sometimes impossible for rural residents. However, implementation of telemedicine initiatives has been underway for some time, opening up significant opportunities for specialized care and diagnosis for rural populations.



Using the dialects in health

### Peru Seeks To Win the War on Tuberculosis with the Help of Digital Imaging

In Peru, tuberculosis is considered a national health priority. According to the country's Ministry of Health, over 55,000 cases were reported in 1992. This figure was reduced by 32.7% by 2007, and the goal for 2011 is a further reduction of 50%.

To aid in reaching this goal, an initiative has been undertaken by the CTIC Foundation, based in Spain, and by Peru's Alexander von Humboldt Institute of Tropical Medicine (known by its acronym IMTAvH). The project, dubbed the "Expert System", is designed to facilitate early detection of the disease. The programme can also save resources by providing services at community hospitals and health centres, making it possible to make diagnoses without transporting the patients.

The system is based on 1,600 sputum smears from TB patients, which are used to develop an algorithm employing 1,600 catalogued microscopic images of bacilli. Each image will have a legend providing as much information as possible.

Once the algorithm has been developed and the images have been input, software will be transferred to IMTAvH to validate the system in a real environment with patients from the district of San Juan de Lurigancho — Peru's most populous district, with a population of one million. In this



Work group: health / education in the communities (leaders)

phase, people will be examined and diagnosed both by the Institute's personnel and by the Expert System, in order to assess the system's accuracy in a real-world setting.

The technology is simple to handle, with medical centre personnel requiring no more than a computer and a printer to use it.



More than 800,000 OLPC-XO in the schools – Peru, next step: creation the contents in

Innovative

Technological integration, in order to improve the quality of education through access to a central web-page and interconnection with the national network in coordination with the Ministry of Education / Health is the

innovation. This will enable teachers, administrative staff and students to share information internally, as well as accessing the home page and the Internet.

## Results

We are provides of various platforms, free to guide by bridging the path between innovation. e-Prevention's goal is to accelerate technology development, deployment, and implementation for sustainability and widespread public health impact. Education system health is supposed to have the greatest priority from the government, investors, thinkers and scientists within the next period as it is the most important parameter that will make a real change in our society.



Team work group

## Additional information

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Nationals and Internationals

# Evasion in Distance Education Courses

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*Abstract:* The aim of this study is to understand the general profile and causes of dropout students in a specialization course by distance learning modality. 32 dentists who voluntarily completed a form available on the course platform participated in the survey. 53% of professionals were in the age group between 26 and 35 years, 16% were aged between 61 and 65 years. 60% of study participants were male. 62.5% were married and 31.3% single. Fifteen (15) professionals had children (54%). Most participants had gotten their undergraduate degree more than 12 years ago (67.0%). 62.5% held a graduate degree, and only 5 dentists (25%) had expertise in the Public Health area. The contract appears to be the most prevalent employment (40%), mainly through the Social Health Organizations. Twenty-three had professional experience in Family Health. Of these, 15 (65%) had 1 to 5 years of experience in strategy. Access to information and course registration happened to 13 dentists indicated by the manager (48%). Of the remaining 14 respondents (52%), 9 (64%) had access to information and browsed across the Internet. 23 professionals (82%) did not get a study leave from their employees in order to devote full time to the course. Lack of time appears as the most prevalent and determinant reason for personal avoidance, followed by family problems. Among the didactic and pedagogical factors that led to the dropouts of the course, we can mention the difficulty of adapting to the method and its tools, as well as the lack of communication and integration with the tutor. It is concluded that professionals were mostly young, with experience in the FHS, but without necessarily qualifying area. Lack of time appears as an important factor in the dropout process, thus being the participation and awareness of municipal managers an important step for the permanence of the professional in the course. Moreover, the team responsible for the course must be more careful with the adaptation and needs of students to the educational method, seeking greater integration with them.

Introduction

Distance Education can be defined as "a mode of education in which the teaching-learning activities are developed largely without students and teachers being present in the same space and time" [1].

Among its main objectives, Distance Education permits a peculiar autonomy to the student, what rarely happens within the traditional structure of education. Therefore, distance education presents some modifications to the teaching / learning relationship, autonomy and needs of teachers and students who are taking part in this modality of learning [2].

Distance Education is a type of teaching/learning process which requires strong motivation from the student and high training from the teachers, it also requires a certain degree of discipline from both, and the good results are usually linked to the maturity of the people involved - students, technicians, teachers and TAs.

Brazilian Law No. 9394 of Guidelines and Bases of National [3] Education regulates the practice of Distance Education in various spheres of education, and it determines that it should be used as supplementary learning.

In health, we can observe several initiatives focused on Distance Education mode, and its presence is grounded in graduate courses, undergraduate subjects, community programs and strategies especially in continuing education.

Many authors report that not only distance education, but also regular courses face attendance problems concerning students dropout [4, 6], however, they also state that such invasion problem should not be seen as inevitable or even inherent to this mode of teaching and learning, but as a problem inherent to the management of distance learning courses [5].

An investigative study of the causes of dropouts in an undergraduate distance course from a public university in Brazil found that most of the factors that influence the evasion are external to the course itself, for instance: personal reasons, mismanagement of time to devote to the course; health problems; prioritizing other activities, among others [7].

It is up to educators and researchers - who are directly working in this area - seek to identify the causes and prevent their incidence in order to try to reduce them. The graduation is interesting not only for students but also for the government, as it invests lots of resources in this kind of courses, such as the ones investigated in this study. The government invests resources in these educational activities aiming at increasing access to education in the country [5].

The aim of this study was to understand the general profile and causes for students drop out of a graduate course, distance learning modality.

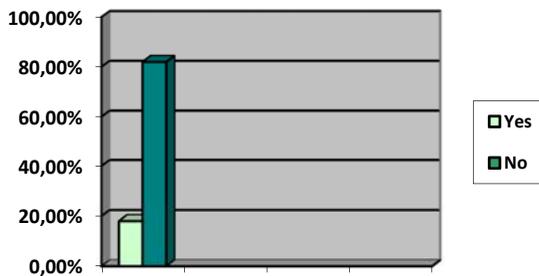
## Methodology

The methodology employed in this study was exploratory and descriptive. There were 32 dentists who voluntarily completed a form with open and closed questions. The form was available on the course platform.

## Results

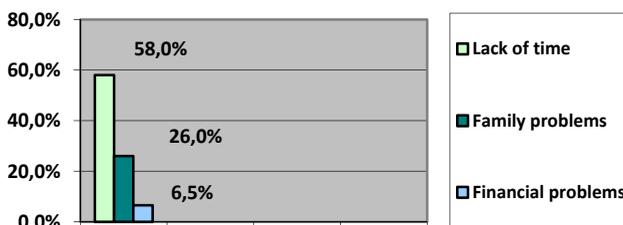
The majority of professionals surveyed (53%) were aged between 26 and 35 years and they were male (60.0%). The contract appears to be the most prevalent way of employment (40%), mainly through the Social Health Organizations. Most participants had gotten the undergraduate degree more than 12 years ago (67.0%). It was observed that 23 professionals (82%) did not get a study leave form their employees to devote to full time to the course (Graph 1). Lack of time appears as the most prevalent personal reason for student evasion, followed by family problems (Graph 2). Among the didactic and pedagogical factors that led to the withdrawal of the course, one can cite the difficulty of adapting the method and its tools, as well as the lack of communication and integration with the tutor. (Graph 3)

Graph 1: Paid study leave from work to have full time dedication to the course



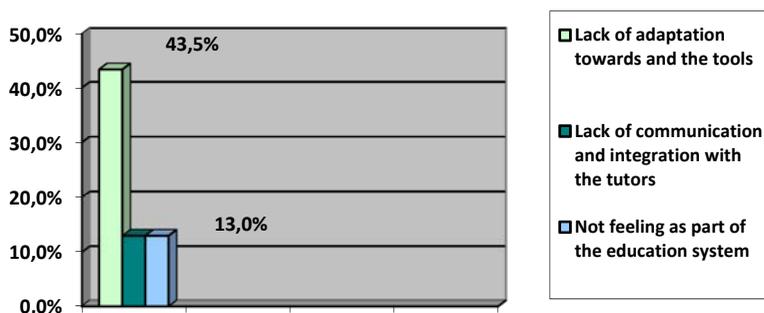
Source: Graduate Course in Family Health UnaSus/Uerj (2012/2013)

Graph 2: Personal Problems that lead to student dropout.



Source: Graduate Course in Family Health UnaSus/Uerj (2012/2013)

Graph 3: Didactic and pedagogical factors that led to dropouts.



Source: Graduate Course in Family and Health UnaSus/Uerj (2012/2013)

### Conclusion

Lack of time appears to be an important factor in the dropout process, thus the participation and awareness of municipal managers seem to be an important step for the permanence of the professionals in the course. Moreover, the team responsible for the course must be more careful when it comes to help the students with their adaptation process to the education method and all their needs, seeking greater integration with them.

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# Factors Influencing the Implementation of Electronically-Delivered Patient Reported Outcomes for Chronic Diseases

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## Introduction

Traditional medical outcomes have mainly focused on physiological endpoints that often do not capture these critical aspects of living with a chronic disease. Patient-reported outcomes (PROs) consist of information provided by the patients on their quality of life, functioning and well-being, without any interpretation from a healthcare professional. The implementation of PROs has been suboptimal previously and only recently has there been renewed interest to study their integration in clinical practice and research. PROs can facilitate communication and the patient-centred model of care by providing a unique insight into one's health status and by systematically collecting personal data on symptoms, particularly for those patients with chronic diseases and multimorbidity.

Internet- and electronically-delivered PROs (ePROs) have several advantages over the traditional distribution of paper-and-pencil based assessment.

The responses to PROs may be affected by different factors, such as the way information is collected, the amount of effort it takes to respond to a question, the willingness of the patient and the respondent characteristics, including the health literacy level.

## Aim

The aim of this presentation is to report on the factors that may influence the implementation of ePROs for the management of chronic diseases.

## Methods

A review of the literature will be carried out to identify the articles that include the keyword "patient-reported outcomes" in their abstract and are indexed under the "Information Science" MeSH major topic. Publications related only to acute conditions and opinion articles will be excluded. The selected articles will be analysed to identify those factors that can affect the integration of ePROs in a workflow for the management of patients affected by chronic diseases.

## Expected Outcomes

The review will identify the most notable factors affecting the implementation of ePROs.

Keywords: patient-reported outcomes, Internet, chronic diseases

# **Health 2.0 Workshop at the International Federation of Medical Students' Associations General Assembly: A Starting Point for Raising Awareness about the Relationship between Information Communication Technology and Health Care among Medical Students**

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## **Introduction and IFMSA Commitment**

Health care has been deeply transformed by digital revolution at every level and many new paradigms allowed by the application of Electronic Health Records (EHR) and Information and Communication Technologies (ICT) in medicine are already mainstream in the everyday medical practice.

The young students and doctors are expected to have a deep understanding of eHealth and its implications. eHealth topic do not receive the deserved attention by the average medical student, and this is not acceptable in a generation of future doctors that is going to be deeply influenced by these technologies.

The International Federation of Medical Students' Associations (IFMSA), the leading and largest medical students' association in the world, with over 1,2 million students represented worldwide and 108 National Member Organizations (NMOs) from 102 countries, decided to advocate to increase the awareness about eHealth among medical students from all over the world.

During the IFMSA 63rd General Assembly (GA) March 2014, held in Hammamet, Tunisia, hosted by the local National Member Organization AssociaMed-Tunisia, IFMSA has tackled the eHealth topic with three initiatives: Policy Statement about eHealth has been approved, a 3 day workshop about eHealth was run in the days before the GA (preGA Health 2.0 Workshop), discussion about the role of the IFMSA Technology Officers as first advocate. These initiatives have been realized thanks to the collaboration between IFMSA and ISfTeH (International Society of Telemedicine and eHealth) and WHO. ISfTeH encourages the involvement of medical students recognizing the potential to facilitate its dissemination.

As future professionals, IFMSA students are aware of this new field of assistance and education, which moreover can help in reducing the assistance gap in less privilege and remote countries, where there is lack of expertise and equipment. Non formal education plays a crucial role for promoting changes and developing key opinion leaders.

### Policy Statement

Bearing in mind that there are several components of eHealth, namely: leadership and governance; strategy and investment; legislation, policy and compliance; human resources; standards and interoperability; infrastructure; and solutions or applications and services [1], in which students would play a role as well, a Policy Statement on eHealth was approved during the General Assembly. This happened also with students aware of many good applications of eHealth such as the Health Ministry of Kenya developing the “Kenya National e-Health Strategy 2011-2017” [4]; Ethiopia’s effort of on health management information systems, electronic medical records, human resources information systems (HRIS), and telemedicine [5]; the development achieved in tele-medicine in countries such as Brazil [6] and Cape Verde [7]; the development of eHealth in India [6] and mHealth in Bangladesh [8]. IFMSA students will also develop ethical guidelines for medical students and physicians who use eHealth to provide health care services [10] and to protect the private health information of all patients [9].

### PreGA Health 2.0 Workshop

The workshop has been organized by: I. Di Salvo, IFMSA Liaison Officer for Research and Medical Associations; O. Cherkaoui, IFMSA New Technology Support Division Director; S. Buttigieg, past IFMSA New Technology Support Division Director, currently freelance mobile developer, A. D’ Ambrosio, past Information Technology Group Coordinator for SISM (IFMSA Italy), currently epidemiologist at the Pediatric Hospital Bambino Gesù; Alexander Carlström, Vice-President on Internal Affairs for AMSA (IFMSA Austria).

During Day 1 many example of how technology is changing how physician and patients approach health care were introduced. Dr. Al-Shorbaji made a presentation through video conference on how health information is distributed to doctors and patients in a modern medical environment. This intervention was followed by a discussion on effects of mobile technologies in the doctor every day work and in patient own care. This is brought to the extreme by the Quantified Self movement. Dr. Tozzi, then gave us an interesting example on how eHealth will change the pediatrician medical practice in the next years. On day 2 was shown how

the internet can change the way Medical Education is approached exploring several platforms. Via online streaming Dr. Etienne from ISfTeH showed how medicine by problems can be taught via tele learning. The day was concluded with F. Falkenbach, Technology Lead of the Open Access Button presentation of Open Access paradigm and a general overview of eHealth impact on Research. On day 3 the effects of ICTs on broader aspects of health were investigated. Dr Molefi, from South Africa described the effects that a modern approach to health care is having in a low-income area. Dr. Dzeowagis discussed how Information Technology is allowing a paradigm shift in resources allocation in medicine, rendering easier and more economic feasible a Health Care based on prevention and chronic diseases, which is where we should go. Disaster Medicine is another field where technology can bring great advantages and simulation tools for disaster management where shown thanks to Dr. Ragazzoni. Then the possibilities brought by more and more advanced computing power were shown, discussing about how new sciences like Big Data and Digital Epidemiology could help tackle many important Public Health issues. Alongside these topics, during the workshop also took part a practical introductory course on mobile medical apps developments, kept by Stefan Buttigieg, where the projectuality bases of smartphones development were presented. The participants had to create a project about a mobile medical app during the workshop, to be presented on the 3rd day. The results have been fairly positive. The students presented a tool to teach kids how to use asthma inhalers and a patient oriented drug leaflet app.

#### Redefinition of IFMSA Technology Officer's Role

IFMSA and its NMOs have officers whose responsibility is technical, and internet based infrastructures of the associations. Since this GA we started to create a framework with the goal to redefine and make uniform the role of this position within IFMSA as main advocate regarding eHealth.

#### Conclusion

IFMSA strongly supports the advancement and accessibility to the use of e-health, to deliver health and healthcare services and information over large and small distances [3]. We, as IFMSA, believe that the obstacles that currently hold back the further implementation of eHealth, can be dealt with by better collaboration between different stakeholders in the health care sector. All of those actions are necessary also to provide access to e-health trainings within undergraduate and postgraduate medical education, to offer access to additional training in e-health to practicing physicians, to invest in the widespread of affordable phone and internet coverage as much as

possible, to raise awareness on the benefits of e-health and to invest in infrastructure to provide access to all to participate in e-health.

Governments and Health Systems leaders should take responsibility in making sure these practices reach rural and vulnerable populations and to monitor and improve the standards of Practice/Quality of Clinical Care in order to achieve the best clinical outcomes, as well as protecting patient confidentiality and applying relevant legislation and regulations related to patient decision-making and consent.

### Declaration of Conflict of Interests

The authors declare that there is no conflict of interest regarding this article.

### Acknowledgment

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# **Journal of the International Society for Telemedicine and eHealth**

Malina Jordanova<sup>1,2</sup>, Richard Scott<sup>1,3,4</sup>, Maurice Mars<sup>1,3</sup>

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## Introduction

The International Society for Telemedicine and eHealth (ISfTeH) exists to facilitate the international dissemination of knowledge and experience in Telemedicine and eHealth, to provide access to recognized experts in the field worldwide, and to offer unprecedented networking opportunities. The Journal of the International Society for Telemedicine and eHealth (JISfTeH) is one of the instruments that help the ISfTeH to realize this mission.

The first issue of the Journal was published in 2013.

## Scope of the JISfTeH

JISfTeH is set up as an international peer-reviewed journal covering the full spectrum of applications of Telemedicine and eHealth.

The journal accepts original research papers, critical reviews and preliminary reports on all aspects of Telemedicine and eHealth including informatics and related topics.

The Journal encourages the submission of papers that focus on research outcomes showing clinical benefits, cost effects, quality of life benefits, or that focus on practical experiences from clinician, care provider, patient/user, insurances, etc. The newly emerging topic of telehealth is not neglected, too. Introduced recently, telehealth is focused on the means by which technologies and related services at a distance are accessed by or provided for people and/or their careers at home or in the wider community, in order to facilitate their empowerment, assessment or the provision of care and/or support in relation to needs associated with their health (including clinical health) and well-being. Telehealth always involves and includes the service user or the client.

## Where to Find JISfTeH

The journal is available at ISfTeH web site <http://www.isfteh.org/> as well as at <http://journals.ukzn.ac.za/index.php/JISfTeH/> (Fig. 1 and 2).

The Journal is hosted on a server at the University of KwaZulu-Natal, South Africa.



Fig. 1 JISfTeH accessed via ISfTeH website

### An Open Source Journal

The journal has been set up as an open access electronic journal using Open Journal Systems 2.3.8.0. This is an open source journal management and publishing software developed, supported, and freely distributed by the Public Knowledge Project under the GNU General Public License.



Fig. 2 JISfTeH website

Open Journal System was chosen as the creators of the journal firmly believe that open access journals will improve the quality and reach of scholarly publishing, information exchange and education.

### User Friendliness

The Journal is created to be extremely user-friendly.

The content of the Journal is accessed for free.

The Journal has a review process of less than four weeks and an immediate publication policy, i.e. as soon as papers are finally accepted and have undergone copy-editing, they are posted online.

In addition, the journal website provides a search engine. Journal content is searchable by issue, author, title or even by pre-defined keywords and phrases!

#### Audience

The journal is focusing on vast audience – healthcare providers and stakeholders, telemedicine and eHealth specialist, decision makers, experts in telecommunications technology and R&D; patients, students, etc.

#### Conclusion

Currently the JISfTeH is indexed in Google Scholar and the Directory of Open Access Journals. Its ISSN is 2308-0310.

The past 3 issues are easily found at <http://journals.ukzn.ac.za/index.php/JISfTeH/issue/archive>

The first issue for 2014 is on the pipeline. The interest towards the journal is steadily growing.

If you would like to hear about current applications and best practice examples, see a glimpse of future trends in Telemedicine and eHealth, and their effect on the healthcare system as a whole, receive and an update on new developments that will allow you to stay ahead and make more effective and efficient use of technologies to improve quality of health, medical and social care – this is your journal!

# Learning Opportunities: Teledentistry Contributions to Continuing Education in Brazil

M. M. P Rendeiro<sup>1</sup>, A. M. Monteiro<sup>1</sup>, R. Postorivo<sup>2</sup>, R. R. Jorge<sup>1</sup>, M. I. C. Souza<sup>1</sup>

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***Abstract:* Brazil has continental dimensions, it is the fifth country in size in the world. Currently, its population is estimated at 190 million people, who live in 26 States divided into 5 different regions, there are 5,563 municipalities, all of them with considerable regional differences, regarding access to education and health services. Political analysts emphasize economic growth, political stability and poverty reduction as some of the main positive Brazilian characteristics. Health is known as a universal right and the implementation of a National Dental Health Policy has been developed in Brazil since 2004. Some challenges faced by the States have also highlighted the need for Continuing Education development, in order to improve all the required skills to operate in the Brazilian Unified Health System - SUS. The program named Telehealth Networks Brazil / UERJ has offered in a systematic way, some distance educational activities, such as virtual seminars and community coursework. The objective of this study was to get to know and map the pattern of access to these two different courses, in order to verify their nationwide reach. We have selected the two most accessible courses: "Pediatric Dentistry" (ODO, in Portuguese Odontopediatria) and "Atraumatic Restorative Treatment" (TRA, in portuguese Tratamento Restaurador Atraumático) and the information about the number of enrollees and place for residence for the years 2011, 2012 and 2013. We have organized all data in an Excell spreadsheet and analyzed them according to the percentage. For the course named as TRA, from the total number of participants (877), 63% are from the Southeastern region of Brazil, 23 % are from the Northeastern region and 9% are from the Southern region. The Central-West and South have shown fewer participants (1% and 4% respectively). For the ODO course, considering the total number of participants (709), 43% are from the Northeast, 27% from the Southeast and 20% from the South. North and Central-West have shown a smaller share (5% each). Based**

**on the data, we conclude that the courses offered and analyzed by Brazil Telehealth Networks/UERJ, located in Rio de Janeiro, Southeastern Region have national representation, offering learning opportunities for all dental professionals from all regions of Brazil.**

### Introduction

Brazil has continental dimensions, it is the fifth country in size in the world. Currently, its population is estimated at 190 million people, who live in 26 States divided into 5 different regions, there are 5,563 municipalities, all of them with considerable regional differences, regarding access to education and health services. Political analysts emphasize economic growth, political stability and poverty reduction as some of the main positive Brazilian characteristics. Health is known as a universal right and the implementation of a National Dental Health Policy has been developed in Brazil since 2004. Some challenges faced by the States have also highlighted the need for Continuing Education development, in order to improve all the required skills to operate in the Brazilian Unified Health System - SUS. The program named Telehealth Networks Brazil / UERJ has offered in a systematic way, some distance educational activities, such as virtual seminars and community coursework [1].

We can also mention some of the challenges of organizing courses mediated by Distance Learning Education tools such as: the articulation of theoretical orientation and practice in public health services, not only on an individual, but also on a collective level with the participation of the largest possible number of different disciplines, and the articulation among services and research and educational activities that are part of a network of health care focused on the needs of primary care, especially in the Family Health Strategy, seeking to strengthen the comprehensiveness of care [2-3].

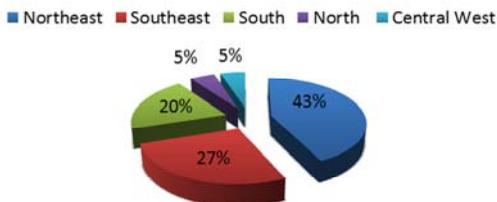
### Methodology

This paper intended to evaluate, know and map the pattern of access to these two different courses, in order to verify their nationwide reach. We have selected the two most accessible courses: "Pediatric Dentistry" (ODO, in Portuguese *Odontopediatria*) and "Atraumatic Restorative Treatment" (TRA, in Portuguese *Tratamento Restaurador Atraumático*) and the information about the number of enrollees and place of residence for the years 2011, 2012 and 2013. That data was organized in an Excel spreadsheet and analyzed in relation to the frequency percentage.

### Results

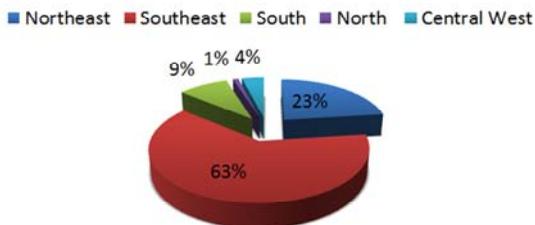
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### Brazil regions



Graphic 1: Pediatric Dentistry Course accesses in 2011 to 2013 by Brazil regions

### Brazil regions



Graphic 2: ART (Atraumatic Restorative Dentistry) Course accesses in 2011 to 2013 by Brazil regions

43% are from the Northeast, 27% from the Southeast and 20% from the South. North and Central-West have shown a smaller share (5% each).

### Conclusion

According to these outcomes, it is possible to conclude that the courses offered and analyzed by Brazil Telehealth Networks/UERJ, located in Rio de Janeiro, Southeastern Region have national scope, offering learning opportunities for

all dental professional from all regions of Brazil.

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# Pressure Ulcer: Software Integration for Development of Interactive Content to Moodle

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**Abstract:** This exploratory descriptive study aimed to evaluate the integration of software which enables the creation and broadcasting of interactive exercises for educational purposes, the Virtual Learning Environment (VLE) Moodle.

## Introduction

The thematic of pressure ulcer (PU) has been extensively worked on educational aspect in nursing area. Most of PU can be prevented by the adoption of appropriate measures for patient care [1] and education, aimed at nursing students who will be future professionals.

For reduction of the PU indexes, it is necessary that the risk factors of patients are known so that preventive measures are implemented [1-2].

## Methods / Procedures

Descriptive study was conducted in a public university in the state of São Paulo, after the Research Ethics Committee approval. First we have reviewed the literature on risk factors and preventative measures to Pressure Ulcer. Later exercises were developed in software using the four formats of existing content available on the same: scrambled word, sentence scrambled text with gaps and loopholes items. Participants were 3 professionals who evaluated the computer software as their technical and operational characteristics and the characteristics of integration to Moodle. For this evaluation, the participants responded to the instrument adapted Sperandio [3]. The data were analyzed quantitatively. They were coded for elaboration of a data dictionary and after were transcribed with the process of double entry in Microsoft Excel. We performed descriptive statistical analysis of the data, with absolute frequency and percentage.

## Results

There were two exercises available for each content format. These were entered into the software. All survey participants were male with a mean age of 43.3 years (SD = 7.09), the majority (66.6%) with formation time between 11 and 20 years. To access the software necessary to install the program Java version 7, update 9 + add Java fx 202, this was the biggest problem for software execution, once took time and did not accept recent updates, according to information of the subjects. Only 10 (30.30%) of the 33 questions of the instrument had the "agreement" of the participants in a percentage > 50%. The question "is easy to install VLE Moodle?" got only 33.3% "agree". One subject failed to make the software work within Moodle, it described the screen went blank after the loading of Java in the three major browsers: IE, Firefox and Chrome. In addition, participants reported that "the software is not in accordance with the standards of portability between browsers and among other versions of Java" and "use older plug-ins for their execution."

## Conclusion

With these results we can conclude that, despite the software built with the purpose to enable the preparation and serving of interactive exercises for educational purposes to be a viable tool for teaching and learning, it is not feasible to install the Moodle VLE due to its format, failures presented and operational data.

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# **Reaching Remote and Disadvantaged Communities at Scale with ICT: SOS Telemedicina Venezuela**

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Venezuela is characterized by marked inequality in the availability of medical services across rural populations.

The “SOS Telemedicina para Venezuela” programme led by the Faculty of Medicine in the Universidad Central de Venezuela (UCV), has set up a Telemedicine network that makes use of information and communication technologies (ICTs), equipping and connecting remote centres for primary care with medical specialists from the UCV to improve their capacity to deal with clinical problems, to provide distance education, to support technology transfer to these regions, to develop skills and to evaluate the benefits of Telemedicine in Venezuela.

The SOS methodology includes research in telehealth, tele-education, software engineering, telecommunications engineering, the processes of tele-consulting and tele-diagnosis, technical platforms, issues in deployment and management, user requirements, integration with social networks and relations with academic, governmental and commercial business organizations.

After five years of implementation of the SOS Telemedicine for Venezuela Programme, we have achieved a clearly conceptualized programme, financing and a committed team.

35 health centres benefiting from links to the Faculty of Medicine in the Universidad Central de Venezuela, from the technical platform for telemedicine and tele-education, and from the support from the University and regional health authorities as well as from the strong alliance with commercial business organizations (HP, CISCO, Microsoft, Digitel).

“SOS Telemedicine for Venezuela” has succeeded in demonstrating that, with the commitment of the different stakeholders, and the appropriate use of Information and Communication Technologies (ICTs) it is possible to offers support for doctors, residents and healthcare staff, to use the network to provide continuing medical education for the benefit of patients, providing specialist medical attention as a contribution to human development.

The latest project part aims to minimize maternal mortality. It uses mobile GIS to monitor mothers in rural centres in the Amazon from the hub in the University Medical School, and uses a range of media to educate rural workers, including short video clips.

# **Telehealth Brazil Networks Program RJ-UERJ Nucleus: Satisfaction Survey of Brazilian health Professionals in the Use of Distance Learning Courses as a Means to Professional Development**

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## **Introduction**

In a country of continental dimensions like Brazil, distance learning courses may enable digital inclusion largely contributing to professional qualification. In this context, the Rio de Janeiro State Nucleus- UERJ1 of the Telehealth Brazil Networks Program2 offers courses for upgrading of primary health care professionals working in the Brazilian Unified Health System (SUS). The purpose of this paper is to present quantitative and qualitative results of a satisfaction survey applied to course participants.

## **Materials and Methods**

Exclusively professional distance updating courses with a workload of 15 hours.

Data collection was performed by analyzing the proper forms developed by the staff; the forms were made available individually for each course. The questions were the following: “Have you ever made any distance learning?”, “What’s your type of internet connection?”, “Were you familiar with the subject matter covered in the course?”, “The course reached your expectation?”, “Did you have any trouble accessing the course material?”, “What were your biggest challenges?” and “Do you intended to make other courses?”

## **Results**

From June 2010 to November 2013, 18.368 professionals conducted 71.370 entries in total of 36 courses.

Of these, only 9.318 participants answered the questionnaires for analysis. 70% of professionals had already attended some distance course, and from these 47% had attended 2-5 courses. To access, 77% used broadband, 10% used Internet radio, 10% used mobile Internet (3G) and 3% used dial-up

Internet. Concerning courses subjects, 80% had knowledge of the subject matter covered.

The course reached the expectation of 96% of the participants. In the assessment of difficulties, 84% found no difficulty when accessing the course material, 35% found difficulty when issuing the certificate, 29% found difficult to access the lessons, 24% found difficult to understanding the methodology and 12% found difficulty for performing the tests. 99.5% of the professionals plan to do other courses.

### Conclusion

Although there are still limitations in the speed of the Internet there is also a high degree of user satisfaction with this way of learning.

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# Satisfaction Survey



Have you ever made any distance learning?



70%

had already attended

of these  
47%

had attended  
2-5 courses



What's your type of internet connection?

77% **Broadband**

10% **Internet radio**

10% **Mobile Internet (3G)**

3% **Dial-up Internet**



Were you familiar with the subject matter covered in the course?



80%

have knowledge of the subject



The course reached your expectation?

99,5%

Professionals plan to do other courses



96% reached the expectation



84% found **NO** difficulty when accessing the course material



35% found difficulty when issuing the certificate



29% found difficult to access the lessons



29% found difficult to understanding the methodology



12% found difficulty for performing the tests

Figure 1- Results of the Satisfaction Survey of Brazilian health professionals

# **Telehealth Brazil Networks Program RJ-UERJ Nucleus: Satisfaction Survey of Health Professionals as Users of a Teleconsulting System (SIATES) in Primary Health Care**

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## **Introduction**

SIATES is a teleconsulting support system directed to specific health issues in primary health care. This system was developed by the team of the Telehealth Center of Rio de Janeiro State University<sup>1</sup> in order to provide specialized second-opinion [1-2] to health professionals working in primary health care in the Brazilian Unified Health System (SUS). The aim of this paper is to present quantitative and qualitative results of satisfaction survey applied to SIATES users.

## **Materials and Methods**

The operational process of teleconsulting includes the use of a web system in which texts, clinical information, files and images can be sent either when the question is made or answered. The questions are grouped into "clinical case", "general practitioner doubt", "family and/or community approach", "team work process" and "continuous learning at work". At the end of this process, the user is prompted to fill out an online evaluation form in which the following questions are made: "The use of teleconsulting modified your personal conduct?", "Did it avoid referrals?", "Would you like another type of expert?"

## **Results**

The nursing was the most prevalent group which filled out the form (45.6%), followed by physicians (30.3%) and dentists (13.3%), among other professions (10.8%). In the relationship between the frequency of the type of questions and modification of personal conduct, "general practitioners doubts" was the dominant (65.9%), followed by "clinical case" and "family/community approach", both with 8.6%; "team work process" got 7.9% and continuing education, 5.6%. There was avoidance routing of patients in 69.4% of general clinical questions and in 7.2% of clinical cases,

and the physicians were the professionals that most avoided referral (45.5%), followed by nurses (43.2%) and dentists (11.3%). Regarding the demand of the specialist, the physician was the most prevalent (40.4%), followed by nurses (39.4%) and dentists (9.6%). The cardiologist was the most requested specialist (13.0%), followed by the dermatologist (10.1%) and the neurologist (8.7%).

### Conclusion

Teleconsulting effectively changes the practice of health professionals by reducing referrals and qualifying service in basic health units.

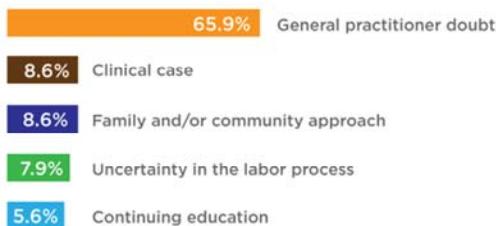
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**TYPE of QUESTIONS**



Most prevalent groups that made QUESTIONS



**AVOIDANCE ROUTING of patients**



professionals that most avoided referrals



most requested specialist



demand of the specialist

physicians requested (40.4%), nurses (39.4%) and dentists (9.6%).

Figure 1- Results of the Satisfaction Survey of Brazilian health professionals

# Telecare Manual for Neurogenic Bladder Patients Using Intermittent Urethral Catheterization

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**Abstract:** Telenursing has accompanied the technological trend towards globalization and has been equipping nurses, mainly in places of more difficult access, whether in care, research or teaching. The result of this scientific study was a systemized guide to speed up nurses' actions in a safe and efficient manner.

## Introduction

Telenursing is the use of information and communication technology resources to expand nursing actions. It promotes the feasibility of resources, time and space to complement health care and education for the community. Different international studies evidence its use as an important strategy for teaching, research and care delivery to the population, mainly in countries that represent great barriers in terms of geography, material and qualified human resources [1-3].

The construction of a theoretical framework to support telecare in nursing is fundamental to enable nurses to deliver organized and systematic care, promoting the expansion and strengthening of telenursing, mainly in countries where this practice has not been consolidated yet.

Objective: To construct a telenursing manual to support nurses in telecare delivery to neurogenic bladder patients who use clean intermittent urethral catheterization.

## Method

An integrative review [4] 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 and technological resources are used in telenursing research.

The main telenursing practices for patients with chronic illnesses were surveyed in the literature, selecting the most compatible resources and the theory that best sustains nursing care when providing orientations to

neurogenic bladder patients who use intermittent urethral catheterization. The manual was constructed and subject to face and content validation by experts in the area [5].

To select the group of experts, the criteria by Fehring [6] were used, who assesses the degrees obtained during the professionals' careers to be defined as experts. Each degree receives a score, with a maximum total of 14. To consider a professional an expert, (s)he needs at least a Master's degree and a minimum total score of five. The instrument used to assess the manual was adapted from Ferreira [7]. The data were discussed in the light of the literature according to the research objectives.

## Results

The manual included the main video call, audio call and text message resources available through the web, as well as audio calls with a free local telephone system for patients to contact the nurse who received training for telecare and clean intermittent urethral catheterization. It was verified that neurogenic bladder patients present self-care deficits, and Orem's General Nursing Theory [8] was selected to support the nursing consultations.

A step-by-step guideline was elaborated for the use of the technological resources selected for the communication between nurses and patients, so as to make it easier and motivate the professional to use this care strategy. In addition, the reference framework by the College of Nurses of Ontario published in the *Practice Guideline: Telepractice* [9] was discussed, so as to support the nurses for telecare delivery.

## Discussion

The elaboration of educative materials or protocols that support and systemize nursing work is fundamental to guarantee a better quality of health care, as well as a form to encourage the search for professional training with a view to specialized care delivery.

Telenursing is a fundamental health promotion strategy, mainly in places distant from specialized centers, where patients' access to treatment and qualified professionals is difficult. In addition, chronic illness with greater difficulties for the patient to maintain treatment may benefit further from this type of treatment [10-11].

Patients who develop a neurogenic bladder have impaired self-care abilities and need help to maintain their own health. Also, they start to use clean intermittent urethral catheterization several times per day, a procedure that demands discipline from the patient in order to be accomplished under appropriate conditions [11-12].

In telecare practice for neurogenic bladder patients, Orem's nursing theory helps the nurses to identify when the individuals are unable to fully or partially accomplish their self-care, offering conditions to plan nursing actions in the attempt to recover or compensate for that impaired self-care [8].

Another important aspect addressed in the construction of the manual is the use of a protocol for clean intermittent urethral catheterization to systemize this procedure among the nurses, so as to guarantee the correct technique for its performance by the patients.

### Conclusions

The development of ICTs (Information and Communication Technologies) enhances the opening of new areas which nursing should use for individual health promotion, recovery and maintenance. The organization of protocols and manuals that help to apply these resources in an organized manner, so as to enable nurses to promote high-quality care, is a strategy that should be sought, practiced and disseminated.

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# Teleconsulting: Problem-Solving Capacity in Primary Health Care in Dentistry

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**Abstract:** Brazilian Telehealth Networks in Primary Health Care aim not only at expanding the problem-solving capacity of Primary Care, but also at promoting their integration with the Health Care Network, developing actions to support health care and workers continuing education, improving attention and promoting increased clinical capacity, having as main offerings the Teleconsulting, Medical Second Opinion and Telediagnosis. The teleconsulting is a registered consultation conducted among workers, professionals and managers in the health field through two-way telecommunication instruments, in order to clarify doubts about clinical procedures, health activities and issues related to the work process. This study aims at determining the problem-solving capacity of teleconsulting in Dentistry. We studied the teleconsulting database undertaken during the years 2012 and 2013, organized it in an Excel spreadsheet, and analyzed it according to the percentage. Dentists themselves have carried out 97 % of the teleconsultations. Regarding the requested topics we observed that 40% of teleconsultations address issues related to clinical questions in general, 17 % of the working process of the teams, 10% of community approach, and 7% on family and health education approach. As for problem-consulting, 98 % of professionals reported that teleconsulting intervened in conduct, reducing the number of referrals to another level of care. All reported there was no need for specialist consultation to resolve the case. Based on data analysis, we conclude that the teleconsultation has contributed to the problem-solving capacity in Primary Health Care, reducing the number of referrals to other levels of care.

## Introduction

In 2007, the Brazilian Ministry of Health [1] implemented The Brazilian Telehealth Program [2], it is a national action aimed at improving the

quality of care and primary care in the Unified Health System (SUS), through the integration of education and service, using technologies as tools of Information and Communication, offering conditions to promote programs such as Telecare and Tele-education Today. Brazilian Telehealth Networks offer teleconsulting services, Medical Second Opinion and tele-education, thereby creating opportunities for continuing education and the expansion of the problem-solving capacity of professionals operating in the Unified Health System (SUS) [2]. Teleconsulting is a consultation among workers, professionals and managers in the health field through two-way telecommunication instruments in order to answer questions about clinical procedures, health activities and issues related to the working process [2].

According Rendeiro [3], Teledentistry enables communication and activities with the different technological areas, both in public health and in clinical. The use of information and communication technologies is an important resource for health, vocational training, continuing education, and research and knowledge management. Rio de Janeiro Telehealth project [4] also provides multimedia for activities in different areas, such as family medicine, nursing, dentistry, nutrition, geriatrics, physiotherapy and leprosy. It is also specialized in telecare with teleconsulting in the area of Teleradiology.

The objective of this study is to analyze the ability of solving problems of Primary Health Care through Dentistry teleconsulting.

### Methodology

The study was conducted using the data base of teleconsultation during the years 2012 and 2013, the Telehealth / UERJ platform. Data were organized in Microsoft Excell and analyzed by percentage.

### Results

Through data analysis, we have concluded that 97% of all requests were made by dentists (Figure 1). Regarding the requested topics (Fig. 2), we have observed that 40% of teleconsultation address issues related to clinical questions in general, 17% are about the working process of the teams, 10% concern community approach, and 7% are both for family and also for health education approach. As for problem solving capacity consulted, 98% of professionals reported that teleconsulting intervened in process, reducing the number of references to another level of care.

### Conclusions

Based on data analysis, we conclude that the teleconsulting has been contributing effectively in order to solve problems in Primary Health Care,

thereby generating a decrease in the number of referrals to other levels of care.

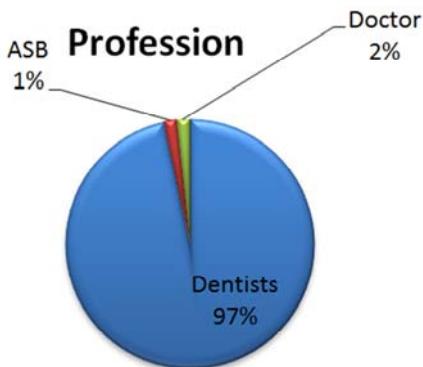


Fig. 1: Professional Profile of the applicant

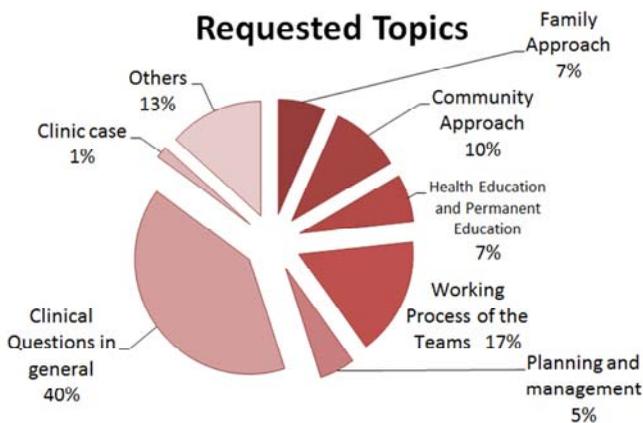


Fig. 2: Requested Topics

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# **Telehealth Brazil Networks Program RJ-UERJ Nucleus: Telehealth as a Means to Professional Update in Primary Health**

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## Introduction

The Rio de Janeiro State Nucleus-UERJ1 of the Telehealth Brazil Networks Program, offers exclusively and multidisciplinary distance courses to senior and middle level audience. The objective of this paper is to present qualitative and quantitative results of this methodology to update primary health care professionals working in the Unified Health System (SUS) in Brazil.

## Materials and Methods

Distance learning courses of university extension for professional development with a workload of 15 hours, including 10 hours of lessons; availability of interactive instructional material; quantitative evaluation for approval and qualitative evaluation form at the end of the course. All courses are available on the Moodle platform of the Telehealth Center at Rio de Janeiro State University (UERJ) [1-2].

## Results

From June 2010 to November 2013, 18.368 health professionals conducted 71.370 entries in a total of 36 courses, with an average of 4 courses per user. The courses were grouped as follows: 18 courses on Primary Care Network, 4 on Maternal and Child Health Care, 7 on Elderly Health Care, 2 on Mental Health, 2 on Buccal Health, 2 on Health Research and 1 on urgency and Emergency health care. From these total, 30 courses were offered for top-level professionals and 6 for mid-level professional. There were 16.293 higher education professionals from whom 45% were nurses, 22% physiotherapists, 13% nutritionists, 8% physicians and 3% dental surgeons, among other occupations (9 %). Among the 2.075 mid-leveled professionals, 44% were community workers, 41% nursing assistants and technicians, 8% oral health agents, 5% oral health technicians and 2% nutrition technicians. The Brazilian national-regional distribution of

these professionals was of 55% in the Southeast, 29% in the Northeast, 7% in the South, 5% in the Midwest and 4 % in the Northern Brazil (Figure 1 and 2).

### Conclusion

The use of health technologies is effectively contributing to the professional qualification, therefore to better serve the population.

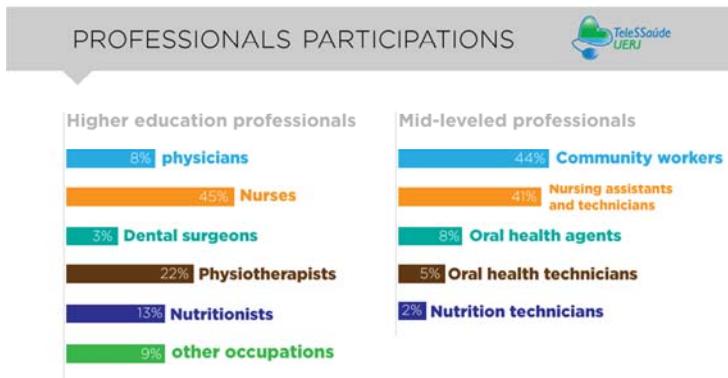


Figure 1- Professional Participations registered on the UERJ Telehealth Center Platform.



Figure 2 – Brazilian distribution of professional participation

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# The Experience of an Oral Health Blog after Two Years of Follow Up

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## Introduction

The present study aims to present statistical data on the volume of traffic, search terms and blog user type about oral health: "Taking care of your teeth" (<https://cuidardosdentes.wordpress.com>). The blog was initially designed to provide information about oral health care for school children. The content available was edited by graduate students under the supervision of lecturers in the Department of Pediatric Dentistry and technical support performed by the Teledentistry Center of School of Dentistry of São Paulo University. Actually it is maintained by the Teledentistry Center.

## Methods

As development method we used the Wordpress content management system application, since it enables the creation and maintenance of blogs on the web, making it easier to use by people who have no prior knowledge of editing HTML codes. Data of traffic site and search terms provided by Wordpress were collected for two years and nine months (February 2011 to November 2013). Data of user profile and most frequently asked questions were collected by means of the reports submitted by users.

## Results

Through statistical analysis of the blog, provided by Wordpress, we obtained as a result that there is a growing demand for specialized information on oral health by adults. It was also noted that from January 2013 (224 unique visitors) to November 2013 (1968 unique visitors) there was an 850% increase of the traffic to the blog. One can attribute this significant increase to the fact that for some of the most popular terms in the search engine Google, related to the topic exfoliation of deciduous teeth ("teeth falling out") and eruption of permanent teeth ("teeth rising") the blog appear in the first positions of organic search of Google Brazil. When we analyze the most frequent inquiries sent by blog users it is also evident that they refer to "exfoliation of deciduous teeth" and "eruption of permanent

teeth”. They also reveal that the vast majority of people seeking clarification on the issue are mothers of school children and adolescents.

### Conclusion

It can be concluded from the study that there is a growing demand for more specialized information on oral health [2] as the internet has allowed access to information in an easier way. It is also important to note the need to stimulate the production of websites and blogs able to provide information on oral health that are reliable and appropriate to the people [1-3].

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# **The Regional Cancer Counseling Center: Technologies and Psychology for a New Organizational Model to Serve Cancer Patients and Their Relatives**

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## Introduction

The network of health organization today is extremely complex and its operation is often guaranteed by the ability of the various operators to manage the communication exchanges and relationships [1]. In this system the patient, in recent years, has taken an increasingly active role, placing himself in relation with the doctor no longer as needy and passive care and prescriptions, but as a person "who knows" and who enters in the care pathway asking for clear and competent information [2]. The Health System, through information and communication, tries to make the person who faces a care pathway as responsible for their choices. The patient is more often a person aware of the offer and services most appropriate. In addition, the changes that are shaping our society from a demographic, economic and social point of view (economic crisis, rising life expectancy, aging population, smaller families with fewer parental resources, reduction of the social network in urban centers ...) have favoured the emergence of more and more sophisticated and complex needs (smallness of the social network in urban centers ...) [3-4]. In relation to all these changes, the Social Health System requires an enrichment of care models, more in line with the needs and expectations emerging in patients who increasingly turn to technology as a tool to inquire about their health and improve their well-being [5].

The European Commission addresses a continuing interest in the development of new models of work in health care, aimed at health promotion and support of patients and their families during the course of prevention, diagnosis and treatment. The EU declares that eHealth has the potential to ensure sustainable health systems, equity of access, an health care more personalized and focused on users, improving the connection cost-effectiveness of health services [6].

## Method

Within this frame of reference is born, in 2009, the Regional Counselling Cancer Centre (CCOR) of Tuscany Region with the scientific collaboration of the Regional Cancer Institute (ITT) and the Healthcare Management Laboratory (MeS\_Lab) of Sant'Anna University, as a "contact center " specialist on the needs of cancer patients and their relatives [7]. The mission is to provide information and counseling about health regional facilities and their professionals and resolution about organizational issues; besides it provides psychological support via telephone. Every citizen can access at facility through a toll-free number (800880101) and email: [ascolto.oncologico@regione.toscana.it](mailto:ascolto.oncologico@regione.toscana.it). This is an important tool for the integration of services in the area of Tuscany and professionals, among them and citizens. The mode of Contact Center provides a system of management of multi-channel communication (telephone, fax-server individually, SMS, intranet platform, etc ....) with either citizens and with the Local Health Authority (LHA). The requests are processed through a communication network in-bound/out-bound. The in-bound activities are aimed at receiving and handling incoming calls. The out-bound activities provide, however, the contact with healthcare referent, the "Focal Point" (FP) and the re-contact the user during the process of resolution and/or verification of the effectiveness of the intervention. All the informations and data are inserted into software; these can be viewed by the operators of the center and by the FP. Each stage of the process enabled by the resolution of the issue, from the first contact with the user at the end of the practice, adhere to internal procedures of the Centre shared between operators and company representatives. This allows to manage continuously the process, to have a global monitoring of the identified needs, to examine the problems and how to solve the problem and finally to assess possible improvement actions paths social care. At the toll-free number, (open 7 days/12h), respond psychologists who, in the business of "Front-Line" (FL), play the role of host, taking charge and demand analysis, needs assessment (explicit and implicit), counselling, health information, orientation to the path of prevention diagnosis and treatment, through problem-solving activities or, where necessary, a link with the representatives of the local health. When emerges a psychological need or a direct request for a psychological support the FL pass the call to CCOR psychologists - psychotherapists who perform a more thorough evaluation and takes charge of a psychological nature. In some cases it is sufficient only a few telephone conversations through the emotional containment experienced in the critical moments of disease pathway and a redefinition of the problem. In others it may continue for a longer period of time and with the targets agreed with the user, and if the need arises, and there is a request from the user, the process continues with

sending to psychologists localized at the various LHA. The easy access and availability phone allows the patient and family to receive instantly an active listening and a competent support, through which they can express and share concerns and emotional experiences related to the disease and the disruption that this generates in the life of the patient and of his/her "family".

## Results

In four years, the service responded to 8,500 calls. A number of calls so high, above initial expectations, connotes the experience, initially experimental and innovative, thus defining the center as a shared reality and a stable reference point for the citizens of Tuscany.

At the center call mainly patients (42%) and family (43%) aged between 25 and 75 years. The 4% is represented by the operators of the system social health of Tuscany, this data confirms the significance of the service and the perception of this as a point of reference and exchange information with a view of the network.

Users, in 75% of cases, need guidance activities within their care pathway requiring information about screening activities and facilities for diagnosis and treatment in the area of Tuscany. The remaining 25% requires a telephone psychological support, of which only 5% required to continue the psychotherapy in the psychology services at hospital. Our data help us to analyze the main phases of the disease in which users express their needs, in particular in the prevention phase (22%), during the treatments (chemotherapy or radiotherapy) in 17% of cases and, in 14% of cases during follow-up. More than 9% of the users contacting the Center are waiting for diagnosis and treatment (7%) and in 6% of cases in the diagnostic phase. The Centre is also a point of reference in the final stage of life (more than 7%), often relatives, contact us at the stage of "end of life" to get information on palliative care and psychological support to share experiences of pain, anger and loneliness, related to this moment so intense.

The most of action performed is defined in 95% of cases as a psychological counseling to managing an "emotional crisis" due to specific events related to health care. The most users called after the communication of the diagnosis, during treatment, or in the phase of the inspection, a critical state of "emotional loss", with anxiety related to the uncertainty of the future, fear of dying or falling ill again. Usually, in the first time, you can manage the sense of urgency, helping to verbalize fears and concerns the condition that the disease has determined, taking the time necessary to express and process emotions, but also to develop ability to reading events and more efficacious problem-solving skills. A brief intervention was also

functional for those users who called Centre for family difficulties to share and communicate about the disease. In this case, the intervention was aimed to stop dynamics like silences, secrets, exclusion and deep loneliness that the disease induces promoting dialogue, sharing, expressing needs and, especially, a disempowerment process of the patient or family.

### Conclusions

The potential of a service like this are various. The phone allows to achieve users with various difficulties (personal or logistics) that don't have direct access to the sanitary services. The strong network created with the Regional Health System (the FP and the LHA psychologists) shortens the gap/distance between professional and user, ensuring their needs; that promotes the patient's centrality and autonomy during the oncological pathway. This approach improve equity of access, continuity of care and the quality of Tuscany cancer network, supporting and accompanying the person for the entire path of the disease. In this way is also possible to recover those users who, disoriented by the impact of the disease have difficulty to move efficiently in the care pathways. In this context, the primary goal of the Center is to promote an autonomous and responsible attitude in relation to their care pathway, supporting him/her or making him/her able to make informed choices about his/her health, through the activation-reactivation of internal and external personal resources.

The data recording allows quantitative and qualitative analyses to improve actions for sanitary services. So, it's possible to bring out critical and to promote future action to implement the effectiveness of pathway of care and the guidelines of Oncology Network Tuscany. The experience of recent years, revealed the need to use further and more specifically to develop the service by introducing, next to the phone mode, new communication technologies through the WEB 2.0. Using these technologies would get more in touch with users under the ages of 25 years, who focuses more on other forms of communication to stay in a therapeutic relationship and who also, at the moment in our series, appear to be not much represented.

In conclusions, the Center is an important hub for the regional health system in terms of efficiency and effectiveness. An informed patient, competent and responsible, has a better result in the management of their disease status and satisfaction in care. A system able to listen and take charge of people's needs promptly, prevents the emerging of critical in social-welfare path (avoiding migrations from one location to another with additional health care costs ) and promotes results in terms of compliance of the patient. In addition, the timely taking over the telephone reduces the

level of pain and discomfort for patients and their relatives in each stages of illness and promotes a process of adaptation.

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## **Three Months Experiment in Telemedicine in Care Home for Disabled Adults**

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Telemedicine is still at the experimental stage in France, especially in the field of disability.

The “Centre départemental de repos et de soins” (Departmental center of rest and care) of Colmar (FR-Alsace) is one of the five pilots participating in a regional telemedicine project in care and nursing homes. This structure led its experiment in a disability care home of 100 beds. The experiment was performed over 3 consecutive months with an exclusive coverage in telemedicine by a unique practitioner, gathering teleconsultations, mobile collaborations and coordination sessions by video conference.

On the 120 teleconsultations, the average duration of the act was 14 minutes. The motives for consultation were varied (dermatology, traumatology, ENT, neurological, psychiatric...). The average age of patients was 49 years, half had cognitive impairments. All patients were satisfied or very satisfied 85% or feeling comfortable. Nurses were satisfied or very satisfied in 89% of cases. The remote doctor had a raised level of confidence in her diagnosis (3.5/4 on average).

During these 3 months, the organization has improved: technologically, in terms of premises, concerning the development of new skills. The duration of a teleconsultation approached the duration of a conventional consultation. The physical examination was limited but it can be improved thanks to the next implementation of tele-ultrasound system. The patient compliance was excellent, with for some a feeling of valuation. Behavioral disorders diminished thanks to the diversion of their attention by the effect of novelty.

This innovative experiment in France showed that telemedicine is possible in the field of disability. It is a useful tool for the medical and psychosocial coordination, the continuity of care, the development of new multi-professional skills, and the ethical appreciation of the patient with disabilities.

Keywords: Telemedicine disability care coordination

# Transmission of Dental Surgery in UHD (4K) in Real Time - the First Latin American Experience

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## Surgery in Dental Education

Follow up surgery in real time is an excellent tool for learning in the healthcare arena; however, it does have its drawbacks. The most common: breaking aseptic chain (students in a sterile environment); inability to properly observe (small surgical areas); and, prejudice viewing (only the students at the front can see). A high quality resolution retransmitted video can solve these problems, however is not without its own set of complications: competition between the available light in such a confined space, the action of the specialist and the image captured by the camera.

Dental surgery also has problem due to the minuscule anatomic details, which are usually lost on video because of the technical requirements of focal length, the size of the equipment and operators. For this reason, dental surgery was chosen to test 4K transmissions.

## Video Collaboration in Healthcare

Today networks allow for a much faster exchange of high quantities of information, which is fundamental for the transmitting of Ultra-High Definition (UHD) digital media streams [1-2].

The 4K technology offers an image quality comparable to that offered by 35mm film and presenting the inherent advantages of digitalization, as a means of easier storage and higher immunity to deterioration. These new applications may have a direct impact in various scenarios such as the transmission and display of surgical procedures (Telemedicine and Telehealth) in UHD [3], for instance.

## Related Work

There are several initiatives aimed at developing solutions for transmitting and displaying UHD video [3-9]. Most of all is based on the JPEG-2000 standard, and the standard recommended by the Digital Cinema Initiative (DCI). However, the result based on this standard relied on dedicated

hardware to perform the encoding and decoding processes when compared to software-based approaches, has a common drawback relatively higher cost and limited flexibility [3].

Alternatively as a solution to the hardware issues, a software-based solution, Fogo Player, for the distribution, transmission and display of UHD videos has been developed. In the experiments presented, the H.264 standard was used however; it is possible to integrate different coding standards for the solution [3, 4].

### Fogo Player

Fogo Player [4] enables the distribution, transmission, and displaying of 4K videos, with or without stereoscopy. It is based on a distributed architecture of software components and does not use dedicated hardware for decoding and displaying the videos. The Fogo Player's architecture allows easy integration of different technologies for video coding, which allows the system to be used for the transmission of raw video using lossless compression algorithms.

To handle 4K videos, Fogo Player slices the videos into quadrants in order to process them in parallel. To display the videos, the Fogo Player decodes each of the quadrants in parallel and displays them in a synchronized manner on a wall screen or via a projector into multiple processors in a single machine or by using multiple machines [3-4] [Fig.1]

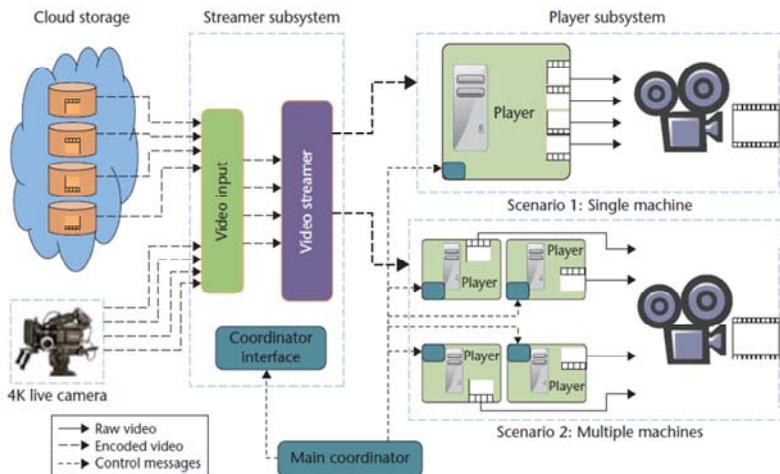


Fig. 1 - Streamer and player operations; a flow-control mechanism of video quadrants to the subsystem. This architecture is independent of transport protocols and encoding standards [4]

## The Brazilian Telemedicine Network

The Brazilian Telehealth initiatives achieved their federal ministerial integration stage to establish a *Telemedicine University Network* called RUTE. This network was to be based on the implementation of a telecommunication infrastructure in University Hospitals, starting in January 2006.

RUTE initially directed their efforts at telemedicine, but is currently increasing developments in the area of healthcare, for example, promoting experiments in the area of Teledentistry.

In this way, the *Video Collaboration in Healthcare Workgroup* or GTAVCS is supported by RNP (Brazilian Agency for Research Network), that propose an infrastructure based on hardware and software with remote management for capturing and securely distributing multiple simultaneous streams in order to provide support for several scenarios of video collaboration in healthcare. As a result of efforts, Arthron [10] is now available: it combines different software technologies to improve a virtual environment to share multimedia experiences, such as surgery transmissions.

### Transmission of Dental Surgery on UHD in Real Time

Among the many occasions in which 4K streams have been transmitted using Fogo Player [11, 12], one of its highlight was the first Latin American streaming, that involves a dental surgical procedure in real time. It was held between the School of Dentistry, University of São Paulo (FO-USP) and the School of Medicine (FM-USP) (Fig.2). A stream of raw 24 fps 4K (3840 x 2160 pixels) was captured and transmitted over networks with bandwidth of 10 Gbps. 4K reached a transmission rate of 3.2 Gbps. This high rate of transmission is due to procedure video coding, thus ensuring a transmission time point to midpoint of 22 ms not be applied.

Capturing raw flow ensures a guaranteed authentic image quality, which is only limited by the camera, furthermore without a delay for encoding the stream for capture and decode at the other end, which significantly increase the flow in the transmission delay between the two points.

### Conclusions

1. The 4k transmission quality benefits dental surgical procedures in education applications;
2. It is necessary that the transmission count on physical and digital infrastructure to support efficient data exchange;
3. The achievement of being the first in Latin America has been successful and prominent internationally.

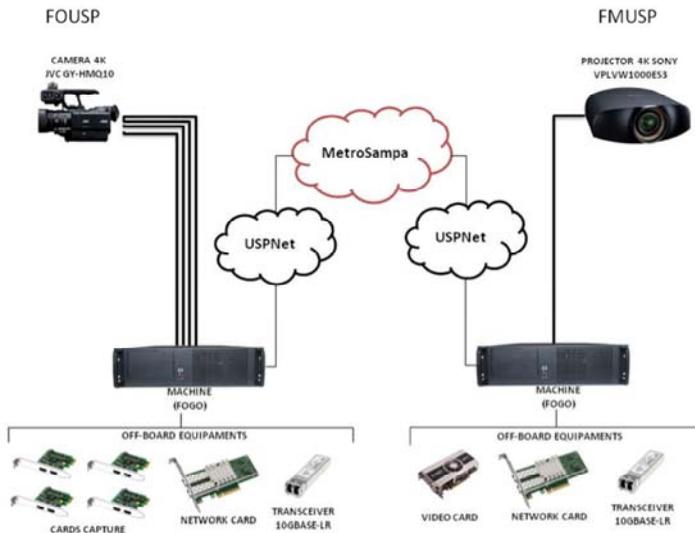


Fig. 2. Scenario of the experiment between the FOU SP and FMUSP

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# Using A Mobile Phone to Assess Dietary Intake in Young Children

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**Abstract: Currently a number of people around the world increasingly own a mobile phone due to its availability and affordability. There are more than 5 billion mobile phone connections worldwide reaching more than 73% of the global population. In North America, there were more than 320 million mobile phone subscribers. Because of the popularity of mobile phones and their utility for health applications and interventions, to date mobile health has become a focus of research. Obesity and other chronic diseases including hypertension, diabetes, cardiovascular disease, and cancer have a strong association with nutritional components; therefore, information on dietary intake is essential in helping parents and children to understand the connection between diet and diseases. There are several methods available for dietary intake assessment such as 3-day food record, food frequency questionnaires. However, these assessment methods have some disadvantages including underreporting, incomplete reporting due to memory dependent or subject to bias. Technological progress in mobile phone features including camera and real time video has further prompted the enhancement of dietary assessment methodology and may help to improve quality of dietary assessment. This proposed study aimed to examine the perceptions of African American mothers with young children aged between 4 and 5 years toward the use of mobile phone to assess dietary intake in their children and as a means of receiving information about nutrition. The findings of this study will inform future development of mobile phone features and applications to be used in dietary assessment and interventions.**

## Introduction

The epidemic of childhood overweight and obesity in the U.S. and worldwide is a major public health concern. Almost one third of U.S. children over 2 years of age are already overweight or obese [1]. Overweight is defined as a body mass index percentile (BMI%)  $\geq 85$  and obesity as BMI%  $\geq 95$  for age and gender [1]. While the rates of childhood obesity in the general population are high, they are even higher in low income and ethnic minority populations. African American (AA) children, particularly girls, have the highest rates of obesity and the largest rate of

increase in obesity from 16.3% in 1994 to 29.2% in 2007-2008, compared with all other racial/ethnic subgroups [1]. Overweight children are at increased risk for multiple health problems such as heart disease, diabetes, high blood pressure, and high cholesterol [2]. Equally disturbing health risks for overweight children include poor self-esteem and depression due to social discrimination [3]. Obesity has a strong nutritional component; therefore, knowing about type and amount of foods children eat is essential for obesity prevention. Assessing dietary intakes of children presents unique challenges. Accurate assessment of dietary intake is much needed so that we can develop appropriately and effectively nutrition interventions and make policy decisions. Technological progress in mobile phone including camera feature has further prompted the enhancement of dietary assessment. Data indicate that smartphone users in the U.S. were higher in AAs than the general US population [4]. This proposed study aimed to examine the perceptions of AA mothers toward the use of mobile phone to assess dietary intake of their children aged between 4 and 5 years and as a means of receiving information about nutrition.

### Methods

The mothers of AA children aged between 4 and 5 years were recruited through a community food pantry center in Milwaukee using a flyer and word of mouth. Qualitative methods using focus groups and individual interviews were conducted to explore maternal perceptions toward the use of mobile phone to assess their child's dietary intake and receive their nutrition education. The mothers who were unable to come to the focus group were individually interviewed using the same questions conducted in the focus group by the researcher. An open-ended question was used to elicit information on current mobile phone use, perceptions on mobile phone features, challenges, and the use of mobile phone to assess dietary intake and to receive information about nutrition. After focus group/individual interviews, the mothers were asked to take images of a meal (food and drinks) consumed by their child and send the images to the researcher using their mobile phone. The focus groups and individual interviews were audio recorded and transcribed verbatim. The transcripts were then analyzed using inductive thematic analysis [5].

### Results

A total of 17 mothers were participated in the study. Most participants had access to a mobile phone and prior experience receiving and sending short messages (SMS) and pictures. Some had tried various apps, i.e. games, news, and calendar. Many participants expressed interest in using

their mobile phone to take pictures of the foods taken by their children, receive nutrition education and healthy recipes to cook at home, and calories calculation. The most concerns and barriers of using mobile phones include cost and privacy.

### Conclusion

The findings suggested that these AA mothers with children aged between 4 and 5 years seemed to accept the use of mobile phone to assess dietary intake of their child and receive nutrition education. The study provided new insight into the use of mobile technology to reduce cost and time on food records and increase accuracy of dietary assessment.

### Acknowledgement

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# US-Mex Border Region Dental Students' Perspective in the Future Application of Teledentistry as A Tool for Preventive Dental Care

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## Introduction

In California oral health disparities are more severe than the national average, particularly among racial-ethnic minority and low income families.

This has led, to a disproportionate burden of oral disease [1]. In California, and likewise in the rest of the US-Mexico Border Region, there have been many proposals to improve the accessibility and quality of Dental care. The reality is that despite of many efforts, the Dental care system in South California, and the rest of the Border Region, will remain insufficient for the near future. An estimated of 952,000 California adults cross the border to Mexico to find Medical, Dental and prescription services annually [2]. One of the most attractive aspects of seeking Dental and Medical services in Baja California Mexico is the fact that the same services offered in the US can be obtained at 40 to 70% less cost.

Teledentistry in the border area has the ability to bridge the geographic gap and improve access to oral health care in Hispanic and underserved populations. This can Improve the delivery of oral healthcare, at lower costs, in the right places, and at the right times.

In this study, we measured attitudes and perceptions of dental students towards the future application of teledentistry as a tool for preventive dental care.

## Methods

This was an observational prospective study, with a sample of 40 Dental Students in the last Semester of Dental school from the Universidad

Autónoma de Baja California (UABC) located in Tijuana, Baja California Mexico. A lecture of Teledentistry, including pros and cons, was given. This was complemented by a Power Point presentation from research publications conducted in US, Brazil, and Switzerland, followed by two cases from the author in which Teledentistry was implemented for triage purposes and referrals. Following the PowerPoint presentation, participants completed a questionnaire containing twelve items assessing subjects' attitudes toward Teledentistry [3]. Responses ranged from 1 (strongly disagree) to 5 (strongly agree) of the Likert-scale questions. For frequency distribution “strongly disagree” and “disagree” responses were combined into one category (Disagree) and similarly “agree” and “strongly agree” responses (Agree). The results were expressed as percentages. Voluntary participation was encouraged and confidentiality was maintained. After the questionnaire was completed, each item was analyzed separately.

### Results

A total of (n=40) participants fully completed the questionnaire, 30% male (n=12) and 70% female (n=28). Age ranged from 21 to 27 years old (mean = 22, SD =1.2). The study demonstrated that the perception of the large majority of participants agree that Teledentistry should be implemented in all Dental clinics equipped with Internet facility, (91%), and will save time and money for patients waiting expert dental opinions (90%). However, 85% of participants believe that Teledentistry can never replace physical face to face consultations (Table I).

Table I

	Disagree	No opinion	Agree
Teledentistry will help improve ease of access to dental care services for rural patients	17%	0%	83%
Teledentistry will save money for patients wanting expert dental opinion	7%	3%	90%
Teledentistry will benefit only the urban community	55%	12%	33%
Teledentistry can never replace face to face consultation	10%	5%	85%
Reliability of consultation by Teledentistry will be poor	16%	8%	76%
Teledentistry will help to save patients time	7%	5%	88%

Teledentistry will help to save patients money	19%	13%	68%
Teledentistry reduces referral time to the Maxillofacial specialist	9%	13%	78%
Using Teledentistry to interpret X-rays is reliable	17%	8%	75%
Teledentistry can be used for early stage caries diagnosis	24%	5%	71%
Teledentistry should be implemented in all Dental Clinics equipped with Internet facility	4%	5%	91%
Dentists will approve of Teledentistry only after getting the statistical evidence & reports supporting the benefits of Teledentistry	4%	13%	83

### Conclusion

Our analyses showed 76.75% agreement that Teledentistry can be a tool for preventive dental care, diagnosis consultation, treatments and can be timesaving in the US-Mex Border Region. Only 7.50% are indifferent. Also, only 16% disagree with the future application of Teledentistry.

Despite the positive attitude of participants towards the future application of Teledentistry as a tool for diagnosis, some participants had less favorable attitudes. This deficit may indeed be due to lack of knowledge regarding Teledentistry, or limited application and training programs in Dental Colleges and Universities. Previous studies have supported the findings that learnings resources can increase knowledge and better practices in the dentistry field with the application of Teledentistry and Telehealth [4].

Times have change and existing players must redesign themselves and their practices to improve dental care delivery methods, dental teaching and implementation of new technologies in the market. This will, in turn allow the development of new skills and increase positive attitudes towards Teledentistry, especially for future dental professionals.

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# **Women, eHealth and Telemedicine at All Ages of Life**

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## **Distance Medical Education Produce and Publish Your Own Lectures on the Web**

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Nelson Mandela said “Education is the most powerful weapon which you can use to change the world”.

Distance medical education meets the needs of doctors and health personal that might be unable to attend classes, due to distance or time constraints. Medical personnel who is working can chose their lectures when it suits their schedule. Distance medical education saves time and money.

Distance education can be asynchronous or synchronous. For asynchronous education written lectures and tests can be accessed at any time. Synchronous lectures are those that require students and lecturers to be online at the same time. For those lectures only audio or audio and video may be available. Students see the lecturer during a videoconference as in a classroom. Some universities provide stored lectures that are a combination of a stored live lecture and the written lectures. Students like this kind of distance education. At universities quite expensive technical equipment is available for the production of combined lectures.

But how about a lecturer who would like to generate its own lectures? How about a university in a developing country who does not have expensive technical equipment for capturing lectures? CampusMedicus is a web-based telediagnosics and teleteaching platform. It is used in many countries for exchanging diagnoses for patient cases. Especially in pathology, cytology and radiology it is the number one telediagnosics platform. With CampusMedicus physicians can produce their own lectures combining a live lecture and a written lecture.

The result is a video that shows the lecturer talking to his students including the written lectures on one screen. These videos can easily be produced on a normal computer. Students with access to the Internet may view the lectures on their computer, a tablet PC or a smart phone. Distance education is important because the knowledge and skills of medical personnel, also of those in rural areas, are a critical factor in establishing sustainable quality services.

Keywords: education, eLearning, web-based platform, videoconference

# How we manage To Provide Diabetic Foot Care in Kosovo

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The diabetic foot is a worldwide burden for many diabetic patients. Regarding The International Consensus on the Diabetic Foot these are the proven facts:

- Every 30 seconds, a lower limb is lost somewhere in the world as consequences of diabetes;
- Up to 70% of all lower-leg amputations are performed on people with diabetes;
- Up to 85% of all amputations are preceded by an ulcer;
- In developed countries, up to 5% of people with diabetes have diabetic foot ulcer. In developing countries the latter figure may be as high as 40%;
- Foot care is of the highest quality when informed self-management is supported by multidisciplinary foot team;
- The multidisciplinary team approach to diabetic foot care has been shown to bring about 49-85% reduction in amputation rates;
- In many countries, there is an urgent need for podiatry training programs;
- Mandatory minimal skills and equipment for these offering a podiatry service should be enforced in order to ensure that people are not put at increased risk by unregulated, unqualified and poorly equipped practitioners;
- Investing in diabetic foot care program can be one of the most-effective forms of healthcare expenditure, provided the program is goal-focused and properly implemented;
- Health economic studies have shown that strategies to achieve a 25-40% reduction in the incidence of ulcers or amputation are cost-effective and even cost-savings.

Neuropathy is the most dangerous problem of creating a diabetic foot ulcer. Losing sensibility means losing the warning signal that the skin is breaking down due to mechanical stress, i.e. walking in a too narrow shoe, or a little stone in the shoe without noticing. In combination with angiopathy the ulcer won't heal with high risk for infection, amputation and

life threatening sepsis. The diabetic foot causes more deaths than breast cancer!

According to the International Consensus on the Diabetic Foot identification of patients at risk for ulceration is the most important aspect of amputation prevention. In 2010 with co-operation with Fonty's in The Netherlands four Dutch students stayed in Kosovo for 6 weeks and together we have implemented the education for patients. In 2011 also together with other students we made an program as part of International Working Group of the Diabetic Foot (IWGDF) to implement the step-by-step program for 36 nurses and family doctors. Also due to this program I have worked several months in other cities in Kosovo with donation of World Diabetes Federation. Unfortunately, due to lack of finances I had to stop this work.

The principles of care of chronic diabetic foot ulcers are: prompt treatment of any associated infection, revascularization if appropriate and feasible, off-loading in order to minimize trauma to the ulcer site and management of the wound and wound bed in order to promote healing. Wound management is relatively simple: regular inspection, cleansing, removal of surface debris and protection of the regenerated issue from the environment.

Kosovo has declared its independence in 2008 even as the international community remains divided on the issue of international recognition of the new country. With a population of close to 2 million people and an economy at the very bottom of the list of the developing nations, Kosovo is a very poor country at the gateway to Europe. In fact Kosovo's GDP per capita is not higher than 2000 euro, which is similar to the levels of Pakistan and Yemen. With 44% of the population living in poverty and 14% in extreme poverty, the country remains heavily dependent on foreign assistance and remittances from compatriots living abroad.

Since the opening in 2009 my clinic was visited from almost 1000 diabetic patients. 10% of them suffer from diabetes type 1 and 90% have diabetes type 2.

From those 1000 patients - 90 % visited the clinic for ulcers and 10% for preventive diabetic foot tests.

From those 90% of diabetic ulcers - 75% where healed and 25% where not solvable and where referred (back) to hospital.

From 75% of those healed ulcers 90% come regularly with recurrent ulcers due to lack of good shoes, lack of good information, bad economic situation, lack of specialized medicine healthcare providers etc.

The methods and materials that I use for wound treatment of diabetic foot ulcers are relatively simple and not very expensive. Also we achieve a good results in prevention and treating diabetic foot problems which are very

important for developing countries such as Kosovo. My experience will be very useful for nurses that work in developing and under developed countries.

#### Future

To be able to treat professionally all diabetic foot problems in the “near future” our wish is to have a multidisciplinary team that consists of diabetes specialist, podiatrist, orthopedic shoemaker, foot surgeon and vascular surgeon. Opening more foot clinics all over Kosovo is a dream to work for. At this point I am the only professional working in this field in Kosovo, in two foot clinics: 1 in Gjakova, 1 in Prishtina.

This is very expensive project that we want to achieve. Using telemedicine- special thanks for Dr. Dashurije Koshi who made this possible in Kosovo and in The Netherlands Dr. Margreet van Putten helped us to improve all this. We are now progressing in our therapy possibilities for our patients, we are about to start making insoles for diabetic patients who need extra off-loading in their shoes. The insoles will help to prevent reulceration and to improve quality of walking.

#### In Conclusion

The above mentioned clinics are made possible with International support from different persons and organizations and we are very thankful for that. Kosovo faces a big challenge in health issues and especially in diabetic foot care. My hope is that with a multidisciplinary team approach we will prevent more legs from amputation and safe lives, as less people will die from sepsis and gangrene of the feet.

The facts in this abstract are from the International Consensus on the Diabetic Foot (2011) and also from my clinic “Hallux-Podiatría” Kosovo.

# IT and Engineering Education: How to Make It More Attractive for Women?

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## Introduction

In last decades there were many discussions about status of women in technology and engineering and also in research. Ratio of male and female university students corresponds to gender ratio in population in most European countries. However we can see many differences across the disciplines and in jobs – the phenomena are called horizontal and vertical segregation.

Recently, 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. There exist already many positive examples in several countries. However the situation in the Czech Republic is still different. According to various studies [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 analyzed the engineering education in more detail in our paper in 2013 [3]. In this paper we discuss the position of women in research and present an example of a solution and also the activities that attract primary and secondary school students to engineering disciplines.

## Horizontal and Vertical Segregation

Horizontal and vertical segregations are terms expressing differences in representation of females and males in disciplines and in hierarchy. Horizontal segregation means different representation of men and women in individual disciplines and sectors. Women are more frequently active in the so-called soft disciplines (humanities and social sciences) and employed mostly in governmental (37 %) and non-profit (38 %) sectors. In entrepreneurial sector there are only 15 % of females in R&D. There is great contrast between soft disciplines (43 % of female researchers) and engineering (only 12 % of female researchers).

Vertical segregation expresses concentration of men and women on different levels of academic hierarchy. Women are more frequently represented on lower positions in the hierarchy, while men have majority on decision making positions. Almost the same situation is across disciplines and sectors. We can illustrate it by numbers from the universities in the Czech Republic: among 25 rectors of public universities there are only 2 females. On the position of a director of a research institute of the Academy of Sciences there are 12 females out of total number of 62 directors. Similar situation exists in other sectors.

In general, the number of university educated women in the Czech Republic represents 56 % of all graduates, in PhD study the ratio is lower – about 43 %. This is still a high number that changes rapidly later. When we observe the numbers in research and development area the females constitute only 26 %. They are concentrated in specific scientific areas and in lower positions in the hierarchy. Definitely one of the reasons is care for children and family. If a woman does not find support in her family, it is usually difficult to continue the career in particular in areas where, for example, frequent and whole-day presence in laboratories is required. These facts show that without systematic work and support from the side of the institutions it is almost impossible to reach more satisfactory results.

#### Change in Scientific Culture and Institutions

In this section we provide brief information about first projects that have been started in the Czech Republic and aimed at cultural and institutional (structural) changes at academic and research institutions. This approach has been supported by EU since 2009. Acceptance of responsibility at the institution is a key assumption for the activities that should lead to systemic changes and their sustainability. Support of gender equality is not a partial or marginal goal. Strengthening gender equality is an important value and inseparable part of the strategic development of an institution. The main aim is change of culture of academic environment that should become more open, free of bias and traditional stereotypes. Such environment may offer equal opportunities for all gifted and qualified researchers of both sexes to participate actively in high quality research.

One of the participating institutions is the University of Chemical Technology in Prague. The implementation of the project will be performed through realization of the so-called plan of gender equality. Its goals and activities correspond to three strategic areas. They are focused on professional placement and career development of females and young researchers of both sexes. An example in this area is a mentoring program for PhD students and postdocs, educational activities and training, career

consultancy, gender sensitive setup of evaluation processes and career advancement or working conditions allowing coordination of work and family life fixed in official documents of the institution. Second area is increasing representation of women in decision-making and leading positions. The aim is setup of transparent and open rules for career advancement, elimination of gender bias and strengthening motivation of women themselves (for example training increasing competences of females aspiring to leader positions or to membership in decision-making boards or advancement in academic hierarchy). Third area is inclusion of gender perspective into knowledge development. That means inclusion of gender dimension into all phases of research cycle, starting from research intention and hypotheses over composition of the research team, selection of methodology, data analysis up to result interpretation and publication. Activities in this area are focused on education and increases of competences how systematically consider gender perspective and work with gender category as analytical variable in different scientific disciplines. And last but not least, the positive examples of successful individuals should be more presented publicly.

#### Bringing Engineering Closer to Children

In addition to the projects mentioned in the previous section, it is necessary to bring the “miracles” of research and technology closer to children at primary and secondary schools. We face frequently their fear of mathematics and physics. There are several possible ways how to do it. We have already good experience with summer camps in university laboratories, clubs and competitions. In recent years there has been regularly organized a robotic competition for secondary school students. Each year the main topic of the competition is different. The aim is to show the students and successively public the possible applications. Again this is a positive example how to attract students to engineering domain. Students learn a lot from physics, programming and especially team work. Robots as moving objects can be advantageously used for publicity.

#### Conclusion

This paper presents briefly overall gender situation across disciplines and hierarchical levels in jobs in the Czech Republic, with focus on gender imbalance among researchers. From the numbers it is obvious there still exists both horizontal and vertical segregation in employment. When it comes to comparison of positions in the companies or institutions, males are more frequently on hierarchically higher positions. Hopefully, with support

on the institutional level as presented in the paper, we will see positive changes in this issue in the near future.

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# Readiness to Manage Intimate Partner Violence in Primary Care

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**Abstract: Background:** Domestic violence is a widespread public health problem affecting one in four women, with serious consequences. For example, the World Health Organisation (WHO) Multi-country study on women's health and domestic violence against women showed that 15–71% of women experience physical and/or sexual violence by an intimate partner at some point in their lives. Despite this high prevalence, it is estimated that only 3% of cases are presently being identified in primary care settings, and general practitioners (GPs) as the most likely first-line professionals to be contacted are uncertain of what to do if a case is discovered. The reason is that most of them have received little or no training and are currently not well prepared to address it.

**Aim:** The aim of this research is to seek input from Primary Health Care health providers in Europe on their perception of their needs for specific training to address Family Violence and preparedness to manage this kind of patients. **Methods:** A pilot study using PREMIS (Physician Readiness to Manage intimate Partner Violence Survey), a 15-minute questionnaire, will be carried out in a span of month through the primary care network in Europe with the aim to investigate physicians' perceptions of their competencies and training needs in Family Violence. This descriptive study will be self-reported online using the "lumos!" platform, which enables the development and coordination of questionnaire-based studies, and the possibility to share the questionnaires on different Social Networks and invite different professionals to participate in them.

**Conclusions:** Domestic violence remains a major public health and clinical problem with a poor health care response. By using this tool it will be possible to identify potential deficits in the Primary Care professional's curricula, evaluate possible training initiatives to develop

## **their competencies and develop curriculum guidelines including assessment of perceived learning needs.**

### Introduction

Domestic violence is a widespread public health problem affecting one in four women, with serious consequences. For example, the World Health Organisation (WHO) “Multi-country study on women’s health and domestic violence against women” showed that 15–71% of women experience physical and/or sexual violence by an intimate partner at some point in their lives [1]. Despite this high prevalence, it is estimated that only 3% of the cases are presently being identified in primary care settings, and general practitioners (GPs) - as the most likely first-line professionals to be contacted - are uncertain of what to do if a case is discovered.

Low awareness amongst GPs concerning intimate partner violence (IPV) has been demonstrated repeatedly, and there is unanimity in calls for effective trainings of primary care physicians in the prevention, detection, early intervention, assessment, treatment, handling, crisis-intervention, documentation, referral and follow up caring during and after an episode of intimate partner violence [2-4].

According to the last report released by the WHO [1], in partnership with the London School of Hygiene & Tropical Medicine and the South African Medical Research Council, violence against women is a ‘global health problem of epidemic proportions’, even though it is still not included in the health-care policies of many countries. In view of this situation the WHO, together with the Department of Reproductive Health and Research (RHR), have recently issued guidelines to offer health-care providers evidence-based guidance on appropriate care, make health-care providers and policymakers more aware of violence against women, encourage an evidence-based health sector response, and improve capacity-building of health-care providers and other members of multidisciplinary teams [5].

Despite some advances in policy and knowledge generation regarding health systems’ role on IPV prevention and management in Europe, general consensus about its importance and the need of health care appropriate response, only few countries have institutionalized IPV detection and management in a successful way [8,9]. There is, therefore, an urgent need to improve medical curricula across countries, to disseminate these guidelines, and to support their adaptation and implementation. A number of shortcomings have been identified that contribute to this situation [10]: 1) a lack of educational programmes on IPV during University; 2) the lack of any specialization for the assessment and treatment of IPV for practicing physicians of the same speciality; 3) the inadequacy of current educational

approaches, which are rarely reinforced during the periods of residency or the postgraduate period, and are not very successful in achieving important changes in attitudes and actual rates of IPV screening in clinical practice.

The aim of this research is to seek input from Primary Health Care providers in Europe on their perception of their needs for specific training to address Family Violence and preparedness to manage this kind of patients.

## Methods

A pilot study using PREMIS (Physician Readiness to Manage intimate Partner Violence Survey), a 15-minute questionnaire through the primary care network in Europe with the aim to investigate physicians' perceptions of their competencies and training needs in Family Violence.

The PREMIS tool will be the instrument used to measure physicians' previous knowledge, attitudes, beliefs, behaviours and skills. This test has high consistency with constructs that theoretically contribute to effective healthcare provider response to victims of IPV; in addition, PREMIS has good external validity with earlier instruments, while being more current and more comprehensive than previously used tests. In addition PREMIS has been demonstrated to be sensitive to change and successfully discriminate between trained and non-trained physicians [6].

This descriptive study will be self-reported online using the “lumos!” platform, which enables the development and coordination of questionnaire-based studies, and the possibility to share the questionnaires on different Social Networks and invite different professionals to participate in them.

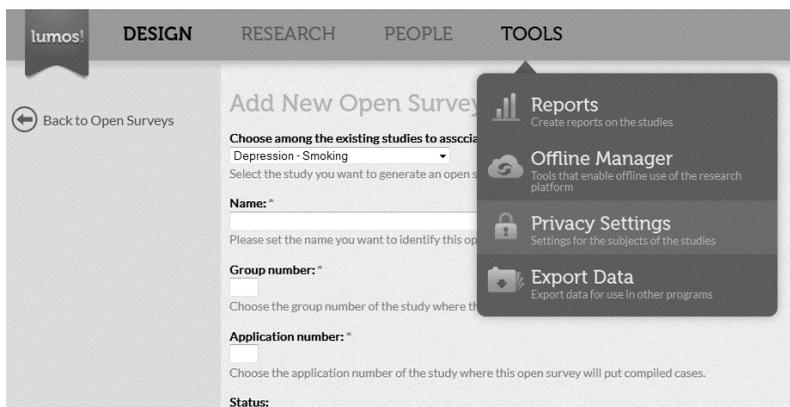


Figure 1. The interface of the “Lumos!” platform

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 and can be employed for the needs of virtually any research study [7].

## Conclusions

Domestic violence remains a major public health and clinical problem with a poor health care response. The easy use of this platform, accessible and feature-complete for surveys will attract more colleagues to participate actively and engage more physicians, due to the advances in the connectivity, the effectiveness and efficiency of “lumos!” platform.

By using this tool, it will be possible to identify potential deficits in the Primary Care professional’s curricula, evaluate possible training initiatives for the development of their competencies, and eventually, elaborate curriculum guidelines based on the assessment of perceived learning needs.

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# The Women Observatory for eHealth, *We*Observatory

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## Introduction

The Foundation Millennia2025 Women and Innovation [1] is committed to highlight the crucial role of women in global health and telemedicine, as well as their unrecognized capacity as builders of alternative futures. The latter is based on women's innate future orientation, their ability as social actors to mediate and network at all levels and to face natural catastrophes and human conflicts by saving lives and creating solidarity among women.

In this context, nurses are root workers whose endless efforts and worldwide commitment to control pain and reduce mortality are still insufficiently recognized. To address this gap, "Connecting Nurses" [2] an initiative supported by Sanofi, in partnership with nurses' organizations, provides a forum where nurses from around the world can share ideas, advice, innovations, and enhance the leading role of the nursing profession in advancing healthcare.

Acknowledging that women remain a forgotten group in many countries, Connecting Nurses and the Foundation Millennia2025 joined forces in September 2012 to launch the *We*Observatory, an innovative Digital Inclusion Platform dedicated to women's global eHealth challenges. The overall objective of the *We*Observatory is to serve as a unique resource center on eHealth and telemedicine, to promote women's empowerment through the access to and use of advanced technologies, combined with innovative integrated collaborative leadership programs. More specifically, the *We*Observatory seeks to:

- Accelerate women's access to and use of information and communication technologies (ICTs) for the provision of eHealth, mHealth and Telemedicine services, especially to those living in the developing world, within the context of the UN Millennium Development Goals (MDGs) 4 and 5;
- Optimize connections, generate creative solutions, and contribute to the drastic reduction of maternal and child mortality by 2015 and 2025; and

- Support women and healthcare professionals in engaging all generations in the use of advanced technological tools, to promote access to eHealth and Telemedicine for the improvement of women's and family health.

By making all ICT tools and services fully accessible, the *WeObservatory* improves communication, facilitates access to healthcare services, and provides cost effective connections.

### Activities

The *WeObservatory* offers a selection of innovative projects, eApplications, online courses, and a Library. The projects are selected from among those posted by participating nurses to Care Challenge—the ideas-sharing website of the nursing community worldwide, created by Connecting Nurses [3]. In 2013, *WeObservatory* decided to select each year five Care Challenge projects that improve the use of telemedicine and eHealth services. Their inclusion in the *WeObservatory* aims to expand the projects' visibility and aid their founders in establishing connections with *Millennia2015* communities in diverse regions and countries.

### Projects

The nine projects selected for the *WeObservatory* since 2013, described below, have proposed activities that include eHealth into their frameworks. They were developed in their original language (English, French, or Spanish) without translation, and expand over four continents: Africa, the Americas, Asia and Europe. These projects cover themes that the *Women and eHealth Study 2010–2012* [4], presented at Med-e-Tel 2013, found to be of interest to women, including: Emergencies during natural disasters, mental health, the elderly, HIV, maternal health, diabetics, mHealth applications, health prevention, and online education through videos.

**pod.RN - The Nurses' Podcast Project, Philippines** [5]: The use of radios remains a favorite communication tool in isolated communities. The Alliance of Young Nurse Leaders and Advocates (AYNLA) in Manila is scaling up its initial podcast project with video podcasts that integrate YouTube, social media and micro blogging sites, reaching a larger audience. A special fund for emergencies contributes to support pregnant women facing natural disasters.

**Répertoire des guides cliniques pour l'élaboration des plans thérapeutiques infirmiers en santé mentale, Canada** [6]: Mental health remains unrecognized in many places. Nurses in Quebec have elaborated therapeutic guidelines to ensure adequate and qualitative care for these patients. The guideline on Consumption of psychoactive substances has

been adapted to the local context of mental healthcare in Kinshasa, Democratic Republic of Congo, thanks to a joint agreement with the Centre Neuro Psycho Pathologique de l'Université de Kinshasa (CNPP/UNIKIN).

**Research-based Community Telehealth Center, Philippines** [7]: The Our Lady of Fatima University, in Valenzuela City, Philippines, is investigating the views of the elderly regarding lifelong learning through telehealth technologies; the preliminary results are promising. Additional research, planned for 2014, will address internet use for healthcare among aging women in Filipino communities.

**VIH TaVie, Canada** [8]: HIV treatment adherence remains a challenge. This project focuses on developing 20 minute-long videos that provide continuous support to patients. Women living with HIV will benefit of having access to specific videos adapted to their needs during pregnancy and lactation.

**Let's Save our Mothers, Nigeria** [9]: Limited progress has been made in improving maternal health in Nigerian communities. Using mobile phones, the Traffina Foundation is addressing identified challenges by targeting pregnant women who are victims of dangerous practices. The project sends participating women weekly bulk short message service (SMS) messages with information about pregnancy and the dangers of harmful practices to increase awareness and help save lives during childbirth.

**Diabetic Foot Care, Kosovo** [10]: The methods and materials used for treating diabetic patients are sophisticated in developed countries, but rarely adapted to areas with limited resources. Targeting these areas, the Diabetic Foot Care project has already obtained promising results in Kosovo and will contribute to the development of a future mHealth application.

**iPansement, France** [11]: This multi-service mHealth platform is dedicated to the wounds and healing field. A special module for women's wounds and Diabetic Foot Care will be developed in 2014.

**ePrevention in LAC and Caribbean, Peru** [12]: The primary benefit of telemedicine lies in facilitating remote access to prevention and care. With ePrevention and the Global Network of Women in Telemedicine at the Millennium2025 Foundation *WeTeled* [13], telemedicine courses are made available in remote communities to train healthcare professionals on dengue and tropical medicine.

**5' (minutes) Program, Spain** [14]: This program provides continuous capacity building to nurses through the development and use of short videos. Available in Spanish, the videos are planned to be included in online courses to benefit nurses in Central and Latin American countries.

In 2014-2015, the *WeObservatory* plans to expand its activities with new projects and additional partnerships to cover more health areas of interest to women and girls, in particular.

### *eApplications*

The *WeObservatory* is supporting the development of innovative healthcare solutions that address multilingualism, a key barrier to women's access to healthcare information, as identified in the *Women and eHealth Study 2010-2012*. In partnership with UniversalDoctor, the Foundation launched the application "UniversalWomen" in September 2013, at the Women Leaders Forum, in New York [15]. This new multilingual mobile application, available for download, provides medical translations on pregnancy, childbirth and overall maternal health in six different languages (English, French, Spanish, Russian, Romanian, and Arabic) [16]. Expanding on this concept, the application "UniversalNurses" will be launched during the Special Women Session at Med-e-Tel 2014, to support multilingual communication with patients. By end of 2014, additional applications will be made available with iPansment and VIH-TAVIE to address women healthcare.

### *Online Courses*

The *Women and eHealth Study 2010-2012* revealed that capacity building is a key factor for women's empowerment in telemedicine and eHealth. To facilitate learning, the *WeObservatory* is selecting online and massive open online courses (MOOCs) in English, Spanish and French accessible free of cost. A list of 30 courses in English [17] and six in French [18] is already available, and will be updated twice a year by the *WeObservatory* expert team.

In addition, the *WeObservatory* and *WeTelemed* provide links to a selection of telemedicine online courses in Spanish and French. In particular, the course on "Introduction to Health Informatics and Telemedicine", developed with the University of Technology of Panama, provides the basics in telemedicine for infectious diseases prevention in Panama and Latin America. Limited to 25 students, the first course received more than 300 inscription requests, demonstrating the vast training needs and high interest of healthcare workers in this area.

### *The WeObservatory Library*

The Library is currently under construction and aims at providing articles, publications, videos, photos, and events related to women involved in eHealth and telemedicine. Currently, the *WeObservatory* Share and Learn

section provides access to 99 selected publications listed in the *Women and eHealth Study 2010-2012* [19], and links to recent events, such as the Women Leaders Forum 2013 [20]. This section is periodically updated and worthy of being consulted.

## Conclusion

Launched in September 2012, the *We*Observatory has developed several activities that promote the use of eHealth and telemedicine by women's associations and healthcare workers in rural and remote communities. Through a combination of projects, applications, online courses and the future Library, the *We*Observatory is expected to become a unique innovative ePlatform at the service of women and health professionals, within the global framework of the post UN Millennium Development Goals.

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Sylvie Coumel is leading Connecting Nurses at Sanofi Corporate, a unique recognition program for nurses to share innovation related to patient education, practice, research. It is a shift in mindset which highlights the Nurses in Leadership current process as key actors in patient centricity and chronic disease management.

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# UniversalNurse Speaker: Improving Multilingual Communication

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UniversalDoctor Project, Millennia2025 Foundation and Connecting Nurses 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.

With 620 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.

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. UniversalNurse will be officially launched during Med-e-Tel 2014, at the Women's Special Session, organized by the Working Group on Women at ISfTeH.

Keywords: nurses, multilingual, patients, communication, mobile,

# Use of Computer Aided Detection in Breast Cancer Screening Programmes

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## Introduction

Diagnosis with CAD (Computer Assisted Detection) systems in mammography started about 10 years ago. In the first studies, CAD systems were not tested in comparison with double reading of mammograms. These studies showed that CAD and double blind lecture are similar in terms of Incremental detection rate (IDR) (against single reading): CAD seemed to improve the recall rate (12,5% CAD versus 28,8% double blind reading) [1-8]. Later studies obtained different results: single reading + CAD showed less sensitivity about carcinoma (-5,1%) versus double reading, while reducing the recall rate (-10%) [9-12].

The differences between the two groups of studies could be attributed to the use of different records and different readers by not controlled studies, that can heavily influence the results. The most important and reliable study (CADET II) showed a significant equivalence about double reading and single reading + CAD [12].

The objective of this study was to compare the performance of single reading of breast cancer screening mammograms + CAD with traditional double reading. The results of this study are expected to help evaluating whether new advices about use of single reading + CAD in first level of breast screening could be introduced.

## Methods

This multicenter study was carried out in three population-based breast cancer screening programmes in the North-East of Italy (Ferrara, Modena and Padova). In the routine practice, 50-69 years old women are invited to undergo a mammogram every two years and mammograms are read by two radiologist independently. All the radiologists involved in the three programmes are highly experienced and read more than 5000 mammograms per year.

The following CAD softwares were installed in the workstations of the three programmes:

- Ferrara: Mammocad by Carestream and iCAD by Philips in five and three stations, respectively;
- Modena: iCAD – SecondLook Digital by Fuji;
- Padova: CyclopusCAD mammo, an advanced IT solution, developed by the University of Palermo [13-14], that uses advanced techniques of artificial intelligence and imaging processing.

The programmes enrolled all the consecutive women attending the screening programme from the study start onward. The reading of the mammograms was carried out independently by each of two radiologists, according to the following sequence for each radiologist:

- Standard reading;
- Diagnosis recording;
- Activation of CAD and highlighting of possible regions of interest;
- Analysis of regions of interest (ROI);
- Recording of eventual change of the first diagnosis.

All cases with a positive mammogram according either to the first reading or after CAD activation were recalled for second level assessment that was carried out according to the usual local care. The results of all the second level assessments were recorded.

The performance of double blind-reading vs single reading + CAD was evaluated in terms of Referral Rate (RR) to further diagnostic workup and of breast cancer Detection Rate (DR).

Recall Rate was calculated as the proportion of screened women who were sent to further diagnostic assessment because of a positive/suspect mammography. This index describes the effect of single reading + CAD on the amount of false positive mammograms and on the workload of the second level versus traditional double reading.

Detection Rate was calculated as the proportion of screened women with breast cancer diagnosis. It compares sensitivity for cancer of the two reading strategies.

## Results

We present an interim analysis with the result on the data about the 23932 women enrolled by 30 November 2013, corresponding to 47864 lectures with CAD.

Overall, the rate of positivity mammograms was 3,0% (n=717), with a decreasing trend as age increased. Most positive cases were in 50-59 yrs women (58% total). We recorded the breast density assigned to each

mammogram by the first of the radiologists, according to the BIRADS classification; about 90% of women in post-menopausal state was BIRADS 1-2.

Double reading + CAD slightly increased RR about 1,6%. This rate is a bit higher in older (+1,47%) than in 50-59 yrs women (+1,67%). The IRR is higher in women with high density (BIRADS 3-4): 2,2% vs 1,41% in those BIRADS 1-2.

Overall, 125 breast cancer have been diagnosed, with a DR of 5,2 x 1000 screened women. As expected according to epidemiologic data, DR is higher in 60-69 yrs women (6,8‰) vs women 50-59 yrs (3,4‰). DR is also greater in women with higher breast density.

All invasive cancer cases were detected by double reading, independently of additional positivity to CAD. In other words, no invasive cancer was recognized by CAD alone, therefore IDR is 0.

The main objective of this study is evaluating the use of CAD by a single radiologist instead of traditional blind double reading. Overall, the RR with double reading alone would have been 2,5%. A strategy based on single reading + CAD would reduce the RR by 0,5 to 0,8 percent points, corresponding to a relative reduction ranging between 19,8% and 30,7%.

On the other side, the overall DR with double reading alone would have been 5,3‰. A strategy based on single reading + CAD would reduce the DR by 0,5 to 0,8 per thousand points, corresponding to a relative reduction ranging between 10,2% and 15,3%.

## Discussion

Our preliminary study data show that single screening reading + CAD, compared to the traditional double reading of mammograms, could significantly reduce the recall rate to the diagnostic workup by 19,8% to 30,7%, at the cost of a 10,2% to 15,3% reduction of cancer detection rate.

In the literature, all the studies that compared single reading + CAD with double reading found a reduced DR, while some of them reported also a lower RR with the experimental strategy [15-16]. This may be due to different reason, such as the experience of the radiologists and the type of CAD. The CAD-stratified analysis will be carried out once the enrolment is completed (expected number of subjects: 32.500).

The preliminary results of our study may contribute to produce definitive evidence about the utilization of CAD systems in the reading of mammograms in population-based screening programmes.

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# What Did I Post to Make the Prime Minister Follow Me?

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## Introduction

Social Media across academic disciplines is deemed invaluable to some, perceived a nuisance by many, and flatly ignored by others. Love it or hate it, it is one of the most efficient ways to get information out quickly and inexpensively in a way that rivals only radio (direct from the source, information arriving simultaneously). International Radio Day is an annual reminder that radio is still relevant media, since much of the world population is without access to the Internet, or SMS (mobile text). Projects such as Google Loon (balloons placed in the stratosphere equipped with technology to connect those on the ground to the internet) may soon change access for the remaining parts of the world that are not connected in a significant way (Google Loon).

One of the primary benefits of social media (such as Twitter) over radio is that it is searchable online after the message has posted and can proliferate through sharing. It is also a way to skip past hierarchy in order to reach out to someone that you would like to (but may not have access to), including the Prime Minister's office. This of course, will change over time as more practitioners become aware of the power and ease of virtual connection through Social Media and the queues become more crowded. With only 140 characters allowed per tweet, searching is succinct and effective as well as timely, within seconds of posting by its administrator. Utilizing SMS for information sharing has proven effective but it does not provide the same efficiency when it comes to re-sharing to thousands of people at once, nor does it usually give you the benefit of two-way communication.

### *Weighing Views of the Public*

Social Media platforms can serve as a public question and answer session, especially when one wants to make answers both public and searchable. Even simple questions one may have such as, "Did I just feel an earthquake?" can be quickly answered via twitter by searching "earthquake". One will quickly see exclamations that reflect their experience, or perhaps see that there indeed *was* an earthquake, but clearly not on their side of the world. Other free services such as Storify can group themed conversation in a readable way to disseminate to others that perhaps

don't use the platform. Hashtags (the number sign “#” in front of the desired term) help create boundaries around specific conversations but don't automatically collect the information based on that topic. An example would be a conference hashtag: #medetel2015. Everyone who knew about the hashtag for a specific conference could review tweets tagged to get an overall idea of proceedings. However, at such events, there often ends up being multiple hashtags, so it is wise to search the event name or other terms to find more information as many users fail to use hashtags at all.

*Hashtags Matter: Data*

When looking at the topic of Millennium Development goals and the post 2015 agenda, using #post2015 at <http://www.twitter.com> (English Tweets) pulls up specific, targeted discussions with the designated hashtag by participants. Searching “post 2015” pulls up an additional 100 Tweets with most relevant terms n= 339 but had 6 mentions with #askcoachb (which appeared to have nothing to do with the topic). Where you see a keen difference, however is in the Retweets of #post2015. Those with the hashtag designation actually had *more* retweets than original tweets, showing trust in information without a need to alter or make the message “original”.

Park, Rodgers and Stemmler [3] analyzed tweets from health organizations and found that a high rate of retweeting (sharing) followed. Further, Nonprofit organizations and community groups had more tweets about health literacy than did other types of health-related organizations. Tweets on health literacy topics focused predominantly on using simple language (pg. 410). Neiger et. Al's [4] study found that as public health transitions to more conversation and engagement online, the potential to help form partnerships and involve the audience as program participants may lead to further action for improved health (pg.177).

Table I

<b>Data February 12, 2014</b>	<b>Original Tweets</b>	<b>Re-Tweets</b>
<b>Twitter Search Term</b>		
Health	447	153
Women Health	336	164
Maternal	319	181
Infant	437	63
<b>#post2015</b>	<b>239</b>	<b>261</b>

### *Twitter Data Mining*

In the case study above (table I) the subject of health was analyzed in general as well as specifically (women, maternal, infant and post 2015 millennium development goals). Twitter data from February 12, 2014 was looked at in light of the most popular news stories of the day. First, the Guardian Newspaper Tweeted that maternal death was down 50% (in reference to the MDGs and a United Nations Report). This resulted in a rash of retweets. Second, in the US a well-known brand of baby seat was recalled for safety issues, which would also garner many retweets. One of the most used terms related to women's health was "mammograms" which is likely attributed to cycling stories that report the lack of helpful impact mammograms have shown over the years despite the medical push for them (that were well intentioned in the medical community) as well as the pieces refuting the study and its "sloppiness". This is a simple example of how released news stories and academic reports can spread, effecting trending topics on social media providing professionals a "snapshot" into what users are deeming the most important thing to share on a given topic.

Twitter users do not have free access to the archives that are full of nearly 8 years worth of data (Twitter.com). At this time, unless one has research money allotted to purchase data, it is only available for a matter of days or weeks in the past. However, in (2014) a handful of Twitter Data Grants for researchers and academics are coming available through application to assist researchers desperate to analyze tweets over a sustained period of time. The data reveals even more specificity, including specific location and subject as well as by even more specific hashtags that group data by theme.

### *Using Social Media to Break Timely Findings*

*Time Magazine* in February 2014 reported a slowing in growth for Twitter, due to its lack of easy "conversation" that competitors like Facebook have on their platforms. However, chatting with friends isn't what Twitter's primary benefit is. One can always take a connection made via Twitter off the platform to a more conversation friendly media. "Breaking News" often comes via tweet faster than any news source as announcements can be tweeted by any audience member so that anyone with an account and Internet access can be a newsmaker. Many public figures have used Twitter as a way to explain rumors or inaccurate stories as they can write their own information and immediately publish it and have it immediately searchable. Many news organizations now use tweets and screenshots of tweets as the source for a story, nearly equivalent to a direct quote without the need to interview. Tweets are now academically citable, and an academic has

recently put forth the idea to use this service to report academic findings, rather than wait for the long peer review process (@twournalof).

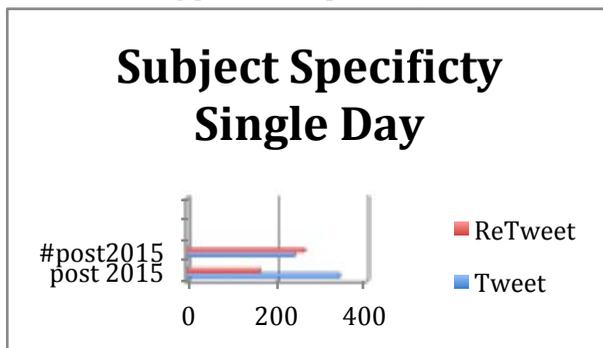


Figure 1

In another snapshot of tweet data, focusing on illness symptoms, a search was run for “sore throat” and then “#sorethroat”. This term was chosen as it was felt to be a specific descriptor of illness that was unlikely to be used to describe something else such as the terms “Headache” or “Fever”. In fact, the term sore throat appeared 434 times with 66 retweets and when a hashtag was added, it increased the frequency to 460 tweets with 40 retweets. Health departments could easily track the number of reports by region to track frequency of occurrences.

Sore Throat	n=500
Sick	n=39
Headache	n=36
Cold	n=23
Fever	n=21

Table II: Twitter search for illness using #sorethroat to determine descriptors

### Conclusion

Social media is a way that practitioners can engage with the global public in an unprecedented way. Building trust with followers can build a “brand” that needs no modification to tweets, which in turn, displays your “name” to your followers. Weighing views of the public audience, mining data from the archives, monitoring public health and engaging in two way conversations that can be retweeted to user followers instantaneously are

inexpensive and efficient ways to build relationships and partners for better public health, especially if organizations work together (even if only by simply retweeting relevant information from each others organizational accounts). Trusted sources are more likely to be retweeted to followers without modification, and when topics of public interest and safety are deemed of importance, users will rapidly share breaking news as they did in the case study above on the topics of car seat safety for infants and mammography updates.

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Kristie Holmes, Ph.D. specializes in topics related to gender, media and global health as well as technology's impact on relationships. She teaches at the University of Southern California, Los Angeles and is in private practice. She has spent a significant amount of time in the past four years working on a project with UNESCO, WeHealth and Millenia2025, acted as moderator for an NGO at the United Nations 57th Commission on the Status of Women as well as participated as a Panelist at the Women Leaders Forum as part of the United Nations General Assembly.

# Zero Mothers Die

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## Context

A silent Tsunami happens every year, as in 2010, 287 000 women died during and following pregnancy and childbirth. This is an unacceptably High Maternal Mortality, and still 800 women die every day, but 99% of these maternal deaths occurred in developing countries, and most could have been prevented. Skilled care before, during and after childbirth, can save the lives of women and newborn babies. The reduction of maternal mortality and improvement of maternal health is a UN Millennium Development Goal (MDG 5).

In parallel, High Potential of ICTs for Health attracts interest of various stakeholders, UN agencies, NGOs, local associations, industrials, telecom providers. Mobile phone networks cover 90% of the world's population, with 75% of mobile subscriptions held by nearly 80% of the population in low- and middle-income countries. Mobile phone interventions targeting pregnant women are associated with an increase in skilled birth attendance, which is one of the most important factors for saving women's lives during childbirth according to the World Health Organization (WHO). Evidence shows that mobile health tools can help minimize time barriers and facilitate urgent care, as well as support health promotion through mobile messaging services.

Within this context, Zero Mothers Die is a commitment towards saving women's lives using ICTs. The Zero Mothers Die project envisioned by a unique partnership targets 100.000 expectant and new mothers at risk by employing a comprehensive approach to improving maternal, newborn and child health (MNCH) and the systematic distribution of mobile phones and SMS messages along the pregnancy and early child life as key elements.

## Zero Mothers Die: The Project

Initiated in Geneva in April 2012 at the Global Health Dynamics Roundtable

[http://www.millennia2015.org/files/files/Publications/GHD\\_roundtable\\_ag](http://www.millennia2015.org/files/files/Publications/GHD_roundtable_ag)

[enda 2012 05 22.pdf](#)), Zero Mothers Die has conducted a series of activities in order to build a strong partnership covering all aspects of the project. Zero Mothers Die is led by the ZMD Consortium constituted by two foundations, Advanced Development for Africa (<http://www.adaorganization.org>) and Millennium2025 Women and Innovation ([http://www.millennia2015.org/Zero\\_Mothers\\_Die](http://www.millennia2015.org/Zero_Mothers_Die)), and UniversalDoctor and Tools S.L (<http://www.universaldactor.com/>). Additional partners have joined the project, UNAIDS, Airtel, and The Peoples Vision. Others leading organizations and private companies are in consideration to complete the partnership.

The project contains five main components. (1) MumHealth, a mobile messaging service delivering maternal, newborn and child health information to pregnant women and new mothers through voice and text messages in local dialects; (2) Systematic distribution of 100,000 mobile phones per year to pregnant women to increase their access to healthcare information; (3) An allocation of 36,000,000 minutes of free airtime per year, to communicate with local health workers and facilities; (4) Training of community health workers (CHWs) in rural communities using ICTs; (5) A mobile money savings scheme to increase access to skilled care during childbirth.

With these components, the project aims at (a) Reducing maternal mortality and maternal health complications through increased access to appropriate healthcare information via mobile voice and text messages in local dialects by pregnant women in rural communities; (b) Accelerating mobile phone ownership and use by at-risk pregnant women in rural communities to increase access to healthcare and empower rural communities. This includes education of women on the benefits of mobile phone ownership and use, as well as facilitating connections with local healthcare workers through 30 minutes of free airtime per month restricted to calling the assigned local health care facility; (c) Educating, training and capacity-building of community health workers (CHWs) using tablets preloaded with up-to-date training materials and content to improve maternal and child health in their communities.

The Guiding Principles of the overall project are Sustainability and Scalability, local ownership, integration within local health ecosystems, and inclusive business models, key elements of the sustainability of the project. Relevant local Ministries (Health, Telecommunications, Family and Welfare, etc.) and partners will be engaged in the project processes to secure their buy-in and local ownership to ensure sustainability beyond donor funding and scale up. Zero Mothers Die will be integrated as much as possible into health services offered in-country and local health information

management systems, in connection with the private sector and telecom providers, thereby integrating within local health ecosystems. Zero Mothers Die aims to establish an inclusive business model to ensure long term sustainability beyond 2015. The mobile phones distributed through the project will be provided to pregnant women who opt-in with a nominal fee in order to generate ownership of the phones (ensuring they are well taken care of and charged) and promote the importance of the services associated with the mobile phone.

As of April 2013, Zero Mothers Die has conducted a series of meetings with potential partners and prepared a project proposal, including estimated costs. Zero Mothers Die has been presented at the Millennium2015 International Conference at UNESCO, 3-6 December 2012, and at the special session on Women and eHealth at Med-e-Tel, 10 April 2013, Luxembourg. In both occasions, the project has elicited a great interest among the participants. Several have engaged further negotiations.

More impressively, Zero Mothers Die has been presented at the Women Leaders Forum, in New York, 27 September 2013, and has gained the critical recognition of First Lady of Zambia, the International Telecommunication Union, mHealth Alliance, and Mobile Alliance for Maternal Action (MAMA) ([http://www.millennia2015.org/UN Women Leaders Forum 2013](http://www.millennia2015.org/UN_Women_Leaders_Forum_2013)).

#### Country Implementation 2013 – 2017

Depending on the development of partnership negotiations, the next phases of implementation will be conducted in countries. Started in September 2013, Ghana is the first country of implementation, followed by Mali and Nigeria. An Implementation Plan is developed with national authorities, including estimated budgets calculated per country of implementation with the contribution of the Millennium2015 communities in countries, ADA experts and consultants, and local representatives of the partners.

#### Conclusion

The silent tsunami of nearly 300.000 women dying every year of preventable causes of pregnancy has to end NOW! Zero Mothers Die is committed to this ambitious objective together with its partners and ongoing initiatives in countries. By joining all forces, technologies, knowledge, funds, this tragic situation can be overcome. You are welcome to join Zero Mothers Die! <http://www.zeromothersdie.com/>



Zero Mothers Die



Dr. Véronique Inès Thouvenot is an eHealth and Telemedicine senior expert for the United Nations since 2006, and Co-Founder of the Millennium2025 Women and Innovation Foundation. Her current assignments cover gender based projects in developing countries to improve the access and use of eHealth and mHealth by women. She is Co-founder of Zero Mothers Die.



Dr. Coumba Toure is a Medical Scientist and Founder/ President of Advanced Development for Africa (ADA), which goal is to bring innovative solutions to contribute to the achievements of the MDGs. ADA aims to use technology to scale up the implementation of projects by bringing partners from specific sectors that provide electronic health (e-health) and Mobile Health (m-health) tools. She is also Co-founder of Zero Mothers Die, and Board of Directors for Women4Empowerment and Fashion for Development.



Dr. Jordi Serrano Pons is a General Practitioner and the founder of the UniversalDoctor Project, the main objective of which is to improve multilingual communication between health professionals and patients. He is Co-founder of Zero Mothers Die, and he collaborates with a number of regional and national governments at European level and Universities specifically focussing in health and technology. He recently started working as a consultant to the WHO and the TicSalut Foundation (government of Catalonia).



Jeannine Lemaire is a global health and development consultant specializing in mobile health, partnership development, project design, communications and new media solutions. Jeannine is the Coordinator for the Zero Mothers Die Project and Consortium. She has worked as consultant in the private sector as well as for multilateral agencies and non-profit organizations focused on leveraging technology, partnerships and innovative solutions to advance digital health and development initiatives. Jeannine is also the recent author of two white papers on scaling up mobile health in developing countries and mobile health partnership development. She received her Master of Science in International Health Policy from the London School of Economics and Political Science.

# **Women, eHealth and Telemedicine at All Ages of Life**

## ***Workshop: Distance Medical Education: Produce and Publish Your Own Lectures on the Web***

*Presented by the Millennium2015 Women and eHealth (WeHealth)  
International Working Group*



*With support from Connecting Nurses and Sanofi*



# **eLearning and Telemedicine in Rural Areas (With Cervical Cancer Screening as an Example)**

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In 1992 the United Nations adopted the Agenda 21, an action plan with regard to sustainable development worldwide. The three dimensions of sustainable development set out in Agenda 21 are economic, social and environmental.

In 2000 the Millennium Development Goals (MDGs) were adopted by all 189 United Nations member states. Several targets and indicators in the current MDGs are based on the conclusions of Agenda 21. The MDGs will finish in 2015.

In 2013 a working group on monitoring and indicators was created by the UN System Task Team on the Post-2015 UN Development Agenda to initiate thinking about the challenges of designing an appropriate monitoring framework for the Post-2015 agenda. This working group stated the access to new technologies as very important for ensuring full participation by all segments of the population in new opportunities, and emphasizes the significance of health and education in developing countries for the next years.

## **eLearning**

The educational aspects of telemedicine were studied within the scope of cancer screening and ultrasound screening projects in developing countries. Besides the direct benefit of saving the patients the cost of transportation to visit the dermatologist, the general practitioner could strengthen his own diagnostic skills under direct guidance and quality control of a specialist. As a consequence he/she will be able to treat more patients locally, close to their homes and families.

### **Operative Goals of an eLearning Project for Cervical Cancer Screening**

eLearning is part of a network for blended learning. Planning an eLearning project, the first step should be collecting experiences in the field of eLearning for a certain issue in a certain country. An eLearning project should have a time period of several years, including the project planning period, the installing period and the main project time for working with the system and for scientific evaluation.

### *Blended Learning*

Blended learning is a formal education program in which a people learn at least in part through online delivery of content and instruction with some element of student control over time, place, path or pace. Face-to-face classroom methods are combined with computer-mediated activities like the telemedicine platforms. The opportunity for data collection and customization of instruction and assessment are two major benefits of this approach.

The NGO OWMN developed a „one-stop smear test“ which can easily be done with low cost staining material. Results are available within a few hours. No difficult staining is necessary. Nurses or midwives can do the diagnoses. Lecturers teach this method during a two-week face-to-face course in rural hospitals. After the lecturers will leave the hospital they will be in contact with the nurses and midwives through the telemedicine platform. This platform can be used with a computer or a tablet PC. When a smart phone is used to exchange patient cases we talk about mobile health or mHealth.

### *Problem Based Learning*

Problem-based learning (PBL) is a student-centred pedagogy in which students learn about a subject through the experience of problem solving. The goals of PBL are to help the students develop flexible knowledge, effective problem solving skills, self-directed learning, effective collaboration skills and intrinsic motivation. Web-based telemedicine platforms are based on the integrated workflow, which includes diagnoses, data management and teaching. All these three topics are used for problem based learning. The goal will be to build up a network of all health professionals who are involved in cervical cancer. This will include health personal that does screening, doctors who do biopsies and cytology and surgeons who treat the women, if necessary. It will also include health personal that is involved in education women and in vaccination projects. Problem based learning within a national and international network will result in a sustainable health care.

## Web-based eLearning Platforms

### *Case.io*

This platform is an easy-to-use platform, which allows registered and non-registered users to exchange diagnoses and lectures. Using computer, tablet PCs or smartphones makes it a versatile platform, which can be used in every place of a rural area.

### *CampusMedicus*

This platform is used in projects where diagnostics, epidemiology and live eLearning is needed within in one community.

Using the eLearning platforms Case.io or CampusMedicus improves training of physicians. Until today books had to be written, printed and distributed. Writing a book means it may be outdated within a few months. Using a web-based platform means you can exchange outdated documents immediately. Printing books costs quite a lot of money. This is not necessary when using a web-based platform, as all documents are available digitally. Distributing books is very time consuming and expensive. Again, when using a web-based platform everybody with Internet or a smartphone, has access to the lectures. Even videos, cartoons or other links may be added to a lecture. Questionnaires, quiz and tests complement the eLearning content.

### Practical Experience in Mongolia

The Millennium Challenge Account (MCA) used the telediagnosics software CampusMedicus for cervical cancer screening in Mongolia. They started screening in 2012 and since then around 100,000 women were screened. In Mongolia the three step visit pap, cytology, biopsy and treatment is done for women from 30 to 60 years. Through the web-based telediagnosics platform CampusMedicus, expert doctors from the capital city hospitals (e.g. University hospital, Cancer Centre) exchange diagnoses for unclear cases with their colleagues from countryside. Women who were diagnosed positive are transferred to a hospital in the capital city for further treatment. This is the short description about the project in Mongolia.

# **Benefits of Open Source Software in Healthcare**

# **Bika Health, an Open Source Laboratory Information Management System (LIMS) for health care laboratories**

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## Introduction

Laboratory Management Systems (LIMS), especially in the health care discipline, are essential tools in any laboratory. Supporting the formalisation of the laboratory workflow and analysis methodologies through SOPs, LIMS allows the implementation of Quality Assurance and Control (QA/QC) mechanisms to ensure consistency, accuracy, reproducibility and integrity of analysis results and procedures.

Two big problems with LIMS acquisition are high monetary cost due to license fees, and lack of access to the system source code, making it difficult to adapt it to the real local needs in the laboratory. In fact, it prevents small health centres and those which do not have sufficient financial resources from implementing LIMS.

Bika Health is an Open Source LIMS which aims to address these shortcomings, for the application of QA mechanisms to no longer be exclusive to larger centres.

## LIMS: Beyond Management System

The prevailing view of LIMS is of software capable of managing samples and laboratory analysis, as well as control mechanisms to monitor and track the processes and agents who participate in these workflows: from sample reception through to publication of analytical results.

This simplified view equates LIMS to traditional business management tools, but designed to resolve laboratory specific requirements. This approach led, for many years, to the use of a wide spectrum software tools, often unrelated to the idiosyncrasies of laboratory work. The use of database management systems (DBMS) conceived for domestic and personal use as well as software used for spreadsheet creation, are still prevalent in small laboratories and those with limited financial resources.

The reality is that LIMS goes far beyond this perception and is indispensable for meeting many international standards and mechanisms for quality control management. Compliance with such regulations and standards ensures consistency, accuracy, reproducibility and integrity of the results and the methods used to produce them. This is unavoidable and important in clinical and health laboratories.

Some examples of standards and regulations applicable to LIMS are: ISO/IEC 17025, ISO 9000/9001, ISO/TS 16949, Good Automated Laboratory Practice (GALP); and for health care LIMS specifically: ISO 15189, 21 CFR Part 11 and Clinical Laboratory Improvement Amendments (CLIA). The implementation of Quality Assurance (QA) and Quality Control (QC) policies are key factors addressed by LIMS.

Thus, a LIMS is not only a system for sample and analysis management, it sets the framework in which all laboratory work processes will take place, for the activities, services and products generated by the laboratory to conform to standards and quality criteria required by legislation and certification bodies.

### LIMS Implementation

LIMS implementation is not a trivial process, and requires the involvement of key people from the laboratory from the start. Comprehensive analysis of the laboratory workflow, formalisation of routines, needs assessment and requirements definition are elements that precede implementation. Thorough knowledge of the laboratory and its peculiarities is essential for success of LIMS implementation and use. This first analysis and design phase is crucial and requires a significant effort from both the laboratory and the development team. The information generated during initial A&D serves to produce a design and functional specification document on which the entire development will be based. Omitting it will see the delivery of a system poorly fitted to laboratory needs, and lab staff is likely to experience the system as adding to their work instead of as a tool making it easier.

In the next stage, active development, the LIMS team incorporates the additional features identified, and parametrise the system based on the design document drawn up earlier. Regular communication between the development team leader and key people in the lab is a fundamental aspect here: small deviations from the functional specification are uncovered and must be resolved to ensure all work is completed 'first time right'. Agile programming techniques are good to manage these modifications, encouraging regular testing and adjustment of functionality as the team progresses developing the new features.

Finally, the LIMS is deployed in a pre-production environment, to be used as acceptance testing platform by laboratory staff. After final adjustments, the validated system is deployed in a production environment. The test platform remains in place for training purposes.

### The Human and Economic Factors

The different stages of development and implementation highlight the importance of the human factor. It cannot be ignored and is an intrinsic part of the entire implementation project: motivation and involvement of laboratory personnel and the development team are essential.

Currently, most systems on the market require the laboratory to pay licensing fees (with annual renewals) that cannot be afforded by many. The licensing cost has to be added to those associated with professional product development and implementation services.

Proprietary systems also do not provide access to the system source code. A LIMS should be understood as a dynamic system, it evolves and adapts while the laboratory incorporates new analytical techniques, changes the focus of the services offered or adapts to new market needs and regulations. Restricted access to the source code requires the laboratory to depend on the manufacturer of the system, locked in without the ability to neither manage or customise the system, nor form a team for its maintenance and support. In addition, the laboratory has no control over system functionality and how it manages data internally. The laboratory loses the freedom to understand and manage a central part of their business model.

Unfortunately economic constraints and the use of proprietary licenses have most severe implications in small laboratories. This problem is especially important in the health centres providing local services in emerging economies.

While the expenditure on these human factors can be considered an investment in knowledge and an opportunity for the development of local economies, license fees and proprietary software use also hinder a return investment to society. A clear example can be found in the training centres for future health care laboratory professionals, it is not uncommon to find training centres that do not have LIMS because of the cost of acquisition, implementation and maintenance. This directly affects the education of students who will enter the labour market as laboratory professionals without knowledge about using such systems nor the aspects of Quality Assurance and Quality Control.

### Bika Health LIMS and Open Source Project

Bika Health forms part of the Bika LIMS open source project, established

as an alternative to proprietary LIMS. The Bika LIMS project comprises a family of open source and web-based applications, each aimed at a different laboratory discipline: Bika LIMS, Bika Health, Bika Epid, Bika Wine and Interlab. Bika Health is the Bika LIMS branch developed specifically for health care laboratories, with patient samples and clinical cases the central elements in the lab workflow. More than 60,000 free downloads of Bika LIMS gave the project traction and rise to an active community of developers and users.

The development and maintenance of Bika Health source code takes place under the stewardship of the Bika Health Foundation, a non-profit organisation in South Africa with global membership. The Foundation has as its most important objective ensuring the Bika Health intellectual property and source code remain available as Free and Open Source (FOSS).

Bika Health provides a competitive advantage over proprietary LIMS, not only through saving licensing costs, but because the design and development team gets to focus all efforts and resources on implementing a custom-made LIMS, responding to specific laboratory needs. The Open Source nature of Bika Health allows the laboratory to take complete control of the system, without vendor lock-in, even transferring maintenance and support to inhouse teams. In addition, laboratories benefit from improvements aggregated from world-wide contributions by the Bika Open Source community. The continued development by project participants, sponsored by fee-paying clients, and the debate generated by users on community forums, ensure a high quality best-of-breed system with constant growth in new features and enhancements.

Bika Health is a robust LIMS that can be adapted and implemented in any laboratory, from those of small size to large research and clinic laboratories. It doesn't require external databases and is independent of infrastructure. On OSS, no web server, database or operating system license fees required.

Bika Health has been implemented in various laboratories around the world: Caribbean Public Health Agency (CARPHA), the Sri Lanka Medical Research Institute and commercial labs soon to be announced.

## Conclusions

The licensing model used in proprietary LIMS is a determining factor that hinders the deployment of such systems in many laboratories, with particular relevance on small laboratories with limited financial resources. This is particularly disturbing in health laboratories, where the deficit implies an added difficulty for compliance with laws and standards, and the establishment of quality policies. This can have a direct impact on the

diagnosis and treatment of the patient.

Bika Health is an Open Source LIMS of high quality, designed specifically for health laboratories and cost saving in mind. Bika Health complies with regulations, standards and quality policies. Thanks to its Open Source model, the laboratory has full control of the system, being able to adapt to new needs independently.

#### Acknowledgment

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# Care2xWeb Based Integrated Healthcare Information and Resource Planning

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## Introduction

Care2x is a Web based Integrated Healthcare Environment (IHE). It allows the integration of data, information, functions and workflows in one environment. Its design can also handle non-medical services or functions such as security and maintenance. The software is web-based, modular and highly scalable. All program modules are processed on the server side therefore module updates and extensions do not require changes on the web browser, thus avoiding network interruptions and downtimes. Its design also supports multiple server configurations to distribute traffic and improve speed and efficiency.

Care2x is open source software released under GPL v2.0 license. The first public version was released in 2002 and within the first few years it was translated into over 20 languages. It has a worldwide developer community, comprised of developers mainly from developed countries.

The requirement was to provide software covering all the key areas in the hospital and thus to avoid the problem of incompatible software in different hospital units - also still a major problem in developed countries.

The requirements of hospital software tend to differ from country to country and hospital to hospital and this is the main reason that there is no standard package commonly used in the hospitals worldwide. This is the big challenge in creating a large developer community and keeping them working together. Local customised solutions with good support from proprietary software companies together with better funding resources in developed countries, have not given space for open source software in that market. During the last few years the development efforts of the original free version have been concentrated in developing countries, which are also seen in the download statistics. Out of 16500 downloads to 150 countries in the last year 85% goes to developing countries.

## The Four Perspectives

Four basic perspectives as described in Fig. 1 are:

- The patients perspective;
- Financial perspective;
- Management (internal business perspective);
- The internal training (learning and growth perspective).



Fig.1: HIS Perspectives

Each perspective represents a single strategy that can be easily broken down in simple levels, depending on the individual needs of the hospital.

Care2x can help solve these issues, by its ability to monitor the values of the main Key Performance Indicators (KPI) in each of the aforementioned perspectives.

- Patient's perspective will focus the value of for example the top 10 diagnosis, infections, etc. when the patient consults a doctor;
- The financial perspective concerns hospital stock management and the financial department;
- Management will have the focus on values of reporting like budgeting aspects and future finances;
- The learning and growth perspective about visions which will sustain the ability to change and training improvement for staff.

Thus, by using those perspectives a metric can be designed to classify processes, structures and finally the needed technical and functional specification for any implementation.

All those four perspectives are part of the Care2x framework, meaning that they must be assessed and populated in accordance to each business case. In order to achieve this, a list of objectives that can be feasibly measured has to be created for each perspective. And, a specific target should be set and the initiative to reach that target has to be described. In

that way, the four basic perspectives create a more valid and future oriented hospital information system and its strategy. These measurements are intangible aspects of the system as shown in Fig. 1.

### Specifications on Implementation

In order to measure the key performance indicators, there is always a need for a specific implementation plan. These include several steps, some of these could be described as:

- Determining of priorities;
- Comply with standards;
- Collect required information;
- Managing changes and improvements.

Based on Fig. 2 a table can be created where above requirements of an initial process are described.

As an example of a workflow we created a diagram of a patient flow by using the patient perspective.

The result of those workflows is a set of tables, in which the minimum available dataset needed for a correct implementation of Care2x is described.

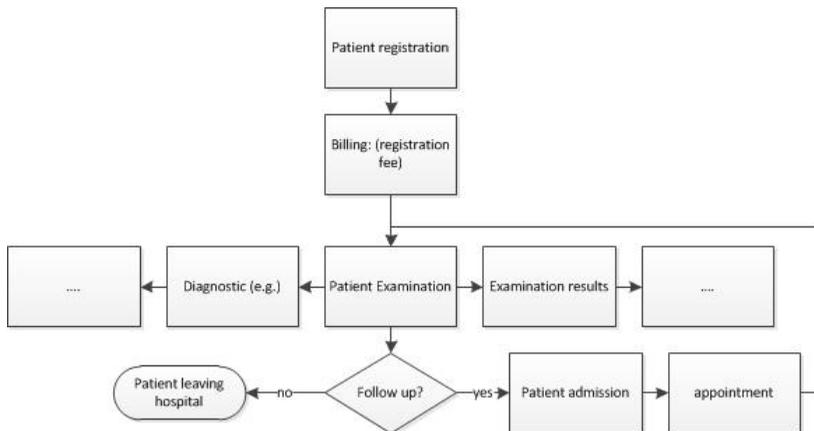


Fig.2. Example of simplified OPD workflow (patient perspective)

Each of the table elements below results from the analysis of the internal hospital process. Each process describes the base steps upon which specific metrics for the needs of the hospital can be met.

Table 1: Based on OPD workflow an example to show up the four perspectives

Workflow	Perspective	KPI	destination
Patient registration	patient	registration	Care2x
Appointment	patient	appointment	Care2x
Registration fee	financial	interface to ERP	ERP
Diagnosis	patient	ICD9/ICD10/OPS301	Care2x
Lab test	patient	values of batches per day/doctors/wards	Care2x
...	...	...	...

As can be seen in Fig. 3, graphical reporting tools allow KPI values to be compared with historic data in a simple way to gain better understanding of the health situation covered by the hospital.

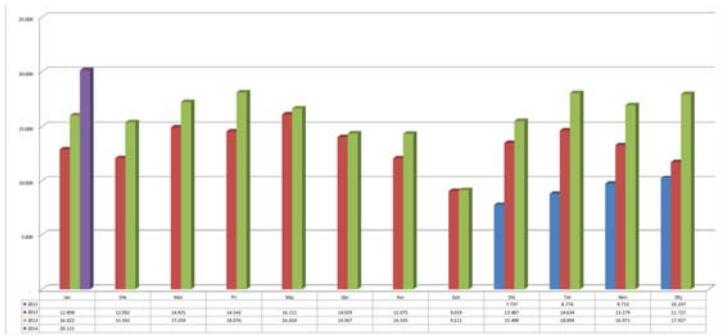


Fig.3.Progressive outpatient registration 2011-2014 report of an implementation in Albania

### Conclusion

During the implementation process of Care2x, several key performance indicators are enabled to create the overall picture. Care2x's main feature is its Open Source license. All source files are open and free for everyone to use. Similar requirements as well as specific adaptation can be easily

realized whenever extensions to the code are required. The individual architecture layers are separated from each other and can be enriched with standardized communication protocols, which also allows the use of mobile devices at any time.

In addition, the increasing know-how over time at the hospital site will result in further projects within the hospital. Many hospitals using Care2x have now a variety of other specialized software, integrated with Care2x, used by specialists, such as for finance, warehousing or reporting to reduce the total cost of ownership. The current development plans for care2x envisage the full integration of an ERP system into the core functionality.

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# Deploying GNU Health on a National Scale: Lessons from Jamaica

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Jamaica is the first country in the world to choose a Free/Libre Open Source Software (FLOSS) for their entire public healthcare system. In 2013, the Jamaica Ministry of Health opted for GNU Health, a Free Health and Hospital Information System under the GPLv3+ license.

The nature of such an implementation is multisectoral and demands pan regional cooperation, regulation and planning. While the approach of GNU Health aims to improve compliance with international health protocols and standards, it still addresses specific local requirements and legislations. Instead of enforcing a cumbersome bureaucracy, this strategy strives to reduce administrative costs and dependence of licensing fees or further lock-in software policies.

Other developing countries may recover valuable lessons from this experience, especially in topics like data synchronization or data replication, crisis management, localization, software functionality, and database or infrastructure setting.

Keywords: GNU Health, Jamaica, Free Software, eHealth, Public Health

# Detection of Pages Respecting Quality Standards: Character N-Gram Tokenization in Automatic Detection of Web-Page Trust

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## Introduction

HONcode of conduct is the result of the Health On the Net Foundation effort towards establishing de-facto standard concerning trustworthiness of health-related information available on the Internet. The process of the website certification, since the HONcode has been established in 1996 has been manual, performed by certification experts at HON. As such, this process requires tremendous amount of the time and human resources. Taking into account the growth in the amount of the information available on the Internet, health related as any other, it has become clear that this process needs to be semi-automated. In this effort, a study has been conducted in direction of using machine learning technics in this purpose [1]. Within this study the sentence was used as a discrimination unit. This has created the difficulty due to the difference between the discrimination unit and the final classification level, webpage in this case.

Most of other studies performed to the moment in the domain of trust on the internet are focused on e-commerce domain for which certain number of criteria have been determined [2]. This lack of de facto standard in online health information makes comparison between different researches almost impossible [3]. The rest of this document is organized as follows; next section brings the information on the experimental setup, followed by the Results and Conclusion sections.

## Experimental Setup

### *Method*

In order to automatically detect accordance of the given webpage with each of the HONcode principles we have opted for the Naive Bayes machine learning algorithm. Probability that the given document  $d$  belongs to a class  $c$  is assigned to each document-class pair by this algorithm. The document is then assigned to the class for which this probability was the highest [11]. The system used for the experiment was built on top of the machine learning framework described in [7]. Separate classifiers were built

for each of the criterion, since the fact that one document belongs to the given class does not, under any circumstances influence its accordance to any other class (*any-of classification*) [9]. All experiments were performed using ten-fold cross validation.

### *Collection*

The research presented in this article is based on the collection of extracts taken by the HON experts during the process of manual certification. In order to support the accorded HONcode principal the justifying segment of text is extracted and preserved. The principle *Attribution* has been divided into two separate criteria namely *Reference* and *Date* due to different requirements for these two elements within a single criterion. Each extract obtained in this manner represents one document within the training/test collection. Although the accreditation process is available in several languages, the study presented in the article is limited exclusively to the English, thus the collection for this language is the most exhaustive one. Table I gives the number of extracts available for this language.

### *Document Representation*

Each document is represented as vector mutually independent weighted “terms” (features). The term itself can be word, lemma, stem etc. In this study, the terms are character n-grams where n spans from 3 to 5. Thus, the “privacy” would give following n-grams in the document “priv”, “riva”, “ivac” and “vacy” in the case of n=4. The choice of the n-gram was driven by the fact that this type of tokenization has proven to be effective for different languages, especially in the case of lack of the linguistic tools such as stemmers [5], they have also proven to be more robust to typos [6]. Words are most commonly used “terms”, thus in this study we compare the results obtained by various sizes of n-grams (Cn) to both word (W1) and stems (W1porter), with the goal of determining to what extent are the words replaceable without important loss in performance. Additionally, prior to the tokenization the stop-words were removed.

### *Feature Space Reduction*

In the case of feature space being too vast, the machine learning algorithms prove to be inefficient. Moreover, reduction of the feature

Table I Number of extracts per criteria (English collection)

Criteria	Code	No. extract
Authority	HC1	2812
Complementarity	HC2	2835
Privacy	HC3	2683
Reference (Attribution)	HC4	2349
Justifiability	HC5	872
Transparency	HC6	2861
Financial disclosure	HC7	2700
Advertising policy	HC8	1412
Date (Attribution)	HC9	2794

space enables distinguishing the features that could help us determine the document's class.

In the article we have tested following criteria: TF-IDF weights, Chi-square [9] and Z-score [10] keeping 30% of original number of features.

### Results

The F1-measure [9], the weighted harmonic mean between the precision and recall was chosen to present results of our research. While the Table II gives the results for different tokenization, with tf-idf reduction, Table III brings the values for 5-grams in the case of different feature selection algorithms. It can be deducted from presented results that the use of n-gram tokenization can result in better classification then that of word or stem, this depending on the criteria. Contrarily, certain feature selectors such as ZS while very efficient for some (HC2, HC6) can prove to be fatal for other criteria (HC5).

### Conclusion

As it can be seen from the presented results, n-gram can be used as an effective alternative for word or stem tokenization. It has been also shown that the choice of the appropriate feature reduction algorithm can play important role in the classification effectiveness.

Table II Results for various tokenizations

Tokenizer	Criteria								
	HC1	HC2	HC3	HC4	HC5	HC6	HC7	HC8	HC9
W1	<b>0.6908</b>	<b>0.8891</b>	<b>0.9448</b>	<b>0.5857</b>	0.4332	<b>0.9332</b>	<b>0.7778</b>	0.7459	<b>0.9574</b>
W1 porter	0.6664	0.8844	0.9385	0.5779	0.3732	0.9276	0.7550	0.7267	0.9276
C3	0.6206	0.7819	0.8642	0.5761	<b>0.5239</b>	0.9233	0.7064	0.7366	0.9531

C4	0.6193	0.8340	0.9141	0.5739	0.4034	0.9073	0.7170	<b>0.7553</b>	0.9466
C5	0.6195	0.8536	0.9355	0.5615	0.3619	0.8895	0.7211	0.7534	0.9402

Table III 5-gram (C5), different feature selectors

C5	Criteria								
	HC1	HC2	HC3	HC4	HC5	HC6	HC7	HC8	HC9
TF-IDF	<b>0.6195</b>	0.8536	0.9355	<b>0.5615</b>	0.3619	0.5939	<b>0.7211</b>	<b>0.7534</b>	<b>0.9402</b>
Ci2	0.4090	0.8611	<b>0.9391</b>	0.4377	<b>0.4011</b>	0.8861	0.7094	0.7368	0.9373
ZS	0.4810	<b>0.8674</b>	0.9213	0.3440	0.0926	<b>0.8895</b>	0.4215	0.5990	0.9128

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# **E-Health Platform for Clinical Hospital as a Modern Frontend-Backend Open Source Solution**

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SOA (Service Oriented Architecture) in the modern world is one of the most popular conceptions in web programming.

We want to present e-Health platform for clinical hospital, which is example of SOA oriented web-application using frontend-backend architecture and only open source solutions.

The system is part of the NCBiR project realized on Medical University of Warsaw, Poland.

Our E-health platform demonstrate, that the open source solutions with engine, which is ruby on rails, could be safe, efficient and modern way to accumulate patient record in national healthcare. Because of using rest-api communication in frontend-backend architecture our system is easy to change and ready for mobile interfaces.

One of the parts of the project is e-learning module which creates anonymous set of patient record with expert comments. This set of patient records is selected by experts to teach students and doctors.

Every part of this software is using FLOSS, and create new standard of programing medical databases in Poland.

Keywords: medical, software, clinical, platform, SOA

# **Merging Medical Device and Clinician Generated Information for Monitoring the Burden of Diabetes and Hypertension in Public Reference Health Facilities in Central Africa**

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## **Background**

Chronic diseases are an increasingly important cause of death in sub-Saharan Africa. This study explores to what extent secondary use of clinical information originating from diagnostic devices and hospital information systems can help to provide evidence related to the burden of diabetes and hypertension in DR Congo, Rwanda and Burundi.

## **Methods**

The reference hospitals of Kisangani, Bukavu, Kigali and Bujumbura implemented open source hospital information management tools (OpenClinic GA) based on international classification systems: ICD-10 and ICPC-2 codes for diagnostic coding and LOINC for recording of laboratory and clinical observations extracted from lab analyzers and blood pressure devices.

Clinical and financial data from treatments in the period 2006-2012 were merged into Diagnosis Related Groups (DRGs) and case load, mortality load and financial burden metrics were calculated.

Aggregated data were sent to a central data warehouse (Global Health Barometer) using DXF messages.

## **Results**

A total of 89,765 electronic out-patient and 59,434 in-patient records were screened based on care-provider and medical device generated evidence for hypertension and diabetes. A significant growth from 6 to 15 diabetes related admissions a month was seen between 2006 and 2012 also showing a remarkable seasonal variation, with lowest incidences in June and the highest between October and March. In-patient hypertension case load showed a constant growth from 3 to 9 cases a month in the same period with a high mortality rate above 10%.

The overall results show a worrying growth of both chronic diseases in the region with disease related costs expected to increase by 10% (diabetes) to 70% (hypertension) between 2011 and 2015.

### Conclusion

The study demonstrates the successful integration of medical device measurements with an open source clinical information system for systematic reporting of public health problems to a regional data warehouse Global Health Barometer.

The problems of diabetes and hypertension grow rapidly in the Great Lakes region. Urgent steps must be taken by governments, the international donor community and local hospital boards to deal with this new challenge.

# Ontology-driven Interoperability in Virtual PHRs

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**Abstract:** This paper presents an architecture of an ontology-based, interoperability platform which can act as a middleware amongst the various systems involved in a virtual PHR to enable the creation of integrated patient information for multiple purpose use.

## Introduction

Personal Health Records (PHRs) can be viewed as a repository of information regarding the patient's health status in a computer-readable form constituting the information dimension of patient-centred care, hence allowing patients to be the owners of their own health information. A virtual PHR, as defined here, is as a collaborative platform for sharing patients' social and bio-health data typically stored in distributed, autonomous data sources, as well as, health data stored by the patient him/herself and assistive technology equipment.

In particular, the virtual PHR, as considered in this paper, is an entity on the network created on the fly and consists of (a) physically stored patient information contained in traditional PHRs, (b) physically stored health information from medical devices connected to patient such as from assistive telecare systems, (c) social care information retrieved on request from social care organizations, (d) health information extracted from various healthcare systems such as primary and hospital care electronic medical records - EMRs; and (e) genomics information such as genotype and sequence data extracted from biobanks and genetic databanks. Information of the latter three categories is extracted on the fly from relevant information repositories to populate the virtual PHR upon a request for access.

Although virtual PHRs can bring important benefits to patients and support sustainable patient-centered care, they pose additional challenges related to the protection of patient information [1]. Thus, in a virtual PHR, an access request for patient information needs to be evaluated by both the global (at PHR level) and the local (at the individual health or social care provider level) authorization systems [2] requiring a harmonization of the local authorization policies with the global (virtual PHR) authorization policy based on current legislation, ethical guidelines and personal preferences. This is mostly a semantic interoperability challenge that can be confronted

by using ontologies for modeling security concepts which, in turn, should be mutually understood by all parties involved.

This paper presents an authorization system for a virtual PHR cloud service that integrates social, health and genomics information over time from the patient and sites of care in a structure (clinical documents) that is readily accessible.

### The Virtual PHR Concept

The virtual PHR concept, as considered in this paper, differs from the virtual patient record concept in that it integrates patient information, not only from the healthcare providers, but also from the patient, the non-professionals and the medical devices and enables information sharing according to patient premises. This, in turn, enhances communication, collaboration and information sharing among patients and providers and ultimately forms the basis for a patient-centered collaborative healthcare environment. Moreover, the virtual PHR can be considered as a foundation for personalized medicine, as it integrates social, health and genetics data for the right person at the right time, and therefore, allows for more specific individualized diagnosis, treatment and prognosis [3].

Current PHRs vary in architecture, scope and nature of functions, content and information sources and although those in general enable patients to control their own health information, and some of them also integrate information from multiple resources, not all of them enable patients to determine who else may access their information [4]. PHR services are basically divided into a) standalone which enable citizens to collect and control their information into a (web-based, portable) PHR which is not connected to any other systems; b) tethered which allow citizens to view their own information from the health care providers electronic health record (EHR) but citizens do not have control of their records; and c) interconnected, which enable citizens to collect health information from multiple sources (hospitals, devices, services), enter their own entries and share information with different parties according to their sharing preferences [5].

In this paper, a version of a virtual PHR is considered, which is populated with document-based data formed on the fly by various data items which are collected from various health and social care providers and genomics labs at the moment of an attempted access.

### System Architecture

Figure 1 shows the overall architecture of the document-based virtual PHR that is provided as a cloud service which provides for integrating pa-

tient health, social and genomics information over time in a standard structure such as the continuity-of-care (CCD) document [3].

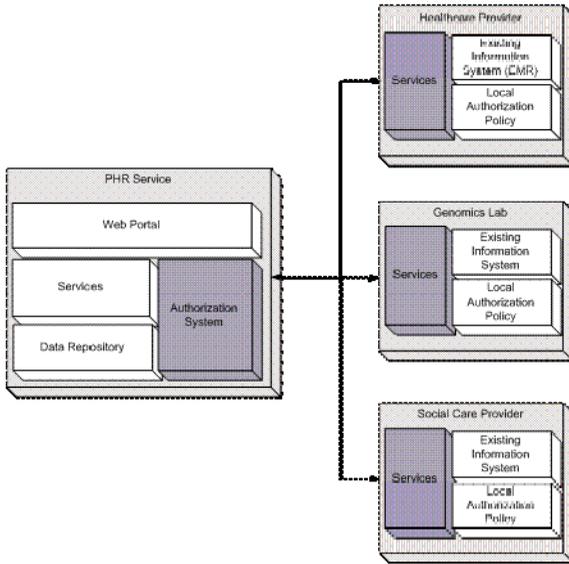


Figure 1. The virtual PHR architecture

Specifically, the virtual PHR comprises the following components: (1) a data repository that stores patient information contained in traditional PHRs and health information transmitted by medical devices in the form of patient XML documents, (2) a web portal, through which, patients can access and manage their lifelong health, social and genetics information and set their sharing preferences, (3) a set of services that are called in order to store and retrieve patient information to/from the data repository, and (4) the proposed authorization system that enables modeling and enforcing patient-centered authorization policies, that are consulted each time a subject requests an action on a resource (patient information), through the web portal in order to decide if the requested action should be permitted or denied.

In addition, in each social and health care provider and genomics lab connected to the virtual PHR there exist services that extract a pre-specified subset of patient social, health and genomics information from various systems upon request and convert it into a standard XML document.

The authorization system incorporated into the virtual PHR is based on the RABAC model and supports the creation of a global PHR authorization

policy according to the policies determined by legislation and ethical guidelines, patient-centered premises and local authorization systems policies. This system is build on top of the security features provided by the participating providers' authorization systems. The core of the VPR authorization system is the knowledge repository that hosts the PHR authorization ontology, the rule base and the rule engine.

The authorization policy has been built in Ontology Web Language (OWL) and contains the subject, object and environment attribute information, in terms of ontology main classes that are further analyzed into a hierarchy of sub-classes. To facilitate semantic interoperability among the virtual PHR and local authorization systems, semantic mappings among internally used security concepts (subject, object and environment attribute information) in authorization rules and the ones defined in the authorization ontology are created in each social and health care provider and genomics lab connected to the virtual PHR service. Thus, subject access requests for virtual PHR information is transformed into subject requests to the local systems which, in turn, are evaluated by the local authorization mechanisms.

### Conclusions

In this paper, a virtual PHR information structure is considered and a PHR authorization and access control service is provided which takes into account the fact that PHR stores patient information to a data repository and retrieves on the fly patient information from social care providers, genomics labs and electronic medical record systems, through the use of relevant services, after a user's explicit request.

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# What, Why, How Open Source

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## Introduction

This note begins with a brief review of the generic principles of Open Source, as intended for newcomers. It will be followed by discussions between experienced users of Open Source softwares.

## What is Open Source

The full name is Free/Libre Open Source Software, FLOSS, but the short colloquial name is simply “open source”. The idea is to share software knowhow in the public domain. Knowhow includes the full documentation and the source code.

[http://en.wikipedia.org/wiki/Free\\_and\\_open-source\\_software](http://en.wikipedia.org/wiki/Free_and_open-source_software)

The main freedoms includes:

- The freedom to use the software;
- To study how it works,
- To modify,
- To re-distribute.

The authors of open sources keep the formal license on their work, but choose an open license. The most typical license is the GNU, General Public License, <http://en.wikipedia.org/wiki/GPL> , but there are many other flavors more or less permissive about proprietary concepts.

A related concept is “Open Data” i.e. here free access to medical knowledge.

## Why Open Source in Healthcare

Since healthcare software requirements are similar everywhere in the world, international communities can exchange ideas and share development efforts.

The transparency allows controlling what software is really doing and not doing, quality control by means of peer review; to have the freedom to modify software in function of local requirements and to avoid exclusive dependency on any single provider, what could become a sustainability problem.

Since healthcare is a societal issue of common interest, the goal is to provide affordable software in developing regions, allowing to make any number of copies, without licenses costs.

## How to Manage Open Source

Many software modules are already freely available in the public domain at 2 levels.

1. Generic repositories provide the infrastructure, as distributions of the Linux operating systems, database systems, software development tools, etc... This is an environment on which specialized applications can be installed.
2. Many medical applications are already available as open source. The MEDFLOSS data base provides a large inventory of medical applications, <http://www.medfloss.org> . Healthcare modules can be retrieved by popularity, by application type, by enterprise function or by standards.

Sharing know-how means that all up to now existing software components in open source are available and may be modified.

### *Development Communities*

The users having a good understanding of the current situation, are continuously asking for more and more software. New development tasks are mandatory for the sustainability of a system. They can be distributed between the members of large communities.

The question is to define the specifications as far as possible in such a generic way that it can cover common interests of diverse groups of users.

Since the documentation is free, several teams can build additional extensions and improvement.

Proposed new versions can be accepted by the coordinators of the community. Possible inclusion in the central trunk of development is highly recommended because future common maintenance will become easier. However it remain possible to make very specific and arbitrary developments, but then at own costs and without support of partners.

### *Interoperability*

In a multidisciplinary environment, doctors need to move easily in all the aspects of a global patient record, including information from different origins as specialist reports, laboratory, radiology, etc... They do not mind about technical issues like file formats. Therefore interoperability is very important and the openness of the open source approach is a great factor of integration since developers can talk to each other. However this may sometimes remain a challenge when definition and granularity of concepts may be a little divergent in different contexts.

### *Support Services*

Good support services are critical for the success of any projects. New users may need help for installation. At any time in case of any problem, medical users need the possibility to call for technical assistance.

### *Economic model*

The open source economic model is based on a clear distinction between development and support services.

- A. At one side pure developments should be supported by donations, welfare foundations and public authorities. A good use of their resources since the development results are made available to a large audience at international level.
- B. At the other side support services remain kinds of traditional business at regional level, in principle to be supported by the users. This is the role of commercial operators, competing on quality of services and prices. This is a perfectly sustainable business.

About developments it is proposed to make a distinction between 3 types of actors.

1. Users need solutions and when not yet available as open source, software extensions must be made. Users are usually willing to pledge resources in order to get exactly what they need, but on condition deadlines will be met. Medical users are not interested in becoming vendors of software licenses. The same is true for foundations and public healthcare authorities willing to help as many people as possible.
2. Technical developers need good explanation about requirements and like interesting challenges. Although not the primary motivation, developers need realistic incomes. While volunteers already do a lot, development budgets are necessary in order to provide solutions within foreseen delays.
3. Brokers in “Open Source Market Place” would become very useful. Their role is to review software requests, to reformulate the in technical terms and in a generic way of common interest. They seek solutions in existing repositories as MEDFLOSS and other repositories and evaluate how to make new extensions when necessary. The broker should guarantee the saved money pledged by users until valuable results will become ready for production. A kind of notary role.

### *Responsibilities*

More and more critical medical procedures rely on informatics, today much more than statistics and invoices. What if ever a medical accident would be the consequence of a software error? With carefully checked software the risks are very low but will never be zero and risks could be shared between many actors.

Both open source and commercial softwares will soon or later face this problem. The responsibilities at stake are much more than simply a replacement of the defective software. In the worst case this is a death due to some wrong information.

Most organizations and individuals have professional insurances but the situation should be clarified. Of course insurance will ask that all reasonable safety measures have been followed. Certification by independent bodies could be required. Be aware that the reliability is not necessarily better in expensive commercial software.

### *Peer reviewed projects*

Many projects claim to be open source. They are well published in a repository, but they have been made by one author or small team and this is why the projects should be considered as “candidate open source”.

Full open source projects must be so good and so well documented that other people did chose to reuse them in an independent context somewhere else.

### *Future of Open Source*

Indeed there are several open source limiting factors. Many people are not yet aware of the benefits of open source and more promotion is very necessary. Here the users need to dare to take initiative to seek solutions, because there are no vendors nor commercial marketing campaigns.

The public in general should become more aware of misleading monopolistic practices. The user do not like to change any habits and there is a lot of inertia.

Sharing open source softwares on large scale is a way to cope with healthcare budget limitations.

More support services should become available because this is a mandatory requirement for any application in production and because they are up to now relatively fewer informaticians having experience in Linux environments.

# Patient View: Digital Support for Coproduction in Health and Social Care

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User involvement is increasingly seen a means of minimizing risk and maximizing value in the design of eHealth services.

The paper gives an overview of research with patients and staff on the benefits and barriers of the Open Source PatientView portal [www.patientview.org](http://www.patientview.org) which is accessed by over 20,000 users patients around the UK, and originally developed by the renal community, to support patients between home and hospital.

Users of the PatientView portal can not only access their records, results, letters, within 24 hours of issue, but can now share them with a distributed team in health and social care, and use a secure messaging system to communicate directly with them if they have concerns. They can also upload data they collect themselves through mobile applications, or from other services, where they have co-morbid conditions, to better coordinate information across a distributed team.

The extension to other chronic conditions is expected to facilitate coordination, coherence and continuity of care which is currently fragmented across disciplines, and where communication is poor. The portal is increasingly being used by other groups to support shared monitoring and management, to avoid unnecessary hospital visits, and to develop better protocols for managing this, building on the potential for patients to add their own additional data, such as BP and glucose monitoring. This also provides a basis for exploring new diagnostic algorithms, and the potential for patient groups to curate manage and benefit from the data resource they create, with health data and lifestyle and sensor data. Collaborative action research/participatory research with users is highlighted as a vehicle for both research, (to identify service development issues on the ground), and for service development acting as a catalyst for stakeholders engagement in the reconfiguration of roles, risks and resource allocations implicit in increasingly digital service redevelopment.

Keywords: patient portal, telehealth, coproduction, user-centred

# The Implementation of Care2x in a Tertiary Hospital of Approx. 60,000 Patients

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***Abstract:* With the Albanian government's initiative on informatisation, the Ministry of Health (MoH) decided to implement an electronic health records (EHR) system. The main issue was how to improve the quality and transparency of the Albanian health care system. This has led to the development of various strategies on the possible implementations in the different levels of the Albanian healthcare scenario, namely family doctor, primary, secondary and tertiary hospitals. This paper aims to explain the steps that were followed between 2011 and 2014 using Care2x to help this initiative.**

**Albania's only tertiary hospital, "Mother Theresa", was chosen as the test bed for this implementation. The implementation was divided into three phases, the first phase being; outpatient, outpatient billing, outpatient release and pharmacy management. The second phase consisting of inpatient, daily therapy, diagnosis, billing and discharge. The third and last phase will encompass blood bank, microbiological laboratory, anatomico-pathological laboratory, imaging and full electronic chart.**

## Introduction

After the fall of communism in 1990 the Albanian health care system faced a lot of challenges. The old paper based system and the increase in corruption led to massive malpractice. Due to this situation the MoH started a pilot project to informatise the patient and resources workflow in the "Mother Theresa". The aim was to reduce the loss of resources, to regularise the outpatients workflow, and to achieve accurate reports for the use by the MoH and the Healthcare Insurance Institute (HII). All hospitals in Albania have a dual sponsorship from the MoH and HII.

The program chosen for this implementation was Care2x which is a Web based Integrated Healthcare Environment (IHE). It allows the integration of data, information, functions and workflows in one environment. Its design can also handle non-medical services or functions such as security and maintenance. The software is web-based modular and highly scalable. All program modules are processed on the server side therefore module updates and extensions do not require changes on the web browser thus avoiding

network interruptions and downtimes. Its design also supports multiple server configurations to distribute traffic and improve speed and efficiency.

### Methodology

The aim of the project was to have a full EHR implementation in the hospital. To achieve that, the project was subdivided into three phases. The first phase was outpatient admission, billing, discharge and pharmacy management, which is almost 60% of the secondary income of the hospital. The second phase was inpatient management, comprising admission, diagnosis, therapy, interventions, billing and discharge. The third phase will be laboratory management, blood bank and operating room management.

During the preparation phase several meetings were held with the main players which are, MoH, HII, hospitals, medical and pharmaceutical staff. This was done to ensure a general understanding of the problem and to garner as much support as possible.

The implementation and patient workflow was based on the regulation from MoH and HII, plus internal orders from the hospital. That comprises a minimum of demographic data, the list of documents that the patient has to present at the registration desk, the items that patient has to pay and the part of the bill that HII pays for the insured patient.

The first phase started in the ENT and Maxillofacial Surgery Clinic. In the second phase, we adapted Care2x inpatient modules to collect data for the inpatient workflow. Which are: registration, admission, diagnosis, interventions, billing, therapy and discharge.

The third and last phase of this project aims to have a digitized patient chart, diagnosis cost, and reports of the measurable activities in the hospital.

### Results

The strategy followed was of continuous meetings with MoH, HII and medical staff. The use of Care2x resulted in the accomplishment of the project goals. The hospital ended the year with a surplus of resources and with a clear increase in secondary income. Another aspect in which Care2x helped was in the core functionality, the loose implementation of the patient's workflow plus strong Role Based Access Controls (RBAC) permitted us to adapt the system for the first phase in less than 2 months.

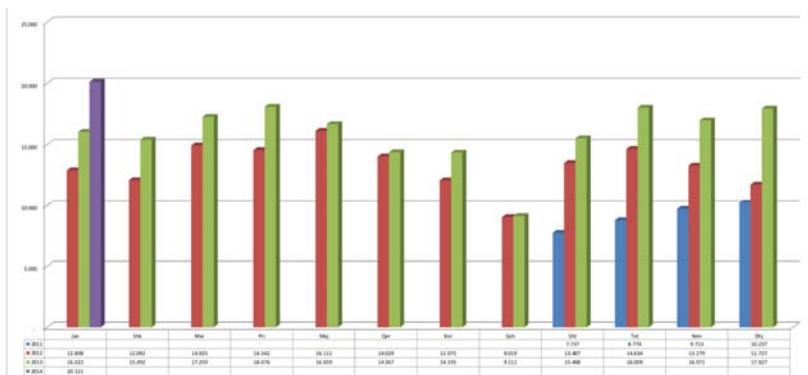


Fig.1. Progressive outpatient registration 2011-2014

Outpatient registration data (Fig.1.) shows that the first phase of the project realised a higher transparency of the informationisation of outpatient admission, which means more income for the hospital. The second phase, was more complicated, being an ADT (Admission, Discharge, Transfer ) system. The start of the second phase came after only 6 months of development.

Thanks to the Care2x modular approach to code and the availability of the main functionality, as registration/admission, nursing modules, diagnosis and procedure and daily therapy, both phases were implemented by a single developer. These two phases will help in the implementation of the third and final phase of the project.

### Conclusion

The success of the first two phases led MoH and HII to implement the software in other hospitals such as the Trauma hospital, Saranda hospital, “Koco Gliozheni” gynecological hospital and “Shefqet Ndroqi” pneumological hospital. A further recommendation from HII suggests the implementation of the system in two first level hospitals in the Tirana region. To be followed by the implementation of the system in all primary level hospitals in Albania.

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# The Potential of the iPath-Network is not Widely Known

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iPath-Network is a web application service offered by Basys Data. The aim of this service is to offer a hosted and supported platform based on iPath, an open source collaboration platform which was originally developed at the University of Basel. iPath is being actively used in 35 countries, in the domains "consultation", "teaching" and "research".

iPath is one of the few, if not the only telemedicine platform based on open source software. The system is stable, easy to use and is not highly demanding of resources. For that reason it is used in many developing countries, where connectivity may be difficult or high bandwidth unavailable.

At first iPath was only used for diagnostics in the areas of histopathology and cytopathology. After the platform had become more established, the iPath network was grouped into communities, and started being used in many more medical fields, and also for the education of doctors and their co-workers.

Tumor boards etc. began to take place as teleconferences. The users have access to the cases prior to the meetings through their group membership. For the transmission of speech we use Skype, which works well in developing countries. Open source solutions like Mconf and openmeeting have shown to be unsatisfactory so far.

Our presentations can be shown in small and large groups, and can also be used for self-study (where previously uploaded and discussed clinical cases can also become a valuable resource). Presentations can individually be set for public viewing (access for non-members). By integrating iPath into existing e-learning programs, even more potential uses for iPath can be exploited.

At universities, internally accessible installations of iPath are being used for scientific research. The amount of these installations is not known to us. On our server alone, over 4300 users are working in 170 groups and closed communities.

Besides the web-interface, iPath has a feature-rich e-Mail interface, which can be a simple option on smartphones.

# Using Open Source Software and Open Data to Support Clinical Trial Protocol Design

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## Introduction

Clinical research, including investigation of the test of hypothesis and clinical trial design, comprises an expensive and very important part of the R&D activities of the pharmaceutical companies. Trials for drug repositioning, which aim at testing established compounds to new medical conditions, appear to gain ground as these compounds have already been found safe in clinical trials and sometimes are already present in the market. Although the uncertainty of safety is lower in such trials, still problematic situations – for example an adverse effect of a drug compound - present important risks [1]. In many cases evidence of such issues already exists in published scientific articles and other clinical data sources but is often difficult to discover and correlate given the volume, variety and distributed nature of the information required. In addition structuring this information into a valid trial protocol can be a challenging and time-consuming task.

Scientific results from medical research, including those from clinical trials, are gradually being published as Open Data and a significant proportion of them are becoming available also as Linked Open Data (LOD) [3]. This rapidly growing collection of well-structured (using RDF, OWL) and easily accessible (HTTP) data [4] contains clinical information about drugs and their side effects, clinical trials, diseases and their mechanisms (pathophysiology) and other aspects of the domain. These semantically linked data sources are especially valuable as they allow semantic search tools to discover information that is otherwise hard to come across.

## Free, Libre and Open Source Software and Data

Free/libre Open Source Software (FLOSS) for semantic web technologies is well established commercially and scientifically and benefits from a broad community support. This adoption is especially strong in the medical domain and an example is the Biomedical ontology Portal [12]. Correlated with this is the importance of being able to link together these sources as for example, a treatment and the disease, and also the side-effects. This advocates for the use of open semantic standards for medical databases. The

same arguments favor also FLOSS to foster trust and reuse of assets. The components we describe here are licensed under Affero GPL [13].

### Ontologies and Medical Terminology Mapping

We have integrated multiple health-related ontologies, models, coding systems, protocols and data sources. The included concepts cover all the semantic description aspects of clinical trial design and are used in several dedicated ontologies. They are integrated and interlinked using the Web Ontology Language (OWL) [10] and OBO [11] technologies. These ontologies are queried to provide descriptions of the domain to guide the users through an ontology-based search engine on relevant clinical literature, the clinical trial protocol, and ensure semantic interoperability between different data sources and information systems.

The CTP ontology represents the CTP model that was developed in close collaboration with medical and clinical trial experts from PONTE project [2]. This model aims at formalizing the representation of Clinical Trial Protocols. Thus the CTP Ontology has (i) concepts that represent all the sections and subsections of the CTP according to its structure, (ii) metadata of the CTP document, hospital information, eligible patient numbers, user search results and other, (iii) imports of the Eligibility Criteria Ontology.

To ensure interoperability between medical systems from different countries, we need a service that maps the specific vocabularies used in these regions. The Semantic Mapper provides vocabulary translation between the different coding systems used among EHR databases of the hospitals that PONTE interacts with. The mapping process is a tedious task that has been semi-automated. It relies on General Equivalence Mappings (GEM) [9] files. These files map source and target vocabularies; they are annotated with the following metadata: (i) approximative: indicates that no one code in the target system or linked combination of codes in the target system expresses the same essential meaning as the code in the source system; (ii) no map: indicates that a code in the source system is not linked to any code in the target system; (iii) combination: indicates that more than one code in the target system is required to satisfy the full equivalent meaning of a code in the source system.

The GEM parser we have developed is open source and uses FLOSS components such as the MySQL database. The semantic mapper is deployed as a SOAP web-service.

### Structuring and Managing the Clinical Trial Protocol

The CTP Repository component is an open source component, implemented in Java and uses the open source Sesame [5] RDF repository

implementation of openRDF community. The repository is used for storing the CTP documents, which are in RDF format and follow the CTP Ontology schema, and all other PONTE ontologies. These are available via two interfaces, a SPARQL [6] query endpoint and a SOAP web service interface. The repository transforms the CTP model from XML following an XSD schema of the Web interface to the native java model of the CTP Repository and then to RDF for storing in the Sesame RDF repository. The RDF representation of the CTP is especially required for the metadata and criteria of the CTP document that need to be in OWL for enabling the reasoning and semantic search capabilities of the platform.

Additionally the repository generates queries for selecting patients for the clinical trial. Specifically it generates a SPARQL query for each of the eligibility criteria concepts from the Eligibility Criteria Ontology that is listed in the criteria section of the CTP document. These SPARQL queries are collected by the hospital communication system for querying the EHR systems of the hospitals that are listed (as metadata) in the CTP.

Finally the web services module of the CTP repository includes a simple XML document storage implementation that is used for caching the XML versions of CTPs. In our benchmarks under normal operation loads this caching has significantly improved performance of document retrieval operations and overall responsiveness of the repository.

### Consuming Linked Open Data

The Linked Data Application (LDApp) is a tool designed to provide an interface to the Linked Open Data (LOD) cloud for the clinical researchers. More specifically this web application, (i) provides mechanisms to examine the related data that exist within these sources, (ii) offers query expansion across multiple sources and navigation through them and (iii) aggregates the retrieved information to be presented to the user. The LDApp interface allows the clinician to enter the question or the problem from one of the main perspectives: Disease, Drug, Target and Clinical Trial. For each of these perspectives we have chosen a domain ontology that provides concepts, instances and relationships (links) to other (linked) data sources.

The LDApp is accessing the selected domain ontologies from the CTP repository and constructs a graph for each of the perspectives. Each graph is composed of concepts and instances representing the taxonomy and relevant questions of the query's main term using query templates. The graph concepts and instances additionally contain relations and RDF links to the web of Linked Data sources, which can be used to execute queries across multiple data sources. In a typical usage scenario, the LDApp provides answers to the initial search request of the clinical researcher starting from a

drug, disease, trial or target. Then it uses query expansion techniques to retrieve results from the LOD cloud. The extended results can be then presented aggregated or filtered according to each of the ontology graphs.

The LDApp was implemented using the open source EasyRDF (arc2) [7] and Graphite [8] PHP libraries as well as JavaScript libraries. The implementation is context independent and follows the MVC pattern aspects and principles that separate the internal model from the graphic user representation. This allows dynamic addition of ontologies into the model.

The evaluation of relevance of results was conducted with the medical partners. The application was characterized as useful to very helpful. The performance of the queries was mainly dependent on the stability and traffic of the data sources. We found that using local mirrors of certain key LOD sources had significantly improved the response times.

### Conclusion

We have presented three tools that provide great assistance to the clinical researchers on building efficiently and faultlessly both the hypothesis of their research and their clinical trial protocol. Researchers can additionally get an idea of the available patients by using the EHR querying facilities. The development of the three open source components was possible thanks to the great variety and quality of FLOSS tools and the rich and rapidly expanding web of Open Data.

### Acknowledgement

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# **Robust eHealth Applications, Ready for Implementation**

# BIOSCREEN – Medical Cognitive Expert System

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*Abstract.* BIOSCREEN is a robust medical expert system, which allows classifying an unknown object (patient) to one of the previously known medical patient diagnosis. These diagnosis data should disjunctively cover the area of interest. The unique feature of the proposed 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. For visualization of results new approach of 2D and 3D interactive graphics was used, which is suitable especially for follow up progress of therapy. As a calibration tool, a new statistical method for gene expression patterns was developed.

The system consists of the modules CANSCREEN for cancer screening, CARDIOSCREEN for monitoring of cardiovascular diseases, and DIABSCREEN for evaluating diabetes subgroups. BIOSCREEN is flexible and modular and can be embedded into ambulance PC software and also into hospital systems based on cloud approach. The system was tested on several thousand pieces of patient data with confirmed clinical diagnosis.

## Introduction

The research has been based on more than 20 years of experience with practical applications of intelligent computer expert systems for evaluation of biomedical data. BIOSCREEN team was probably the first in Europe, who introduced the cognitive diagnostic approach, now called “biomedical data mining”, as early as beginning of the nineties. It should provoke thoughts about a new way of use of IT in the Czech Republic in accordance with the concepts of use of IT technology in health care outlined in the eHealth documents of the European Commission as „out of hospital“ approach.

## Methods

BIOSCREEN system is based on the following software tools:

1. CLUSTEX - New unique cluster analysis;
2. SVM – Prof. Vapnik’s Support Vector Machine;
3. IVR – 2D and 3D interactive visualization of results;
4. NGEF – New gene expression patterns analysis.

CLUSTEX module was from the beginning the kernel of BIOSCREEN project. Goals of the program development were to:

- Make a robust system, which would allow users to assign an unknown object to one of the previously known diagnosis of clients. These diagnosis data should disjunctively cover the area of interest;
- Bring the program closer to attributes of optimal algorithm on the most effective classification of unknown object to one of the known diagnosis. As a difference to currently available classifying programs, this one provides better efficiency of diagnosis classification especially in the boundary areas of diagnosis;
- Allow the user insert data to diagnosis and prefer annotation “can’t decide” offering unclear result by employing fuzzy processing. In those cases program comes up with indeterminate result of classification as a correlation of examined data to more diagnosis or as an impossibility to classify - assign given data;
- Enable intuitive and simple manipulation with data, simple and fast changes of structure of variables describing processed data;
- Enable effective classification of data even for small volumes of data.

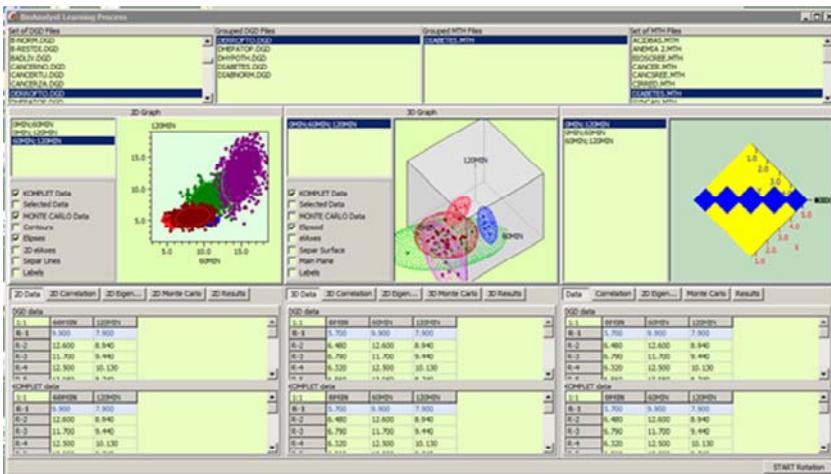


Fig. 1 IVR module: The ellipsoids are examples of diabetes subgroups

For commercial application the software package BioAnalyst was prepared, consisting of module CLUSTEX combined with the new interactive graphical module IVR, which allows combination of tested biomedical parameters and visualization in 2D and 3D graphs, including calculated ellipsoids of patients with given disease [3].

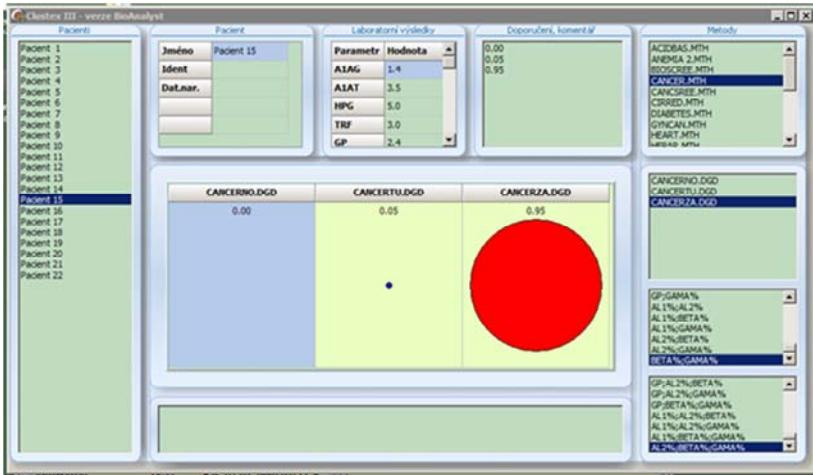


Fig. 2 Example of BioAnalyst V 3.01 CANSCREEN module

## BioAnalyst

BioAnalyst was designed to simplify complex diagnostic tasks through user-friendly and attractive graphic environment. To handle this program, user does not need to know any syntax of commands. Instead of that was developed intuitive graphic interface, which eliminates a need of learning complex syntax that are usually necessary in other similar programs.

## NGEP

NGEP module was design to solve the problem of selection of a small subset of genes from broad patterns of gene expression data, recorded on DNA micro-arrays. Using available training examples from cancer and normal patients, a classifier suitable for genetic diagnosis was developed, based on application of Support Vector Machine. Genes, selected by this technique, yield better classification performance and are biologically relevant to cancer and to all other diseases.



This method is naturally expensive and therefore is not optimal for mass application, but it will be mainly used for “calibration” of standard biomedical tests used for routine diagnostics.

### Conclusions

- New „data mining“ system BIOSCREEN was developed.
- The system was tested on several thousand patients aiming at cancer screening, monitoring of cardiovascular diseases and evaluating diabetes subgroups.
- Very high sensitivity and specificity of all used biomedical tests was verified by clinical trials in several Czech and Slovak hospitals.
- New gene expression patterns analysis based on Vapnik’s Support vector machine was developed
- Patent pending for some of the diagnostic methods for cancer screening and monitoring of cardiovascular diseases.

Commercial package will be available under the brand name of **BioAnalyst** from the third quarter 2014 on.

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Jaroslav Jansa, Ph.D. 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 is author of 30 Czech, EU and US patents. He published more than 100 scientific and technical papers in Europe and USA



Vladimír Příkryl B.Sc., studied at the University of Economics in Prague (VŠE). He entered the public health sector in 2009, when he started to work for CompuGroup Medical Czech Republic, Inc. as a finance director. In 2011, he led the division of Hospital information systems, which supplies hospitals and laboratories in the Czech and Slovak Republic with complex information systems. He was appointed general manager of CompuGroup Medical for the Czech and Slovak Republic in January 2012.



Karel Kupka, Ph.D., Ph.D. has received his master degree in physical chemistry from University of Pardubice in 1986. His first doctor's degree in Analytical chemistry and his second doctor's degree in Applied mathematics and statistics has received from the same University. He is founder of hi-tech company Trilobyte Statistical Software. He is member of American Statistical Association and International Statistical Institute. He has published more than 50 scientific articles worldwide.



Karol Bitto, M.Sc. received his master's degree in the Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering in 1983. He worked as a researcher in the Research Institute of Glass Technologies in Trencin. Since 1995 he has been the head of the software company KB-soft. Bitto is an author of 10 Czech, EU and US patents. His scientific interest has oriented to the field of unique algorithms for medical and industrial applications.



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# **BrainControl Basic Communicator: A Brain-Computer Interface Based Communicator for People with Severe Disabilities**

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The “BrainControl Basic Communicator” is an augmentative and alternative communication (AAC) system based on Brain-computer interface (BCI) technology. The system has been designed for patients with severe disabilities due to pathologies such as Amyotrophic Lateral Sclerosis (ALS), Multiple Sclerosis, ischemic or traumatic injuries.

Brain-computer interface (BCI) technology interprets the electrical signals that correspond with certain brain activity and allows a computer or other external device to be controlled with thoughts.

BrainControl project aim to develop a BCI platform that allows people suffering from sever disabilities to overcome physical and communicative impairments. In particular, BrainControl can help patients suffering from diseases that paralyze the whole body or parts of the body, but who retain their intellectual abilities.

BrainControl Basic Communicator consists of noninvasive wireless EEG headsets, a tablet PC and software including a classifier of EEG patterns and a user interface designed around the needs of locked-in patients.

Future versions of BrainControl, which are currently under development, will include advanced communication and entertainment functionalities, home automation, the control of a wheelchair and robotics.

## **Connected Home Health Solutions for Assisted Living Improving Efficiency and Self-Reliance of Patients**

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Two examples of assisted living coordinated by 24 Care Group in the Netherlands will be presented:

1) Homes for elderly people provided with latest home automation, care communication technology and monitoring of vital signs and security in 67m<sup>2</sup> and 120 m<sup>2</sup> for €10/m<sup>2</sup> up to €12/m<sup>2</sup> currently developed/build in Tilburg. Self-reliance is combined with home care and accessibility of care provided by a nursing home operator.

2) The development and implementation of care communication technology, personal security and building management for a 150 room nursing home and adapted to mentally disabled patients. A wireless easy-to-use, easy-to-configure solution allow transition to independent living with swift and cost effective transfer facilitating patients' self reliance.

Keywords: connected health, homecare, assisted living

# HeRo (The Health Robot)

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## Introduction

One of the great challenges in the health care is the identification of key information needed in order to ensure sufficient effectivity of the system for control and prevention of health of an individual. For this purpose, there are available a number of systems for the remote supervision not only of the patient, but of any subject in general. It is important to realize that the majority of fatal problems can be significantly reduced by prevention. In view of the ageing population in well developed countries, this problem becomes more and more important. An essential part of health problems and eventually death cases are attributed to the cardiovascular problems. Consequently the necessity of a long term monitoring is evident as well as the evaluation of all data essential for the prevention and subsequent treatment, preferably using expert systems. Standard medical examination of the data obtained during the doctor's visits and stays in medical facilities like routine examination, blood and other analyzes and tests, subjective communication, etc. will be completed by continuous or quasi-continuous monitoring of key health data.

This idea has obviously many pitfalls, among others it is the difficulty of realization, bothering of humans in their daily life, size of the device in general, communication skills, etc. Despite of the long-term development in the e-Health, only a few of really applicable equipments are available for the remote monitoring of human conditions. Moreover, they are mostly single-purpose devices which monitor only a limited number of data, e.g. temperature, pulse rate and respiration. Consequently most of them can be found rather in the centers for monitoring of athletes. Another important drawback is the size of these devices and their limited opportunities regarding non-bothering operation. A typical example is the measurement of systolic and diastolic blood pressure, where the pressurization cuff is standardly used. It is difficult to imagine the application of such devices for the entire population and for a continuous operation. The power consumption of such systems represents a further problem. A major challenge may be the Orwellian world. There is nothing worse than the idea of easily accessible data on the individual health supplemented by the time and location

information. Therefore, equally important is the security of both the data and its transmission and processing.

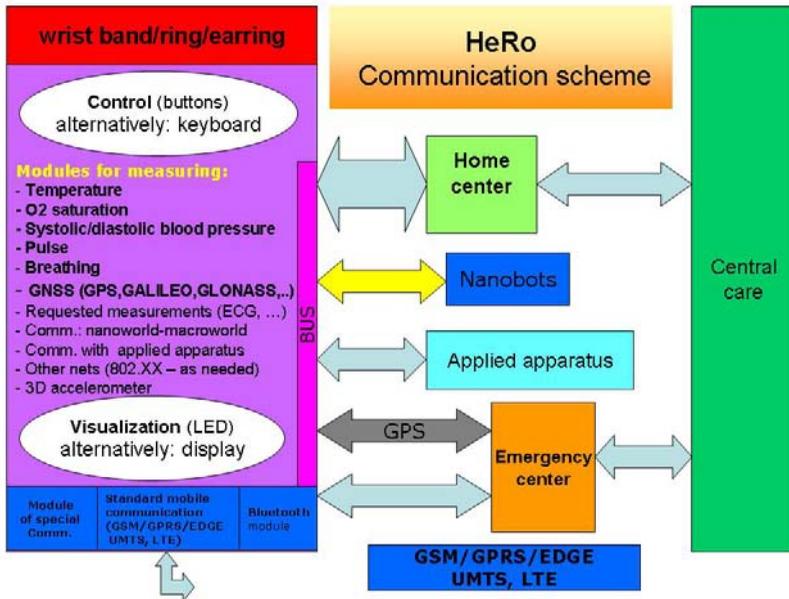


Fig. 1. Communication scheme HeRo

Here we would like to report on the recently completed project HeRo (Health Robot) which solves numerous issues in this area. The obtained results seem to be suitable for the mass deployment. The developed system may represent one of the possible foundations for future electronic medical supervision not only of the patient, but also of the whole population in general. The aim of the project HeRo is the design and implementation of a mobile terminal which supervizes an individual. It is a terminal which independently controls the wearer's vital signs and communicates with home centers, medical centers and emergency first aid centers. In our initial implementation, it processes standard quantities, i.e. the temperature, content of blood oxygen, pulse rate, systolic and diastolic blood pressure. The next evolution should include other modules like ECG, EEG etc., and in a more distant future the communication with nanobots in the human body and exploitation of their information. If necessary, they must be able to call the emergency first aid. In the future, it should be able to pass the data to other devices like insulin pump etc. Such complex needs to include the GPS/GLONASS/GALILEO module, a close range communication modem

like Bluetooth and a long range communication like GPRS, WiMax, LTE etc. The goal of the project is therefore a device whose implementation can have a major impact in both the near and distant future not only in the health care, telecommunications etc., but also on the daily lives of citizens. Such a system must also be capable of further development and continuous expansion of individual modules and their integration, see Fig. 1. All measurements are based on a non-contact sensing. The most important result, however, is not the miniaturization of the device, but rather a new method for evaluation of the systolic and diastolic blood pressure based on the plethysmographic curve, i.e. without the use of any cuff and its inflating. This opens up a quite new vistas which will not only change the actual way of measurements, but also will open up new possibilities for a global deployment and systematic monitoring in order to prevent the population. The new principle will be discussed in detail after the confirmation of the pending patent rights. A sample result of the evaluation of the systolic blood pressure based on the plethysmographic curve is demonstrated in Fig. 2. The diastolic blood pressure is evaluated by analogy.

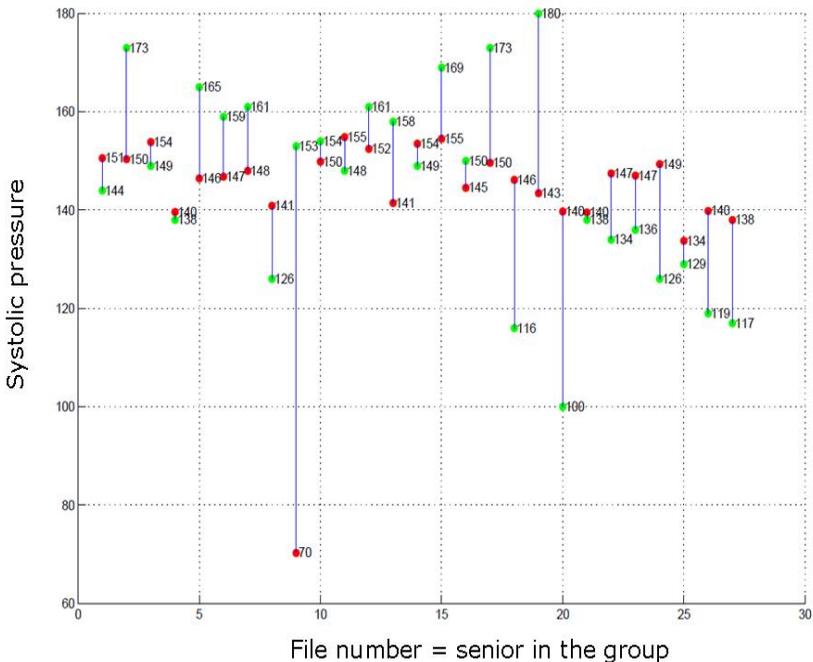


Fig. 2. Example of evaluated of systolic blood presure and their verification in a group of seniors

The design of the ring in the project HeRo is shown in Fig. 3 and the result in Fig. 4.



Fig. 3. Design of HeRo ring



Fig. 4. Ring prototype and one of SmartPhone screenshots

Our solution and designs currently comprise five basic variants which involve the implementations in form of bracelet, ring, earring etc. Each variant represents either a fully autonomous system or a system cooperating with other systems like tablets and smartphones.

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- [3] Industrial design application PUV2013-28107: “Unit for monitoring and measurement of human vital functions”



Jiri Chod graduated from the Czech Technical University (CTU) in Prague in 1969 and obtained his Ph.D. in 1984. He is with the Dept. of Telecommunication at the CTU since 1969. He became an assoc. professor in 1991. His scientific interests include the mobile communications, microprocessors and e-health technologies.



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Jaroslav Jansa received his master's degree in Control engineering from the Institute of Chemical Technology 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. His current scientific interests are focused on telemedicine and computer assisted biomedical research.

# InspectLife - Complex Services for Telehealth of Diabetic Patients

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***Abstract:* InspectLife is a web based platform for telecare and telehealth. It consists of several services which together represent complex tool for telehealth of chronic patients especially with diabetes mellitus type I from their home environment. The main services are telemonitoring of blood glucose, telemonitoring of blood pressure, telemonitoring of body weight, telemonitoring of physical activities and surveillance of diabetic patients. Telemonitoring measurement devices with wireless Bluetooth data transfer and mobile application are utilized. InspectLife solution is accessible for authorized users with different user roles (physician, patient, family member, operator) via internet with the help of standard web browsers. InspectLife solution includes receiving and storing of measured data, data processing, visualization and their analysis and also communication between all participants in the process of treatment of chronic diabetic patients. The InspectLife solution can help to diabetic patients and their physicians in terms of better diabetic compensation, better motivation and more effective treatment. Also the frequency of communication between patient and physician could be increased and also the quality of life of diabetic patients could be improved.**

## Introduction

Number of patients with Diabetes Mellitus and associated diseases is constantly growing worldwide during last decades and actually this number is near 10 % of population not only in developed countries. Not only the Diabetes Mellitus itself but also associated serious health complication (i. e. renal failure, blindness or acute myocardial infarction) represent medical, social and also economic problem. In some countries also the availability of professional healthcare in remote rural areas is not sufficient. The principal goal in care of diabetic patients is the long term optimal compensation and minimization of extreme values (hypo- and hyperglycemia). Telehealth and telemedicine with the help of up-to-date information and communication technologies could help to solve all the above mentioned challenges and to improve the quality of life, independence and self-sufficiency.

## Description of InspectLife Solution and Services for Diabetic Patients

InspectLife is a web based platform for telecare and telehealth. It consists of several services especially for chronic patients with Diabetes Mellitus type I, i.e. telemonitoring of blood glucose, telemonitoring of blood pressure, telemonitoring of body weight, telemonitoring of physical activities and surveillance of diabetic patients.

The 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 of patients, namely patients, their family members, medical doctors and healthcare professionals and operators of assistance surveillance centers.

Monitored patients could be equipped with several telemonitoring devices, i.e. glucose meter, blood pressure monitor, body weight and pedometer. With the help of these devices patient is able to measure physiological parameters independently. Measured data are easily transferred via Bluetooth into mobile phone form which is consequently automatically transferred via the Internet into the InspectLife solution. Within the InspectLife solution all the received data is stored, processed and visualized. Patients and their medical doctors could remotely evaluate both actual and trend information about treatment based on complete and precise measured data. Also automatic notification of responsible persons in case of emergency situations (i.e. hypo- or hyperglycemia) could be raised.

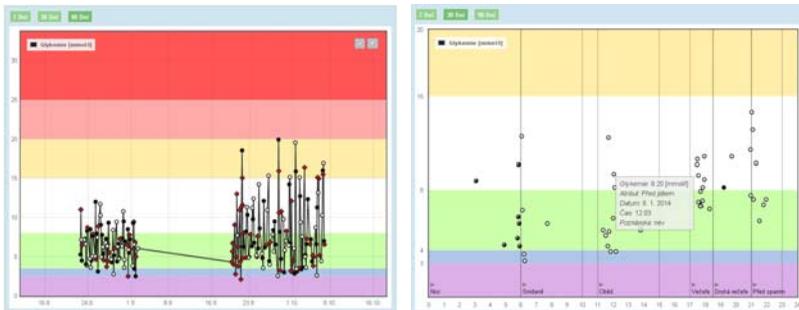


Fig. 1. InspectLife “Telemonitoring glycemia” service – time and summary graph

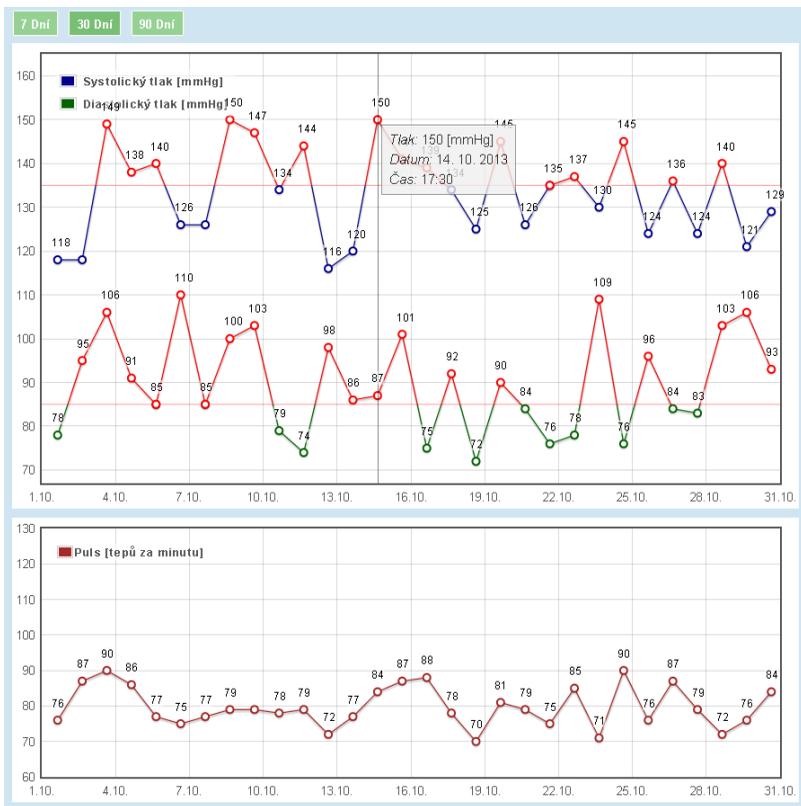


Fig. 2. InspectLife “Telemonitoring blood pressure” service graph

## Methods and Results

Pilot testing of InspectLife “Telemonitoring glycemias” service is being carried out in 2013 and in the first half of 2014 in cooperation with the Institute for the Care of Mother and Child (Prague, Czech Republic) and 2nd Internal Clinic of Vinohrady University Hospital (Prague, Czech Republic).

The goals of the pilot testing are: 1) to verify the functionality of the InspectLife solution with real users – diabetic patients, 2) to demonstrate that InspectLife telemedicine solution can help in quality and complexity of acquired data, effective communication between patients and medical doctors and in better diabetes compensation.

Characteristics of one selected patient were following: woman with Diabetes Mellitus Type I diagnosed in 2002, treated with insulin pump from 2006. Telemonitoring during pregnancy in August and September 2013. Approximately 200 glycaemia measurements per month were carried out. The results and influence of remote telemonitoring were the following: 1) patient has no technical or user difficulties with using of glucose meter, wireless data transfer and web application, 2) patient was regularly sending measured glycaemia values and was satisfied with this possibility, 3) patient appreciated the possibility of quick remote contact with her diabetologist from home with the purpose of glycaemia profile consultation.

### Discussion and Conclusion

InspectLife “Telemonitoring glycemia” service is being tested in pilot project with real users. Target groups were suggested: diabetic women during pregnancy, labile diabetics with very unstable metabolic compensation, diabetics before surgical operation and young diabetics. The quality of life and comfort during diabetes treatment was increased. The quality of acquired data was increased.

### 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).

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# **Telemedicine in the Republic of Cabo Verde: A Necessity, Not a Choice**

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A horseshoe-shaped archipelago of ten islands off the west coast of Africa, the Republic of Cabo Verde sits in a strategic crossroads of Atlantic air and sea lanes. The one-time colony of Portugal and now-independent island nation of 500-thousand people, known unofficially as Cape Verde, finds itself at a crossroads concerning healthcare. Until recently, air and sea transport have been the only ways for patients to get to the available specialty care at the Hospital Dr. Agostinho Neto or at the Hospital Dr. Baptista de Sousa on the main island of Santiago.

Despite the construction of new airports and significant improvements in harbors, travel between the islands is limited to one or two flights and/or ferry rides each day. Discouraged by an inconvenient schedule and the time-consuming means and cost of transportation, residents tend to procrastinate and delays going to the main hospitals until health problems become serious. These patients and others who could have been treated on their home island crowd hospital facilities on Santiago. Patients with serious chronic disease may have to travel to Lisbon for treatment.

Faced with both the need for healthcare and a means of delivering it to Cape Verdeans, the government decided to put in place new procedures which would require patients to have telemedicine consultations with physicians before being transferred to Santiago. The International Virtual e-Hospital Foundation (IVeH) accepted the challenge to accomplish the directive. Beginning in 2011, the IVeH team began working on the design and implementation of a telemedicine program for the islands. Recently, the foundation received an extension for more time to work with local government authorities and physicians to ensure the program's sustainability.

Dr. Rifat Latifi, the founder and Chief Executive Officer of the International Virtual e-Hospital (IVeH), first contacted GlobalMed® about the telemedicine project for Cape Verde. Among his many roles, Dr. Latifi is Director of the Telemedicine Program of Kosova (TPK). In the United States, he is a Professor of Clinical Surgery and Vice Chairman for International Relations, Department of Surgery, at the University of Arizona in Tucson. He also serves as a Director of the Telemedicine Program at

University Medical Center in Tucson and as the Associate Director of the Arizona Telemedicine Program.

The collaboration between the Republic of Cape Verde and the Republic of Slovenia led to the development of the Integrated Telemedicine and e-Health Program – Republic of Cape Verde (ITeHP-CV). The ITeHP-CV Program aims to increase quality, accessibility and efficacy of healthcare services provided in Cape Verde.

The ITeHP-CV provided the International Virtual e-Hospital (IVeH) with a grant funded by the International Trust Fund. In consortium with Croatia's Supra Net Projekt, d.o.o. (SNP) and Slovenia-based Nove Komunikacijske Tehnologije, d.o.o. (NKT), Telemedicine systems provider, GlobalMed®, was awarded the Cape Verde project and began working with IVeH and its founder and Chief Executive Officer, Dr. Rifat Latifi, to establish an integrated and self-sustainable nationwide telemedicine and e-health program connecting 10 telemedicine centers throughout all 9 inhabited islands of Cape Verde.

In Phase One of the project, GlobalMed shipped six FirstExam™ Telemedicine Stations to Cape Verde in September 2012. A subsequent shipment of four more in Phase Two took place in April 2013. Each station was equipped with a TotalExam™2 examination camera, stethoscope, a vital signs monitor, a ClearProbe™ ultrasound and a 12-Lead ECG to be used for 'tele-trauma' cases, primary care and many other clinical disciplines identified as priorities in Cape Verde. The stations' computers were loaded with CapSure® Image Automation Software to acquire and save visible light medical images; EasyShare™ videoconferencing codec; and eNcounter™ - GlobalMed's intuitive, user-friendly interface for seamless workflow between multiple configurable applications.

Delivery of the telemedicine stations turned out to be quite challenging due to a strike by port workers in Portugal. The units were airfreighted from Arizona to Lisbon and then trucked to the only port operating during the strike. Because of the backlog, the stations sat in a warehouse for two weeks. NKT handled the shipments for GlobalMed from Portugal to Cape Verde. Since GlobalMed ships the fully assembled stations in cardboard crates, NKT had to find a vessel whose cargo containers could accept them. Once loaded onto a ship, the trip to the Cape Verde capital took two weeks. The move to their final destinations on the outlying islands was completed in another two weeks. For those islands without fork lift trucks, the nearly 400-pound stations had to be unloaded by hand at the dock.

NKT was responsible for setting up the video conferencing infrastructure, as well as the system to be used for technical education and training on the FirstExam Telemedicine Stations. SNP engineers spent a combined two

months creating links from the small hospitals on the outlying islands to the hospitals in Praia and Mindelo. Once the infrastructure was complete, the GlobalMed Telemedicine Stations were connected and the program was ready for launch.

In November 2013, Manoel Coelho, GlobalMed's Brazilian-born Director of Global Business Development, went to Cape Verde to help clinicians understand how to use the GlobalMed systems in their practices. Telemedicine was not unfamiliar in Cape Verde. Cardiologists in Portugal have been using telemedicine to evaluate island children born with heart defects for years. Those who require it are flown to Lisbon for surgery.

Training sessions did produce some interesting results. On one island, a pregnant physician was able to view an ultrasound of her baby for the first time using the abdominal ultrasound probe (Fig. 1). On another, a nurse used the TotalExam camera with its tongue depressor attachment to conduct an oral exam on his own mouth. A dentist on Santiago watching the live video could readily see he had an abscessed tooth, and he told the nurse that it needed attention. When Coelho used the camera on his own mouth, the dentist quickly pointed out he had a cavity.

The telemedicine project underscores the role that technology can play in providing quality healthcare where geography separates people from providers, but it also helps advance medical knowledge. "I had the opportunity to watch a telemedicine class of Cape Verde doctors learning how to read a 12-lead ECG, taught by the head of the Brazilian cardiology board," Coelho said.

Could this be a textbook example of what needs to be done to put together a telemedicine program for an entire country? "Perhaps," Coelho said. Even though Cape Verde is a stable country, Coelho said, "It depends on how committed the government will be to its adoption and then, how the program is managed."



Fig. 1 Ultrasound exam of a pregnant woman using the FirstExam™ Mobile Telemedicine Station in Cabo Verde



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# **Telemonitoring Blood Pressure By Secure Message on a Patient Portal: Use, Content, and Outcomes**

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## Introduction

Home telemonitoring is available for a number of patient measurements including blood pressure, blood glucose, weight, and oxygen saturation among others. Telemonitoring has generally sent data directly from a home monitor to an in home hub which then transmits data to a server. The patient portal has opened up another secure platform for telemonitoring data. Patients can self-monitor blood pressure, glucose and other parameters and send the results to their provider in a secure portal message.

## Methods

We searched all 56,000 Mayo Clinic Rochester patient-generated secure messages from 2012 for content concerning blood pressure. We performed a detailed review on a random sample of 100 blood pressure messages. Measures for review included blood pressure reading counts, type of blood pressure data (individual readings, averages, and blood pressure range). We also examined whether the data provided was sufficient to treat blood pressure with a new medication. We captured the provider secure message response to the patient-generated blood pressure message and determined outcomes of prescriptions for antihypertensives, change in medication dose or if an appointment was suggested.

## Results

Almost 1% of the 56,000 secure messages contained content about blood pressure. Of those blood pressure messages we sampled, there were specific blood pressure values in 85% with a median of 2 blood pressure measurements per message. Individual blood pressures were supplied in 53% with blood pressure ranges in 20% and implied or stated average blood pressure in 20%. The number of blood pressure readings in each message ranged from 0 to 92. Providers responded to these messages 15% with a

new medication prescription but in 15% of the cases more information was requested and in 17% an appointment was suggested.

#### Conclusion

Patients and providers are using secure messages on the patient portal for blood pressure telemonitoring. Despite blood pressure content that is highly variable, providers are using the supplied data to make changes in medication and to prescribe new antihypertensive medications.

Keywords: telemonitoring, eHealth, patient portal

## **eHealth User Acceptance & Attitude**

# Acceptance of Diabetes Apps among Diabetes Patients 50+ and Attending Physicians

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Mobile applications (apps) are increasingly used for supporting persons suffering from diabetes mellitus type 1 and 2. However, due to a lack of acceptance and usability, apps are rarely used by the elderly.

We therefore examine the following question within the framework of our study: How should a mobile application be designed to support an effective self-management for diabetes patients 50+?

We carried out a systematic review in the first quarter of 2013 in order to get an overview of all currently available diabetes apps for the currently leading operating systems iOS and Android. Additionally, based on a 10%-sample of apps a usability-test was performed in order to examine the question: „Do the available applications serve the special needs of elderly diabetes patients?“

The systematic review provides a comprehensive overview of the apps' range of functions, user groups, languages, acquisition costs, popularity/user ratings and the availability of interfaces to external sensors/devices. Moreover, as an outcome of the usability-test, first design features improving/hampering the user-friendliness for the elderly were derived. The review provided the basis for a survey among diabetics 50+ and attending physicians/ diabetologists we carried out between July and November 2013.

Within 44 guided interviews we investigated the current use of mobile devices and applications, acceptance promoting/ inhibiting factors, potentially needed support and concrete design features for the development of a user- and needs-oriented diabetes app.

Amongst others, the results provide evidence for differences in acceptance between different age groups, type-1- and type-2-diabetes patients, and between patients and attending physicians.

Merging the results of the systematic review and the conducted survey, a user- and needs-oriented diabetes app will be developed for diabetes patients 50+. In order to guarantee user-friendliness, the prospective users are involved in the product development from the beginning.

The results of regular usability tests are integrated continuously in the app optimization process.

This study is conducted within the ESF-funded project InnoMedTec.

Keywords: apps, mHealth, diabetes, elderly, acceptance

# Are Our e-Health Applications Addressing the Right Health Needs?

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## Introduction

This paper questions whether there are lessons to be learnt from the Global Burden of Disease Study 2010 that would allow e-health to have greater impact on people-centred health systems through re-evaluating the focus of our research and implementation efforts. Examination of the literature shows current e-health applications focus on clever, narrow, or ‘one disease’ applications (e.g., telediabetes; telesurgery), or creation of electronic records (e.g., EHR’s; EMRs; HIS’s) and accumulation of ‘big data’ (e.g., biosurveillance). But patients typically do not have one disease, and few of the world’s 7 Billion plus population will need or benefit from telesurgery, or a ‘life-long’ health record. If our focus is patient-centred health systems and poor, vulnerable, and at-risk populations, then we must answer the question: are our current e-health applications addressing the right health needs?

The recently published Global Burden of Disease Study 2010 provides measures of the impact of hundreds of diseases, injuries, and risk factors in 21 regions around the world. Country Profiles also summarise changes in a countries health between 1990 and 2010, highlighting trends that must be addressed. The GBD data also describe leading diseases and injuries that cause people to die prematurely or become disabled, as well as the main risk factors attributable to different diseases and injuries.

Key findings and perspectives of the GBD study are summarised and contrasted with foci of current, published telehealth applications. This leads to the suggestion that a shift is needed in the focus of our future e-health research and implementation efforts.

## The Global Burden of Disease Study

The recently published Global Burden of Disease Study 2010 [1] provides measures of the impact of hundreds of diseases, injuries, and risk factors in 21 regions around the world. Country Profiles also summarise changes in a countries health between 1990 and 2010, highlighting trends that must be

addressed. The GBD data also describe leading diseases and injuries that cause people to die prematurely and become disabled, as well as the main risk factors attributable to different diseases and injuries. Of significance is that findings are very much regional and even country specific. In this paper, the focus is only on ‘risk factors’ and disease burden.

### Primary Risk Factors Globally

Risk Factors represent potentially modifiable causes of disease and injury. Since they are potentially modifiable, they might be good candidates for e-health interventions that focus on behavioural modification. Table 1 shows that for more than half of the countries the primary risk factor was ‘dietary risks’. This includes components such as high sodium intake and lack of fruit, nuts and seeds, and whole grain intake. GBD found that the diseases linked to poor diets and physical inactivity were primarily cardiovascular diseases as well as cancer and diabetes.

Primary Risk Factor	Number of Countries
Dietary Risks	101 (53%)
Childhood Underweight	31 (17%)
High BMI	19 (10%)
Household Air Pollution from Solid Fuels	12 (6%)
Alcohol Use	8 (4%)
High Blood Pressure	6 (3%)
Tobacco Smoking	5 (3%)
High Fasting Plasma Glucose	3 (2%)
Suboptimal Breast Feeding	2 (2%)

Other relevant features are revealed when examining the GBD 2010 results. Table 2 shows those risk factors that have caused more healthy years of life lost (HYL) over 10 years by geographic Region, as well as examples of the causes for large rises in disease burden and increase in diabetes specifically. From these data, it would appear that telehealth applications that could reach the populace and achieve sustainable behaviour change for specific identified health issues (e.g. alcohol abuse, lack of exercise, diabetes) would be the most appropriate to research, evaluate, and implement.

Table 2. Summary of Regional Reports for Risk Factors and Disease Burden				
Region	Risk Factors (More HYL 2010 cf 1990)	Rise in Disease Burden	Diabetes Increase	Comment
East Asia and Pacific	Alcohol use; High BMI	Vietnam - 278% from alcohol	Philippines - 290%	NCDs leading cause of premature death and disability in Region.
Europe and Central Asia	Alcohol use; High BMI	Turkmenistan - 366% from alcohol		
LAC	High BMI; High Fasting Plasma Glucose	Dominican Republic – 225% from high BMI		
Middle East and North Africa	High Blood Pressure; High BMI	Egypt - 125% from high BMI		
South Asia	Dietary risks; high BMI	Bangladesh – 749% from high BMI.	Sri Lanka - 211%	
Sub-Saharan Africa	Alcohol use; High BMI		Namibia - 123%	

### What Do We Currently Research and Implement in E-Health?

This is not an easy question to answer. A recent PubMed search, using the search string ‘telehealth or telemedicine or e-health or eHealth or m-health or mHealth or health informatics or medical informatics’, produced nearly 332,000 results. Omitting ‘health informatics or medical informatics’ resulted in 20,259 publications, most published after 1992, peaking in 2012 at 2,016 publications. While not systematic, a scan of the results for 2012 showed application areas as seen below:

*Application areas:* Teleaudiology; telecardiology (ECG transmission); teledentistry; teledermatology; teledentistry; telemental health (telepsychiatry, telepsychology, forensic telepsychiatry); telehomecare; teleneurology; telenursing; teleophthalmology;

telepathology; teleradiology; telerehabilitation; telesurgery; and telewoundcare.

*Disease specific applications:* COPD, Chronic Heart Failure, Diabetes, Coagulation, Arthritis, Depression, and Obesity.

*Modalities:* robotics, videoconferencing, and mobile devices (m-health).

## Conclusion

Some examples of health risks seen in the GBD 2010 study were as expected (increase in diabetes or BMI), whereas others were unexpected (household air pollution). More importantly, there is a lack of congruence between priority health issues highlighted in the GBD 2010 study, and the ‘priority’ telehealth applications seen in recent literature. If e-health is to have greater impact on people-centred health systems, then insight from the GBD 2010 (and similar studies) and the lack of congruence with current initiatives should give us pause for thought. Such data are invaluable to policy- and decision-makers (particularly in developing countries) and vendors, because they indicate where simple, low-cost, but targeted e-health interventions would best impact the most significant health issues to the greatest benefit of the population.

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Louise Affleck-Hall, MSc., is an economist by training (with data analysis experience), and a Research Assistant with the University of Calgary and a Consultant with NT Consulting. She has expertise in project management, and performing and analysing Key Informant Interview and Focus Group activities, as well as Cost Consequence Analysis aspects of e-health.

# **Patient Access to the Clinical Note in the Electronic Medical Record - Provider Attitudes and Concerns**

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## Introduction

The patient portal is a web service which allows patients access to their medical records. This access may be important for shared decision making and a potential tool to improve self-management.

Setting a goal for essentially complete online record transparency, in March 2012 Mayo Clinic allowed patients web portal access to their clinical notes.

We surveyed a group of providers prior to this implementation to assess their opinions and how this might impact their clinical note process. We looked for factors that could alleviate or offset concerns about the possible increase in workload.

## Methods

This was an e-mail survey of 352 primary care providers at the Mayo Clinic in Rochester, Minnesota USA. The survey comprised of 11 questions with opportunities for free text comments. Questions pertained to the provider's current process in generating a clinical note and anticipated changes to this process, impact on provider to provider communication, clerical burden, and patient safety and self-management.

## Results

There were 197 responses from the 352 invited providers. They anticipated major process changes due to online accessibility of clinical notes to patients including changes in workflow. One hundred twenty six (65%) anticipated changing how candid they would be regarding patient behavior and social history. Fifty seven (29%) thought there would be modification of differential diagnoses to avoid anxiety provoking or sensitive possibilities. Providers anticipated that this access would increase in patient self-management. Fifty one (26%) indicated they would create an area in the plan specifically dedicated for the patient to follow. Most

providers thought ability to communicate with peers would decrease. Only a small percent of providers thought safety would increase with this online access.

### Conclusions

These results have implications for change management in institutions desiring to allow patients access to clinical notes. To ensure a smooth transition it is important to understand and address providers' concerns. Systems should be in place to facilitate workflow without compromising patient safety and satisfaction.

Keywords: Patient online access, Provider attitudes

# Telemedicine, Professional Autonomy, Patient Empowerment and Conflicts Of Interest

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The main force shaping the evolution of healthcare is technology development. Of course, the beginning of new technologies is determined not only by innovative nature of Homo sapiens, but also by social, demographic and other factors as well, including the emerging needs of clinical practice, changing lifestyle and even warfare, as well as space penetration. However, the development of technologies remains the main factor, contributing healthcare paradigm shift (Fig.1).

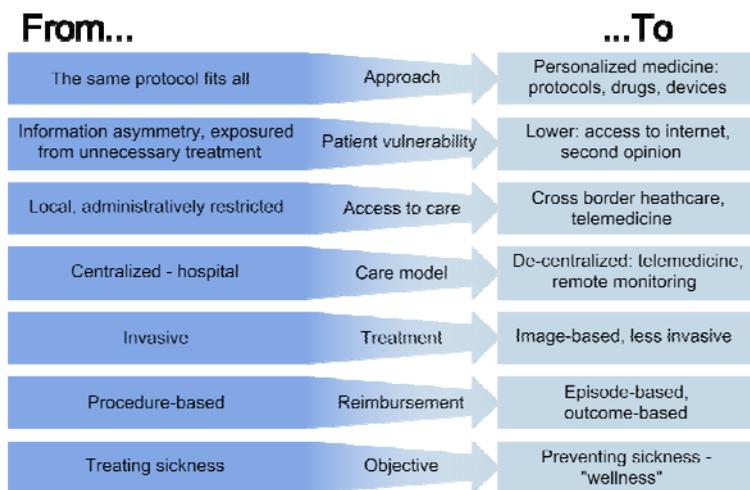


Fig.1. Healthcare Paradigm Shift

New technologies enabled personalized treatment protocols, drugs and medical devices. They reduced information asymmetry between doctors and patients, as well as ensured fast and secure transmission of patient health records between healthcare providers in different countries. Patient health status at home, remote overhaul, diagnosis and even surgeries are carried out through technologies already today. Advances in genetic engineering

enabled to find the cause of disease and changed the concept of treatment, redirecting it to the source instead of fighting its after-effects.

Telemedicine emerged as result of information, telecommunication technologies and robotics penetrating into the core of healthcare processes. Those technologies radically change the forms of care delivery, processes and entire organization of healthcare. Medical services started to be carried out from remote facilities through technologies. More care delivery is provided in or near home through advanced technologies such as Assisted Living systems. In parallel with traditional competence based national healthcare institutions networks with pyramid structure (primary care, general hospitals, regional hospitals and specialized centres of excellence), satellite structure technology based international healthcare network is under development.

Telemedicine solves many problems faced by national healthcare systems: improves care accessibility (especially in case of uneven territorial distribution of doctors), fights the rise of treatment costs which is the result of the balance shift between the young and the old, as well as the introduction of new advanced, but more expensive pharmaceuticals, medical devices and treatment technologies, and also ensures the quality of care. It may sound strange, but in a number of cases telemedicine enables to provide higher value care than traditional medicine. However today there is more enthusiasm about telemedicine outside medical community, than inside it. The opponents require to present evidence that telemedicine is safe, properly tested and creates added value. But why does no one question whether health care services, the way it was before telemedicine, complied with the requirements of good medical practice and the law?

To understand background of the opposition telemedicine has to confront all the forces shaping evolution of healthcare has to be accounted (Fig 2.). Technologies are the life-force of the changes which take place in modern medicine. The investments into new medical technologies pay off not only via more precise and timely diagnostics and more economically efficient treatment with better outcomes, but indirectly as well. Many of the telemedicine innovations present an opportunity to redesign traditional healthcare processes. They return in better access, lower costs and higher care quality. But the success of adopting new technologies and processes in healthcare practice depends not only on their innovativeness and efficiency. The critical factor is how they are accepted by medical staff, patients and influence groups.

The backbone of telemedicine is digitalization of medical information, its archiving, transmission and processing. The digital nature of this information enabled to develop new (remote) forms of medical care

delivery. It enabled to redesign the bureaucratic patient service processes in healthcare institutions relocating many of them to the Internet. But for the same information and telecommunication technologies provide governments, public and private health insurance institutions, patients and their organizations with powerful instruments to monitor performance of medical institutions, doctors and to trace their connections with Big Pharma and other influence groups.

Together all those changes have a significant impact on professional autonomy in medicine, empower patients and highlight conflicts of interest between different players inside national health systems. The conflicts of interest are the main obstacle to the future development of telemedicine.

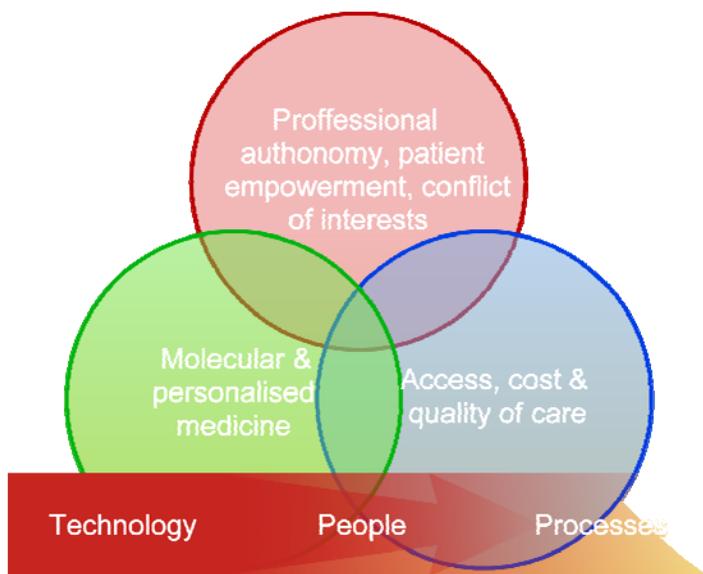


Fig. 2. Forces shaping the evolution of healthcare

National healthcare systems, like the church, too long were closed brotherhoods with their own dogmas and prophets. Doctors, as the priests, accustomed react defensively to any critical comments regarding their professionalism or behaviour. Until recently their motto was “give money and don’t control”. But professional autonomy in medicine is no so much a right as a historic privilege for self-control and regulation that society has entrusted to it. Meanwhile the reality is that this privilege is already increasingly undermined. Health care has experienced a cultural change and unquestioned trust in medical knowledge no longer exists.

The way patients will be treated is no longer for the doctors alone to decide. They already have to live up to guidelines, protocols, and standards. Medical performance is regularly audited, and complications, infections, and mistakes have to be reported. Individual medical performance is under control. In some countries patients may have access to data regarding the individual performance of medical practitioners. Freedom of decisions is restricted by financial conditions set [1].

In addition, telemedicine brings competition (including international), more transparency and a number of other poignant tablets restricting professional autonomy, threatening stability and extending boundaries of personal responsibility. Digital information could be easily processed, statistical data of prescribed drugs, implanted medical devices and treatment procedures applied compared by measuring the performance of healthcare providers and national health systems as well. Results of individual performance become even better seen and easy available to external audit.

Telemedicine changes the model of relationship between the doctor and the patient. It partially associates with depersonalization of the relationship and elimination of an emotional contact. Telemedicine puts the emphasis on the patients' direct contact with paramedic staff, which acts as a mediator between the patient and the doctor. On the other hand, telemedicine enables a patient to access any doctor and healthcare institution servicing patients through technologies from remote facilities, and provides them with access to personal health records. It became a time and cost effective high quality solution not only to get a second opinion, but even to accomplish medical tests and provide treatment.

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## **Legislation & Quality Standards in eHealth**

# **Accountability in a sub-Saharan Hospital: Impact of Use of ICT Tools at the Gabriel Touré Hospital of Bamako**

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## **Introduction**

The University Hospital Gabriel Touré is a third level Hospital of the health pyramid of Mali. As such it is one of the largest hospitals in terms of offering tertiary care in the national health system. Added to this is its central location and proximity to the people of the Malian capital Bamako. These factors make this hospital the most frequented and most solicited by citizens of the Republic of Mali.

As part of an efficient operation and providing quality service to the public, senior management of the hospital wanted to achieve concrete improvements of the working environment for the benefit of its employees and users actions. But it was quickly confronted with problems of availability of quality information necessary for the proper control of the institution.

The most pressing problems were the lack of reliable information on the situation of income and also the exact number of operational human resources at the hospital. Added to this was a crisis of confidence between the hospital staff and management on one hand and on the other hand between the users of public hospital and healthcare professionals of the institution. It is in this context that the senior management of the institution initiated the process of computerization of the entry-office and biometric census of hospital staff by using the expertise of the National Agency for Telehealth and Medical Informatics (ANTIM) because of the mission entrusted to this structure by the Ministry of Health.

## **Methodology**

The project was realized by ANTIM, focusing on discussion and including involvement of various stakeholders in the hospital. The most senior leaders of the hospital accompanied the process of performing an audit of existing information systems to determine the needs of all stakeholders and finally propose a technological solution taking into account all these factors. This allowed the implementation of a hospital information system software package called OpenClinic for fund and human resources management.

## Results

OpenClinic became operational on 29 January 2013. Financially it was noted that from its implementation, it improved significantly the revenue of the hospital.

In terms of direct revenue (payment by patients, cash directly perceived at checkout) without insurance and cesarean reimbursement, the hospital recorded after ten months of operation 446054837 XOF. This equates to a monthly average of 44605483 XOF against 35090725 XOF before.

It should be noted that the hospital had previously recorded 18,497,590 FCFA in December 2012 and 35,490,000,665 CFA francs in the month of January 2013.

Table 1

Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013
50,540,965	68,485,395	64,204,959	62,402,837	61,804,855
Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013
44,014,080	47,777,350	59,670,480	64,792,390	63,293,825

The table above shows the evolution of direct revenue (perceived directly at the patients checkout) without insurance reimbursement and cesarean per month at the beginning of the implementation of the software.

Table 2

Feb 2013	Mar 2013	Apr 2013	May 2013	Jun 2013
56,105,550	75,494,950	67,981,500	60,911,550	67,377,900
Jul 2013	Aug 2013	Sept 2013	Oct 2013	Nov 2013
57,623,450	63,580,350	74,266,750	74,761,450	74,583,500

The table above shows the evolution of total revenues of the hospital including all insurance (AMO, Mutual, Hospital's Halfprice, Free of charge

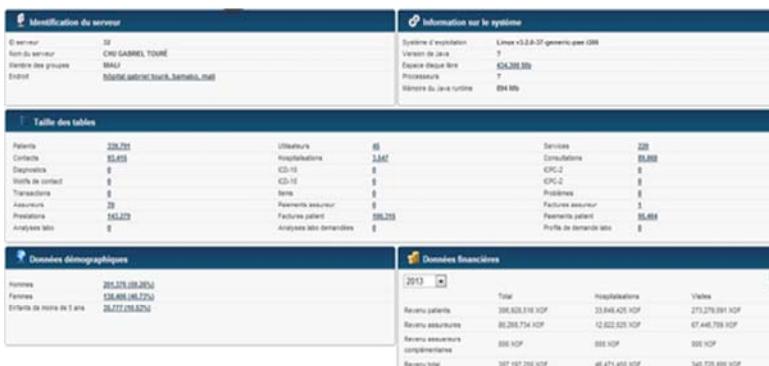


Figure 1 : Technical and Financial data dashboard

care for hospital staff) since the implementation of the software with the



Figure 2 Hospital human resources Dashboard

possibility for the hospital management and health authorities to monitor financial results in real time thanks to the interface of the national health data repository (Global Health Barometer of Mali).

In terms of human resources, it was noted that the services responsible for staff at the hospital had too divergent information; the census has resolved definitively this issue and has allowed producing secured badges for staff.

The biometric census of the entire hospital staff in OpenClinic software showed that the hospital has only 648 employees instead of 811 provided on the list of discounts. The operation allowed removing 163 fictitious



Fig. 3 Example of automatically generated message with the CSV file

employees from the list of discounts.

In addition, the installed system manages Compulsory Health Insurance (AMO) patients, this through authorization mechanisms managed directly by agents of the National Health Insurance Fund (CANAM) in the space dedicated to this purpose. This allows editing invoices that integrate CANAM's logo for any insured AMO patient; reducing significantly fraud attempts to health insurance. Data on services provided by the AMO patients are sent every night at midnight by e-mail to CANAM and to the direction of the Hospital Gabriel Touré.

This reduced significantly the misunderstanding between CANAM and hospital's management, concerning invoices. It was also highly appreciated by doctor's controllers of CANAM, who saw their work greatly simplified by data availability online and in CSV format, ready to be analyzed in software like Excel.

All these data can be queried at any time by leaders with a security code that gives them access to a dashboard containing different modules appropriate to their responsibilities. The dashboard in addition to provide the opportunity to obtain statistics or generate graphics, also automates a large number of operations as centralized printing of identification cards or transfer data coverage and disease billing between providers and insurers.

## Outlook

The outlook is to quickly activate and configure modules on medical patient record, pharmacies and laboratories within the UHC-GT. In other words it is to make available the system to the physicians and other professionals (nurses, midwives, laboratory assistants, technicians ...) in the box of consultation and hospitalization services with electronic publishing orders (sheet of electronic care). This will significantly reduce fraud to care sheets which tend to become widespread in health institutions.

## Conclusion

The implementation of the modular hospital information system OpenClinic at the University Hospital Gabriel Touré has improved substantially the revenue of this institution.

In addition to this improvement, the dashboard was the most appropriate to implement. Because it allowed the decision-makers to better manage the hospital based on verifiable and proven data.

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Tidiani TOGOLA is the Technical Director of the National Agency for Telehealth and Medical Informatics, of Mali.

He was Computer System and Network Administrator of the

Department of Health and Assistant of the Focal Point of Telehealth from 2008 to 2009. He was the National coordinator of the international volunteering Association, ICVolunteer, in Mali, where he promoted the concept of cyber-volunteering from 2006 to 2009.

Tidiani TOGOLA is active in several sector of ICT and is now one of the key actor in the development of Telehealth in Mali.

Student, he was noted for his creativity and his love for ICTs through the development of several computer programs available for his teachers and classmates. Originally Master graduated in Applied Physics from the Faculty of Sciences and Technic of Bamako's University, Tidiani TOGOLA also holds a Master of Computer Network Engineering and Information Systems of the euro-african university Sup'Management, and a Master of Standardization Quality Certification Test of the University of Technologies of Compiègne.

Tidiani TOGO trained several professional in computer programming and networks during workshops. Tidiani is Secretary for Industry and Environment of the Malian Association for Quality. There, his work are very focused on quality management applied to the ICT sector and particular approaches such as ITIL V3, ISO 2000, ISO 27000, ISO 9001 standards and all major international standards related to ICT.

# Analyzing the Nigeria's e-Health policies; seeking solutions: A case study of the Nigerian e-Health Policies

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## Introduction

### *Problem Definition*

E-Health has become an undeniable trend which makes the deployment of healthcare to the most remote areas easier. In Nigeria, only 19.8 % of Doctors, nurses and midwives attend to a population of 10,000 patients; this clearly indicates an unequal distribution of health workers [1].

The unavailability of a National e-Health policy to facilitate a systematic, coherent and sustainable telemedicine and e-Health structure has been undermined in the development and integration of the nation's healthcare delivery system, producing poor implementation of policies from national, state and local government or the lack of policies as a result of unclear provision in Nigeria's constitution are all issues.

Several efforts to put together policy documents have proved futile, which has led to poor coordination of Nigeria's Healthcare system. Research posits factual attempts to introduce eHealth, these are stated below:

1. The Department of Planning, Research & Statistics of the ministry of health made efforts to develop documents for eHealth development and deployment in 1996, but the project did not evolve under the Late General Sani Abacha administration;
2. The Pilot project initiated by National Space Research and Development Agency (NASRDA), Abuja 2007 (is a project that will serve as a resource if evaluated for wider implementation of eHealth in Nigeria) in collaboration with the Federal Ministry of Health, but fell short of sustainability beyond the pilot phase. The mobile unit is packed at the premises of the Ministry of Health till date;
3. The challenges faced by the NASRDA project are due to lack of proper research, planning, national need and demand analysis (assessment) of telemedicine & eHealth services for the country. There was no structure in place to address these issues because they are important for the sustainability of eHealth projects [2].

## Analyzing Policies

Some policies are however reviewed in this paper:

- The National Information and communication (ICT) final draft Policy, 2012 and
- The National Strategic Health Development Plan (NSHDP), 2010-2015.

At the time this paper was written, both policies have vague policy statements that address ICT in health.

The National Information and communication (ICT) final draft Policy document recognizes that ICT development is limited by the absence of a cohesive ICT policy framework that cuts across the various sectors and states that appropriate measures would be put in place to create an enabling environment that will enhance effective and coordinated ICT development across all sectors (including Health) by the year 2020. The policy also encourages and promotes effective use of ICT in Governance within every sector and program, including health [4].

NSHDP has eight priority areas, of which National Health Management Information System (NHMIS) is one. This area has “infrastructural support and ICT of health databases” as a sub component of this area, and speaks application of Health Information Systems, data warehousing and decentralized software systems for health data collection. This is the only component that addresses eHealth in any in the document [6].

A committee has however been formed to draft an eHealth policy for the Country’s capital. However, an official draft has not been inaugurated and therefore could not be analyzed at the time this paper was written.

## Way Forward

### *Policy Options*

In seeking solutions to better this situation, these points will clearly bridge the gap:

1. Advocating articulation of ethical and evidence based policies for the use of ICT in the health sector;
2. Building national capacity by supporting the development of eHealth experts, health providers capable of harnessing the power of eHealth in their work and all eHealth literate citizens in the country;
3. Develop the evidence base on eHealth, what works, why and under what conditions, and ensuring the sharing and reapplication of this knowledge widely;

4. Government should also get fully involved to promote the advocacy at all levels of government involved in eHealth implementation and sustenance;
5. eHealth should be integrated into our educational curriculums.

### Conclusion

eHealth policies have been initiated in other developing countries compared to Nigeria. If all these solutions could be given attention, then all these are achievable. Internet based ICT solutions have brought about the greatest impact and they are rapidly changing the way health organizations, providers, care plans, payers, regulators and consumers access information, acquire health products and services, deliver care and communicate with each other [4].

To achieve the benefits of deploying eHealth in healthcare data processing, communications and use in the Nigerian health systems we need an appropriate unified document which will bring all these together for better healthcare deployment even to the most remote areas of the country. This is achievable if the government will pay attention.

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# **Brazilian Telehealth Program: Follow Up of the Legislation Advancement along the Implementation of the Program**

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## **Introduction**

Brazil has adopted e-Health 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. The multiple strategies for eHealth include mainly the Brazilian Telehealth Program ([www.telessaudebrasil.org.br](http://www.telessaudebrasil.org.br)), Open University of the Unified National Health System - UNA SUS ([www.unasus.gov.br](http://www.unasus.gov.br)) and University Telemedicine Network – RUTE ([www.rute.rnp.br](http://www.rute.rnp.br)), the electronic health record (National Card of Health) and the Center for Strategic Information in Health Surveillance – CIEVS, equipped with the most modern technology to receive information about outbreaks and epidemiological emergencies that endanger the health of the population in any country site resource room, having a specialized team on call 24 hours a day, every day of the week, to receive notifications and notify the authorities in case of emergency.

The Brazilian Telehealth Program offer teleconsultations and the Second Formative Opinion. It started in 2006 and it has been implemented and developed so far at 3 different stages concerning its legislation.

The aim of the present study is to present the evolution of the legislation as it reflects the evolution of the program.

## **Methods and Results**

The first edict by the Ministry of Health, in 2007, established the Pilot Project, defined criteria to implement the program predominantly in remote areas at the five different regions of the country. Until then, the program has been implemented in 9 states.

In 2010, a new edict recognizes not anymore as a pilot project, but as the Brazilian National Telehealth Program and determines its structure in each of the 27 states of the country. Up to that time, the program was applied to

the primary health care level. The evaluations of the teleconsultancies followed a standard of answer and were mediated by a Family Doctor. As a result, for each two teleconsultancies, one of them could help to solve the problem at the primary care level and avoided the transfer of the patient to another healthcare service [8].

Based on the proved results, specially the increased solvability observed with the teleconsultations, the actual edict, published in 2011, expanded the Program to high complexity services and as strategy to reinforce the network of health care delivery as a whole. Another set of evolution reflected at the legislation is that it brings the concepts of teleconsultancy, telediagnosis, Formative Second Opinion and also that the services of telehealth are incorporated to the list of health care services of SUS, the National Health System.

### Conclusion

The Brazilian Telehealth Program started in 2007 as a pilot project in 9 states, then turned into a National Program, first applied to primary care and then, thanks to its positive results, was expanded for the Unified Health System as a whole, in its secondary and high complexity level as well.

The program also established new concepts and had telehealth included in its roll of services. These accomplishments are reflected in the Brazilian legislation, which consider and apply e-Health as a national policy.

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# **Building Innovation into Tele-Health and e-Health Delivery Agreements**

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## Introduction

Effective procurement practices require intermittent approaches to market and in order to achieve value for money, service agreements with Tele-Health and e-Health vendors may often be up to 2 to 4 years. The rate of change in technology is likely to be significant in that contract period alone. Consider also the rate of changes in e-Health and Tele-Health settings (health literacy; priorities in primary care; legislative or other compliance requirements) and you will find that most agreements in this industry today, do not adequately address the need for contracted solutions to be refreshed in line with technological advancements or changes in consumer preferences/priorities. This is not surprising given that contracts seek always in the first instance to protect the interests of parties arising from known transactions during a term, rather than the intended outputs or value outcomes of the transactions to be derived from that term. Below are suggested contract provisions that have proven effective in delivering an agile and scalable Tele-Health or e-Health solution to the benefit of the purchaser and the consumers it serves, whilst at the same time, secures for the vendor further opportunities for commercial gain.

## Context

Difficulties arise when conventional contracting principles inherently result in a focus on drafting known deliverables, service levels and pricing. If included at all, contract provisions that require vendors to refresh solutions in line with technological advancements are mostly soft obligations to maintain environmental scans or at best, reflected in clauses that “agree to agree”. The legal effect of such arrangements is generally weak and innovative solutions during a contract period are largely at the cost and effort of a purchaser. As with most contracts, clauses dealing with intellectual property ownership and the indemnities and warranties expected of vendors in service delivery, act as inhibitors to what should be a collaborative arrangement where both parties realize longer-term commercial benefits.

Hence the contract process alone is not a panacea to achieving innovative solutions during a contract period. It is important for purchasers to use the approach to market and resulting competitive tension to get as much commitment from vendors to establishing frameworks for accommodating future innovative solutions. In developing the tender process, purchasers should consider including a description of the importance of innovation to future service delivery so that vendors have a clear understanding of the context of this issue. For example, purchasers should articulate as an objective, the patient or population health outcomes in which the Tele-Health or e-Health solution is expected to play a role.

### Suggested Contract Provisions

The contract should strike a balance between facilitating the development and implementation of innovative solutions and allocation of risk arising from the innovation. The detailed contractual provisions required to strike that balance are unlikely to be determined with precision until the nature of the innovative solution, its costs and benefits are known. The best position that the contract can achieve is to:

- i) Establish a framework for the development and implementation of innovative solutions; and
- ii) Accommodate some flexibility in key legal issues so as to not present an unbalanced risk profile for innovative solutions.

Outlined below are suggested contract mechanisms to consider. The precise details can be negotiated as variations to the contract at the time the innovative solutions are known.

#### *Governance Arrangement on Innovation*

Contract provision binding the parties to participate and cooperate in a cross-organizational committee creates a structured forum for the exchange of ideas concerning emerging health need and what the vendor and market is able to offer. Innovation initiatives would then be mutually identified and agreed on by parties in this forum and will be based on innovative transformation, need and the ability to return on investment.

The contract should clearly outline the collaborative nature of any proposed governance arrangements in innovation. Typical points to consider include:

- i) Representation: Appropriate skill set and seniority of representatives (including specialist clinicians or other third party experts);

- ii) Composition: Where multiple service providers are engaged, it is important that the governance structure addresses the process where innovation impacts those providers;
- iii) Agenda: The nature of information to be canvassed. For example, the purchaser may want to bind the vendor to provide regular presentations about the latest developments in the market and solutions it is offering/developing for its other clients;
- iv) Process: Business case proposals and approval process including accommodating proof of concept phases;
- v) Cooperation: An innovation developed by one service provider may need to be implemented by, or involve, another service provider or stakeholder.

### *Intellectual Property*

In technology agreements, the key inhibitor to enhancement or change in a contracted product or service is likely to be the Intellectual Property (IP) clauses. If a contract requires that any IP created in the course of the agreement will vest in the first instance with the purchaser, there is no real motivation for a vendor to invest in considering, developing or in any way collaborating with a purchaser to ‘re-invent’ an alternative solution to the one already under contract. Likewise, this premise holds true if IP ownership vests in the vendor.

The key issue to be considered is one of ‘control’ rather than ownership. Control of innovative solutions created during an existing contract, can be effectively managed through licensing provisions. For example, licensing provisions could provide a vendor with exclusive exploitation rights to the IP outside of the contract, provided such use or exploitation is not in competition with the purchaser’s interests.

However, in order for the contract to shift from dealing with straight out IP ‘ownership’ to one that deals with IP ‘control’ under licensing arrangements, the parties need to appreciate each other’s roles in realizing the IP’s commercial benefit. For example:

- i) Who invested in the development of the innovative solution? If the solution was developed by the vendor ‘outside’ the contract then the vendor would have a legitimate expectation to control the IP;
- ii) What degree of risk did the parties commit to? This might be diluted if the purchaser were to be a ‘first customer’ or part of the ‘proof of concept’. Alternatively if the vendor is responsible for getting the solution to the market (e.g. providing marketing and sales force, branding) or being responsible for clinical issues, then

- the vendor would usually argue for greater control (and vice versa); and
- vi) The potential commercial upside for the parties arising from commercialisation of the innovative solution. This in turn will be affected by any market segmentation, the degree to which exclusivity is secured and the factors referred to above.

### *Risk Allocation*

The key risk allocation issues relevant to the development and implementation of innovative solutions concern indemnities, warranties, disclaimers, liability caps and insurance. The fundamental principle of risk allocation - risk should lie with the party in the better position to manage the particular risk – is relatively clear at the outset of the contract but the principle, if carried forward to apply to any future innovation or enhancement, may deter the party carrying most of the initial risk, from even considering any change to the contracted service or delivery model. A balance in the allocation of risk in the implementation of any innovative solution should be agreed at the outset recognising that any innovation to be developed jointly by the parties would, in the first instance, be borne equally until the details of the actual risks are known.

The actual allocation of risk will vary according to:

- i) The relative commercial benefit that may accrue to the parties;
- ii) The relative investment made by the parties in the development and commercialization of the solution; and
- iii) The potential adverse impact on the reputation of the parties.

### *Pricing for Innovative Solutions*

There are many options to apply a ‘price’ to innovative solutions. Pricing structures may include:

- i) Fixed fee which may be as low as zero – i.e. a ‘value add’ to the services offered;
- ii) Incentive payments or gain share arrangements for performance that is ‘over and above’ the standard normally expected;
- iii) Where the innovative solution may have application to markets – a licensing arrangement that includes royalties, licence fees and/or referral fees. Depending on the sophistication of the commercial terms this may be reciprocal

### Conclusion

Whilst this paper puts forward from a legal perspective, suggestions to the contracting process to address the issue of innovation, it also raises the

question as to whether there is a need for the Tele-Health and e-Health industry to consider moving towards commercial agreements that reflect a more strategic relationship between parties that mutually fosters innovation and change to help ensure a sustainable and transformative future for relevant and effective e-Health and Tele-Health services.

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# Clinical Quality Control of a Large Brazilian Teleconsultation Service: The Telehealth Network of Minas Gerais

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**Abstract:** The objective of this study is to assess the quality of the teleconsultations performed by the Telehealth Network of Minas Gerais (TNMG) and the impact of focused interventions to improve the quality. The first phase consisted of the analysis of the teleconsultations performed from 12/12/2012 to 12/01/2013 (n=440). Questions and answers were classified as “appropriate” or “inappropriate”. Subsequently, an intervention was applied towards the most common reasons for inappropriate questions and answers, and then a second analysis was performed from 01/07/2013 to 31/07/2013 (n=434). In the first phase, 15.0% of the questions and 14.7% of the answers were considered “inappropriate”. The most frequent reasons were “unfriendliness” (use of only uppercase letters) and “not enough information provided” for the questions, and “unfriendliness” for the answers. There was an improvement of the system to promote more structured questions, and staff and users were re-trained. In the second phase, 12.9% of the questions and 3.4% of the answers were considered “inappropriate”. In conclusion, this study highlighted the importance of performing regular analyses of a teleconsultation service and implementing focused corrective measures, in order to improve the quality of the service provided.

## Introduction

Minas Gerais is a Brazilian state with 853 municipalities and has a population of more than 20,000,000 inhabitants distributed in an area equivalent to France [1]. The remote areas of the state suffer from lack of quality of basic services, such as healthcare. Telemedicine is an important tool

to assist primary care professionals in these areas, in order to improve the medical attention for the population [2].

The Telehealth Network of Minas Gerais (TNMG) is a public telehealth service which assists 660 municipalities in the state, performing teleconsultations (second opinion) for a large variety of specialties and electrocardiogram analysis [2]. It is a regular health service, therefore it demands frequent improvement. The evaluation of the quality of the activities performed by TNMG is an important instrument to promote the excellence of the service. For the purpose of this study, the quality of teleconsultations was assessed, as well as the impact of focused interventions adopted to improve their quality.

### Methods

The study was divided in 2 phases. In the first phase, teleconsultations performed from 12/12/2012 to 12/01/2013 were assessed. Questions made by the healthcare practitioners from the municipalities and answers given by the specialists from the TNMG were classified as “appropriate” and “inappropriate”. If inappropriate, the possible reasons were evaluated.

Subsequently, focused interventions were applied: there was an improvement of the system to promote more structured questions; specialists from the TNMG and healthcare professionals from the municipalities were re-trained; and a manual was elaborated for the specialists. In the second phase, teleconsultations performed from 01/07/2013 to 31/07/2013 were analyzed by the same researcher.

Categorical variables from phases 1 and 2 were compared using the Chi-Square test.

### Results

In the first phase, 440 valid teleconsultations were assessed; 66 (15%) questions and 65 (14.7%) answers were considered “inappropriate”. In the second phase, 434 teleconsultations were assessed; 56 (12.9%) questions and 15 (3.4%) answers were considered “inappropriate”. There was a significant reduction in the number of inappropriate answers ( $p < 0.001$ ) when comparing phase 1 to phase 2.

The reasons for classifying questions and answers as “inappropriate” are shown in tables 1 and 2, respectively.

Table 1 – Reasons for classifying questions as “inappropriate”

Reasons	Phase 1	Phase 2	P-value**
	N(%)* n=440	N(%)* n=434	
Not enough information provided	47 (10.7)	35 (10.2)	0.20
Unfriendliness	14 (3.2)	10 (2.3)	0.53
Request for hospitalization or presential consultation	6 (1.4)	2 (0.5)	-
No possible answer	3 (0.7)	0	-
Teleconsult (self or familiar consultation)	2 (0.4)	5 (1.1)	-
Unethical	2 (0.4)	2 (0.5)	-

\* As the same question can be classified in more than one category, the sum is higher than the absolute number of inappropriate questions.

\*\* p-value was not calculated for variables with values lower than 5, due to imprecision

Table 2 – Reasons for classifying answers as “inappropriate”

Reasons	Phase 1	Phase 2	p-value**
	N(%) n=440	N(%) n=434	
Unfriendliness	43 (9.8)	7 (1.6)	<0.001
Not enough information provided	18 (4.1)	5 (1.1)	0.001
Long and not objective	2 (0.4)	2 (13.3)	-
Poorly written (bad spelling)	2 (0.4)	1 (6.6)	-

\* As the same answer can be classified in more than one category, the sum is higher than the absolute number of inappropriate answers.

\*\* p-value was not calculated for variables with values lower than 5, due to imprecision

## Discussion

This study highlighted the importance of a quality control to improve the quality of a teleconsultation service. The “inappropriate” questions and answers detected on phase 1 triggered focused actions that reduced

significantly the number of “inappropriate” answers on phase 2, reducing drastically the number of teleconsultations classified as unfriendly due to the use of only capital letters on the answer, which may be interpreted as aggressive, and also significantly reducing the number of teleconsultations which did not provide enough information. Although the count was already low, the goal for every teleconsultation service is to keep this number as close as possible to zero. It was reduced with easy measures: developing a manual to the staff and re-training them.

It was observed that it is more difficult to make changes to impact the users from the cities. Although they were also re-trained and a new system was developed with more structured fields to make it easier for them to perform clearer questions regarding the clinical cases, the proportion of teleconsultations without enough information provided remained stable, as well as the proportion of the ones classified as unfriendly.

As there were a reduced number of questions and answers classified as “inappropriate”, the assessment of the interventions on each cause is limited due to the small sample size. Despite this, the study had an important role in alerting that it is essential that this activity is ongoing, in order to guarantee a constant improvement in the quality of the service.

In conclusion, this study highlighted the importance of a quality control in a teleconsultation service. The analysis of teleconsultations motivated focused corrective measures that promoted, mainly, a reduction in the absolute number of answers classified as “inappropriate”. Therefore, the TNMG can better assist primary care in municipalities in the state. To improve results, subsequent studies should include a bigger sample of teleconsultations, in order to increase the power to assess the different causes for classifying questions and answers as “inappropriate”.

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# Developments in and Uptake of the European Code of Practice for Telehealth Services

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***Abstract:* The evolution of the European Code of Practice for Telehealth Services is evident from releases of drafts at successive Medetel Conferences (in 2012 and 2013). The final version of the Code was launched in October 2013 at the European Telemedicine Conference. The procedures by which telehealth services can become accredited to the Code are now in place. This paper outlines the contents of the European Code and points to the way in which it is helping to influence thinking about telehealth - moving it away from narrow understandings that have focused on vital-signs monitoring towards those that are equally concerned with lifestyles, prevention, behaviour change and self-management.**

## Introduction

The European Code of Practice for Telehealth Services (the European Code) is the primary outcome of the TeleSCoPE Project that was part-funded by the European Commission under their Health Programme 2008-2013. It provides quality benchmark standards for telehealth services and a framework to which detailed guidelines for specific telehealth services (relating e.g. to particular telehealth ‘domains’) can be linked.

## Background

The European Code responded to the calls for standards in the arena of eHealth. These calls were being increasingly made and were noted as important and as a contributor to ‘building trust in eHealth’ within the European Commission’s eHealth Action Plan [1]. Areas of particular concern in the Action Plan included the need to achieve greater interoperability between eHealth technologies; having safeguards in place for people regarding their personal information; quality of life issues and patient empowerment.

The TeleSCoPE project was led by Coventry University and drew on the support and expertise of other academic partners, commercial organisations, user-representative and user-facing bodies (see [www.telehealthcode.eu](http://www.telehealthcode.eu)).

Background research undertaken in the initial phases of the project enabled the development of a broad understanding of telehealth; identification of the ways in which telehealth services were harnessing different technologies and seeking to meet the needs of different user groups; and the setting out of a number of telehealth service ‘domains’. This research was used to help develop the draft of the European Code that was released at the Medetel Conference in 2012.

Wide consultation ensued with events taking place in the countries of project partners viz. Belgium, Bulgaria, Hungary, Italy, Slovenia and the United Kingdom; complemented by case study work and ‘validation’ in meetings with 14 telehealth service providers. Subsequent work of the project enabled further refinement of the European Code leading to its launch at the European Telemedicine Conference in Edinburgh in October 2013. In the ensuing period to April 2014 details of the framework for operationalisation of the European Code have been completed.

### Defining Telehealth

Before outlining the features of the European Code and the way in which services can seek to become certified or accredited to it, it must be pointed out that the telehealth is a subset of eHealth. The definition of telehealth adopted by the TeleSCoPE project (and now embedded within the European Code) is such that ‘telehealth is the means by which technologies and related services concerned with health and well-being are accessed by people or provided for them, at a distance’.

This means that telehealth is concerned as much with the way that people access and use services as it is with the way in which such services are provided. It positions telehealth in a way that can accommodate the changes in service paradigms that are reflected in moves away from top-down service provision (as determined, in the main, by professional assessments); towards more partnership approaches with users and carers; and, ultimately, towards people’s self-management of their health and any specific conditions that they may have. In this way the European Code helps to influence changes in thinking and can embrace telehealth services that are concerned with lifestyles and behaviours as well as with supporting (often older) people with long-term conditions.

### Features of the Code

The European Code has a total of 54 clauses. For a telehealth service to be certified or accredited to the European Code this requires compliance (determined through inspection / assessment) with 47 of these; and 49 within 12 months of service commencement. Each clause guides the

telehealth service in relation to particular requirements. These, in many cases, require information to be posted on the service website - meaning that services are more open than might otherwise be the case to users and carers as well as to service procurers or regulatory agencies.

There are nine sections to the European Code as follows:

- A. General Considerations
- B. Ethical Principles
- C. Governance and Financial Issues
- D. Personal Information Management
- E. Staff and Staff Management
- F. Contact with Users and Carers
- G. Interpretation of and Responses to Information
- H. Communications Networks
- J. Hardware and Technological Considerations

Overall, it is important to note that the European Code is not over-prescriptive. It does not, for instance, put forward performance indicators – excepting in the sense that each applicable clause requirement must be satisfied. Rather it offers a high level framework that enables and encourages telehealth services to plan and manage their services in inclusive, sustainable and ethically appropriate ways.

Other codes, some of which reference the European Code, are available that may be able to guide or prescribe operational procedures in relation to certain types of telehealth services. Such other codes relate to social alarms, telecare and vital-signs monitoring [2].

### Assessment and Inspection

During this first phase of the life of the European Code, assessments and inspections that determine the eligibility of telehealth services for certification or accreditation are being undertaken by DNV (Det Norske Veritas) Healthcare [3]. The team of staff, as well as having more generic skills, have been specifically trained in relation to telehealth issues. A four year cycle for assessments and inspections operates as follows:

- Year Zero (now) and Year Four: Foundation Assessment
- Year One: Interim Review
- Year Two: On-Site Review
- Year Three: Interim Review

These cyclical ‘events’ can be supplemented at any time with pre-assessment or service reviews. It is important to note, however, that what may appear to be a ‘lighter touch’ inspection regime is supplemented by ‘spot-checks’ that can take a variety of forms (both on-site and off-site) in order to ensure compliance or to respond to concerns that may have arisen.

The building in of spot-checks within the four year cycle may, it is suggested, be a better guarantee of service quality than is the case for more routine approaches based on a shorter cycle. There are accompanying procedures by which any incidence of non-compliance can be dealt with in a timely manner. And tips and suggestions for service improvements are routinely provided as part of the assessment / inspection process.

### Uptake and Forward View

There is expected to be a good uptake of the European Code throughout the European Union. This good uptake is signalled by the early interest expressed by a range of telehealth services and the simple fact that there is no similar benchmark standard by which telehealth services can be guided. Initially, the uptake will, it is anticipated, be highest in those countries where telehealth services are most developed – such as the United Kingdom and The Netherlands.

A consolidation of the position of the European Code will then take place as other codes are either adjusted or developed with a view to ensuring their compatibility. Such compatibility will allow for services to be certified or accredited to those other codes (which will testify to their meeting more detailed operational requirements in specific service areas) and to the European Code (which will testify to the quality of their governance frameworks, etc.).

The above approach, and the links between codes, necessitate some co-ordination. This will, it is envisaged, be achieved through a new organisation, possibly a European Foundation. This new body will have responsibility for the European Code - ensuring (a) its further development so that it will remain up to date; (b) its effective operation in relation to any linked codes; and (c) its potential evolution to becoming a European standard.

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- [1] European Commission “eHealth Action Plan 2012-2020 – Innovative Healthcare for the 21<sup>st</sup> Century” Staff Working Document SWD 413 Final, Brussels 2012.
- [2] See [www.telecare.org.uk](http://www.telecare.org.uk); [www.cecops.org.uk](http://www.cecops.org.uk); [www.wdtm.nl](http://www.wdtm.nl); and [www.dke.de](http://www.dke.de)
- [3] See [www.dnv.com/industry/healthcare/](http://www.dnv.com/industry/healthcare/)



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# Necessary Skills and Knowledge for Staff Providing Telehealth Services

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**Abstract: More telehealth services are being established as frameworks for health provision in the EU are being transformed. The transformations involve not only changes in approach to service provision, but also require service staff to have appropriate knowledge and some understanding of the technologies concerned. That knowledge and understanding must include the ways in which telehealth technologies can (a) be harnessed by users - in order to give them greater control over their conditions and/or lifestyles; and (b) be deployed to support people who are dependent or vulnerable. This paper, drawing on the UK and wider European experience, sets out six skills and knowledge sets that can now appropriately apply to health and social care staff that are involved in telehealth service provision.**

## Introduction

The context for changes in telehealth services is set by the European Commission's eHealth Action Plan and the accompanying Staff Working Paper [1]. These set a direction that both offers the prospect of resolving some of the difficulties around health and support service provision; and should lead to new ways of thinking about the very nature of the services that are provided.

There are, of course, some barriers to the realisation of the desired outcomes. What may be 'new' telehealth services can be established according to old service norms. The staff concerned (whether health or social care) may receive little in the way of training regarding the transformative potential of telehealth and may see, therefore, such services as simply a kind of 'add on' to what already is provided. The configuration of services can, furthermore, be such that clinical goals are emphasised at the expense of goals that are concerned with wider well-being. This may, of course, be legitimate, depending on the nature of the telehealth service, but other imperatives that relate to people's greater self management may be being overlooked.

The Staff Working Paper [1] references 'a lack of and inadequately trained and practising staff'. It makes a call for 'improved awareness'

among healthcare professionals through the inclusion of ‘eHealth in medical curricula’ and ‘training in the workplace’. Such exhortations go a little way to indicating what is needed, but the potential contribution of social care staff to people’s health and well-being is not being sufficiently considered though the eHealth Action Plan itself calls for ‘healthcare and social care professionals ... to work together to achieve objectives’ relating to health and well-being.

Taking things a little further forward, however, is the need, (recognised by the European Commission in a further Staff Working Paper) for ‘forecasting health workforce and skills needs’ in the context of ‘new integrated care delivery models’ [2]. The need for new skill mixes is affirmed and member states are called upon to ‘adjust their education and training curricula ... to equip people with the right skills for the job’. The potential emergence of an EU Skills Council ‘in the area of nursing and care’ is noted. The reference to integration means that it is at least implicit that the ‘boundary’ between health and social care should be blurred and that there are health support roles that social care workers can fulfil.

The tenet of this paper is that telehealth services must harness both health and social care expertise if justice is to be done to objectives around health *and* wellbeing. In this context it becomes absolutely necessary to consider a range of new skills (or a new skill ‘mix’) that is applicable to both health and social care staff. New skills and knowledge sets in the context of telehealth services are, therefore, suggested. These draw in part on work undertaken by the author for Skills for Care and Development in the United Kingdom; take some account of ongoing work by the European Commission in the context of EU-US collaboration (where a Workforce Development Group is exploring needs for the eHealth / health IT workforce); the work of an EU eHealth Stakeholders Group that is soon to report; work within the European Innovation Partnership on Active and Healthy Ageing; and outcomes of the Carenet project which has set out ‘domains’ of competence for both home care workers and, importantly, care recipients.

### New Skills and Knowledge Sets

In the first instance it is necessary to state that, in a digital age, there is a need, as far as possible, for all people to become more digitally competent. Such ‘digital competence’ is recognised as one of the eight ‘key competences’ for lifelong learning by the European Commission [3] with it being seen as a precondition for people to engage with not only health and support services but also with the wider world of work, social and family life.

There are basic IT and technical skills and knowledge, therefore, that are increasingly necessary. But, because of the advent of telehealth services, these must be part of the daily fare for both health and social care staff. To these ‘basics’ must be added a range of more specific skills and knowledge that are range from the handling of personal information to the operation of telehealth services.

Further work will be undertaken to reconcile such competencies with those that emerge from the different initiatives that are ongoing (such as those noted above). But in providing a potential framework that can embrace these, some initial skills and knowledge sets for health and social care staff are suggested below.

1. Basic Information Technology (IT)
  - a. Digital literacy (including switching, charging and the use of mobile phones)
  - b. Awareness of user benefits of IT (including the social / well-being benefits, access to information and services)
2. Personal Information
  - a. The importance of privacy and confidentiality (including the risk of breaches to the same and the ways that risks can be combated)
  - b. Protocols between agencies (whereby the sharing may take place)
  - c. Procedures for obtaining informed consent (and the related procedures that are required where there is cognitive impairments)
3. Telehealth Technologies / Equipment
  - a. Understanding the range of technologies available and how they can be procured
  - b. Knowing how to access independent advice and information regarding such technologies
  - c. Appreciating the wider range of assistive technologies within which those associated with telehealth should be considered.
4. Assessment / Self Assessment
  - a. Recognising the place of telehealth within the range of services within which assessment / self-assessment can take place
  - b. Undertaking or supporting assessment (including the exploration of risks)
5. Installation, Removal and Disposal of Telehealth Technologies / Equipment

- a. Basic safety procedures
  - b. Links to power sources and Broadband networks
  - c. Fault finding and testing (per manufacturer / supplier guidance)
  - d. Cleaning, decontamination and infection control
  - e. Removal, storage and recycling
6. Telehealth Services
- a. Role and purpose of services in relation to health *and* well-being (including telehealth ‘domains’)
  - b. The fit with other services (including home care and ‘hospital at home’)
  - c. How calls are made and handled

### Discussion and Conclusion

The skills and knowledge sets noted above represent a reference point by which further work can be undertaken. Such work will help to ensure that there is greater clarity about the training needs and required competencies of both health and social care workers. Such clarity is essential in a context where there is a growing number and range of telehealth services.

With greater clarity comes the potential to put frameworks in place within the EU that will not only help support the effective operation of telehealth services but it will also contribute to the closer integration of the health and social care workforces.

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- [1] European Commission “eHealth Action Plan 2012-2020 – Innovative Healthcare for the 21<sup>st</sup> Century” Staff Working Document SWD 413 Final, Brussels 2012.
- [2] European Commission “Action Plan for EU Health Workforce” Staff Working Document SWD 93 Final, Brussels 2012
- [3] European Commission “DIGICOMP: A Framework for Developing and Understanding Digital Competence in Europe” Joint Research Centre 2013



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# Telemedicine Evaluation and Assessment in Mpumalanga, Department of Health

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**Abstract:** Few telemedicine and eHealth implementations survive the initial pilot implementation and the return on investment on capital expenditure seldom materialises. A reason for this in South Africa is that insufficient analysis is made of need and eHealth readiness. **Objective:** The aim of this study was to develop a systems based tool to evaluate, assess and describe the state of current eHealth implementations and readiness in Mpumalanga Province for future planning purposes. **Methods:** A systems approach, using metrics around the elements People, Processes and Technology, supplemented with (physical) Infrastructure, was used to measure the appropriateness of telemedicine sites and implementations. These elements were sub-divided into critical telemedicine related metrics. Using balanced Score Card principles, each metric was scored between 1 (poor) and 10 (good). This enabled a review of current performance. The Telemedicine Evaluation and Assessment Tool for Health (TEATH) and a Telemedicine Project Prioritisation module were developed, allowing comparison and graphical representation of data. **Results:** TEATH allows easy identification of weak and lagging telemedicine implementations supporting evidence-informed project prioritisation. Project plans can then be developed and costed to improve weak implementations and turn-around failing projects. **Conclusion:** TEATH provides a simple, generic tool to evaluate planned and existing telemedicine sites and implementations and the soft (non-technology) side of telemedicine. It provides guidance to health planners and should minimise wasteful expenditure which will facilitate implementation and uptake of telemedicine in South Africa.

## Introduction

The literature is replete with statements regarding performing a readiness assessment and needs assessment prior to implementation of any e-Health solution, and formative or summative evaluations during and after implementation [1]. For various reasons, such approaches are very seldom taken. A more likely scenario is that a new policy (Minister) or decision-maker (hospital manager) finds themselves inheriting a setting where a

number of disparate e-health activities have been initiated with unclear rationale or history, and are now perceived to be poor ‘opportunity costs’ [2]. It becomes their responsibility to determine what is successful, and what should be focused upon. In such circumstances it is necessary to re-assess and perform ‘mid-course correction’, re-allocating already scarce resources to successful or ‘needed’ initiatives. Currently, no tool exists by which to perform such a ‘situational analysis’ for e-Health.

This study fills this gap by utilizing expert opinion and experience to develop a minimum set of metrics against which to assess current e-Health initiatives. The tool was developed to provide the Department of Health in Mpumalanga Province in South Africa with information of their current eHealth initiatives to be used for planning and resource allocation. The province has a population of 3 million people, 66% of whom live in rural areas and who are served by 23 doctors per 100,000 people. There have been several attempts to establish telemedicine in the province. Of 13 sites where telemedicine has been planned and implemented only two telemedicine sites were functional and that 14 telemedicine units installed at clinics were not yet operational because of incomplete installation and poor network coverage.

### Method and Results

The Telemedicine Evaluation and Assessment Tool for Health (TEATH) was specifically developed for quantitatively analysis of telemedicine systems after implementation. It is based on the principle that telemedicine is a system, a group of interrelated or interacting elements forming a unified whole, that should be evaluated using a systems approach [3]. Evaluation of implementation focuses on the quality and usefulness of the implementation whilst assessment focuses on how it was done.

TEATH looks at four areas, people, processes, technology and infrastructure, each with three subgroups, which are scored from 1 to 10 by users. The metrics are not equally weighted with for example connectivity (available bandwidth) given a higher weighting as provision of synchronous telemedicine services are bandwidth dependent. The information derived during on site visits and completion of questionnaires by relevant staff is entered into a spreadsheet and is presented as a balanced score card for performance management, the TEATH tool. The subgroups, scoring and weighting were determined through discussion and consensus with local telemedicine users.

The tool establishes a baseline which can be used for planning and subsequent measurement of improvement. An example is given of the total

scores for each of the 12 metrics measured at the three hospitals with teleradiology equipment. (Table 1)

Table 1. TEATH scores for the 12 metrics recorded at the three teleradiology hospitals

Hospital	People			Processes			Tech- Nology			Infrastructure			Score
	Attitude	User Training	Personnel	Scheduling And Set Up	Awareness And Use	Appropriate Diagnostic	Bandwidth	Rate Clarity	Tech Support	Appropriate Equipment	Furnishing		
	12 %	8%	6%	6%	16%	6%	16%	6%	6%	6%	6%	6%	
RF	1	4	7	1	2	3	8	9	2	5	4	6	45
WB	2	1	2	2	0	0	8	9	2	0	0	5	29
T	3	3	5	2	2	2	8	8	7	8	7	7	51
<b>AVG</b>	<b>2</b>	<b>3.5</b>		<b>2</b>	<b>1</b>	<b>2</b>	<b>8</b>	<b>9</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>6</b>	<b>42</b>

TEATH has been extended to include a Telemedicine Project

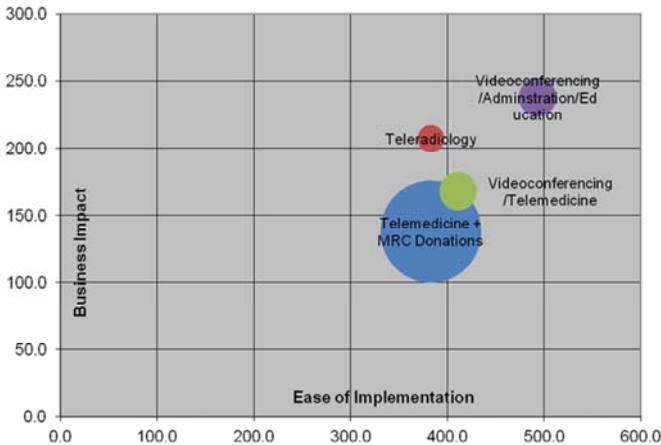


Figure 1. Bubble graph of business impact, ease of implementation and cost of four eHealth options in Mpumalanga Province

Prioritisation tool. This tool examines 5 issues related to business of patient impact: cost benefit after implementation; population impacted; improvement of patient satisfaction; practitioner productivity; and quality of care. It also examines 7 areas related to ease of implementation: availability of technology; availability of skills; ownership buy-in; support from management and key stakeholders; likelihood of end-user acceptance and use; time required to initiate and complete the project; and dependence on other projects.

Data entered into the telemedicine project prioritisation tool can be graphically depicted as a bubble graph reflecting the ease of implementation on the x axis and the business impact on the y axis. The size of the bubble reflects the implementation costs. (Fig 1) As can be seen in figure 1 while videoconferencing for administration and education will have the greatest business impact, teleradiology, while having a lower business impact will be cheaper to implement.

## Discussion

TEATH allows easy identification of weak and lagging telemedicine implementations supporting evidence-informed project prioritisation. Project plans can then be developed and costed to improve weak implementations and turn-around failing projects. It is a simple, generic tool to evaluate planned and existing telemedicine sites and implementations and the soft (non-technology) side of telemedicine. It provides guidance to health planners and will minimise wasteful expenditure and facilitate implementation and uptake of telemedicine. The Telemedicine Evaluation and Assessment Tool for Health (TEATH) was specifically developed for quantitative analysis of telemedicine systems after implementation. It is based on the principle that telemedicine is a system, a group of interrelated or interacting elements forming a unified whole, that should be evaluated using a systems approach. Evaluation of the implementation focuses on the quality and usefulness of the implementation whilst assessment focuses on how it was done. Further development will include linking the tool to department of health personnel and financial databases to improve

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# **eHealth Applications for Wellbeing and Personal Assistance**

# **Ariane: An Innovative Tool to Maintain Connectedness When In Hospital**

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***Abstract:* Hospitalization still involves physical and social isolation, even today. In many cases, patients experience a sort of quarantine, i.e. disconnection from their usual backgrounds, on top of physical pain. One of the crucial factors generating this feeling of loneliness is lack of communication. In this case the word communication includes contact with relatives, friends, helpers, daily news (radio, TV, etc.) as well as contact with more distant relatives thanks to modern communication tools. The goal is to identify the most relevant tool, combining essential functionalities, so that patients would maintain social links and thus “age well”.**

## Hospital Room Phones: Technically Obsolete and Inadequate

Paradoxically, the standard phone in a hospital room, whereas it is supposed to help keep in touch, actually often proves to be more annoying than helpful. It is hardly convenient, intrusive and may not meet patients' needs. This is precisely what the community hospital of Le Dorat in Haut Limousin noticed, particularly in the case of residents confined to bed. A study was carried out within different hospital units and patients were surveyed, which revealed serious complaints concerning technical features and usability of the standard phone. The object itself has many flaws, the ringtone is either too loud or too low, the keys are tiny or difficult to decipher, the phone is often difficult to grab or not hung up properly, the base is unstable.

## Hospitalization: The Loss of Familiar Landmarks

Analyzing the deeper reasons for rejecting the device reveals that not using the phone or even outright aversion for the phone, are actually not directly related to the device itself. This dismissal only aptly reveals patients' practical and social disconnectedness. When persons are hospitalized they tend to lose their landmarks, such as everyday life routine, familiar places and social links. Being deprived of a social role involves to various degrees, losing one's identity. Specifically, the patient in an

unfamiliar environment is no longer in a position to manage his daily life or timetable. Figure 1 shows what essential landmarks an isolated person will lose in terms of time, space, relations and freedom.

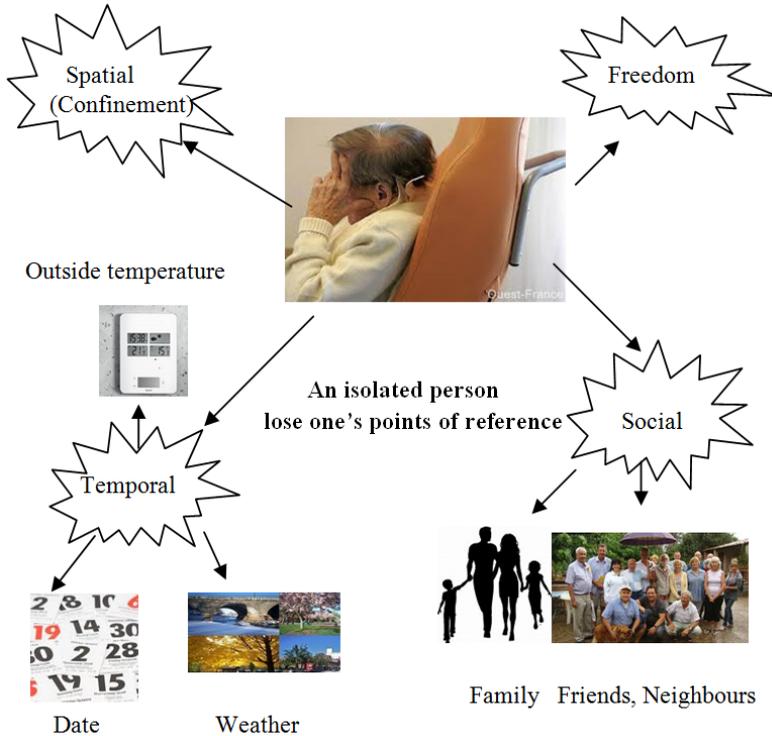


Fig. 1: An isolated person's loss of daily landmarks

### Ariane: The Concept

The goal of the Ariane project is to empower patients by enabling them to actively manage their daily lives, and by providing them with familiar temporal human and cultural landmarks while in hospital. The concept consists in a portal of activities and communication resources customized so as to match the patient's own specific profile. It offers a range of varied activities defined according to the user's daily routine. When a patient checks in, the first step for the staff consists in collecting as much relevant information as possible about the person thanks to a questionnaire. All medical and personal data are also recorded. The system, relying on the

established profile, then provides the patient with a choice of activities, so that he/she would be able to insert her own landmarks and to seamlessly maintain a continuity of identity and activities during hospitalization.

### The tool

The first version of the tool consists of an all-in-one tactile computer meant to be user-friendly for persons who are not familiar with ICT, as it is similar to a television set and relies on a natural gestural interface. Thanks to a choice of applications, the patient quickly and intuitively learns how to settle again within a familiar environment and how to handle personal information. Interface display can be adjusted or enlarged to enable the resident to navigate comfortably regardless of the pathologies or injuries that led to hospitalization. The set of activities offered to the patient is defined in agreement with both the patient's profile and medical staff (Table 1).

<b>Activities</b>	<b>Comment</b>	<b>Reason why</b>	<b>Landmarks</b>
Social networks	Via Skype, Facebook or Twitter as well as mail	To maintain social contact with relatives (family, friends, neighbours, healthcare staff). To share messages, photos, documents.	Social landmarks
<b>Activities</b>	<b>Comment</b>	<b>Reason why</b>	<b>Landmarks</b>
Daily activities	Thanks to agenda and weather apps	To keep temporal landmarks with notifications of appointments and weather forecast	Temporal landmarks
For fun	Cognitive games	To maintain and stimulate memory and mood	Intellectual capabilities

Tab. 1: Some examples of activities offered

Moreover, services dedicated to healthcare and administrative staff will be implemented into software architecture thanks to semantic intelligence tools [1] for example. They would improve management of healthcare protocols, follow up with the GP, administrative procedures via patient file and connectedness with relatives. It is possible to envisage using the same tools when the patient returns home, by seamlessly integrating applications dedicated to home care follow up into the portal [2].

## Conclusion

Thanks to the Ariane project, the patient no longer has to adjust to the hospital; it is the hospital which adjusts to the patient. Medical staff can monitor and easily analyse patient progress with regard to abilities and intellectual autonomy. Any new activity requested by the person can easily be added. For example, a new cognitive game or a new interface to control bedroom shutters. Our Ariane project is ground-breaking because its interface focuses on accessibility for elderly persons and customized applications meant for senior citizens. Ariane will not make patients feel uneasy with new technologies. It will be necessary to train healthcare staff so that they would adequately familiarize patient with the tool, thus leading to comfortable efficient usage. To begin with, an all-in-one Ariane computer should be made available to all hospital residents in an open space, with a view to familiarizing them with it, just like they became familiar with the WiFi. Then the project will spread by having Ariane set up in residents' rooms as soon as they wish to.

## Acknowledgment

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# Continuing a Journey towards Implementation of Innovative mHealth in Health Services

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***Abstract:* This continuing 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. Steps 1-4 were reported at Med-e-Tel 2013, and this paper reports steps 5-8. Funding and approval to recruit members of the public was obtained. A feasibility study of a weight loss mHealth intervention in diabetes was undertaken in the UK. The results were analysed, and it was concluded that a full pilot was feasible. Findings are being disseminated and built upon. The steps required in trialing an effective intervention are not necessarily sequential. Revisiting steps and tracking the changes in available intervention technology is essential.**

## Introduction

The National Institute of Health (NIHR) UK ‘Collaboration for Leadership in Applied Health Research and Care’ (CLAHRC) supports developing new knowledge to implement research to improve health and wellbeing. The Yorkshire and Humber CLAHRC [2] uses telehealth or mHealth technology to support the self-management of long term conditions. Obesity and diabetes are well-known global and local challenges to people’s health, and health services [3-4]. The authors are collaborating on a project looking at the use of mobile digital devices to help support weight loss amongst overweight or obese people with diabetes [5] building on a systematic review for weight loss employing mobile digital technology [6].

At Med-e-Tel 2013 the authors reported steps 1 - 4 of a case study observation of a journey [7] 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 (Table 1). Steps 1-4

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

included finding an intervention of interest, examining details of the ‘best’, forming a project team and developing a study protocol. Steps 5 – 8 were then the natural follow on steps. However Table 1 was always acknowledged as a simplification.

It is common practice in health technology assessment that having obtained independent scientific review of the proposed protocol this needs to be tested in a feasibility study. If the latter demonstrates promise then a single site and randomised controlled trial would follow. In turn further positive results would lead to a multi-site randomised controlled trial. It should be noted that each of these three sequential studies would each traverse the simplified steps 5-8 in Table 1. Furthermore it can be forecast that the randomised controlled trials would also each require returning to step 4, before repeating step 5, to make any necessary revisions to the protocol.

In 2013 steps 5-8 for the feasibility study have been travelled as well as following changes in available intervention technology [8-9]. These will be discussed in the paper.

### Continuing Steps in the Journey

Step 5 involved obtaining funding from CLAHRC South Yorkshire; independent scientific review of the protocol; and ethical and research governance approvals to recruit overweight and obese adult members of the public with diabetes to the feasibility study. Step 6 involved conducting the feasibility study of a commercially available CE marked medical device - offering diet and physical activity motivation support: Aipermotion 500. This device had previously been shown to be effective in a (n=70) weight loss trial in obese people with diabetes in Germany [10]. Our study investigated whether the trial design was appropriate and the device was acceptable to UK citizens to aid weight loss and/or HbA1c reduction in the UK. For the purposes of testing the mixed methods protocol, incorporating

a deliberately small number randomised controlled trial the feasibility study still required collection of quantitative data such as weight, and HbA1c as well as participants' views through focus groups and interviews.

Step 7 involved analysing the quantitative and qualitative results, which found the mHealth approach was acceptable to UK overweight people with diabetes. It suggested that the device was a beneficial aid to clinical weight loss/HbA1c reduction (as judged by the clinicians), which resulted in identifying changes to the protocol and resources needed to ensure that a full pilot would be a success. The latter highlighted the benefits of bringing a psychological perspective to the research and the intervention. Behaviour change psychologists were added to the team of academics at the University of Sheffield, and the clinicians at Sheffield Teaching Hospital NHS Foundation Trust to increase expertise and confidence in going forward to a pilot. Both these additions thus mean, referring to Table 1, the process has returned to step 3.

Dissemination for Step 8 has been occurring [8, 10], including this paper. The process of building upon findings is on-going.

#### Following Changes in Available Intervention Technology

While the clinical expectation for research teams to gather sufficient evidence is understandable, this particular journey highlights an increasingly recognised problem. The slow pace of technology adoption by the health service and developing acceptable evidence, versus, the rapid advancement and unpredictability of availability of digital technology. Indeed the Aipermon device is no longer commercially available and the authors were faced with the option of either revisiting step 1 or designing a whole new device – which is a step not even shown in Table 1.

In order to build upon latest technologies, published evidence and the findings, an open approach is being adopted. Having identified effective elements of the device used so far, matching or improved innovative products in the market place will be sought (effectively step 2 in Table 1). Meanwhile, a new device will be developed through user centred design processes with the intent to enter directly to step 3.

#### Summary

The case study highlights the importance of clinical/academic collaboration in undertaking a successful feasibility study to test a mHealth intervention within a UK healthcare setting, and also the challenges of using commercial devices.

## 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 <http://clahrc-sy.nihr.ac.uk/resources-clahrc-yorkshire-humber.html>

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**Ruth Bacigalupo PhD:** Research Fellow at the University of Sheffield with 20 years experience in the field of health informatics. Ruth is particularly interested in how mobile technology interventions can help in weight reduction and maintenance and how pioneering technologies can impact on the daily living of older people and be integrated into policy and practice.



**Peter Cudd:** 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.



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# Google Hat: Treat Yourself to a Solid as Rock Butler

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***Abstract:* With the evolution of technology and the development of many mobile applications, the concepts of support, monitoring, guiding and safety of persons are democratized, and affect more or less strong on people mobility. With the multitude of applications that emerged, presentations, features, purposes and usages are many. The possibility of setting scenario and connection between them is a complex and burdensome exercise. In this context, we have worked in terms of features and use, transcending the applications themselves.**

## Google Applications

Google Apps has distinguished themselves from other existing apps particularly in their specificity to respond to a context of mobility applications. With Google, there are links at the applications interfaces and user profile levels as it can be seen with Google Drive, Google Keep, Google Maps, Google Calendar, etc., that is to say a kind of "bricking" built with a single account for different and various applications. However, these links still seem greatly underutilized, because they are unknown and complex, making them difficultly accessible and identifiable.

The objective here is to grow these links to their paroxysms to create a secure environment, personalized for everyone, whether in terms of functionality, degree of interaction, guidance and interface. We study the parameters for setting up the possibility of an application combination within a single interface in order to compensate for the loss of autonomy, a ubiquitous real-time assistance framework. The proposed interface will overcome information overload increasingly present in this type of application and increase the ergonomic appropriation [1] of such a tool.

## The Google Hat Concept

Google applications are already built today around one of the most developed intercommunication and interoperation scheme on the mobile environments market. Our concept, Google Hat, exploit those relationships

in order to make accessible for people with loss of autonomy, who need mobility, the enhanced benefits of Google services. The "hat" application simplifies access through a single intuitive interface to the functionality of popular applications from Google, but also allows an almost complete interaction with an environmental context by the use of geolocation and time landmarks. As shown in Figure 1, the user is at the top of the hierarchical Google Hat pyramid. The only direct interaction of the user is made through his butler who manages for him the application package and provides contextually relevant services at his disposal.

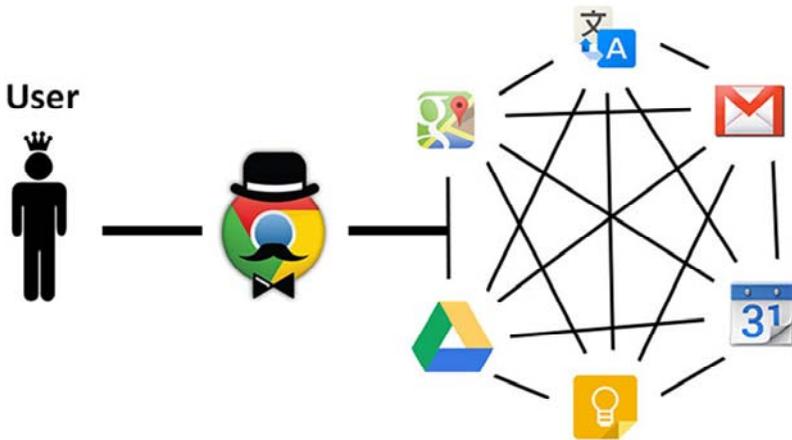


Fig. 1: Principle of Google Hat hierarchy

The user does not have to juggle from one application to another depending on the function he wishes to apply, since the “hat” covers the most relevant features to the user in question and has a kind of decision-making and advising power related to the context of the person, temporally or geographically. Therefore, each Google Hat becomes personal and customizable.

Applications that are returned to the customs for a large part of the population yet seem obscure to others. Google Hat then can debunk these tools by putting forward itself as a provider of contextual services rather than a toolbox which is necessary to know the operating procedures. Contextuality and approach by functionality meeting real time needs replaces with benefit, a connected tool hosting applications which benefits and usefulness are not always immediately grabbed temporally and geographically.

In addition, it is important to note that effective contextual support does not mean neither unwanted proactive nor invasive/submersive interaction. Google Hat is above all non-intrusive. It guides and assists the user without disrupting his daily activities business by adapting to the context and the degree of need of the resources it can provide. All applications are linked between each other, ready to flow information, need or request to answer in the best possible way.

The project concept is the combination of the hat, benevolent and protective, with the Google applications, which, like bricks, can be integrated or not in the application pack depending on the objective use and usage. These services are thus implied, offered, at disposal, on a tray. Once the pack has been correctly set, the user has access only to the upper layer: the hat. In the manner of a personal butler, Google Hat submits and fits the profile of the user, while respecting his privacy.

### Google Hat at Work

Let's consider the example of a person with mild cognitive disorders, of the dementia type. He/she wishes to maintain his/her mobility capability. If, during a walk, he/she sometimes loses, the Google Hat interface offers an emergency button, previously identified, and that he/she knows how to use. If he/she activates this option, a window opens and the butler offers his help via two ways as shown in figure 2: either go home (represented by a picture of his/her house) and then guide through GPS assistance, or contact caregiver (identified by his portrait). If he/she chooses to go back home then Google Hat tells him/her the way back by implicitly using Google Maps services. If, at the contrary, he/she chooses the "caregiver option", this caregiver will be notified of the situation and will be able to provide direct assistance, making use again of Google Maps, Google Mail or SMS. For medical follow-up, his/her doctor will be informed of the number of times he/she has been lost via a shared file on Google Drive which is incremented for each action achieved.

Google Hat will propose several algorithms of the same type, which will be parameterized but the caregivers or the users themselves.

### The Future of Google Hat

In a more advanced version, Google Hat will be able at term to fit needs of lost and disoriented people, and adapt to their physical or cognitive disabilities. Whether on a permanent or ad hoc assistance, Google Hat will be set according to the user to maintain in the best way his capabilities of autonomy and mobility.

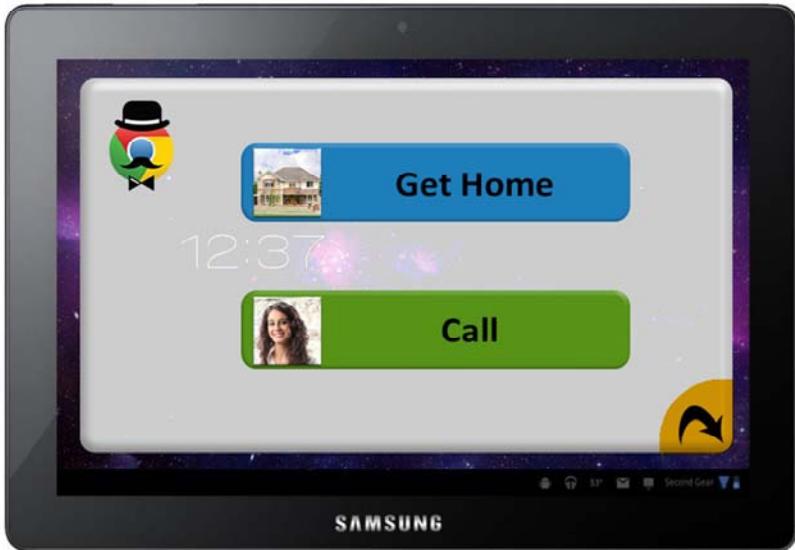


Fig. 2: Example of personalized Google Hat interface

The interface thus created can be managed by caregivers or family, and be contextually and naturally present to the user. Google Hat will become the perfect butler, who will answer all the needs of the user without being intrusive in his everyday life.

#### Acknowledgment

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# Healthy Eating QR Codes - A Mobile-Based Technology for Wise Management of Eating Habits

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Smartphone platforms have introduced to make management of daily diet easier. These apps help the users to add the consumed foods in a day and then to add their contents to reach the whole daily calorie and nutrient received. These Apps have tools to collect data of the "nutrition fact" tables of the food added by users, for example MyNetDairy app for iOs. In this app the user can select the food from the list to add it to the list of daily consumed foods or can use smartphone camera and a Barcode scanner module to scan the barcode printed on the food package and connects to an online database to extract the nutritional content and add to the user's daily file. These apps in various studies have been shown effective in weight reduction, fitness and reaching the optimum nutrition profile by tight monitoring the detail of consumed nutritional goods. This is especially in diabetic, or those due to other metabolic illnesses need a tighter control of consumed materials to avoid subsequent complications. But the only limitation of such apps is need to internet connection to connect to the database and also need availability of food barcode in the database related to the app.

QR codes are a quadrant barcodes first designed and used in Japan for automobile industry and are so called 3D barcodes as they are two dimensional (as a quadrant) and indeed the normal line barcodes can store not just the numeral, but also any string within them. These codes are readable by cameras of Smartphone with the special apps. In a research project we used PHP programming, US food and agriculture database of food "nutrition facts" of more than 8000 records and designed a database of QR codes for all of these foods. This equipped to a search engine with QR code generator module that as soon as a food is selected, the QR code of it beside its nutritional fact table in a standalone dynamic webpage is displayed. We registered a new format of QR code in US trademark and patent database (application no. 4993) so called "Healthy eating QR code"

that has two types of online and offline. The online format is a link to a particular webpage showing a nutrition fact table of a certain food.

Keywords: Healthy eating, QR codes, smartphone, nutrition

# **Inter'Actions: Promoting Efficiency and Societal Wellness in a Rural Community**

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***Abstract:* In terms of territory planning, the development of new technologies and the possibility of broadband internet access have provided an opportunity for economic development that can avoid heavy industrial infrastructure to benefit the welfare of territories and its inhabitants. The simple philosophy, but so essential today, is to restore individuals and services, regardless of their cultural, economic and social conditions, in the position of rewarding and valued actors, especially with respect to cultural intellectual, economic and social values. The goal is, through these reconstructions, to optimize and to make profit with economic activities and to develop them in a modern model of society.**

## **Objectives of Welfare of Territories: A Complex Environment to Restructure**

Longer life is today a parameter of concern for the whole society. Demographically, socially, economically, great challenges are emerging and require necessary immediate responses. The Inter'Actions project aims to generate participatory cultural activity, recreate social links including intergenerational collaboration, economic activity and business for the local trade market, deployment of information and communication technology, and in a final step to facilitate the development and testing of telehealth and e-health solutions. The basic concept considers all solutions in the service of society and individuals, especially in rural areas, involve the creation of win-win "intersections" between several target audiences that are:

- The various ages generations, especially learners from universities, individuals in insertion and / or rehabilitation, active people, people who are no longer active but participate in community life, the institutionalized elderly and who could benefit from this cultural and social exchange network;

- Local traders services who, until now, had only referred potential towards people with reduced mobility capabilities (so rather elderly and / or disabled) and could expect an activity extension by solutions of e-commerce or e-services in the direction of learning generations (especially to foreign students in academic institutions), disadvantaged people and communities, but also the general public and finally organizations facilities for dependent elderly, in a unique global approach;
- The network equipment manufacturers who can provide a reliable, secure and high-speed communication architecture support to the heart of exchange and services networks in the territories;
- The designers of web solutions and / or communications services and social networks that are the backbone of the technical part;
- The medico-social and socio-economic coordinators whose results and performance objectives could be optimized in practices and costs through the tools put in place;
- Care services at home or in institutions, including through systems of teleconsultations, teleprevention and teleassistance, brought up to the place of life of people, and that would optimize nursing and caregivers human resources even to better structure them. In this context, telehealth experimentations could rely on the technical support and the general philosophy of this territory project;
- The territories themselves to get a label of High Quality Region combining quality of life and social and technological innovation in a territory-scale project [2-3] which aims would be to strengthen, through economic development, values of solidarity, equal opportunities and social cohesion, and to think the economic and societal future of the territories in helping the emergence of tomorrow's businesses.

#### Overall Methodology and Planned Actions

To achieve these ambitious goals, various actions have already been initiated. The main one that conditions all the project process has been to bring together stakeholders and potential actors, first in a targeted manner and then transversely, with the aim, in a first phase to identify all of them and get them to brainstorm on how to bring added-value. This first connection has greatly helped to establish various actions, from people to people, people to services, services to individuals, but also services to services to enhance the effectiveness of each action to be put in place on the territory. Figure 1 summarizes the triptych “user” / “services” (health care, technology, etc.) / ”meeting places” and bases its performance targets on

shares of information gathering, knowledge transfer and implementation of responses within the context of a broad participatory process.

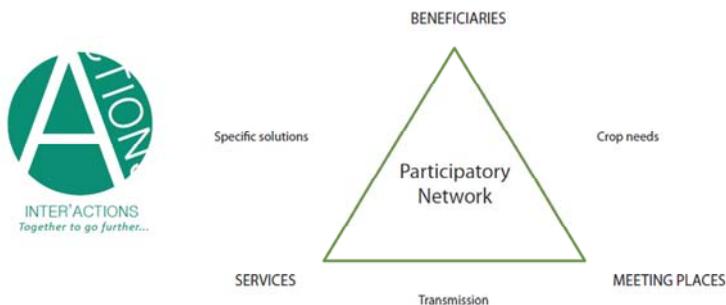


Fig 1: Logo of the project and participatory network scheme

Thus, actions to implement are as follows:

- Creation of a student association, where the expression place will be a dedicated website or internet platform enabling interactive exchanges (social network type services), project management, link with the local trade and local services, general information on the university campus, etc. A possible platform model is that used by the Horéka network [1].
- Organization of conferences and public debates dealing with multiple topics that could be of interest for all generations, in a participatory way with the support of newspapers and local radios;
- Active and collaborative identification of needs and expectations of users (e.g. gathering information on the expectations of seniors towards assistive and home support technologies in order to improve their impact). With the participation of users associations, focused questionnaires and focus groups will be created to emerge technical or societal recommendations and innovative projects.
- Organization of an efficient stronger communication through the systematic involvement of local media in all the actions. The objective is to promote actions by informing and attracting new actors and stakeholders that could benefit from the network.
- Implementation of effective interactive exchange places.

Encouraging Initial Results

Inter'Actions is a project that is at the crossroads of several fields of skills, sectors, local stakeholders and potential interests which makes it a complex project. This is a long term project that will grow and evolve.

The first conclusions we can draw from the realized actions (or envisaged following discussion meetings) are quite encouraging; indeed, the meetings held were felt by the actors as a useful tool to optimize, under every possible angles, the welfare and well-being axes in its most transverse dimensions whether social, societal, economic and even medico-social. A strong desire to get involved and make things change and move has upraised and will allow in phase 2 of the project, to put in action for the end-users, the proposed schemes and procedure modes.

The need to establish places of exchange is the second key point that emerged from our conclusions. An interesting tool would be a collaborative platform of supply and demand, which would allow linking via an internet social network. The provision of physical places is also important to discuss and reinforce the emergence of innovative ideas, discussed, shared, tested and adopted by the larger number of actors and stakeholders.

### Acknowledgment

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- [3] <http://www.autonom-lab.com/english/>

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# Mobil-e-Desk - A Mobile Solution for More Efficient Health Care at Home

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***Abstract:*** As the population keeps ageing, more and more persons lose their ability to move so as to access health care. The mission of health care professionals consists in visiting people whose mobility has declined, which may entail long trips. Many tools need to be carried along, to perform medical administrative and communication tasks. The electrical autonomy of some of these devices then proves to be an issue. This article introduces our concept of luggage which offers extended mobility by relieving health professionals from worrying about autonomy.

## The Context of Health Care Professionals Today

Today health professionals perform a large amount of the medical care duties at their patients' homes, mostly because ageing involves reduced mobility. In rural areas in particular, the carer has to be constantly mobile, while distances between patients are notably longer. Mobility makes it imperative to carry along many medical devices, but also more and more documents and tools used for administrative and communication tasks.

In this regard, new technologies should be able to bring more comfort and efficiency insofar as they can relieve the nursing staff from a number of constraints by assisting them (with automated keyboarding of medical and administrative data, by validating prescriptions, automating transmissions, etc.). The use of ICT and digital devices also improves the quality of follow up, thus preventing potentially serious care mistakes from occurring. However, the wide range of tools used (medical devices, digital devices and computers, etc.) can end up making the whole process more complex and penalising than beneficial. Stumbling block can be as varied as connectivity or interoperability, but also operation and battery life over a whole workday. Many digital apparatuses actually have a relatively limited autonomy, and sometimes none at all, which may require to recharge some devices on a daily basis or even to plug some in permanently so as to enjoy optimal operating conditions.

## Mobil-e-Desk: The Concept

Our concept aims at supplying mobile health staff with the same tools as those they would use back at the practice, while providing usability and comfort on par with sedentary conditions. The Mobil-e-Desk, as described in figure 1, is comparable to an all-in-one small-scale mobile office.

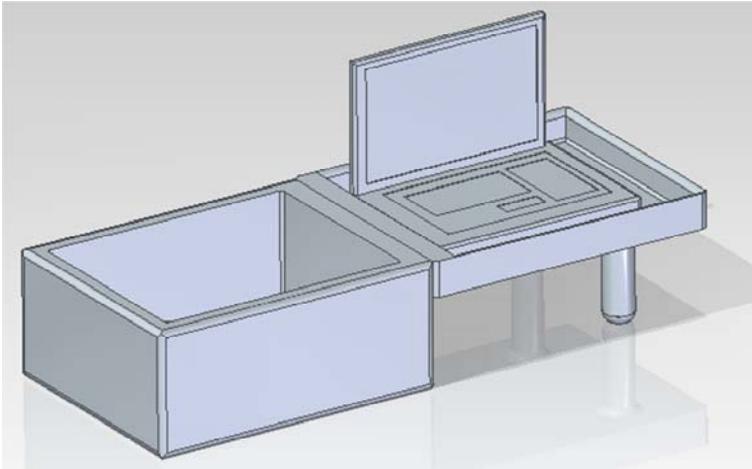


Fig. 1: Representation of the Mobil-e-desk open

Due to its innovative design and convenient functionalities, it enables the practitioner to optimize all patient-related tasks: adapted multiple wiring, modular power supply to operate or recharge various devices (for medical apparatuses, communication, data processing, etc.). The luggage offers many available storage compartments (for medical devices, documents, camera, peripheral devices, etc.) including dedicated bays meant for a 3G modem for example.

### Goals and Suggested Approach

Keeping devices in working order and ready to use, conveniently and at any time, are essential for practitioners to be more efficient all along their workdays. It enables to save time on logistics and organisational tasks, by reducing them as much as possible (a single wire is required to recharge all the included devices for example). Saving time on logistics also means that it will be much easier to perform administrative tasks (keyboarding medical documents, teletransmissions, etc.), given that those tasks imply using

information and communication technologies which involve high electric consumption. The time saved is bound to benefit patients and medical staff equally. It will bring about better care-giving quality for the first and less stress over a day's work for the last.

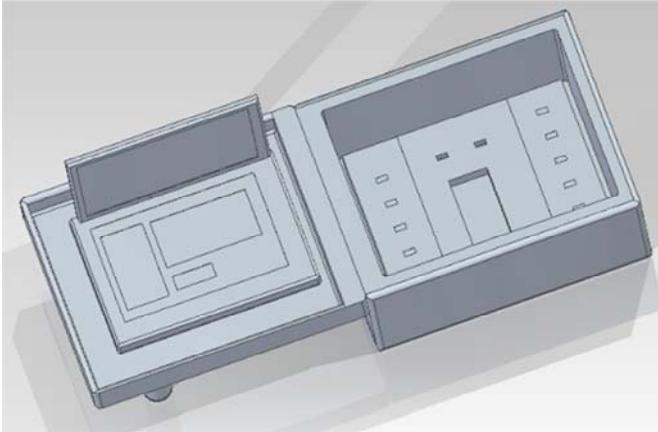


Fig. 2: Design representing the power module fitted in the bottom of the luggage

One of the innovative features of the product is that the mobile desk can be conveniently plugged in and recharged thanks to an electric power plug or a vehicle power adapter. It assures the health professional that all devices will be up and running anywhere anytime. As shown in figure 2, the power bay is composed of optional blocks depending on the number of devices. The main block is reserved for the power supply (electric power plug or car power adapter). It is also possible to plug in a laptop if needed. The other blocks, or secondary blocks, provide extra plugs. They can be connected to the main one so as to supply more optional devices. It is possible to plug devices directly into the main block (like a docking station), or alternatively to leave them in their own storage compartments while extracting a wire from the base to supply the desk without moving anything.

Moreover, Mobil-e-Desk is innovative in other ways. Most devices can be used and accessed without being extracted from the luggage. Sockets and docking bays can hold a choice of peripheral devices simultaneously (for electric supply, recharge, data transmission and storage). Besides the luggage as a whole is customizable and can evolve over time. It is actually compatible with most digital devices (laptops, smart card readers, etc.).

Thus, each practitioner can use most of his usual devices without having to worry about compatibility. On the other hand, Mobil-e-Desk is permeable to mobile signals, so that a 3G modem can be fitted in, for health professionals to be accessible anywhere anytime. This feature can potentially improve patient follow up, particularly by giving access to patients' medical data and health record in real time. Typically, adding photos to patients' health records will be much easier thanks to 3G connection, which in turn will facilitate information sharing between diverse healthcare staff (in case of wounds or lesions for example).

### Perspectives

The method used makes it possible to consider transferring the Mobil-e-desk solution to other situations or professional requirements, as long as mobility involves added constraints while performing professional duties. Moreover, the emergence of 3-D printing technologies offers an opportunity to even consider producing custom-made modules to meet the specific needs of each user. For instance, it would be interesting to offer healthcare professionals the opportunity to have modules made to order so as to match ideally their existing devices. Customizing the organisation of compartments within the luggage to match each user's working habits would allow envisioning addressing the needs of a large number of professionals.

### Acknowledgment

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# User Involvement and Adaptability of the Systems

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## Introduction

Based on our experience from previous projects and development of applications for elderly and disabled people we found out that the most important issue in assistive technologies and ambient assistive living is active involvement of potential users. In case of long-term monitoring the possibility of application of adaptive systems should be considered. The systems can be personalized because they learn from the data of a particular person. The idea is to recognize changes of health state and cognitive abilities of the potential users. To summarize the 'gaps' from our point of view, the following issues are important: higher involvement of potential users in the development process; education of the users – showing them that technology can help them and they need not fear of technology; harmonizing technological solutions with legal and ethical regulations.

In the paper we will try to address some of the technological and psychological issues that must be solved in the future. The aim is that the lay users will be willing to use the technology, will accept it and it will not cause them any problems.

## Basic Requirements on the Solutions

If we plan to offer and test new technological solutions for improving quality of life of seniors and challenged persons, the solution should be very low cost and easy to use; it should provide entertainment and health care functionalities, support their independence when living on their own at their homes with tele-assistance, e.g. of local public services. The solution may combine tele-medicine, tele-assistance, tele-entertainment and tele-company into a federated internet based system usually intended for 3 very different and complementary groups of users: the customers (elderly/handicapped persons who need some sort of support), their care givers (e.g. organized in public or non-for-profit services) and health professionals (medical doctors and nurses). Each of these groups requires/ensures specific type of services and consequently the developed system should provide them by group specific access rights. The designers and developers have to have in mind that the design must be user centered.

## User Interface to the Technology

Human-machine interaction represents one of the key issues. If the interface is poorly designed it can influence negatively the attitude of the users of the system even if the system otherwise performs well. The interface should try to copy, to a certain extent, constructive human-human interaction; it should be designed as practical and intuitive as possible.

One of the issues that must be reasonably solved is amount of data shown to the user and the form, in which the data are visualized. The information provided to non-expert users should be aggregated and presented in understandable way. Usually precise numbers do not have the proper expressive power for the lay users who better understand graphical form (e.g. trends, deviation from normal values). The user interfaces will also differ in dependence on the main functions of the system. For example, the recommendation and suggestion systems serve mainly for informing the users (clients) about their health status in form of several numbers and/or graphs. Decision support systems used by professionals provide more detailed information in relatively standardized way. Present interfaces of some decision-support systems are uncluttered and intuitive, the “data avalanche” of accurate but irrelevant information is suppressed, and the interaction is such that users can predict in advance the consequences of their actions (and undo those actions, if necessary). In both categories it is necessary to consider the function of interaction, i.e. control input by the user. This feature must be well designed, in particular in case of interfaces other than standard keyboard and mouse. The touchscreen has many advantages but also certain disadvantages. There is an ergonomic problem, namely stress on human fingers. Users having problems with fine motor control might have difficulties when controlling an application using a touchscreen. For example, writing a message on a soft keyboard for a person with multiple sclerosis or after a hand injury could be a problem. Thus, there should be always an option in setup to select another control mode.

It is often difficult to find optimal layout of the interface, optimal number of entries required from the user, optimal volume of information the system displays to the user, etc. The challenge is linked to familiarity and repetition of task: a task that is infrequently performed needs a system that supports the user though the activity; but one that is repetitive needs a shorthand. Since this may vary from user to user the system should offer certain personalization of the interface. The simplest way is to have a choice from pre-defined options (from full support to shorthand). Additional improvement can be reached if an adaptive component is included in the human-machine interface; learns from each interaction between the user and

the system, and adjusts so that it finds the optimal (or at least sub-optimal) interaction.

### User Involvement

Each of us is a personality with unique experience, background knowledge, emotional and psychological setup, acceptance and perception of other humans and also technology. Thus we will find high variation in attitude towards high tech systems. As we are so different, it is difficult to design a general system that is easily acceptable for everybody. Therefore a lot of research must be done in interaction with as large set of potential users as possible. These users must be selected from a large variety of population, i.e. city / village, healthy / motoric disabilities / visual impairment / hearing impairment / cognitive disorders – all on different levels, male / female, different age, different experience with technology (none/weak/medium/intensive).

The designer must obtain a thorough understanding of the users, in general there will be two large groups of users: care givers of all kinds and patients. Their requirements, abilities, environments, and problems can be very different. The greatest challenge for the designer is not solving the problem but fully understanding the problem. User evaluation is an essential tool for obtaining proper understanding. Technology developed for use by lay users must have such control or user interface that is easily accessible, usable and useful for its intended users. Therefore the user-centred design process must be used.

In the development phase it is highly advisable to use a tool known as the Virtual Usability Laboratory for software development (<http://openvulab.org>). Such a tool is designed to unobtrusively monitor users of web-based applications remotely. At the same time the tool allows querying users after their interaction with the application. After experiments when a large number of users have tested the application the usability data is collected and analyzed. This data contains, for example, browsing patterns, system invocations, user interactions. Similar approach is used in standard Usability Laboratory (<http://ulab.cz>) where tangible devices and tools are tested from all aspects of their design, i.e. functions, ease of use, ergonomics, safety, demands on cognitive and motoric abilities.

### Conclusion

This paper presents briefly several aspects of design and development of applications for elderly and disabled people. We tried to point out the importance of user involvement in the system and in particular user interface design. We mentioned the issue of interface control using different

tools and its relation with the skills and abilities of the users. Last but not least we briefly described utilization of usability laboratory.

### Acknowledgment

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# **eHealth Economics**

# Cost Reduction Using a Tele-ECG Method in Southern Brazil

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## Introduction

Underserved and geographically large countries, such as Brazil, tend to have very difficult access to specialized health services in the countryside. Small towns situated far away from those services, associated with a low health budget, make things worse. Telemedicine has proven to be an excellent tool of health promotion, demonstrating special importance in the scenario above. Its increasing use evidences the most diverse benefits it can offer: basic care to distant communities, early diagnosis, e-learning, specialized second-opinion, and others. Heart diseases, as one of the most common causes of medical emergency and the leading cause of death around the world, become an outstanding health problem in these regions. Cardiologic emergencies, such as myocardial infarction for example, need to be treated as soon as possible to improve survival odds. Therefore, diagnosis must be done *in loco* and as quickly as possible. Tele-electrocardiography offers a great opportunity in assisting this kind of diagnosis and guides the correct specialized treatment at a low cost [1]. Through this technology, myocardial infarction can be immediately recognized and therapy promptly started, reducing mortality rate [2]. However, unawareness and misinformation about the real economic benefit still limit its large-scale application.

## Objectives

This paper aims to: 1. Measure and compare costs of a conventional local electrocardiogram and of a digital tele-ECG system in remote and small towns. 2. Analyze the difference in waiting time for obtaining a report through both methods.

## Methods

This is a cross-sectional study conducted between September and December 2013, under the coordination of the Telecardiology Centre of the *Instituto de Cardiologia do Rio Grande do Sul* – Brazil. The last seven out of thirty eight participating cities were included in the study. First of all,

data from remote towns were obtained through a simple questionnaire applied to local health authorities, regarding the use of the conventional local electrocardiogram method – before installation of Tele-ECG Digital System. The following information was collected: number of exams, cost per exam, average waiting time for obtaining the report, need to travel for the exam (and distance), cost for displacement (if necessary). Emergencies and ordinary exams were required separately. The second step was to deploy the new system into these seven cities and train health care professionals, such as physicians, nurses and nurse technicians. Finally, after certifying all the units were working perfectly, we calculated the total cost to maintain the whole Tele-ECG Digital System running 24/7. The total amount was divided between the number of exams and a final price was reached and compared to those collected in the first step mentioned above.

### Results

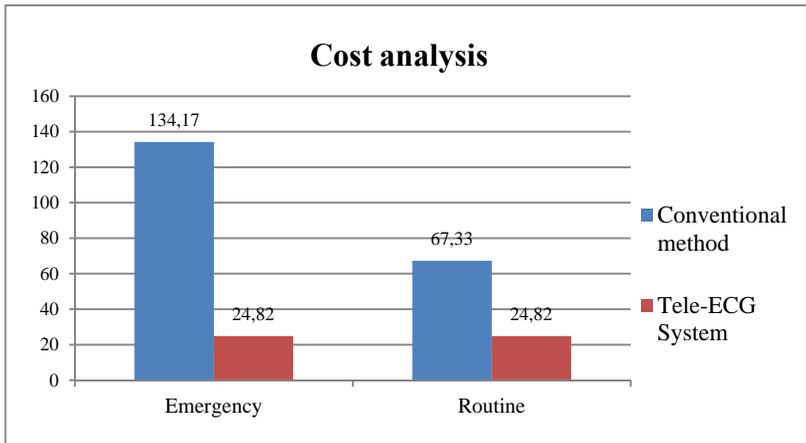
Having finished collecting the data, the amounts spent by the cities and the waiting time were calculated and are listed in Table 1. It was found that just two cities did not need to displace patients for exams, but none of them had access to emergency reports. Just 3 out of the seven towns had access to emergency ECG reports after displacement. Cost analysis demonstrated that the mean value for a conventional ECG was R\$ 67,33 for routine exams and R\$ 134,17 for emergencies. The results are shown in Table I.

Table I

<b>Towns</b>	<b>Routine ECG</b>	<b>Waiting time for routine report</b>	<b>Emergency ECG</b>
1	R\$ 56,20	less than 1 day	-
2	R\$ 30,00	15 days	-
3	R\$ 55,12	45 days	-
4	R\$ 52,50	4 days	R\$ 15,00
5	R\$ 77,50	12 days	R\$ 107,50
6	R\$ 20,00	20 days	-
7	R\$ 180,00	7 days	R\$ 280,00
<b>Average</b>	<b>R\$ 67,33</b>	<b>14,7 days</b>	<b>R\$ 134,17</b>

Table I: Results obtained from remote towns

Graphic I



Graphic I: Cost comparison between Conventional and Tele-ECG systems. The values are in Brazilian currency (Reais)

After implementing Digital Tele-ECG, the price of each exam dropped dramatically to the average of R\$ 24,82, independently whether it is an emergency or not. To calculate this price, the total amount spent to maintain the whole service working 24/7 was divided between the monthly number of exams.

Another great difference found in the study was regarding the waiting time for an ECG report. Using the conventional method, the mean time was around 14 days. Meanwhile, using the new method with Tele-ECG, the average felt abruptly to around an hour.

### Discussion

This research demonstrated that the digital tele-ECG method can contribute to the improvement of cardiac disease diagnoses, both in routine and emergency settings.

Implemented Tele-ECG Digital System proved to have lower monthly costs than conventional ECG in the countryside of the state, justifying a large scale implementation of public Telecardiology networks.

The reduction of waiting time to obtain the report of an ECG must speed up the diagnosis, consequently, beginning the treatment earlier. It also promotes an improvement in health assistance to those living in the

underserved areas and optimizes the use of scarce resources in the health sector.

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# Cost-Benefit Analysis of the e-Ambulance Project in Depopulated Areas in Japan

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## Introduction

Telemedicine or e-Health in some countries has already passed the experimental stage, and is entering the diffusion stage. In order for e-Health to be diffused further, there are still lots of obstacles such as the legal framework, economic foundations of implementations, and other regulations. In order to overcome these obstacles, one important requirement is to demonstrate its effectiveness, that is, e-Health contributes to efficiency of medical services and enhances wellness of people. One measure is to prove its cost-effectiveness by comparing its benefits and costs, but measuring concrete benefits in monetary terms is analytically difficult. CVM (Contingent valuation method) which has been recently widely adopted in the fields of health economics and environmental economics is one of methods to evaluate benefits in terms of WTP (Willingness to pay), which is the monetary amount that users want to pay for receiving the service [1-3].

This paper applies the Cost-benefit Analysis of the e-ambulance project in two cities in Japan: Aki City and Muroto City, Kochi Prefecture. Ambulances are equipped with ICT devices which transmit images of patient to remote hospitals. Two cities began the e-ambulance project in 2012. From there, it takes about approximately one hour to reach emergency hospitals located in Kouchi City, the prefectural capital. One of the merits of e-ambulance with the image transmitting system is that doctors in the accepting hospital can monitor the real time situation of a patient and prepare for necessary treatment when patient arrives. They thus save time and effort [4].

## Estimation of WTP

### *Surveys to Residents*

The surveys were conducted to residents in Ino Town on November 5, Aki City on November 18 and Muroto City on November 19, 2013. 55 residents were asked to answer questionnaire in Ino Town, 61 Aki City, and 48 Muroto City, totaling 164, and questions were pertaining to the following: (a) WTP; (b) effectiveness; (c) frequency of usage; and (d) user properties such as age, gender, income, education, and health condition. These are factors to affect WTP of residents.

### *Questionnaire*

The questionnaire related to WTP is based on the three-stage dichotomous method. We begin by asking whether they would be willing to pay monthly charges of 1,500 yen (US\$15). This initial value in the CVM method is important, since WTP tends to depend on the initial value. If their answer is “yes,” we then ask whether they would be willing to pay 2,500 yen (US\$25). If they reply “yes” again to 2,500 yen, their WTP is 2,500 yen. If “no,” then we lower the amount to 2,000 yen (US\$20). If they reply “yes” to 2,000 yen, then that is their WTP. If again their answer is “no,” we lower the amount further to 1,500 yen. In the first question of 1,500, if the reply is “no” to 1,500 yen, then we lower the amount to 500 yen, and so on. These series of questions are standard in the evaluation of public services, environments, and so on.

The distribution of WTP responded is as follows: more than 3,000 yen (5 answers), 2,500-2,999 yen (5), 2,000-2,499 yen (5), 1,500-1,999 yen (10), 1,000-1,499 yen (18), 500-999 yen (30), 250-499 yen (36), and 1-249 yen (11).

### *Estimation of Demand Function and WTP*

Based on the above WTP of each respondent, the probability of acceptance to amounts questioned is estimated and the number of residents who will agree to pay. The functional form of demand to be estimated is assumed to be logistic, namely the average WTP is calculated as the area under this demand function, which results in being 1,747 yen (US\$175) per resident per year.

## Cost-Benefit Analysis

### *Total Benefits*

WTP obtained above is for per resident per year, and it is multiplied by total number of residents, since all residents have a chance to use an ambulance. The population of each city is 18,657 in Aki City and 17,490 in Muroto City as of January 1, 2014, and thus total population is 36,147. Multiplying WTP 1,747 yen by total population 36,147 yields benefits per year 63,148,089 yen. The period of the project is three years. To obtain three years' worth of benefits, the present values of three years' benefits are calculated with a 4% discount rate, resulting in 175,243,694 yen.

### *Total Costs*

The total cost of the system consists of initial fixed and annual operating costs. The former is the items which have to pay at the first year of the project and covers that (i) ICT hardware equipment of the systems of transmitting and receiving images and related equipment, (ii) ambulance, (iii) costs related to software development and the purchase of software, (iv) installment, and (v) initial training cost. The initial costs amount to 231,459,775 yen. The latter is required annually and contains the followings: (vi) salaries of ambulance crew; (vii) maintenance fees which consist of those related to hardware and software; (viii) gasoline for ambulances; and (ix) communications charges. The annual operational costs amount to 9,990,328 yen and total operating costs over the period three years are 150,332,453 yen. Therefore total cost is 381,792,228 yen.

### *B/C Ratio*

The B/C ratio over the period of three years is 0.459, that is, benefits are about half of costs for the three year project. It can be concluded that benefits are far smaller than costs. However, from the view of local governments which implementing the project, that is, Aki and Muroto City, they only bear the costs of operating costs, since initial costs are borne by subsidies from the central government, and they can bear only operating costs. The B/C ratio calculated in this way is 1.166 over the period of three years indicating that for two local governments, benefits exceed its costs. Thus from the view of city, this project is favorable and worthy to implement.

Thus the B/C ratios obtain for e-ambulance are similar to those of telecare, which were operated by local governments and received subsidies for initial equipment from the central government. As a project, they are

less than 1, that is, benefits are smaller than costs, while for local governments it is worthy to implement since benefits to the users are larger than costs which were borne by local governments.

### Conclusions

In this paper, WTP in Aki, Kuroto and Ino Town is estimated by CVM and WTP obtained is 1,747 yen and the B/C ratio is 0.459. According to our rigorous analysis, we found that this value is similar to the ex-post WTPs estimated in our previous research [3, 5]. The effects of the e-ambulance in Aki and Muroto Cities are also similar to realized ones in the other regions. These results indicate that WTP can be an indicator of potential effectiveness of regional health policy.

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# Economic Aspect of Medication Adherence Using a Wireless Medication Reminder in French Health System

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**Abstract:** Orange and Isip harm (Astera group) have developed and tested with pharmacists a new application of wireless medication reminder using 2D barcodes. This application flashes the information of the prescription and automatically places medication reminders in the calendar of the smartphone.

The purpose of this paper is to analyze the potential economic aspect of medication adherence using a wireless medication reminder in French health system. Analysis is made in terms of cost and benefits for the health system.

## *Introduction to Non-Adherence Consequences*

Non-adherence is generally considered as the failure to take medications on time, in the prescribed dose, and by the correct patient.

The incidence of non-adherence has been widely studied at countries level and a common observation is that about 50% of all the millions of annual prescriptions are not taken as prescribed.

In the world, the overall cost of non-adherence is estimated to \$390 to \$500 Billion (€375 Billion) each year [1].

In Europe, the consequences are approximately 200,000 premature deaths and an overall cost estimated to €125 Billion each year [2]. In USA, the consequences are approximately 125,000 premature deaths and an overall cost estimated to €158 Billion each year [3]. In France, the consequences are approximately 8,000 premature deaths and overall cost estimated to €19 Billion each year [4].

## *What Are The Benefits of Medication Adherence?*

The benefits of medication adherence, and in particular avoidable costs, have been widely reported through the literature. Indeed, studies report many ways to get a better use of drugs like medication compliance, prevention of iatrogenic effects, efficient and timely medicine use,

prevention of misuse and overuse (especially of antibiotics), prevention of medication errors, optimized use of generic drugs, management of polypharmacy (particularly among the elderly, chronic...) and others (professional advice, training ...).

In Figure 1 below, an international study has identified critical levers to improve medicine use and estimated avoidable costs due to unnecessary annual healthcare spending in 186 countries [5].

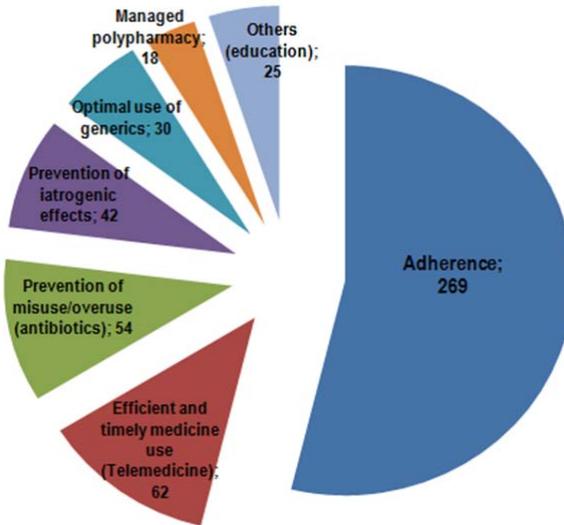


Fig.1 – Pie chart of global avoidable annual healthcare costs (\$Billion)

Moreover, literature also describes many solutions in the areas of Telemedicine and Electronic Health Records, and many tools like medication devices (smart pill containers, alert watches, blister packs, wireless medication reminders)...[6].

However, since a given tool can be linked in part to one or more levers of improvement and since a given lever can contribute in part to several adherence benefits, it seems today difficult to evaluate which solution brings what part of the overall benefits and profits of medication adherence.

For this reason, we developed below a methodology of calculating the economic potential of an adherence tool.

*Measuring the Efficiency Rate of the Pill Tag Solution through a Pilot Test*

Pill Tag is a new wireless medication reminder using 2D barcodes. It is composed of a Flashcode and Calendar patented Application by ORANGE and the barcode printing is a part of the Pharmacy Management Software by ISIPHARM. The Pill Tag application flashes the information of the prescription and automatically places a medication reminder in the calendar of the smartphone.

The solution was implemented through a pilot test in a real situation with 40 pharmacists. We measured an Utilization rate of 65% and a Follow-up rate of prescription of 80% by the patients.

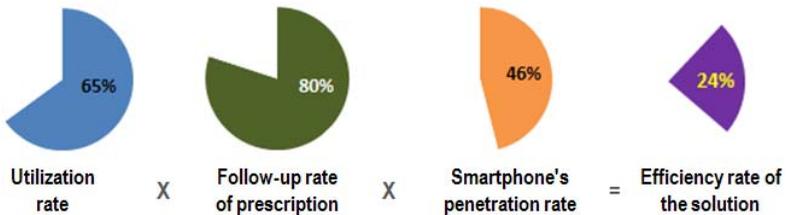


Fig.2 – Calculation of the efficiency rate of Pill Tag solution

Then, the Efficiency Rate can be calculated as the product of the Utilization rate by the Follow-up rate of prescription and by the Smartphone's Penetration rate (46%) in France. As a result, the Efficiency Rate of the Pill Tag solution is calculated to be 24% such as in Figure 2.

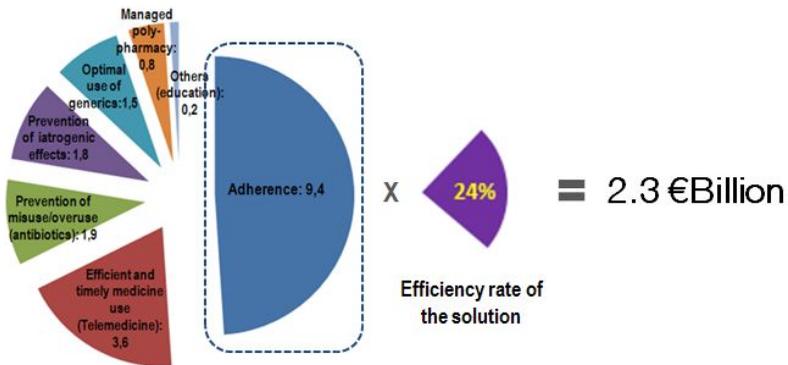


Fig.3 – Calculation of the maximum economic potential of the solution in terms of reducing costs to the French health system

### *Calculating the Economic Potential of an Adherence Solution*

The methodology of calculating the economic potential of an adherence solution in terms of reducing costs for the Health System is the following:

- (1) Using data from the literature, a rate of Potential Cost Reduction is assigned to each lever of avoidable health costs in the Health System;
- (2) The levers actually operated by the solution are identified and rated;
- (3) In parallel, the Efficiency Rate of the solution is measured by a test driver on Population;
- (4) Then, the economic potential of the solution is calculated in terms of reducing costs to the health system such as in Figure 3.

Using this methodology, we calculated a theoretical maximum Economic Potential of €2.3 Billion. It should be noted that such an economic potential corresponds to a theoretical enrolment rate of 100% of patients and pharmacists.

In addition, we have elaborated a potential business model for the French health system. For this, we assumed an incentive model to pharmacists such as the successful French Pharmaceutical Record model where pharmacists receive 35% commission for dispensing generic and also lump incentives for remote electronic transmission, updating electronic health insurance cards. In 2012, this incentive model has achieved €400 Million of cost reduction for the health system.

Therefore, assuming an individual remuneration to pharmacists for supporting medication adherence and assuming a 50% enrolment rate of patients after 4 years, we calculated a potential €150 Million of avoidable annual healthcare costs with an annual investment of €44 Million for the French Health System.

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# **Issues and Scope of m-Health using Tablet for Patient at Home: From a View of e-Health Economics**

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## Introduction

The objectives of this paper is to present necessary conditions of further implementation of m-Health using tablet which becomes popular among physicians, nurses, public nurses, care takers, and other healthcare providers. Based on the field survey on Taka Red Cross Hospital in Taka Town, Hyogo Prefecture, in November 2013, this paper introduces how tablet is used for sharing information on patients at home among above shareholders.

The background of m-Health of this category lies in facts such that (i) the number of the elderly who stay and receive medical services at home has been increasing due to the ageing society and the medical reform aimed at reducing medical expenditures by early discharge from hospital which raises and (ii) the number of the elderly who want to die at home.

m-Health is a suitable system to cope with the above situation, this paper addresses how tablet is used to achieve sharing information by taking above hospital as an example. In particular, we focus on the system how tablet is connected to electric health record at the hospital and how it improves not only the communication between nurses at patient's home and physician at the hospital, but also sharing information among medical and care staff around patient.

Although m-Health has above potentiality to solve current medical issues, there are still many problems to be solved for further diffusion, and this paper suggests necessary solutions such as (i) deregulations on medical services; and (ii) imbursement of m-Health from medical insurance which is required for economic basis. One example of deregulation is to expand the roles of nurse and co-medical in such a way to participate in m-Health, which is related to the "credentials" of telemedicine. Pharmacy is also

connected in this system, which enables to issue prescription at patient's home.

### Case study of m-Health: Taka Red Cross Hospital

#### *Taka Town*

Taka Town is located in the center of Hyogo Prefecture, and the town is surrounded by mountains. The major industries are agriculture. The population of town is 22,870 as of December 2013 and there are 7,476 households. The aging ratio is about 30.8%, much higher than the national average. But an issue is that the number of households with senior couple or single senior has been increasing. The reasons of death are cancer, heart failure, stroke, and pneumonia. The medical and care institutions in the town are one hospital, nine clinics, and five related to care.

#### *Taka Red Cross Hospital*

This hospital was established 70 years ago, currently has 13 medical departments, and provides major medical services including rehabilitation facility for the elderly, visiting nurse station, and care at home supporting center. In April 2012, the regional medical supporting center was added. It owns currently 110 beds and 186 staffs.

The mission of the hospital focuses on providing the regional medical services by the unified approach of medicine and care at home as comprehensive medical care. In particular, the regional medical supporting center is aimed at (i) life-style related or chronic diseases, (ii) patients with multiple diseases including mental, (iii) home healthcare

#### Survey on Taka Red Cross Hospital

#### *m-Health at Hospital*

The survey on m-health using tablet at the hospital was conducted on November 11, 2013. 5 iPads are used but the hospital wants to own 15 tablets. The ways to use tablets are (i) D2N and (ii) D2P.

In case of D2N, a visiting nurse brings a tablet with her/him to a patient at home. The nurse can communicate with a doctor at the hospital while seeing a patient and consult with the doctor. Via the camera attached to a tablet, nurse can transmit patient's images to doctors, which makes real time consultation possible. 2 tablets are installed at the care center where no medical doctor is stationed. Then tablets are useful when emergency occurs, for example; when a patient took off bladder catheter by himself, staff could

reinstall it by using a tablet under the doctor's guidance, since it can send moving pictures.

D2P indicates that a doctor brings a tablet with him/her and its main usage is to connect from the patient's home to the diagnosis record installed at "Regional Collaboration Cabinet (RCC)," which is the electric medical record (EMR) system of the hospital. Currently they cannot connect to whole functions of RCC except the diagnosis record. It is important to connect to the RCC from the tablet. Doctors can upload the diagnosis to the server via tablets from patient's home, which reduces the burden of doctors and promote efficiency.

### *Issues to Be Solved*

The ideal situation of monitoring patients at home is 24 hours operation, which is impossible due to the human resources the hospital owns. If they increase one doctor, additional 20,000,000 yen (US\$20,000) is required, since the reimbursement of comprehensive medical management at home patient paid by public medical insurance is about 30,000 yen (US\$300) per month per patient.

Another serious problem is availability of mobile communication infrastructure in the Taka region. When the survey was conducted, iPad is available by au and sot bank. Among three major mobile carriers, NTT Docomo covers the largest areas in Japan, but it did not sell iPad. The available networks of au and Softbank did not cover whole town areas. Some patients at home living in the midst of mountains do not receive the merit of m-Health [1].

### Conclusion: Issues of m-Health for Further Diffusion

#### *Uncertainty as to who can Implement Telemedicine*

Because no official guidelines for telemedicine exist in Japan, it is unclear who is authorized to implement it. The primary interpretation is that only medical doctors can implement telemedicine, but for the full benefits to be realized, other medical professionals can and should be allowed to participate. Given the shortage of physicians, particularly in rural areas, implementing a system is required that expands the services that nurses, psychiatrists, clinical engineers and other healthcare professionals can provide under a doctor's remote guidance. In the US, credentialing for telemedicine clearly designates the persons who can implement specific telemedicine treatments and operate specific devices. Both the government and the medical sector are active in educating, training and monitoring telemedicine practice in U.S. medical institutions [2-3].

### *Limitations of the Current Reimbursement System*

Teleradiology, telepathology, telephone consultation, guidance and management fees for a pacemaker (telemetry) and asthma treatment at home are some rare examples of telemedicine services whose costs are clearly approved for reimbursement. It is uncertain whether other telemedicine practices qualify for reimbursement or not. Medicare protocols in the US clarify which treatments are subject to reimbursement in a simple way by using CPT (Current Procedural Terminology) or HCPCS (Healthcare Common Procedure Coding System) codes.

Telemedicine is also suitable for health management in ways other than direct treatment such as for continuous monitoring of a patient's condition, consultation by medical specialists, disease-management, prevention of the worsening of illnesses, and guidance and education for patients. The costs of these telemedicine practices should also be reimbursed. As an example, Medicare in the United States accepts the costs of telementoring, guidance and education on diabetes and dialysis treatment in its reimbursement scheme [2-3].

### Acknowledgement

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# Medico-economic Evaluation of a Teleconsultation Program in Lorraine (France)

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**Abstract: The study [1] reviews 4 care workflows (for inmates and dialysis patients) and compares total cost with and without the use of teleconsultation (TC) devices. Based on 4 workflows only, the teleconsultation generated in Lorraine net savings of 195 K € per annum.**

**The infrastructure implemented in Lorraine allows, at a very low marginal cost, the deployment of TC on new medical workflows or the extension on other sites of existing workflows.**

**The variability of unit costs and benefits for each actor makes difficult to enforce a fee for service model to cover the technical cost of telemedicine.**

## Introduction

The TC program in Lorraine region is developed by Télésanté Lorraine (TSL). TSL has implemented an infrastructure provided by French telemedicine company Covalia and proposed for free the equipment, the training and the operations to several institutions.

Four specific TC workflows have already been implemented, four other ones being currently prepared. After one year of utilization, the TC program has undergone a medico-economic review, with two targets: to estimate economic benefits of TC and to develop a generic economic model suitable for the future reimbursement of telemedicine procedures. Only the first target is presented in this article.

## Materials and Methods

### *Methodology Issues*

We have built a cost-comparison model, designed to evaluate the total cost of operations of a specific workflow without and with the TC program. Due to the factual impossibility to compare specific outcomes with and without TC, we have, after a review of scientific literature [2-5], assumed the equivalence of both processes. We have however measured the

conversion rate, i.e. the number of cases when TC needed, according to physicians, to be transformed into a physical consultation. Among the 4 workflows, only one case has been declared, at the very early stage and was due to an improper use to the solution.

### *Workflows Reviewed*

Two workflows relate to inmates: teledermatology and preoperative anaesthesia consultations. TC avoids costly and sometimes risky extractions and transfers of inmates to a penitentiary medical unit. Unit cost of a transfer for a consultation has been evaluated at 800 €

The two other ones relate to the weekly consultation for patients experiencing dialysis for End Stage Renal Disease (ESRD). In one case, the implementation of TC has allowed the opening of a local dialysis centre and reduced transportation of patients to the reference centre, whereas in the other one, the use of TC has saved medical time by avoided transportation of the physician from the reference centre to the local one.

### *Infrastructure Cost*

The whole project is based on a central architecture shared among several users and workflows. The infrastructure cost is composed by following items: central hardware and software acquisition and maintenance cost, data sheltering, and the operating expenses incurred by TSL, i.e. mainly procurement and legal cost and project management. This infrastructure cost is calculated over 5 years to allow proper amortization of equipment. It is annualized and split over 8 different workflows. It amounts to 177 091 € (22 136 €per workflow).

### *Workflows Cost*

Each workflow is estimated with and without TC by taking into account a series of costs: share of the infrastructure cost, local hardware and software cost (software licences, workstation, TC cart, specific devices such as a dermatoscope), implementation fees and maintenance contracts, training cost, direct medical cost (valuated at the price of consultation by a specialist physician), indirect medical cost (indirect cost is related to the necessary presence of a physician (or nurse or paramedics) with the patient for some specific procedures or due to the fact that inmates must not remain alone), cost of medical time lost between each patient, physician transportation cost, patient transportation cost (calculated on an estimate of 800 € for inmates and an average of 85 € for dialysis patient), indirect planning and organizational cost [6] (very heavy cost of planning of transfer of prisoners), invoicing of the TC to health insurance (medical fee only), and conversion

cost (i.e. cost of conversion of a TC into a physical consultation or cost of cancellation and rescheduling of a physical consultations for an inmate).

## Results

Teleconsultation brings considerable savings compared with physical consultation, most being linked to transports.

For inmates, preoperative anaesthetic teleconsultation has addressed 60 patients, for a total cost of 270.08 € out of which 193.41 € accounts to the telemedicine infrastructure. It compares with a cost of physical consultation of 898 € TC has thus generated an annual saving of 37 675 € Currently, TC is used only for orthopaedic and maxillo-facial surgeries. In 2014, other specialties planned to develop TCs and 100 patients are expected. In such case, annual savings will amount to 70 575 € Dermatologic TCs for inmates is more frequent and concerned 100 patients in 2013. TC's cost is 250.34 € compared 888 € for classical consultations and the annual savings amounts to 63 766 €

For ESRD patients, we must consider two different solutions. The first case relates to the creation de novo of a local dialysis unit which saves an average of 110 km ambulance travel once a week for 8 patients. Based on reimbursement fees for ambulance transportation, it represents 85 € per week per patient, i.e. a 29 K€ bonus for Social Security, where TCs has incurred an additional cost of 15 800 € The net savings is thus of 13 100 € In the second case, physical consultation in an existing local center has been replaced by TC. Nephrologists (the scarce resource) have thus avoided twice a week losing 2.5 hour in a travel by car of 102 km. During this period of time, they can produce for their institution an amount of 375 € of medical fees. The net savings of TC is thus of 6 924€ per annum based on 16 patients per week.

## Discussions

The total savings over the first 4 workflows amounts to 195 K€ per annum, for a central cost of 177 K€ over 5 years. This represents a return of investment of 560 %. Moreover, considering Lorraine's strategic choice of a single regional architecture of teleconsultation, new workflows or new sites on existing workflows can be added at a very low marginal cost. This choice has been a key factor of success for teleconsultation both for technical and economic reasons. New uses diminish in return the unit cost for all existing uses, generating a virtuous cycle. Some issues however must be raised.

Since there is no reimbursement for TC technical procedures, the expenses are borne by TSL, whereas the savings are perceived by "free-riders", i.e. Social Security, Penitentiary administration or Dialysis centres.

This is not an issue in this pilot stage but it will begin a key point in a near future as resort to TC increases. The high variability of costs makes very difficult to use a fee-for service to cover technical cost.

Some savings can be discussed. The use of TC in jail has not resulted in a real decrease in the total spending. Indeed, the diminishing in transfers for dermatologic and anaesthetic TCs has been absorbed by the increase in other consultations. The resort to TC has nevertheless allowed a reduction of waiting lines and a better use of capacity of medical transfers.

Conversely, some savings are probably undervalued. We have for instance valued the savings on dialysis only on the weekly consultation of patients, whereas the creation of a local centre has avoided transports on each of the three weekly transports of patients.

Eventually, the pilot stage for the deployment of teleconsultation has proven to very positive. TSL will deploy in 2014 at least 2 new dialysis centres, will increase the TC activity in existing ones, and will experiment TCs in geriatric institutions.

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# **Mobile Health is worth it! Economic Benefit and Impact of a Population Based Mobile Screening Program in New Mexico**

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## **Background**

HABITS for Life was a 3 year initiative to deliver a biometric and retinal screening program via a mobile unit throughout New Mexico.

## **Introduction**

The program goal, to identify health risk and improve population health status, was tested over a 3 year period. Value to participants and impact to the healthcare system was measured to quantify impact and value of investing in prevention at the community level.

## **Methods**

Mobile Health Map ROI calculator, mobile screening unit, biometric screening, retinography, community coordination.

## **Materials**

Systems: satellite, DSL and 3G, Tanita® automated BMI, Cholestec® - biomarkers and A1C. Canon CR1 Mark II camera, and Picture Archiving Communication System (PACS).

## **Results**

Reported for FY2011 timeframe. 6,426 individuals received biometric screening, 5,219 retinal screening. A 15:1 ROI was calculated; this excluded retinal screening for the under 65 year olds, estimated at \$10Mil in QALYS.

Statistically significant improvement in health status evidenced by sequential screening indicates decrease in total cholesterol ( $p=.002$ ) ( $N_t=308$ ), increase in HDL after the 1st and 2nd screening ( $p=.02$ ,  $p=.01$ ), decrease in mean random glucose not statistically significant ( $p=.62$ ).

Retinal results indicate 28.4% (N=1,482) with positive/abnormal finding, 1.79% (N=93) required immediate referral for sight threatening retinopathy, 27% (N=1,389) required follow-up from 3 month - 1 year.

#### Discussion

Screening programs are cost effective and provide value. They should be considered in healthcare redesign.

#### Conclusions

Community based screening is an effective strategy to identify health risk, improve access, provide motivation to change health habits and improve physical status while returning significant value.

Keywords: mobile health, eHealth economics, compliance

# **Telemedicine, the Law and the Economics: A View from Both Sides of the Atlantic (US and EU)**

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Telemedicine and E-Health is one of the fastest growing areas of medicine and continues to be one of the most challenging from a legal/regulatory and economic perspective. The populations in the US and the EU are aging at a rapid pace, there is a growing shortage of qualified medical providers and the increasing cost of health care on both sides of the Atlantic Ocean require new legal rules for delivering quality health care and new economic strategies and models. Both the US and the EU need to timely resolve these legal and economic hurdles to allow for the full expansion of the use of telemedicine and e-health which will not only reduce costs for the citizens of the US and the EU but will also provide greater access to high quality care.

The audience will be provided with an interactive presentation that outlines the why the legal and regulatory issues that surround telemedicine and e-health as well as the economics of providing such care must be resolved in the near term.

The presentation will include a concise summary of the primary legal and regulatory issues related to the delivery of care via telemedicine and e-health and examples of solutions to many of these issues. In addition, the presentation will include several examples of how the economic challenges of delivering care via telemedicine and e-health to the populations of the US and the EU can be resolved.

The presentation will be provided by professionals supporting an international academic medical center with a robust telemedicine and e-health delivery platform that is centered on providing patients in both the US and the EU with high quality, cost-effective clinical care via telemedicine and e-health technology. The audience will gain a better understanding of several important legal, regulatory and economic issues including provider licensing and credentialing, patient privacy and data security, online prescribing, developing cost-effective models for incorporating telemedicine and e-health across multiple clinical specialty

areas and best practices for developing and expanding programs for maximum benefit including the better health of an aging global population.

Keywords: Legal, Regulatory, Economics, International, Technology

## **Lifetime eHealth Applications**

# Assure Health: A Sustainable Model of Remote Healthcare Delivery

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**Abstract:** Wipro's Assure Health initiative is a disruptive remote healthcare monitoring platform focused on patient, physician and healthcare provider's experience and business outcomes ensuring assurance.

**Remote foetal Monitoring and Cardiac Care are two examples which have demonstrated successful use of the platform.**

## Introduction

Shortage of healthcare staff and a sustainable business model are pressing issues in healthcare delivery today. Remote health monitoring has been touted long as the solution to this challenge [6]. Studies in remote health monitoring has been either [1-3] on the technology feasibility; or economic feasibility or on user adoption however a comprehensive experiment to roll out the model has been lacking. Assure Health is a noble attempt in this direction.

## Assured Patients

*Choice of Sensors* long term monitoring demands focus on usability of sensors. We defined two inclusion criteria for sensors. (1) High SAI [4] (sensor acceptance index): wearability, small size and unobtrusive (2) certainty of data.

*Wearability:* A light necklace design ensured cultural adoption, low surface area of contact for long term monitoring, ease of use with different body types and privacy aware being worn inside clothes. The same device also provided activity, fall, and body position and respiration rate ensuring unobtrusiveness obviating use of multiple devices. An interactive mobile app ensured proper positioning and application of the app.

*Certainty of data:* The system involved data transmitting from device to mobile phone to cloud. Any point of loss of connectivity alerted the user through usable UI as well stored the data in proximal end to sync back when connectivity is restored. This ensured data certainty and patient trust. The time of wearing the device and duration of data availability were almost 100%.



Fig 1: Assure ECG design, certainty of data alarms

### Assured Physician/Provider

Remote health monitoring has always struggled to convince physicians on accounts of either “data brevity” or “data overload” and “ease of use”. To address this assure health physician assurance was designed keeping following criteria: (1) Medical grade comprehensive data; (2) Usable clinical decision support system (CDSS); (3) Intuitive intelligent high throughput application for evidence based feedback; (4) “WIFM”(what’s in for me) easy reimbursable model.

Multi-parameter continuous monitoring provided rich amount of data for comprehensive analysis. Built in clinical decision support system helped them focus on right alarms. A central monitoring station made it possible for a single nurse to monitor up to twenty patients and triage the critical patients appropriately. All alarms were logged for quality assurance and availability of historical data enabled easy contextual diagnosis of events.



Fig 2: central monitoring station with built in CDSS and auditing



Fig 3: Physician application

The physician application interface was built keeping the experience as close to reading email as possible. This ascertained easy adoption and no need of special training to use the application. Physicians were informed based on their preference for severity and they could access the current data and the historical data along with CDSS recommendation. Each reporting was also linked with provider’s ability to be reimbursed for the virtual consultation.

### Assured Healthcare Providers

The system was built with following criteria to keep it sustainable for the institutes: Pay per use business model, Cloud based architecture, Reuse of existing infrastructure (mobile phone, connectivity, and IT infrastructure), Easy to train and scale with back office health monitoring station.

The above criteria made the system affordable for the institute and sustainable. Adoption was easy as this didn’t have the stiff barrier of adoption like heavy capital investment, long training period, heavy upfront infrastructure investment, people investment. On the other hand the hospitals using this technology could discharge patients faster, create virtual beds by monitoring patients from home there by creating a new business revenue stream for them.

### Observation

We have tested cardiac and maternity assure health solution in corporate hospitals in India for more than 2 weeks on more than 25 patients. We measured the outputs under following categories.

*Patient:* (1) how long it took to learn the system; (2) was it easy to do day to day work wearing the system; (3) was it easy to maintain the system without any supervision; (4) was the patient app educative and was it of assistance for trouble shooting (need to call helpline in case of the system

not knowing); (5) assurance based on future use or use for others based on NPS (net promotion score) [5].

The observations were: it was quick to learn, non-obtrusive to use and there was no need to call for assistance to learn the system. Most of patients responded assurance with high NPS10 (>9) score.

*Nurses and Doctors:* (1) How long it took to learn the system; (2) How long it takes to educate the patient on the system and apply it on them compared to conventional system; (3) How long it takes to provide intervention / virtual consultation for a patient using the system; (4) Any observation of data discrepancy.

For all the clinical users it was easy to learn and provide intervention and feedback based on the app. Not a single user needed repeat training and quoted as “the workflow of assure health is as they were doing the manual process”. It made work faster and evidence based. There was a high NPS10 from all the clinical users.

*Hospital Administrators and CIO:* (1) Does it need a heavy investment (training, infrastructure, people) to use and implement the system; (2) Do you feel it’s easy to use the system with minimum interference of existing system and reuse of many components; (3) Do you feel you can be perceived as a better quality healthcare provider with this system.

They liked the idea of faster discharge for patients, home monitoring, non- requirement of heavy process change and heavy upfront investment. These hospitals have started projecting assure health as their “high quality patient care” offerings.

### Summary

Wearable sensors, mobile phone, cloud based application and analytics have made remote health care technically possible. However to make it a sustainable healthcare delivery model a holistic approach like assure health may be the way where the system is designed keeping patient, doctors and institutions experience and apprehensions in mind so that each stake holder is assured of safe and quality healthcare delivery.

### Acknowledgement

We acknowledge the participation of Wochkardt hospital and Max hospital in our co-innovation journey.

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# **BBEEG: Telemedicine Taking Care of Newborn Babies**

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*Abstract:* **The BB EEG platform project aims at developing an Internet portal providing telemedicine and e-learning services in the field of the electroencephalographic (EEG) signals of the newborn.**

**The EEG consists in recording the spontaneous electrical activity of the brain through several electrodes placed on the scalp. It is a functional review that provides additional results to brain imaging data (MRI tomography). The neonatal period is a high risk neurological damage period because of the immature nature of the brain for the premature births and/or because of non-optimal conditions at birth (anoxia, infection). The consequences can be severe and cause permanent and severe disabilities.**

**The EEG enables the assessment of the brain function. It monitors the brain maturation during the first weeks of life if the child is born prematurely. The EEG makes possible the evaluation of the degree of brain damage in cases of difficult birth (e.g. cerebral anoxia). It can also detect possible seizures and monitor their evolution under treatment. In this case we must couple the EEG with a synchronized video of the patient in order to properly identify abnormal clinical manifestations. The techniques of neuroprotection starting to be commonly used, as for example the controlled hypothermia for cases of cerebral anoxia, require that an accurate assessment of the severity of brain damage is done. The EEG allows the physiological assessment but requires trained personnel for both the acquisition of EEG signals and their interpretation. The neonatal EEG requires highly specialized personnel. The French expertise is recognized but its daily practice suffers from a growing shortage of specialists. The Video EEG signals are recorded in digital form by a technician and visually analyzed by a doctor after their acquisition. They can also be analyzed by tools of signal processing in order to complement, accelerate or intensify the visual analysis. These characteristics prove that the EEG signals will fit**

well to telemedicine activities. Thus some members of the consortium have developed in Loire Valley for several years a EEG signals transport mean between hospitals Laval and Le Mans. In Bourgogne there is also an telemedicine activity around the EEG. In the Pays de la Loire region there are adapted facilities that enable the transmission of large amount of data. However, technical constraints (transport of medical data) and organizational (type of economic exploitation, work organization conditions for different personal ....) are hampering the application of EEG telemedicine activities on an industrial scale. Moreover, it is very important to ensure that the development of remote interpretation is not accompanied by a loss of competence. The BB EEG project will thus pave the way for the industrial development of the telemedicine activities and will contribute to maintaining the recognized excellence of the French school in this area. Our consortium brings together all the players necessary to tackle these barriers. It combines several hospitals in the region of Pays de la Loire with industry specializing in the secure transport of medical data, the work flow organization and its potential applications for learning strategies, with researchers in mathematics and signal processing fields. The hard goal of the BB EEG project is to provide a portal offering a combination of different services for a much rapid and secure diagnostic and for the newborn EEG training. The target audiences are hospitals that do not have the competence of physicians who request a second opinion and professionals (doctors and technicians EEG) who wish to gain competence in this area. Our project will constitute a methodological framework for other initiatives in other medical fields.

### Introduction

There is one crucial question when labour is difficult or very premature: Has the child's brain been affected? In such cases the electroencephalogram (EEG) is needed. The problem is that in the case of newborn babies, this very delicate examination can only be carried out and interpreted by specialists, of whom there are currently very few.

To deal with this lack of specialists, the BB EEG project is developing a telemedicine portal that offers three types of service:

- The first one is dedicated to remote diagnosis. It enables a technician to carry out an EEG and take a video of the child, then send them securely to a specialist doctor;
- The second one is an online learning platform intended to train doctors and specialists;

- As for the third service, it uses advanced signal processing techniques to complete the visual diagnosis with an automatic analysis of the EEG.

BBEEG also offers a suit of collaborative work.

### System Architecture and Function

#### *Telemedecine and Signal Analysis*

Based on the know-how of the ETIAM, its SMN router network, and on the know-how of the HIS integration from THELEME, BBEEG enables an authenticated signal processing (with CPS card), secure, monitored and standardized (DICOM and HL7 protocols) for EEGs and videos through an end-to-end workflow.

The user logs on to a remote desktop where the tools he needs to perform an exam are present, and also a signal analysis tool (EEGDIAG) built by the UCO. This tool allows the user to spot anomalous sequences on an exam through algorithms regularly updated by a scientific community. A BBEEG HMI allows the user to follow the different steps of the workflow, to send or receive exams.

The HMI also allows the user to access a database of exams he can query or feed.

#### *E-Learning*

The e-learning module from 4SH is populated by anonymous exams chosen by the BBEEG expert community. Another community of teacher writes lessons from this content.

An EEG web viewer can be integrated into the lesson.

Students can access to the e-learning through the BBEEG web portal.

#### *Collaborative Work*

As a unique log-on gateway, using a web-sso (Web Single Sign-On Protocols) solution, the portal offers a set or range of tools for collaborative work. News and notifications, phone books, Skype access, forums, video conference systems, chats and desk sharing are integrated. It's an integrated life of the BBEEG community.

The BBEEG web portal is available on the internet at <http://bbeeg.chu-angers.fr/portal>

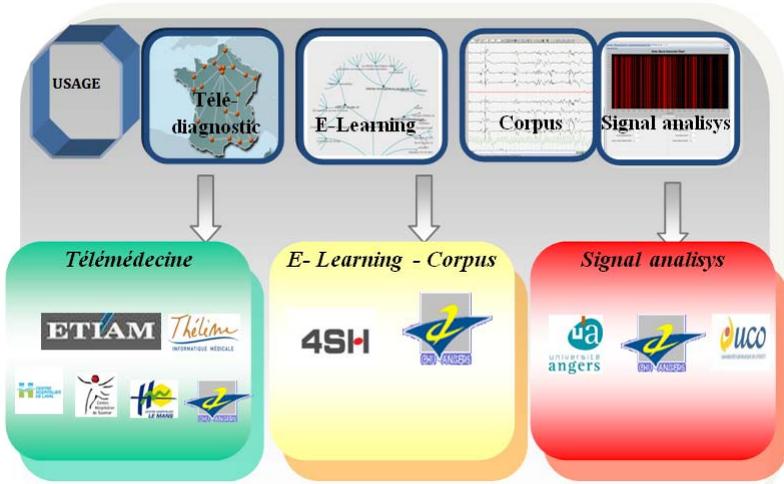
### Perspectives

#### *Functional Perspectives*

This architecture can be applied to a lot of domains. It could be easily used for adults. What we want is to build the solution on a top of an existing community, which is the force of our solution.

### *Geographical Perspectives*

The aim is to ensure the growing of our network. The first step is the region Pays de la Loire, but there is no limit and we have already generated lots of interest and fulfilling a strong world-wide demand.



# Deployment of Mobile-based Child Immunization Alert System (CIAS) in an Indian Setting

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## Introduction

Infant mortality is inversely associated with immunisation [1-2]. In 2008, WHO estimated that 1.5 million deaths of children under the age of five were due to diseases that could have been prevented through vaccinations. In India, for the year 2012, the immunization coverage in the rural areas stood at 58.5% whereas the national average was 61% [3]. The major reasons for such dismal indicators are:

- Lack of awareness: Majority of the mothers are not aware about the vaccines [2-3];
- Lack of knowledge: With the prevalence of traditional beliefs, people feel that their child should develop ‘natural immunity’ [4];
- Lifestyle: Owing to frenetic lifestyles in an urban setting, parents tend to forget.

Numerous studies by healthcare providers indicate that technology enabled methods could be adopted to overcome the apprehensiveness of parents and prevent diseases from spreading [5]. In this, the use of mobile technology and the text messages have achieved success in different parts of the world [6-8]. Given the scope and penetration of mobile health in India, Child Immunization Alert System (CIAS) a mobile application was conceptualised. CIAS provides alerts to parents, having children up to the age of 5 years, as recommended by India’s Ministry of Health and Family Welfare.

## *System Design*

The Functional Specifications Requirement (FRS) was prepared by having detailed discussions with paediatricians from various healthcare delivery institutes in and around Chandigarh, India. Based on the discussions, it was concluded that:

- The content of the messages should be positive and reassuring;
- Creation of parallel web based system would have wider penetration because of growing number of internet users [9];

- Apart from the parents, enable access of CIAS to field level healthcare professionals for outreach activities has to be provided.

Based on the FRS, the CIAS system design was conceptualised as depicted in figure 1. The key highlights of the system developed are:

- Access: CIAS has been designed based on HTML5 technology with the data being stored on a web-based database. It is platform independent as it can be accessed over desktops and mobile devices. The mobile application has been developed on the Android OS and uses the mobiles' internet connection for the exchange of vaccine information.
- Alert Control:
  - Types of Communication Modalities:
    - SMS: The Mobile Service Delivery Gateway (MSDG) conceived by the Government of India, was integrated with CIAS and is being utilised for sending free SMS to the users [10].

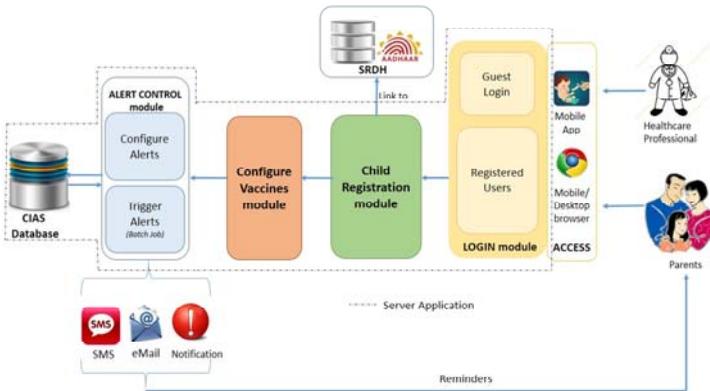


Figure 1: CIAS System Design

- Real time notifications: CIAS makes use of 'Push Messages' part of Google Cloud Messaging service in Android, which enables the sending of on-the-fly vaccine notifications directly to the user [11].
- Emails: Numerous studies have indicated that people who prefer emails feel that it provides a quick and convenient access to healthcare information [12]. Hence, this modality was also integrated in CIAS for sending alerts.

- Configuration: The alerts sent by CIAS have been classified into two categories: vaccine-due alert and vaccine-overdue alert. In case of vaccine-due, two alerts are sent one-day ahead and two-days ahead of the date of vaccine. In the event of the parent receiving the vaccine overdue alert, he/she is prompted to provide the reason for the delay which would help design suitable interventions in the future.
- c. Linkage to Unique ID: Unique Identification (UID), a biometric project which uniquely identifies an Indian citizen, is being implemented by Government of India [13]. For mapping the UID of the parent with the child, the integration of State Resident Data Hub (SRDH), containing state specific UID information, with CIAS is underway.
- d. Location based service: To address the concern of enabling the parents reach the nearest hospital/clinic, CIAS makes use of mobile devices which are 'location sensitive' [14] to provide localised hospital details.

## Results

The mobile app, CIAS, has been made available for download on the Government of India's portal, mGov App store. In a short period of 3 months, the mobile app has been downloaded 587 times, which proves its acceptability. To increase its penetration, it has recently being made available on the Google Play store. With the feedback received, the future version of CIAS would be enhanced to include pull-SMS facility and localised voice-based alerts, so as to enable the section of society which is non-smart phone and non-IT user.

## Conclusion

With the deployment of CIAS, it can be concluded that:

- The lack of information, personal beliefs and misconceptions about vaccinations can be removed [5];
- Multiple communication modalities can be used, which are cost effective, to send vaccine alerts;
- Localisation factors like location awareness, training and empowerment of local experts is required to achieve speedier and deeper diffusion.

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# **Design Considerations for a Wireless Sensor Network Architecture Attached to a Cognitive Training System for the Elderly**

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## Introduction

The last decades the world has experienced an enormous growth of population exceeding 60 years, passing from 8 per cent of total population in 1950 to 10 per cent in 2000 [1]. It is preview that by 2050 the number of older persons in the world will exceed the number of young people, being 21 per cent of the total.

This will affect our society and economy, being one of the primary domestic public policy issues [2]. These new horizons have stimulated in recent years the research and development of health care solutions powered by TIC technologies. In this paper we present some considerations in the design and deployment of the wireless sensors network proposed for our already developed e-health care system.

## A Health System for Elderly People

The system is aimed to offer elder people an environment where their cognitive capacities can be monitored and exercised as well as their functional and social skills. It is focused on the elderly affected or threatened by neurodegenerative diseases as the Alzheimer's disease. This is achieved through a series of activities including reading newspapers, watching videos and playing educational and therapeutic games (serious games). Each activity is planned according to a therapeutic guideline specifying what to expect from the patients.

The system can be used by the patient himself, at home, or with the assistance of others like friends or family. The patient may even benefit from the remote assistance of a tutor. At the base of the system there's a touch computing device through which all activities are carried out and the patient's information and progress is remotely managed at the system's site. The platform also includes the possibility of carrying out group sessions led by a therapist, for example in a retirement home, where the monitoring, difficulty grade, and progress stage could rest at an individual level.

Patients' data related to his health state and progress is backed up at the system's site and can be accessed remotely by patients as well as by therapists and medical personal according to access policies. The same is valid for system management activities.

The system's first stage has already been deployed and some evaluation tests are carried out with real patients.

### A Wireless Sensor Network into Cognitive Training System

The possibility of sensing, processing and communicating several environmental and physiological signs at the patient's end is an added value to the supervision of patients' health. This allows increasing, for example, the information related to the development of targeted diseases and, at the end, helping in improving the patients' quality of life.

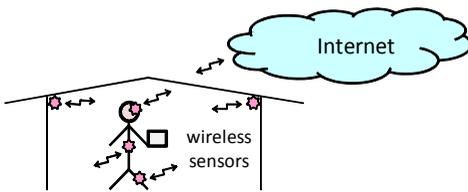


Figure 1. Addition of a wireless sensor network to the system

In the case of our cognitive training system we are proposing the addition of a wireless sensor network that would bring valuable data related to the patient's health and environment and that can evolve according to

particular needs. The main characteristics that we have conceived for the network are:

- Start with basic variables such as room temperature and vital signs, but easily allowing the addition of other parameters;
- Growing capacity in a compatible way, both in physical and management aspects;
- Able to distinguish data from different users belonging to the same network;
- Able to joint other wireless networks in the same physical building.

### An E-Health System within A SDN Infrastructure

For the first stage of the project, we argued that the platform requirements are set up mainly by the serious games needs as well as by the user's number growing rate [5]. In this way it is necessary to take into account a deployment architecture that favors an easy scalability and efficient manageability, all without being hardware demanding to the users.

Cloud computing can bring the needed technology for providing apparently infinite computing resources available on demand. In this way,

the type of systems as the proposed in this paper for health care, intended to be widely deployed, can start small and increase software and hardware resources only when needed [4]. More specifically:

- The resources and users' capacities can be increased without limitation and according to the real demand;
- Applications hosted in the Cloud can be run in the Cloud itself from a low-level client computing device;
- Centralized storage of patient's health information that can be accessed from anywhere by the authorized personal.

The benefits of using Cloud computing in health care systems, both from the system manager and patient and medical personal perspectives, have been inspected in many proposals.

Once the system is deployed in the Cloud and the number and diversity of applications and workloads grow, including specialized types of servers, Clouds require a network architecture that adapts to these elastic demands of diverse, increasingly pervasive applications. Some of the issues presented under this situation can be overcome by an infrastructure based on the software-defined networking (SDN) paradigm [5, 6]. In this sense it's of particular interest the work in defining and standardizing open SDN protocols, such as OpenFlow, which has encouraged the development of SDN software.

We argue that a health system, as the one that we are developing, can be easily scalable with an efficient management capability and without demanding from the user a high-end hardware requirement, if it is deployed with a distributed paradigm-based structure and deployed on a Cloud computing architecture that is specified using a software-defined networking (SDN) based infrastructure [3].

### A WSN with SDN Architecture

When looking for the architecture design to use in the case of a wireless sensor network added to the cognitive training system, it is necessary to take into account the conditions that will allow in the future an easy scalability and manageability of the network, without needing to do strong changes to the already deployed system.

In this sense, there are already good technical and standardized solutions to be used in a wireless sensor network at the physical and data link layers, some of them normally based on the IEEE 802.15.4 standard. Nevertheless, at the networking and higher layers there are a lot of options that are application and vendor dependent. This leads to a series of problems regarding:

- Resource underutilization;

- Counter-productivity;
- Rigidity to policy changes;
- Management difficulty.

These problems are deep-rooted in the architecture of WSN, where each node possesses all functionalities, from physical up to application layers. These issues can be adequately overcome by the use of an architecture that could bring to the network a good level of abstraction, thus allowing its programmability from a central perspective. This is a favorable scenario for the application of the SDN paradigm, which allows the software definition of the network and indeed its easy evolution and management.

While SDN was originated mainly as a solution to enterprises and carrier networks problems, the wireless sensor network conditions present some particular characteristics that must be taken into account to achieve an efficient adaptation of SDN. These features are:

- Communication in wireless sensor networks occurs at low rate;
- Energy consumption must be guaranteed to rest at a low level;
- Support of nodes mobility and resulting topology changes;
- Necessity to deal with the unreliability characterizing wireless links

According to the previous section, we propose to adopt the OpenFlow based SDN implementation in the WSN architecture. In this scenario the data plane consists of sensors that besides its sensing function also perform flow-based packet forwarding. The control plane is an entity (software) centralizing the network control, as seen in figure 2. The specific sensor application lies at the application layer without taking care of the physical communication network.

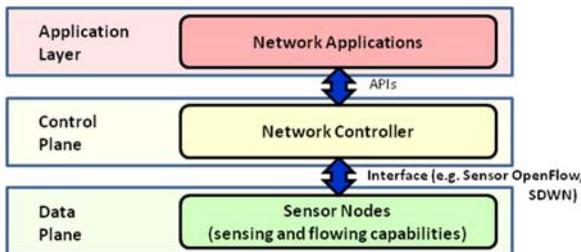


Fig. 3. The SDN model applied to a WSN

The SDN model must be appropriately adapted to the characteristics of WSN networks, which is illustrated by two proposals introducing

some modifications to the OpenFlow standard. The first one [7] presents a SDN architecture called Software-Defined WSN (SD-WSN), featuring a clear separation between a data and a control plane. It defines Sensor OpenFlow (SOF) (based on OpenFlow) as a proposed standard communication

protocol between the two planes. The goal of the proposed OpenFlow adaptation is to transform traditional WSN into networks that are:

- Versatile. They can support multiple applications in a plug-and-play way; sensors are no longer application-dependent but application-customizable;
- Flexible. Easy to enforce policy changes throughout the entire network;
- Easy to manage. Building an NMS is no different from adding another application on top of the control plane, using open APIs.

A second proposal of SDN architecture for a WSN is explained in [8]. It presents the advantages of SDN in the common wireless networking scenarios and how the concept should be expanded to suit the characteristics of wireless and mobile communications, especially in the case of IEEE 802.15.4-based low rate, wireless personal area networks (LR-WPANs). The proposed solution is a SDN protocol for wireless networks called SDWN. The architecture defines the existence of two kinds of nodes: generic nodes, with limited computing and energy capabilities, and sink nodes where the network controller is executed, with significantly higher computing/communication capabilities. Some implementations are made in a first step attempt towards the definition of a complete working solution, including the execution of the protocol by a network operation system (NOS) to support communications between a generic node and the controller, the specification of rules and actions and the format of relevant SDWN packets.

Although it's not the same case, there are some common aspects between wireless sensor networks and wireless mesh networks (WMN), as the unreliability characterizing wireless links and the topology changes. That's why it's interesting to consider the integration of OpenFlow to a WMN architecture, consisting of Open-Flow enabled mesh routers and mesh gateways, and the use of NOX (Open-Flow based Network Operative System) as the network controller. It takes advantage of the use of different identifiers (SSIDs) allowed by the IEEE 802.11 MAC layer for virtualization. The tests showed a good performance of the architecture related to client-mobility (fast handovers) and integration to existing networks.

## Conclusions

The addition of a wireless sensor network to the cognitive training system must guarantee a future easy scalability and manageability of the network. This can be achieved by the application of the SDN paradigm to WSN but in such a way that it considers the special features of this kind of network in order to obtain an efficient performance. The adaptation must primarily take

into account the low-rate data and low energy consumption characteristics of WSNs.

There are already some SD-WSN proposals that had added some modifications to the SDN architecture originally designed for enterprises and carrier networks. They show that it is convenient and possible to adapt the SDN paradigm to WSNs, validating it as the base for an efficient architecture to be used in the design of a wireless sensor network for the cognitive training system.

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# eHealth in Practice

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## Introduction

emCare is a joint venture between two well established organisations in Malta.

Business Partner 1 - Established in 1990, CareMalta today operates eight Homes for Elderly people in Malta with over 1000 residents across the eight homes. All residents are cared for within a standard care framework based on good practice. A key attribute of the daily care plan is the daily monitoring of the residents vital signs such as Blood Pressure, Weight, Diabetics and more.

Business Partner 2 – Established in 1996, 6PM today operates in Malta, England, Ireland, Scotland, USA, Georgia and Turkey. 6PM is specialised in providing pragmatic benefit directed Health Solutions. In collaboration with the NHS in the UK, 6PM developed and implemented several Health Solution such as HIV management, Stroke Management, Dementia, Pathology and non-clinical but health relate solutions.

eHealth Education – Many people are aware of eHealth solutions and devices but people are still not embracing the importance of proactive health care and the benefits that eHealth brings with it. Our experience over the last 2 years has thoughts us that within this space there are many stakeholders and for the sake of being Agile and start from somewhere, the natural place to start was with Homes for the Elderly and Hospitals.

The Health Care Need – In both Homes for the Elderly and Acute Hospitals, residents must have their vital signs monitored at least once a day but more often than not three times per day. emCare has investigated daily requirement in these institutions and it transpired that this process does in effect carry with certain business and care risks.

- **Care Risks**
  - Quality of Data – the data gathered from vital sign testing at the bed side of the resident is written on a daily log and thereafter manually transferred on to the resident's medical record posing potential transcription issues.
  - Trend Analysis – the daily test results are captured not providing the Carer / Nurse with immediate visibility of trend analysis and alerts aid.
- **Business Risks**

- Accountability – given the human dependant manual process, the institution (Hospital or Home) has no way of measuring accountability in sense to be assured that all daily routine tests did in effect take place at the stipulated time.
- Productivity – given the manual process, the carer or nurse conducting the vital sign testing requires time to transfer results on to the medical records. This is time consuming and reduces their ability to spend more time with the residents providing care.
- Stakeholder Involvement – Clinicians, Nurses, Carers and next of kin do have visibility of any of the vital signs results which are only found either in a paper based medical record or an electronic medical record that can be accessed from within the institution.

*SCOPE by emCare enables Carers, Nurses, Doctors and Individuals to Safely Communicate health Observations in a Productive and Efficient way.*



**The Health Care Solution** – emCare developed **SCOPE** – Safely Communicate health Observations in a Productive and Efficient way. SCOPE is tablet based solution that is mobile placed on a trolley together with devices such as:

- Blood Pressure Monitor;
- Blood Glucose Monitor;
- Ear Thermometer;
- Pulse Oximeter;
- Weighting Scales.

The health care solution provides several benefits to all involved stakeholders.

- Residents in Hospitals and Homes of the Elderly
- Caring and Nursing Staff
- Clinicians, Consultants and General Practitioners.

#### Next of Kin (Family)

The table below outlines some of the most tangible benefits that are derived by the different stakeholders.

**How Does it Work** - The vital signs test end to end manual process time cycle has been reduced using emCare's Health Care Solution - SCOPE. Besides increasing productivity and data quality, the overall medical record is improved in more ways than one. SCOPE delivers accurate data in a timely manner because it is instantly communicated to the emCare Health central data repository updating the appropriate electronic Medical Record. The vital sign result can also be sent and integrated to update the Hospital

System or the Care Home system through standard communication protocol such as Health Level 7 (HL7).

Benefit	Resident	Care Home & Officials	Next of Kin	Medical P or C
Increased accountability and enforcement with routine check-ups	√	√	√	
Improved data quality through automation of the updating of the Medical Records	√	√	√	√
Reduced time and increased efficiencies within the routine check-up process		√		
Increased auditability with the caring of the resident.		√		√
Visibility of the medical status of the resident			√	√
Automated workflow notifying the GP and the Next of Kin in case of irregularities.	√	√	√	√

In practice, SCOPE works as follows.

1. The Caring Official on duty accesses the system using their unique security credentials. This guarantees that all processed medical records are maintained with a proper user, time and date stamps for audit purposes.
2. To guarantee proper authentication of the Resident and access the proper medical record, emCare provides each resident with a SMART swipe card – “My-emCard”. When the Caring Official swipes the “My-emCard”, the residents’ medical record header is displayed on the screen providing the Caring Official with information of the resident and the details of the Vital Signs tests that are required.
3. Once the physical device is applied on to the resident body, the Caring Official selects the device picture found on the tablet and the test commences (e.g. Blood Pressure Monitor).
4. Once the selected vital sign test is done, the test result is automatically sent via Bluetooth from the device to the tablet. The Caring Official is able to verify that the process was successful. The Caring Official is also prompted with the results of the last five most recent vital signs tests attributable to same device. These appear on the tablet along with the most recent test result.

5. The test results are processed using a connection to the internet established either through a Wireless Local Area Network in the Institution (Hospital or Home for the Elderly) or through a Mobile Network using 3/4G SIM Card installed in the tablet. The test data is pushed out of the tablet into emCare's central eHealth Record Repository updating the appropriate resident's medical record or the Hospital Information System or the Care Home Information System.
6. Upon receipt of the test results, the emCare's central eHealth solution conducts comparative analysis between the actual test result data with the thresholds of the resident's test header data as entered by either the Caring Official or the Medical General Practitioner or Consultant. If the comparative analysis result is outside the predefined parameters, the emCare central eHealth solution triggers off an alert the preferred stakeholders get notified.
7. Facility Managers, Matrons, Lead Nurses and Lead Carers have full visibility of the tests completed upon the resident by the Caring Official. They can also check to make sure that all pre-scheduled vital signs tests have been complete.

The following are some of the screen shots related to the process described above.

Once a particular test is done, the results are displayed in the grey box on the right hand side while the recent five results are displayed on the left.

From a management perspective SCOPE provides a new level of transparency, accountability and auditability of its' services.



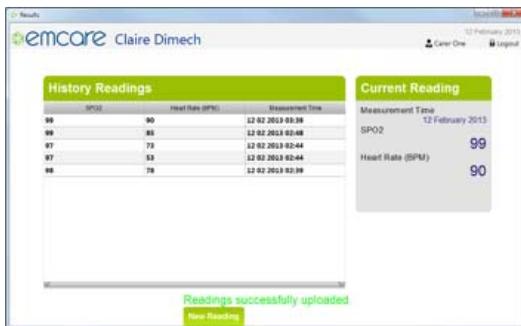
Health Care Official authenticates the Resident on the solution



Health Care Official is presented with the list of tests that must be conducted for the authenticated resident

Reports related to medical records are available instantly at the touch of a button. These can be reviewed using different reporting views such as:

- By resident;
- By care provider nurse;
- By ward / home / clinic;
- By time.



All tests results are stored as described above along with the time and date of the test and the security credentials of the Caring Official.

An authorized Medical Practitioner or Medical Consultant can have instant access to a resident's medical record and review the full history of a resident. Access is achieved through available secure GP Web Portal. The Medical Practitioner or Medical Consultant can access this web portal from their private residence, clinics or the institution itself.



In the event of Medical Practitioner or a Medical Consultant visiting a Care Home or Hospital to see to one or more residents, the Caring Official is able to prepare the resident's medical record by printing a report directly from the tablet through a compatible wireless printer.

# Innovation Framework for People with Dementia and Their Carers as Users

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***Abstract:* Dementia is a well recognised challenge to health and social care services worldwide. The poor state of the art in reported innovation of digital technology for people living with dementia is summarised. It is noted that the articles put considerable emphasis on the participatory involvement of people with dementia to the neglect of many other aspects of scientific study. It is inferred that researchers/inventors should employ an appropriate innovation framework that contextualizes and improves their approach, and one is described. The framework should provide an appropriate context to place future studies, and importantly allow care service organisations to have some confidence in planning their digital inclusive care based on the published research findings.**

## Introduction

Dementia has been and remains headline news in many countries globally as a major health and social care concern for society [1]. With large numbers of people with dementia currently projected [2] and the focus on maintaining their independence as long as possible, the potential for telehealth, telecare, mHealth etc. systems and services tailored to that population is obvious.

Such technology is being reported at conferences, in literature and online. However the poor state of the art in published innovation of digital technology for people living with dementia is summarised in three papers by the author and colleagues [3-5]. The main relevant points were the failure to address the heterogeneity of people with dementia, no or little account of the impact of communication impairments in interface design, and a failure to recognise the need to more fully account for the role and skills of carers. It was found in the literature review of the 24 selected articles from the last 10 years that considerable emphasis in the writing was placed on reporting participatory involvement of people with dementia to the neglect of many other aspects of scientific study. The strength of evidence seems to be only proof of concept level, invariably a design was created and only validated by the same population as co-produced it. Most often, the population was poorly described. Thus the usefulness of the

Table 1 Innovation framework

<b>Step</b>	<b>Description</b>
1	Establish what the desired function/service is
2	Establish a process model of the activity/activities in the function.
3	Produce the best 'test-bed' and an experimental protocol to explore acceptability, usability and scenario-based functionality with end-users.
4	Conduct the exploration.
5	If changes are needed, return to the appropriate step above. Otherwise go to the next step.
6	From above produce a fully functional prototype and an experimental protocol to validate acceptability, usability and scenario based functionality with users over a short time.
7	Conduct the validation.
8	If changes are indicated, return to the appropriate step above. Otherwise go to the next step.
9	From above produce a fully functional pre-production prototype and an experimental protocol to evaluate full functionality and usefulness with users over a period of time long enough for regular use to be established and, to make natural use of features and allow critical events to occur.
10	Conduct the evaluation.
11	If changes are indicated, return to the appropriate step above. Otherwise go to the next step.
12	Conclude R&D processes
13	Deliver the working production Technology
14	Preparing Marketing and launch
15	Execute launch

solution for other populations is unclear. In addition, often there was little information about the design of the software, e.g. reporting details of what worked well and what did not. Indeed most of the articles made no or little comment on generalisability or how their work may be built upon. Finally whilst a large majority of the articles did involve both users and their carers, the role and organisation of the carer was so slightly described as to be useless for others to consider delivering solutions based on the innovation.

It is inferable from the above that researchers/inventors would benefit from at least a research framework to contextualise and improve their approach. A framework to guide designers was described previously [4]; it

is expanded upon here by inclusion of commercialisation, i.e. making a solution usable for the benefit of many.

### The Framework

A general framework is shown in Table 1 that has been hypothesized for innovating a digital technological solution for the health market. The term ‘test-bed’ is used to mean anything that represents the solution, i.e. anything from a storyboard to a fully functioning prototype. Management of health and safety, ethics and user involvement in the process has been described previously and is unchanged [4].

#### *Accounting for the Dyad of Users*

The innovation of digital solutions for people with dementia in general must allow for disease progression, i.e. increasingly one or more carers will be involved in supporting its use. In general therefore there is a dyad of end-users, namely the person with dementia and a carer involved in use (scenarios with more simultaneous end-users are not considered). The framework must allow for the following situations: where it is appropriate that the person with dementia is the only end-user; where the latter is true but a facilitator separately sets it up; where the dyad are simultaneously involved in the use of the technology as peers; or, where the carer is prompting and facilitating the use by the person with dementia in real time.

The framework is set apart from others by consideration of the user dyad. In step 1, initial dialogue should be with both and include a period of getting to know them. Separate elicitation of their goals and skills is also preferable. In step 2, if the activity and the process model are the same for both, then this and all the following steps can be conducted with the dyad. But if there are marked differences between the activities of the members of the dyad, then separate process models are needed. These models should conform to each other. Whoever is involved in conducting a task within the process model(s), their appropriate joint or separate involvement in the exploration, validation and evaluation should occur. No specific methods within the framework have been stated because it is up to researchers to select what is appropriate in their circumstances, resources and time often having a big influence.

#### *Considering Commercialisation*

Commercialisation is overtly shown in steps 13-15 only. When kept within in these steps in a project this is occasionally acceptable, but in most circumstances it is not. It is more likely that almost at every step of the innovation process there are business considerations that could be

considered and worked on prior to step 13. Who has funded/is funding the project and the resources available can both have a marked influence.

Illustrating the commercial approach in a simple representation is difficult especially in the limited space here. However it can be said that: IP management; costs; following ISO standards – for technological and business practices; meeting any regulatory requirements (including appropriate and sufficient evidence); full consideration of how the solution will be used/implemented in service; thorough market analyses; and, marketing, are likely to always be present.

### Conclusions

The steps shown in themselves are not that innovative – they have a strong similarity to many standard frameworks; what makes the framework more novel is the explicit consideration of the dyad as end users. The framework needs evaluating over many studies but it should provide future inventors and innovators of technologies for people with dementia with an appropriate approach for their work, and importantly, result in care service organisations, and indeed informal carers, to have some confidence in planning their digital inclusive care.

Future work will explore scenarios in care settings where staff are working with a group on a single activity (multi-end-users) and a fuller understanding of commercial factors need.

### Acknowledgment

The author would like to thank the UK Social Care Institute for Excellence for their support.

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# Innovative ICT Systems for Integrated Care

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## Introduction

Current practice and state of the art in building large-scale ICT systems, especially when delivering integrated services, is underwhelming. Nobel Prize winner Herbert Simon demonstrated that building monolithic systems from scratch is infeasible [1]. Accordingly, common ICT practice aims for interoperability amongst available systems, augmented by coordination or supervision. Sadly, interoperability only delivers a “common denominator” curtailed by incompatible design choices in these available systems. When applied to ICT for integrated care, patients will suffer significantly, health care professionals will be solicited severely when they must absorb these incompatibilities, and this poor ICT service will be prohibitively expensive.

Consequently, new approaches for the design of the ICT systems that offer integrated care are needed, targeting especially older persons and patients suffering from multiple disorders, entailing the complexity of comorbidity and poly-pharmacy. These ICT systems, which will become part of a larger integrated solution, have to be designed such that future conflicts and incompatibilities are avoided or easily resolved. This paper outlines a design for ICT systems, delivering integrated care, achieving this objective.

## Patient as a Resource

An important observation guiding the design of conflict-avoiding systems is that the world-of-interest is among the most stable aspects of an ICT application. Reality-mirroring ICT components inherit this property. In addition, these components inherit the consistency of the real world. Coastal maps, used for navigation, are examples of such information artifacts. Preferably, this reality-mirroring includes reality-tracking capabilities (in the coastal map example this would be a map updating service).

Thus, our innovative design places an “in silico” counterpart of the patient at its center. The design mirrors the patient by a small set of executable models: a patient resource type, a patient resource instance, a patient activity type and a patient activity instance. Each instance knows its type and delegates all type-related information processing to its type. Patient types, although they are knowledgeable on patient states and state transitions, rely on instances to be the repository for such state information.

The modeling of patients as resources is instrumental for the ICT support for integrated care. Indeed, a widespread implicit design choice in existing systems is the assumption that a system has sole “ownership” of the patient; alternatively, the system has a simplistic view on how the rest of the world affects its operation. The patient resource models are components that make it explicit how and where all patient-affecting activities and decisions come together and interact. They become the “single source of truth” for a patient.

Note that the execution of such a patient model may involve a human expert performing an information processing task (e.g. a GP indicating how a specific poly-pharmacy situation affects a liver absorption capacity). In this situation the ICT system interacts with humans. Similarly, the model may represent that some information is unknown, e.g. when human experts delay or fail to provide some requested information for whatever reasons.

Integration of an existing ICT system into our novel design involves introducing support for explicit resource allocation in this existing system (analogous to computer programs executing on top of a modern operating system). This requirement is justified by the fact that all health care activities will interact, compete and possibly clash in the corresponding reality anyhow.

#### *Patients as Complex Resource Aggregates*

In a health care context, patients are sophisticated composite resources. For starters, allocation services need to use an agenda. Indeed, health care activities exercise control over a patient as a function of time: physiotherapy on Monday from 10:00 to 11:00, removing stitches on Tuesday 14:00, ...

Furthermore, patients correspond to multiple resources. Each of the major organs is likely to become a resource in its own right. For instance, in case of poly-pharmacy, an organ’s properties and limitations are modeled and execution of this organ model reveals the implications of performing the envisaged activities (e.g. following a medication scheme). Blood constitutes another resource, whose agenda enables e.g. to find out whether special precautions are needed in case of an emergency involving surgery.

Here, the realization of our novel design will capture expertise from the medical domain to build the reality-mirroring executable resource models. The system design and implementation allows to only automate well-known and simple cases initially, involving humans to handle all the other cases, and gradually automate more when sufficient experience has been gained. The most complex and rare situations are unlikely to be automated ever.

Moreover, other patient abilities and disabilities, relevant for health care activities, belong in its model as a resource. A patient may be unconscious, mentally unable to follow a medication scheme, eat or drink as required,

have limited capabilities to perform physical rehabilitation exercises, etc. Again, the design allows introducing aspects into the model when needed. Finally, the patient's location is relevant as far as it concerns the ability to receive medical attention when and as needed.

### Patient Health Care Activities

Patient activity models complement the above resource counterparts. Having both model types is key to integrate-ability and system scalability. In comparison, combinations of activities and resources are too short-lived and too situation-specific to be viable software components (i.e. user mass would be insufficient to sustain such complex software components [2]).

These reality-mirroring models are executable, which implies that an activity can be virtually executed on given resource models. This results in an on-line special-purpose "simulation" to be used in different manners. Execution in step with reality, of the activity model, generates instructions while tracking and tracing the health care activities.

Execution of the model much faster than reality will estimate and predict. This mode may be used to explore alternative ways of (health care) action. In addition, it may inform resource models of future usage, effectively reserving capacity, which will reveal conflicts and opportunities in time to address or grasp them. For instance, a diabetes treatment activity will inform the patient resource model of the expected medication scheme. In this manner the system becomes proactive.

Note that this scheme [3] was originally elaborated to coordinate normal activities. As a consequence, it coordinates resource allocation both in a health care sense (e.g. revealing how a blood thinning medication scheme impacts the planning of surgery) and the everyday sense (e.g. revealing that a patient or health care professional can only be in one place at a time).

Moreover, the scheme specifically targets the handling of unpredictable and uncontrollable activities. To this end, the faster-than-reality virtual execution of the activity is performed repeatedly, adapting the information to the latest information available. E.g. when a diabetes treatment – unsurprisingly – deviates from the nominal, the medication scheme (timing, dosage, ... ) is adapted to account for the input from reality.

The above reveals that activity models need to account for a range of situations. They need to account for an unpredictable and uncontrollable reality (e.g. patient responses to medication). Particularly, the models are to account for the patient state (over time) as a resource. Activities will adapt not only to account for reality but also for the (predicted) patient resource availability. Activity type models will be non-deterministic, knowledgeable of alternative treatments. Activity instance models will be opportunistic.

## Implementation

Reality-mirroring of activities requires our models to have corresponding capabilities: they respond to queries and service requests and self-initiate actions. Accordingly, they are executable code that is interacting in manners mirroring reality. Executable patient models support interaction protocols to answer queries about their properties, state, agenda, intentions (plans) and commitments. Likewise, they are capable of initiating actions. Ideally, the technology used for implementation supports this directly and at high level of abstraction. The technology used for this research – OTP/Erlang – truly qualifies for this role [4]. It was developed in the telecom industry.

OTP/Erlang allows creating one or more persistent computing processes for every patient; over a million processes (threads) execute on a normal PC without a problem. Erlang is a high level language; programs typically are orders of magnitude more compact than their mainstream counterparts. OTP is a middleware comprising a distributed operating system. Stability and robustness are among its strong points. This technology – e.g. used in the Danish Shared Medication Record [5] – provides scalability and a high 24/7 service availability (i.e. capable of 99,999%).

The technology fits well within cloud computing enabling it to use, to ensure privacy, services like VITALINK [5]. Moreover, the low cost of adding computing processes allows splitting of a model's implementation into two or more processes – e.g. a delegator and an executor – exchanging information on a need-to-know basis, enabling fine-grained authorization for information access and disclosure.

Furthermore, the technology supports run-time code updating, allowing enhancing and extending the system without restarting or freezing it. Whenever a model is found to be lacking, corrections and extensions are implemented while systems remain on-line. In combination with a design consisting of communicating processes, changes will be “business as usual”, regardless whether they are software updates or patients changing their mind.

## Remarks

Space limitations prevent discussing the (executable models mirroring) health care professionals and other elements, driving and managing the health care activities of patients. Likewise, many design principles remain unaddressed. This includes having all decision-making elements as separate components, which can easily be replaced. Also, the design only requires interoperability in the manner interactions occur in reality. Finally, the

design builds upon research results from neighboring application domains; more information can be found in [6-8].

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# **Network System of Electronic Patient Medical Record for Telemedicine and Telecare in Kagawa Prefecture and International Future Deployment**

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## **Introduction**

The Great East Japan Earthquake on March 11, 2011 caused devastating damage on the coastal area of the northeastern region of Japan. The medical field was also seriously affected by this earthquake, such as death of medical professionals, destruction of facilities, and damaged/loss of medical records. For short-term disaster medicine and emergency medicine, medical professionals dispatched not only from other parts of Japan but from all over the world devoted huge contribution and managed difficulty. Lately, introduction of telemedicine has rapidly attracted attention in the field of emergency medicine and perinatal medicine as well as chronic disease management. It is necessary to introduce the latest medical information technology (IT) such as telemedicine and electronic record network to reconstruct the medical system in the stricken area. Furthermore, it is necessary to build comprehensive medical IT network that covers whole region, linking medical facility, pharmacy, patients' residence and the resident health check system, let alone mutual cooperation among a core hospital and individual clinics.

Kagawa Prefecture has developed a perinatal electronic patient record system called maternity health record book, "IHATOVE". This system was very effective for maternity management in Iwate Prefecture, one of the stricken areas. Thus, the importance of data center type medical IT network has been recognized. Telemedicine technology draws attention from the government and other related parties as a foundation to urgently reconstruct the stricken area's medical provision system in case of a possible future disaster, Tonankai earthquake in southwest area of Japan.

In this presentation, the telemedicine network developed in Kagawa Prefecture, especially the outline of Kagawa Medical Internet Exchange (K-MIX) and the videoconference system "Doctor Com", combined with electronic medical record functions will be reported.

The Sequence of "Kagawa Medical Internet Exchange (K-MIX)

In Kagawa Prefecture, efforts have been made to establish a patient record network for pregnancy monitoring (perinatal network) as a model work since 1998. In 2003, “Kagawa Medical Internet Exchange (K-MIX),” managed by Kagawa Prefecture, Kagawa Medical Association and Kagawa University, Department of Medicine has started to support remote image-diagnosis. K-MIX was developed on the general budget of Kagawa Prefecture. This was the first project of this kind in Japan led by the whole prefecture. As of March 2012, more than 111 facilities (including 11 outside Kagawa Prefecture) have participated in this project, and it draws nationwide attention (Figure 1).

### The outline of K-MIX

The participating facilities share a common center server, network programs, and managing regulations in K-MIX. This is the first nationwide and user-friendly medical network system.

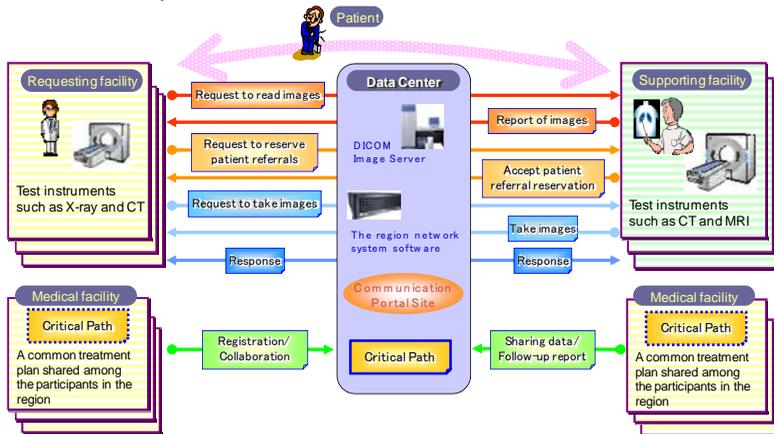


Figure 1. K-MIX Function Reinforcement

K-MIX functions have been reinforced every year from the outset. In addition to DICOM and JPEG format, it can now transmit various format data such as moving images, sound data, and MFER.

Unlike a conventional telemedicine system which generally transmits images and medical data from one medical facility to another, K-MIX places its data center outside of medical facilities. The server is placed at STNet, a company related to Shikoku Electronic Power Co., Inc. The patients' data and images are transmitted to the center server, and medical staffs access the data at this center. The basic functions of K-MIX are: sending responses on CT and MRI images (reporting), referring patients,

requesting for tests, and sharing critical paths. K-MIX was planned to incrementally add functions from the outset. Thus, K-MIX is a complete match with “Seamless Community-collaborated Medical Services” and “My Hospital Everywhere Concept,” and so called Japanese Electronic Health Record (EHR).

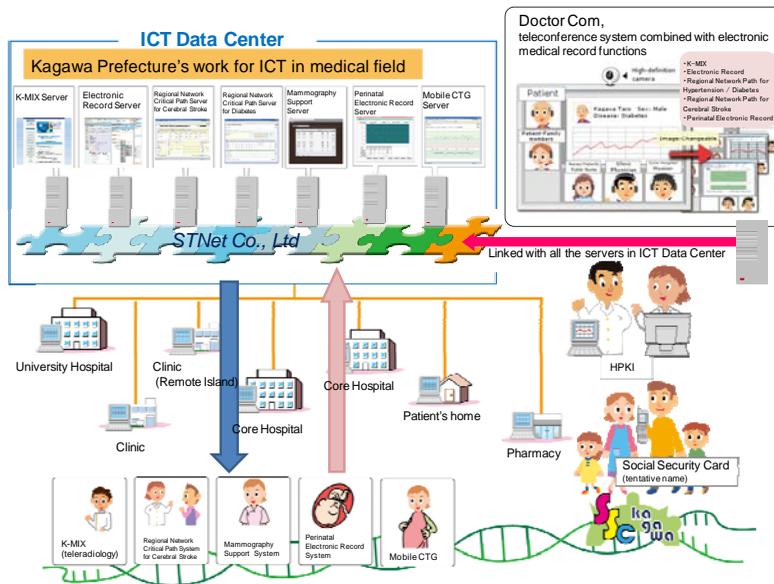


Figure 2. K-MIX for “My Hospital Everywhere Concept”

K-MIX collects and records people’s medical data such as perinatal data and image data. Japanese Electronic Health Record (EHR) is to be realized by combining K-MIX and other servers for the diabetes regional network path, the electronic prescription network and so on.

### Development of Perinatal Electronic Patient Record System Networking Project

With the approach of the society with a low birthrate, the perinatal medicine in our country is experiencing great changes. The Ministry of Health, Labour and Health has been proceeding with a nationwide project for the “Systematization of Perinatal Medicine.” These days, fewer clinics can deal with deliveries due to the aging and decrease in obstetricians. Accordingly, it is suggested that an open/semi-open system for obstetrics be introduced, and cooperation among hospitals and clinics is more important

than ever. Considering what future obstetrics and gynecology should be like, the Japan Association of Obstetricians and Gynecologists Information System Committee has been engaged in the development and promotion of medical IT, in particular a perinatal electronic patient record system that complies with networks. The aim of this project is to integrate the electronic patient record network for perinatal care and the home monitoring system using mobile equipment into a complete network connecting all medical institutions and homes (Figure 3).

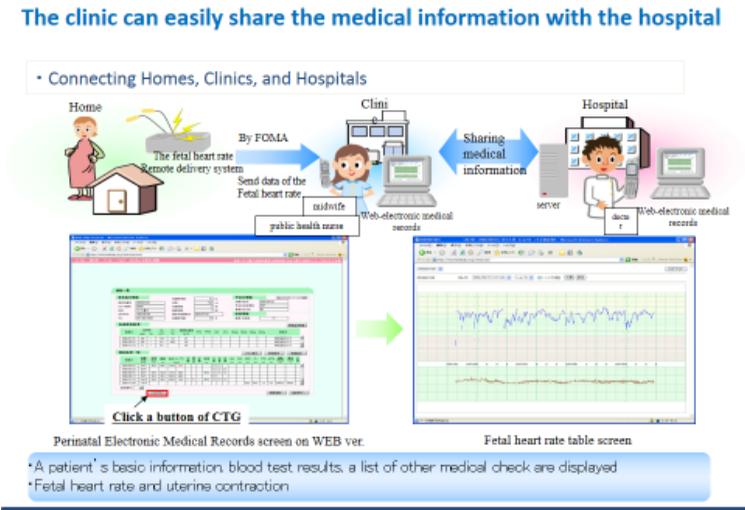


Figure 3. The integration the electronic patient record network for perinatal care and the home monitoring system using mobile equipment

As the first step, we will establish a perinatal network in each of the four regions (Kagawa Prefecture, Tokyo Metropolis, Chiba Prefecture and Iwate Prefecture, "IHATOVE") to meet their own local needs. The systems of the four regions will be connected with one another, with the ultimate goal of networking all perinatal institutions all over the country. Concerning the home monitoring system, the mobile equipment has enabled patients and healthcare workers to exchange information anywhere at any time, and it also functions as a mutual support tool for healthcare workers (Figure 4).

### Conclusion

The Great East Japan Earthquake has drastically changed medical environment, and needs for telemedicine has been rapidly recognized. Introduction of telemedicine technology is necessary to rebuild the medical service system in the stricken areas. It is expected to build a medical IT network which comprehensively links a core hospital, a clinic, a pharmacy, and a patient at home.

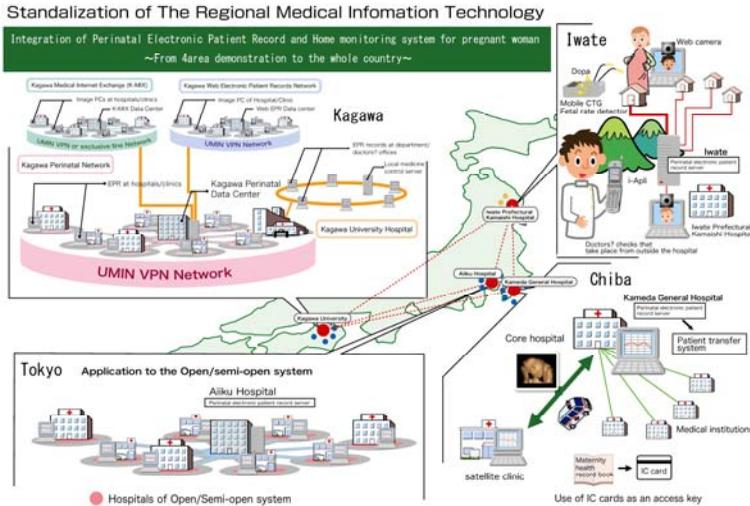


Figure 4. Perinatal Electronic Patient Record System throughout Japan. Integration of the perinatal electronic patient record system and the mobile fetal rate transmission system, starting with model experiments of the four regions to establish a network throughout Japan

In addition, Perinatal Electronic Patient Record Network System combined with the mobile fetal heart home monitoring system for pregnant women will lead to a reliable and useful system for both pregnant women, their families and healthcare workers.

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# Perinatal Telemedicine in Ukraine: Achievements and Further Challenges

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Teleneonatology network in Ukraine joins national Association, primary-tertiary hospitals in six regions, university clinics in 3 regions, international perinatology project and industry.

## Material & Methods

Main tool for the store-and-forward tele-neonatology is a telemedicine web-platform iPath (open source web application written in PHP scripting language and storing the data in MySQL database).

The implementation of the iPath telemedicine platform in Ukraine started in 2003 as part of the Ukraine-Swiss perinatal health project. Since 2009, the Ukrainian iPath platform has been running on a server in Donetsk hosted and maintained by the Association for Ukrainian Telemedicine and eHealth Development. By 2013, this server has more than 1,200 users in 12 groups. More than 1,200 clinical cases have been posted. As a tool of teleneonatology network the iPath platform is officially used by more than 80 medical institutions in 4 regions.

## Results

The pilot project of tele-ECG consultations at neonatal ICU shows good technical and clinical results, including fast and comprehensive diagnostic of cardiac pathology, suggestions for treatment and patients' management tactics. Tele-ECG consultations (duration 10-15 min) were performed for the newborns age 1-27 days (premature infants - 25%, pregnancy pathology ~ 80%). Different changes at ECG were found in 83% of the cases.

During the last 2 years the National Cardiosurgery center operated a few videoconferences networks (room-units and desktop solutions) for teleconsultations of pregnant women and newborns with congenital heart diseases.

## The new challenge

In 2013 an anti-tuberculosis eHealth network was created in the Donetsk region of the Ukraine (due to financial support and kind efforts of Rinat Akhmetov Foundation for Development of Ukraine).

The Network is focused on better management and care of multidrug-resistant tuberculosis (MRTB), but after a few months of operating we found that about 2% of telemedicine consultations in the Network made for children and pregnant women. This is extremely hard clinical and social situation. Thus, we should create special patient-focused approach for such cases. External experts in perinatal medicine, psychologists and social workers have to be involved in work-flow of the Network, also as individual telehealth services at the second stage of MRTB have to be proposed for this category of patients.

# Process of Designing a System for Early Detection and Treatment of the State of Depression in Older Adults

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## Introduction

Mexico's population is aging, this implies the need to design proposals that benefit the existing and growing population, specifically great seniors, many of them require special care involving that can produce problems within a family. Mental health is one of the main diseases afflicting population. This paper presents an approach of an Internet of Things-based System useful to detect and treat early depression in older adults.

This research started with a literature review regarding concepts like Internet of Things (Io), Context Awareness and e-Health. The aim was to establish a state of art concerning the proposed problem and thus validate it. In specific we were interested in discovering similar experiences but focused in elderly people and depression.

Then, a first set of prototypes was developed with the intention to have a better outlook for selecting the appropriate technology that would allow us to monitor and represent a state of depression. Early prototypes were built with Arduino© and compatible sensors. For detection and gesture recognition OpenCV© and a webcam have been used.

Nowadays, a prototype is under construction. It uses Raspberry Pi® for processing and detecting patterns movement, coupled with pulse sensors, temperature and movement controlled by Arduino©.

## Theoretical Approach

Mexico is a country where aging population is increasing [1]. This growth involves the increase of diseases, ailments specific to the elderly and disabled, and so on [2]. And according with de OECD definition for disability in older adults, the Activity Daily Living (ADL) tends to be partially or severe limitations [2]. Likewise is associated to the presence of comorbidities, social isolation and depressed mood, necessitating the use of systematic evaluations for detection [3]. The ADL in older adults is impaired by increasing ailments where the main character is mental as related to mental disorders such as depression and Alzheimer.

Depression is a disorder which affects the thoughts and feelings of a person and their ADL. It can be associated to physical problems, such as sleep, appetite, energy, libido and various body pains. It also relates to a reduction in physiological activity, including emotion and cognition [4]. According to the World Health Organization (WHO), depression is common in many countries [5]. For detecting depression there are various tools and methods such as the Geriatric Depression Scale (GDS) [3].

### The Internet of Things (IoT) for detecting Depression

The concept of IoT opens the possibility to make proposals and generate profits in the health sector. The IoT allows interaction between people, between people and objects with objects [6]. This raises new forms of communication using [7] "open" standards and "persuasive" services; [8]. Moreover said the IoT refers to the networking of everyday objects [9].

The IoT aims to improve the ADL through proper management of information and transforming it, making the "processors" can perceive and integrate this to react in all sorts of aspects of the physical world [10].

Context Awareness (CA) and the e-Health arise within the model of IoT. The CA aims to acquire and utilize information about the context of a device, an environment or a person [11] to provide services tailored to a particular need, referring to the physical and social situation in which computational devices are integrated [12].

The e-Health has used development of wireless technologies, especially wireless sensor networks and techniques to improve ADL through monitoring and treatment of patients ubiquitously [13]. In healthcare, sensors and data links offer possibilities to monitor the behavior and symptoms in real time [14], resulting in benefits such as prevent deterioration, helping older people and involve family [15].

The increased use of mobile devices or smart phones with Internet access, set the tone for the development of new applications for monitoring of patients with diseases [16].

### Empirical Approach

We started with the relations between psychological and physiological signals, in which to establish elements like temperature and heart rate to identify a mood or an emotional pattern [17].

Given this, a system that could detect the state of depression and then execute actions to start treatment early, not integrated to reduce the severity of depression in older adults is proposed. It approach take as a technological basis the IoT, but it also considers some elements regarding CA and the e-Health paradigm.

## Detecting a Depression state

Initially, the idea was to identify depression by recognizing the context and gesture. The data collected to identify the CA would be built by obtaining the lighting data, the color of the environment, temperature and humidity. Moreover, the gesture recognition gesture would help identify the Elderly equipping gesture recognition elements that would allow detecting emotions [17]. It was determined that a gesture is a sequence of postures linked by movements in a short span of time. Usually a sign consisting of one or more positions that occur sequentially in the time axis [18] and in the end, the collection of gestures would become a series of commands that should be learned by the system [19].

Given this, we establish that the main parameter for identification of a state of depression is lack of physical activity, we take as granted too that the postural recognition is often the main target for recognition system in elder care [20]. The aim is to register a "pattern" to represent the ADL of elderly, in addition data from body temperature and heartbeat will also be related.

By identifying this "pattern" movement, governed by the ADL, we will be able to build a data model of space and time, pulse and temperature. This model is constantly compared through gesture recognition and data, so that when an event is recorded (Event is defined as the abnormal situation in the "pattern" such as prolonged stay in one place, deviations, changes in body temperature and heart rate) is recorded and notice of the treating doctor for a message (either a SMS) and their dependents.

### Prototype Design

The use of physical computing (PhC) is a requirement. We highlight the use of software and hardware free or Creative Commons, specifically used Arduino©.

Prototyping arises through raise three modules: data collection module 1 as the ambient temperature sensor is (DS18B20), lighting (YwRobot 553 518), color sensor (TCS230) and humidity (DHT11) connected by Arduino Pro Mini©. Module Two will connect a PIR motion sensor, two servos and a camera OV7670 SG90 FIFO controller using an Arduino Mega 2560©. Module 3 aims to collect user data (elderly) through a LilyPad© connecting a three-axis accelerometer (MMA7361), a temperature sensor (DS18B20), blood pressure sensor (pulse sensor©).

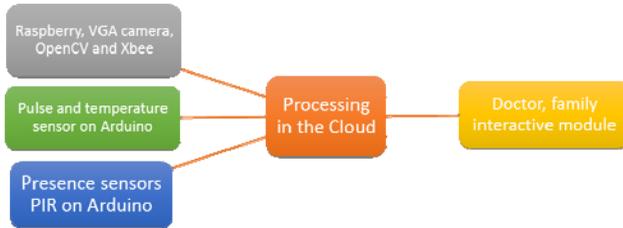


Figure 1: Model for the Prototype System Detection and early treatment of Depression

Each of these three modules would be communicating information through a network of point to point using Xbee® S2 module that will send the information via Internet connection and would be processed in the Cloud to implement actions or send the proper information.

#### Changing the Hardware

Tests with Arduino®, in any of its versions, was not suitable for image processing, so the Raspberry Pi was chosen as the main processor element for images, in addition to the OpenCV® gesture recognition technology for a Linux environment . The Arduino pro mini® and Xbee® to retrieve information from the Elderly body and to place motion sensors controlled by Arduino® pro mini in places where it is necessary to maintain the privacy of the Elderly.

For the operation of the Raspberry and gestural recognition is tested three distributions of Linux (Piadora, Raspbian and ArchLinux™) general purpose, selecting ArchLinux ARM.

OpenCV® library for use as the principal object detection technique specifically "Haar-Cascade" for identifying with the advantage that consumes less computing resources, something necessary for this project. The selected programming language is C / C + + and compilation with "gcc" additional libraries and application development.

#### Work to do

The next step is to perform a "pattern" model, collecting data x and y, and movement in a predetermined base built in the "pattern" model time. The second step will be the design of the algorithm used to identify the events that can trigger the alert to the treating physician and the family caregiver.

For algorithm design, decision theory is used, particularly the deterministic and probabilistic chaos that arises generate a model from the call been ideal or perfect scenario, which in this case will be "track" Dream

given variables by X, and space, the T (time), the temperature T and P the heartbeat [21].

Once model has been established and tested, the prototype will be applied to AM patients who have been diagnosed with some type of disorder and depression that can determine their "pattern" in the ADL and, where appropriate, identify depression Events.

### Conclusions

At the moment it can be concluded that the proposal is viable. The technology available is sufficient to carry out the project with low cost and use of limited resources. We still need to do some laboratory work before using it with patients, however collaborative and interdisciplinary work give positive expectations to reach a successful conclusion.

This approach can have others applications, if it works as expected, like in the case of detecting falls in older adults, monitoring Alzheimer looms and even increase variety of people with diseases that require identifying a pattern of behavior.

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# Serious Games in a Health Care System Aimed to Train and Monitor Cognitive Functions in Elderly People

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## Introduction

Medical and health care services are finding opportunities in increasing low-cost and pervasive technologies (i.e. anywhere, anytime and from any device) facing challenges such as the aging of the population. Projections of United Nations and the European Commission [1], [2] agree in the enormous growth of population exceeding 60 years and in its social and economical impacts in the near future. This is particularly true in the case of health issues and health care which has promoted the launch of many public and private initiatives in the matter.

In this context we've developed a health system aimed to offer the elderly an environment where its cognitive capacities can be monitored and exercised, promoting to keep them in good health at home for a longer time.

This paper discusses the importance of using the so-called serious games at the base of the activities to be achieved by the patients and show some considerations followed in its design cycle.

## An e-Health Care System for Elderly People

A first prototype of the discussed e-health system is already in a test phase. At the base of the system there's a set of activities aimed to exercise the patient's cognitive functions. In the next section the system is briefly described. Some of the main proprieties of serious games, pointing out their use to exercise cognitive functions in the elderly are also discussed as well as the game's design cycle.

### *System's Description*

The e-health system at the base of this paper focuses in the elderly affected or threatened by neurodegenerative diseases as the Alzheimer's Disease. The core of the system is a set of specially designed activities to exercise the cognitive capacities of patients. They include reading newspapers, watching videos and playing educational and therapeutic

games (serious games). The activities' difficulty level can be adapted according to the progress of each particular user.

There are three usage levels in the system: the first one is for the healthy elderly people, who can accomplish the activities autonomously, they may even benefit from the remote assistance of a tutor. The second level is for elderly people already affected by the disease that needs the aid of an assistant. The third level is for a collective usage, under the direction of a group leader, where the patients' results are managed individually.

At the base of the system, common to all users, there's a touch computing device, a tablet, through which all activities are effectuated and the patient's information and progress is remotely managed at the system's site. The first tests have shown that the tablet is rapidly accepted by the targeted users, Fig. 1.

The system's development is supported by a multidisciplinary team composed of partners who contribute their knowledge and experience from different fields: content creation, interactive and shareable games, cognitive exercises, specialized medical approach, medical information security management, information and communication technology for health, and computer networks.

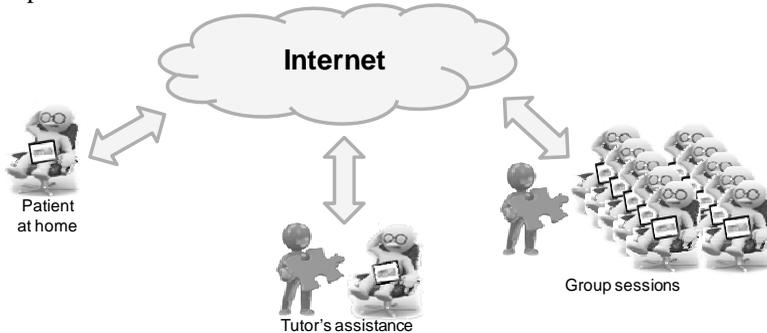


Fig. 1. Cognitive training system's usage levels

### *Health Care Serious Games*

Among the activities set proposed to the patients the educational and therapeutic games represent the one with the greatest chance of cognitive impact in the patients. This kind of games is part of the so-called serious games, which are specialized in other purposes than just entertaining [3]. A formal definition in [4] states that a serious game is "a mental contest, played with a computer in accordance with specific rules, that uses

entertainment to further government or corporate training, education, health, public policy, and strategic communication objectives”.

A broad overview of different applications of serious games can be found in a survey of games related to health [5].

The use of serious games in an e-health system has multiple benefits. Many works have already pointed out some of them. In particular, in using computer based activities for training and therapeutic goals, we can mention the following:

- The digital game form does make the tasks more exciting and induces a heightened sense of flow in gamers of all ages [6-7];
- Repetitive tasks are part of therapeutic activities and they can be designed to be attractive and fight against patient’s boredom [5];
- The game can be adapted to the cognitive state of each patient [8];
- Monitoring and real-time game estimation of patient’s cognitive performance can be assessed during the game [8];
- Simulation of real-life situations without the physical risks associated to people suffering from this disease [7];
- It allows for ubiquitous training, not needing to stay in a training and therapy center [9].

Other results show that digital games make a positive experiential difference for the elderly when solving logic problems [6]. Additionally, the so-called mixed reality serious games, as applied for rehabilitation after stroke, have a higher potential to be accepted by patients [10]. Finally, related to the management of information issued from an e-health system, a cloud-based serious game for obesity is discussed in [11] which has the possibility of remotely collecting in-game patient information.

There are many more examples, supported by real tests that show the benefit of using serious games in an e-health context.

### *Serious Games Design*

In our case the games are defined in such a way that 6 cognitive domains of the high-order thinking functions are stimulated: memory, attention, executive functions, language, visual and spatial skills, and volition. In particular, the designs cycle of a game into our system observes the following steps:

1. The medical team defines the cognitive and social goals to be reinforced by an activity as well as the role of each participant: elder, patient, helper and group leader;
2. The game concept is transmitted to the cognitive games expert team who develop a prototype game;
3. The prototype is review and feed-backed by the medical team;

4. The prototype is delivered to the production team who produces the final game taking into account aspects as the game art and the usability.

## Conclusion

We have discussed the importance of using serious games at the base of the activities to be achieved by the patients using our health system dedicated to the training and therapeutic cognitive care of elderly people.

The main considerations in the design cycle of the games have been shown; where a huge relation between the game creation team and the medical team is required among the final production team in order to achieve a game that really accomplishes the targeted goals.

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# The Role as a PHR in the Specific Case of the Electronic Maternity Passbook

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## Introduction

Declining birthrate and aging population of Japan have been progressing from early compared to Europe. Currently, 25% of our total population is over 65 years old. It has been estimated that the rate of aging will be 30% in 10 years, and a nearly 40% in 30 years. This means that the number of young people who take care of the elderly people will also be reduced. The current care system will no longer work. An era is coming up where people manage their own health. We say it is a current problem that such practice has not yet taken root among people.

## Current Issues

In recent years, lifestyle-related diseases have become a problem in the world. Incidence of diabetes is significantly higher in our prefecture. Once a person contracts diabetes, he cannot cure the disease. Diabetes is one of the diseases that require health care the most. Patients with diabetes need to travel various facilities depending on the degree of the disease. To treat this disease, we thought PHR, community medicine, and telemedicine was valid. Thus, we developed a diabetes passbook system for patients. We asked doctors, nurses, pharmacists, and patients to use our diabetes passbook system "Karada-Navi." Diabetic patients were able to enter into the system daily data of insulin injections and blood sugar level, and the paper-version passbook was no longer necessary. The patients started to understand their check-up results more clearly by entering their own data. Because patients can visualize and evaluate their check-up results with graphs, their motivation for treatment has increased. However it could be difficult to use an electronic passbook for the generation that is not familiar with tablets or smartphones.

## Development of the Electronic Maternity Passbook

We have decided to develop an electronic maternity passbook. Because maternity passbook is the starting point of the PHR. We assume that

relatively young women who use a maternity passbook already utilize a tablet or a smartphone. We take advantage of the experience gained in the development of electronic diabetes passbook "Karada-Navi." We emphasize that this system is connected to the hospitals' information as well as the municipal information. When a patient tries to maintain one's health, diabetes or perinatal care indeed requires self-data management. We decided to proceed with the development based on the opinion of the medical staffs and patients at one of the major hospitals in Japan.

The electronic maternity passbook is named "Mama Note". The concept of this electronic maternity passbook is after the information of the user is automatically input from his municipal and his primary care hospital, and the user has confirmed the information, then the user can take the necessary action immediately from the system. This system has an advantage not only for the direct users, that are women raising children or pregnant, but also should bring benefits to hospitals and local governments where she belongs, any shops or companies that she is interested in.

#### Collaboration with Simulated Hospital Systems

The hospital we asked to use our system already had implemented an electronic medical record system. In order for our system to connect to their EMR system, our security policy and their hospital policy have to come to an agreement. It will take some time to solve this problem. We first limited "Mama Note" to manage pregnant women's data only. Doctors and midwives enter the data into a simulated hospital system and pregnant women receive her health information through "Mama Note." "Mama Note" users can also enter the data by themselves. In "Mama Note", they can see a list of the information, graphs, images, calendar, gestational age, time line and medical examination results etc. in accordance with her age.

#### Summary

For 10 years, we have been developing perinatal electronic medical records. In addition, we have developed perinatal telemedicine, as well as perinatal emergency system. It is desirable that the information gets entered into the PHR via a system like "Ihatov" which fuses municipal data and hospital data. We are further aiming to develop a PHR mechanism where you can obtain information from many companies or shops upon request. It will require a standardization of data and operation. It should not be also forgotten that a unified national ID should be incorporated in advance in the PHR system design.

#### Acknowledgment

We express our thanks to the Electronic Maternity Passbook Standardization Committee for the standardization of operation and data normalization.



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# **eHealth for Low Resource Settings and Developing Countries**

# **A Conceptual Model of Practitioner Authentication for Telemedicine Services in Developing Countries**

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## **Introduction**

Africa has a disparate burden of disease, shortages of health professionals, unequal workforce distribution, large rural populations, poverty, low levels of literacy and limited infrastructure [1-2]. Telemedicine is seen as a potential solution to some of these problems as it allows medical providers to evaluate, diagnose, treat, share expertise, give guidance and follow-up care to patients and provide continuing medical education to their peers at a distance [3]. It also offers the opportunity of overcoming the shortage of doctors through international cross border telemedicine.

However, cross border telemedicine raises legal and ethical concerns [4]. Doctor anonymity, an important but less often cited regulatory issue, can be resolved through practitioner authentication. The e-Health Strategy Toolkit identifies authentication as a foundational element for establishing an e-Health strategy and subsequent services [5]. Authentication will be of particular importance in cross border, international telemedicine where one will want to know that the doctors participating are qualified, licensed and in good standing within their own jurisdictions.

Currently in the public sector in South Africa, as in other developing countries, telemedicine activities proceed largely in the absence of formal authentication processes. Where authentication exists in South Africa it is usually in the form of userid and password or linked to a specific device and password [6-7].

This paper proposes an agent-based conceptual model of doctor authentication, that is device and service agnostic for a developing country as part of a telemedicine episode.

## **Methods**

Structured literature search was undertaken on PubMed, Scopus, Science Direct, Google Scholar and IEEE Xplore supported by information extracted from industry standards and best practice models and architectures found in the public domain. A thematic analysis using the key descriptors “authentication”, “developed world” and “developing world” focused the

search. A theoretical framework of General System Theory, Generic Component Model, Generic Component Model, Service Oriented Architecture, and Software based agents was formed, providing a set of structures and guidelines that influenced and shaped the proposed conceptual model.

## Results

A conceptual model was thus created, that provides a modern consistent architectural framework that surrounds legacy systems with new reusable component orientated processes and services. In principle, a services environment with SOA and software agents encapsulated the essence of this model, as shown in Fig. 1.

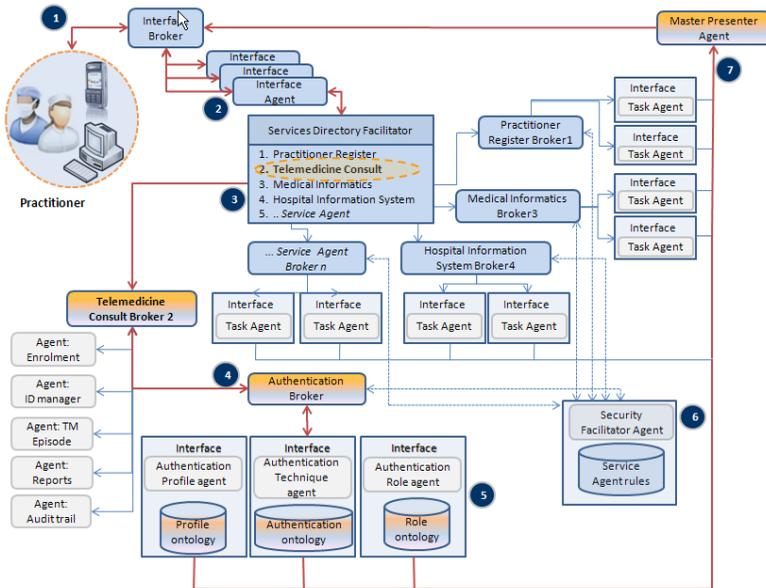


Figure 1: Authentication capability using software agents and 'intelligent' routing

Starting at step 1, the practitioner (user) uses any device (e.g.: smart phone, PC etc.) to access the healthcare services. The point of entry is at the interface broker (IB) which provides direction and acts on behalf of user interfacing with agents transparent to the user. IB actively interfaces with

and transfers metadata to the relevant interface agent (IA) which can present, store and interact in accordance with the users' device format. At step 2, the IA verifies the request by transferring the meta-data to the Service Directory Facilitator (SDF). The SDF menu has service broker agents for 1) Practitioner registration, 2) Telemedicine consultation, 3) Medical Informatics, 4) Hospital Information Systems with other service broker agents allowing for expansion.

At step 3, the SDF examines incoming requests (e.g.: Web service requests, Wireless service requests, SMS service requests, Email service requests and Utility requests) and routes the metadata to intermediary broker agents within the relevant domain. The SDF now selects support from the telemedicine consultation and the data is transferred to the telemedicine consult service broker agent (SBA).

At step 4, the telemedicine consult SBA, for the purpose of this example, focuses on authentication, and metadata is transferred to the authentication broker agent (ABA). This ABA is responsible for multi-service agents which contains agents with reusable functionality. At step 5, the ABA connects with interface agents that have designated tasks and confirms the practitioners' authentication profile, role and technique ontology associated with the device details in the metadata.

At step 6, the ABA, along with all other broker agents, must have connected to the Security facilitator agent (SF) that protects the agents and system from unauthorized access. At step 7, all interface agents route to the Master Presenter agent (MP) which ensures final response and display to the IBA at entry point. The output is displayed in a suitable format for the user or user stereotype (i.e.: nurse, doctor or specialist). The response is tailored for display using the interface ontology. As suggested by Singh [8] this is of particular value in a developing country with perpetual mobile device software upgrades and need for adaptive display is necessary considering the cultural dynamics.

### Conclusion

The model is generic, not restricted to Telemedicine clinical services only and can be applied in many business environments. The architecture remains unchanged as it interfaces to relevant systems like Electronic Medical Record (EMR) and Hospital Information Systems (HIS). The conceptual model caters for flexible, simple, shared services, aligning business and IT, considers globalisation and leverages scarce medical skills to reaching underserved communities in geographically remote areas. Adopting this generic conceptual model for a developing country can

potentially assist decision makers manage Tele-Health Services and possibly incentivize doctors offering this service.

The model is valid and relevant to the existing regulatory issues in South Africa possibly meeting regulatory authority requirements and erases the contentious Telemedicine perceptions of ethical practices and overcome the lag in its adoption in a developing country.

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# Experience of Tele-Medicine Implementation to Counteract Professional Isolation of the Healthcare Specialists

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Human resources (HR) are the key strategic elements of the healthcare system. Specialists who render medical services to the people define the status of the healthcare system in the society, efficiency of its functioning; play decisive role in primary and tertiary care system. HR are characterized by high profitability as the specialists training expenditures, their upkeep and development are significantly lower in comparison with the social and economic effect that society receives when keeping human and labor potential.

Analysts, who studied problems of medical specialists, noted the aggravation of human resources for health (HRH) issues in the world. Urgent and coordinated measures should have been taken to counteract HRH crisis [1-4]. The analyses of HRH problems of various countries indicated the similarity of the formed problems. Shortage of health workers was estimated as 4,3 million specialists worldwide [1].

In spite of the fact that the medical service density was higher in Belarus than in the developed countries there was also indicated evident shortage of both doctors and nursing personnel. There were 46760 specialists with higher and 112992 with secondary medical education who worked in the system of the Ministry of Health of the Republic of Belarus in 2012. Doctor/population ratio and nurses/population ratio counted 49,4 per 10000 people and 119,4 per 10000 correspondingly [5]. Together with that medical service density was characterized by the shortage of employees, concentration of specialists in cities, a great deal of hospital staff and small in PHC system. There were also noted such HRH problems as misbalance of specialists and non-optimal doctor/nurse ratio [6].

The problems of HRH upkeep in Belarus were similar to the ones of the post-Soviet countries, e. g. irrational usage of the existent HRH, their

limited reproduction, discontinuation of work based on the brain drain from the healthcare system.

One of the main reasons for HRH problems in Belarus is the peculiar demographic situation – ageing of the population. Professional brain drain and migration to other economic sectors are indicated as hot issues for the healthcare system. Yearly 3000 healthcare specialists leave the organizations of the Ministry of Health. The main reasons for this professional brain drain are external and internal migration, natural loss of medical staff connected with retirement, disability and death.

The main reasons for internal and external migration of HRH are dissatisfaction with the payment, housing, carrier development opportunities, social status change (marriage) and etc.

There is a real risk of the increase of Belarusian HRH brain drain to the Russian Federation and European Union countries. It happens because of the existent particular programs of hiring healthcare specialists from the neighboring countries assisting them with adaptation, language learning and immigration.

It should be emphasized that professional isolation of medical specialists has an influence on the shortage of HRH (brain drain). The main reasons for professional isolation of doctors and specialists with the secondary medical education are territorial remoteness, low level of availability of modern information technologies, insufficient financial and technical resources, etc.

The strategy of equal access to primary healthcare is implemented to counteract professional isolation and brain drain of HRH from scarcely populated and remote areas of the Republic of Belarus.

In Belarus outpatient clinics of general practitioners (GPs) are fitted with the required telecommunications equipment; educational center for GPs is set up; eLearning seminars are carried out by means of tele-consultations and tele-mentoring systems.

The main problems with the IT implementation are connected with the financing and telecommunications organization. It is of a great importance to equip doctors' working places with modern computer technologies, to develop and adopt regulatory and a legal base on telemedicine for the efficient implementation of tele-consultations. On-line emergency consultations using carrier channels and postponed off-line consultations are defined as the most perspective forms of tele-consultations.

HRH qualification development also plays an important role in counteracting professional isolation. State Educational Institution Belarusian Medical Academy of Post-Graduate Education is the leading educational establishment which provides medical specialists with equal opportunities to improve their qualification and professional skills. There

are more than 15 thousand doctors who study at the Academy every year. The Academy consists of 4 faculties (Surgery Faculty, Therapy Faculty, Faculty of Public Health and Healthcare Management, Pediatrics Faculty) and 53 departments. Educational platforms of the Academy's departments are based on 55 medical prevention organizations of the Republic of Belarus.

Self-education of HRH also plays an important role in the development of a medical specialist's qualification. E-learning is the most effective approach in realization of the form of HRH professional development. In Belarus specialists' working places should be equipped with modern technologies to make e-learning implementation more efficient. It should be mentioned that there are certain restrictions for e-learning of doctors. The main one is connected with such technical aspect as lack of the required equipment. These restrictions are also connected with the obligatory element of medical education – bedside teaching.

There is also a problem of professional isolation in the Republic of Belarus. It is important to carry out large scale implementation of eHealth systems for the positive solution of the above mentioned problem. The most perspective directions of tele-medicine development in Belarus are tele-mentoring and tele-consultations.

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# ICT in Counteracting Brain Drain and Professional Isolation of the PHC Specialists

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## Introduction

Analysts who studied problems of medical specialists noted the aggravation of human resources for health (HRH) issues in the world. Urgent and coordinated measures should have been taken to counteract HRH crisis [1-4]. The situation of HRH shortage and professional isolation are typical not only for European Union countries but also for Russia and Belarus [3-5]. Many specialists have an opinion that implementation of the eHealth technologies will serve as one of the solutions to counteract brain drain and professional isolation. The Northern Dimension Partnership in Public Health and Social Well-being (NDPHS) offered its Belarusian partners to become members of the international project “Counteracting brain drain and professional isolation of health professionals in remote primary health care through tele-consultation and tele-mentoring to strengthen social conditions in remote Baltic Sea Regions”, PrimCare IT. PrimCare IT project implementation in Belarus was carried out by the State Educational Institution Belarusian Medical Academy of Post-Graduate Education (BelMAPO) which is the leading educational, scientific center and the health care institution Ostrovec Central Regional Hospital (OCRH).

Within the framework of the project Belarusian partners implemented tele-mentoring and tele-consultations into the work of doctors from remote areas and studied opinion of Belarusian Primary Healthcare specialists on the usage of Information and communications technology (ICT).

## Materials and Methods

Interview was chosen as the method of the study. There was developed an interview template including questions on ICT (tele-mentoring and tele-consultations) usage in medicine to analyze the opinion of the specialists (incl. GPs) who had worked in the remote areas of Belarus and to study its influence on brain drain and professional isolation. The interviewees were instructed and informed about the terms and procedure of the research. The

minimum term to fill in the form was 20 minutes and 40 minutes – maximum.

There were 26 specialists who participated in the interview. There were 6 GPs, 16 OCRH doctors and 4 highly qualified specialists of the General Practice Department of BelMAPO including 1 Doctor of Medicine, professor and 3 PhDs, associate professors. None of the 26 participants refused to participate in the interview.

There were 10 (38.5%) male and 16 (61.5%) female participants of the interview. Among the interviewed the relative density of the people with the age 25-30 years counted 15, 4% (4 of 26), 31-40 years – 15,4% (4 of 26), 41-50 years – 19,4% (5 of 22), 51 and older -31,8% (13 of 26). The mean age of the participants was 47,4 years including mentors - 66,3 and mentees - 43,9 years.

### The Results of the Study

There were 26 specialists who defined the following factors of influence on brain drain: payment, lodging provision, professional isolation, territorial remoteness, available technologies and etc. The main factors of influence on professional isolation included: territorial remoteness, absence of the possibilities to communicate with colleagues, low information provision level, working load of a doctor, low level of technologies and lack of motivation for self-improvement.

Almost half of the specialists (12 of 26) considered that tele-mentoring and tele-consultations had not been the leading factor of counteracting brain drain in remote primary health care (PHC) specialists. However, 15 of 26 professionals considered that tele-mentoring and tele-consultations could counteract professional isolation in remote PHC.

The main arguments of the participants who considered that tele-mentoring and tele-consultations had been able to counteract professional isolation were the following: possibility to improve qualification, possibility of experience exchange, possibility of education, possibility to support communicational connections also with qualified specialists-mentors.

The interviewed specialists had an opinion that the main disadvantage of using tele-mentoring and tele-consultations was that they could not have solved the following problems: labor compensation; lodging provision; experience gaining; remoteness from civilization. Besides, the main arguments of the less significant part of the interviewed that tele-mentoring and tele-consultations had not been able to counteract professional isolation were the following: lack of motivation of doctors to use new forms of education and consultations, low equipment provision, lack of experience in tele-mentoring participation.

The main obstacles which prevent specialists from participation in e-learning and tele-consultations included: equipment, lack of normative legal base, which regulated the process of e-learning and tele-consultations, poor experience in tele-consultations and tele-mentoring, lack of time due to the working load of a specialists, low level of telecommunication network quality; lack of motivation to use ICT.

However, it should be mentioned that all the 26 participants of the interview demonstrated positive attitude towards tele-mentoring and tele-consultations and high interest in their implementation into the healthcare of Belarus.

### Conclusion

All the interviewed specialists acknowledged the importance of tele-mentoring and tele-consultations implementation to support PHC specialists in remote areas.

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# Needs Assessment of Telemedicine in Afghanistan and a Global Call for Action for an International Tri-Partnership Agreement

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## Introduction

Telemedicine improves access to healthcare in underserved communities by removing time and distance barriers, extending the reach of medical education, and optimizing the use of limited health services [1]. However, due to armed conflict, poor technology infrastructure, and complex geographic terrain in Afghanistan, telemedicine projects are challenged and have been significantly hindered [2].

WHO-ATLAS eHealth Country Profiles, Global Observatory for eHealth Series –Afghanistan Results: The World Health Organization (WHO) completed a 2009 global survey on the state of eHealth development in 114 WHO Member States. Survey results show the current information and communication technologies (ICT) used for health and provide data regarding the progress of eHealth applications in Member States [3]. Though Afghanistan reported no national telemedicine policy, a lack of technical expertise was the only validated barrier to development of telemedicine in Afghanistan [3]. Furthermore, other factors, such as cost and cost effectiveness, evaluation, legal and ethical concerns, impact on human resources, and patient perceptions were described as not significant.

## Methodology

The primary goals of this study were to: 1) identify Afghan telemedicine initiatives categorized by implementing institutions and describing best practices from each initiative; 2) characterize the extent to which Afghan healthcare professionals understand the concepts and practices of telemedicine; 3) determine the needs of community clinics for providing, sustaining, and/or expanding telemedicine services; 4) identify technology capacity of community-based health providers; and 5) provide recommendations for a sustainable nationwide telemedicine program. Research included a comprehensive literature review with the selection criteria including studies pertaining to telemedicine initiatives or

interventions in Afghanistan for the *civilian/national* population. It also utilized a survey instrument called the “Afghanistan Telemedicine Needs Assessment Survey” administered to participants affiliated with the Afghanistan Ministry of Public Health (MoPH) and leading Afghan physicians/healthcare administrators. The focus of the survey was to examine perceptions and attitudes on the knowledge of telemedicine use within the country and current needs of healthcare leaders and community health centers in providing and expanding telemedicine services.

## Results and Discussion

Identifying areas of knowledge deficit, potential best practices, and improvements in the standards of processes were the specific aspects reviewed and analyzed in the two cases that met the review inclusion criteria for the study. The first case involved the joint efforts of the Aga Khan University Hospital (AKUH) in Karachi, Pakistan, Aga Khan Health Services, French Medical Institute for Children (FMIC) in Kabul, Afghanistan in connection with Roshan, Government of Afghanistan, Cisco Systems, and Bamyán Hospital in Afghanistan’s first telemedicine project. The first phase of the multiparty telemedicine project consisted of linking FMIC Kabul to AKUH Karachi. The second phase extended the link to Bamyán Provincial Hospital (a region with the highest level of maternal and child mortality) [4]. Initial services provided included teleradiology with the goal of providing an average of 60 to 80 transmissions and 10 to 15 teleconferences between hospitals per month, with services increasing over time. Project extension included expansion to Faizabad Provincial Hospital in March 2010 with further expansion to Kandahar Province with Merwis Hospital [4]. Telemedicine challenges identified in the studies included provision of care, learning, and information management needs [4]. The efficacy of telemedicine initiatives was not discussed nor were specific procedures for implementing capacity building initiatives provided. Additionally, the need for telemedicine to facilitate e-learning, hospital management, nursing training, and specialist clinics was identified.

The second case involved the Swinfen Charitable Trust. In this case study, implementation of telemedicine links between medical practitioners in the developing world and expert medical/surgical specialists from various developed countries provided free telecom assistance. This link facilitated low cost healthcare for 200 telemedicine cases in Afghanistan [5]. Best practices from this initiative included the need for referrals of obstetrics in Afghanistan [5]. A telemedicine support system was seen as beneficial, sustainable and exemplified effective case-based learning that could be

provided to local community Afghan physicians, leading to improved quality of care and subsequent improvement of care for future patients.

The comprehensive needs assessment survey was provided to 22 key healthcare leaders in Afghanistan (90.9% men, 9.1% women) of which 22.7% were Ministry of Public Health (MoPH) Afghanistan directors, 13.6% U.S. military medical/healthcare directors, 9% hospital administrators, 9% national healthcare consultant/advisors, 13.6% health managers, 4.5% WHO/CDC health director, and 27% whom did not specify affiliation. Causes for the lack of a successful national telemedicine program in Afghanistan are summarized in Figure 1 below. Findings show that aggressive management of any Afghan health system telemedicine program is crucial for success.

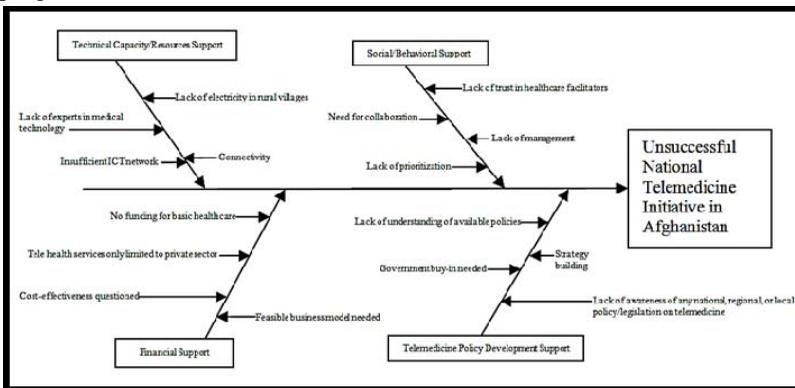


Figure 1: Support barriers as causes for unsuccessful national telemedicine initiative in Afghanistan

Based on analysis of survey results, recommendations below could facilitate the implementation, continuation, and sustainability of telemedicine services in Afghanistan and could provide transferrable knowledge to provide access to care for underserved populations.

### Recommendation

*#1. Installation of knowledge of telemedicine in all medical facilities and “buy-in” of all national healthcare practitioners:*

- Identify the complex roles and capabilities telemedicine can offer;
- Establish system-wide initiatives to provide direct awareness to managers and health professionals through practical demonstrations of telemedicine;

- Teach Afghan physicians and healthcare administrators to proactively champion efforts in creating and implementing telemedicine programs;
- Develop national videoconference-based graduate educational course(s) on eHealth & medical technology for medical trainees as prerequisites.

*#2. Creation of Policies and Procedures for Telemedicine Implementation:*

- Organize round-table discussions at the Afghanistan Ministry of Public Health and legislative bodies for telemedicine education and policy;
- Establish telehealth as a public policy priority and incorporate tediagnosis and teleconsulting into the primary care public health system;
- Create national telemedicine policies;
- Pursue national and local governments' investment in building IT infrastructure to enable telemedicine utilization.

*#3. Technological Capacity Building through Joint Partnership Effort:*

- Strategically introduce pilot programs requiring lesser broadband connectivity in rural areas (e.g., simple email system telemedicine projects to demonstrate success, feasibility and sustainability);
- Educate and incentivize senior health managers and IT professionals in use of telehealth and demonstrate use at all stages of the care process;
- Share resources with international and national military organizations in various provinces to strengthen technological capacity;
- Coordinate public and private sector engagement and tighten the relationship with healthcare IT firms globally.

*#4. The Strategic Solution of a Business Proposal for Telemedicine Global Tri-Partnership Pilot Program:*

- Create telemedicine partnerships with facilities and organizations capable of providing the necessary technology and intellectual property;
- Engage academic medical facilities in developed countries as one multi-unit branch of partnership;
- Coordinate and partner with the American Telemedicine Association to promote telemedicine use;
- Strengthen national system through engagement and cooperation of Roshan (mobile network operator (MNO) owned by consortium of international stakeholders) and expansion of telemedicine networks into hospitals and clinics throughout Afghanistan focusing upon areas of greatest need.

## Conclusion

Health care access is minimal or absent in Afghanistan. Reaching all areas of the country is crucial for comprehensive health stabilization and improvement. Telemedicine initiatives have the ability to improve health, reduce disparities, and protect against global threats in the wartorn country.

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

*Session Co-chaired by European Junior Doctors*



# **e-Health and e-Learning: A Way to Transform Medical Education in order to Achieve Universal Health Coverage - Perspective of Medical Students and Junior Doctors**

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## Background

The transformative scale-up of health professionals, education and training is defined as the expansion and reform of health professionals' education and training to increase the quantity, quality and relevance of health professionals so as to best meet population needs and expectations in an equitable and effective manner and, in so doing, strengthen countries, health systems and improve population health outcomes [1]. This multidimensional process involves not only the development of a sufficient and competent workforce but also, the utilization of effective education methods involving new technologies and an access to adequate learning tools in order to ensure that globally there is a health professional workforce that meets the health care needs of 21<sup>st</sup> century towards achieving universal coverage of health systems.

Medical students and junior doctors as new generations of health professionals capable of leading change and equipped with competencies including a culture of critical enquiry and effective use of new technologies [2] must be integrated into health systems and take a lead in a continuous process of adaptation to a new reality in health.

## Objective and Methods

The aim of the research is to conduct a comprehensive assessment of the current situation of e-Health and e-learning within medical students and junior doctors as well as to propose within strategic planning of the project further initiatives that foster community engagement in using e-learning and e-Health tools. The comprehensive assessment is based on a quantitative research among health science students including medical students, premedical students, residents and physicians in training. The approach will

be inclusive of a comprehensive scoping literature review and analysis of systematic reviews covering other related published evidence.

### Conclusions

Increased use of information and communication technologies is recognised as one of the key strategies to build strong education and training systems [3]. E-learning as an innovative teaching and learning strategy as well as the utility of e-Health tools can be perceived as a significant catalyst of much wider change in the curricula, initiating a fundamental shift [3] from inward-looking institutional preoccupations to harnessing global flows of educational content, teaching resources and innovations and addressing critical shortages and gaps in the training of personnel in public health matters.

New generations of health professionals should be considered leaders to implement e-Health solutions into the health systems and perceive [4] e-learning at three different levels: as behaviour, as construction of knowledge, and as a social practice.

The role of cost efficiency and utility of e-Health tools should be emphasized to the public in order to build social awareness for the health workforce education, for future doctor-patient communication and to improve a condition of public health in local environments. Creating a social accountability in using e-learning, e-Health tools and tele-health tools both in high-income and resource-constrained countries becomes a crucial step on a way to achieving Universal Health Coverage.

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## **e-DENT Project: Teledentistry in Languedoc-Roussillon (South of France)**

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### **A Disparity in Access to Dental Care**

Residents of health-, medical-social- and social-care facilities, whether they suffer from reduced mobility or not, have a very limited access to dental care. According to different studies [1], 86.2% of residents have not had an odonto-stomatological consultation for 12 months (Provence Alpes Côte d'Azur region) and 42% of residents have not had one for more than 5 years (Essonne department). At the national level, 35% of dentate residents need conservative dentistry, without mentioning other oral health needs. This may result from the difficulty for healthcare managers finding out dentists willing to come to such institutions and from the nursing staff lack of knowledge about the importance of oral health for people with reduced autonomy.

Oral health of prisoners is also an important issue, even if prisons are equipped with dental offices. Indeed, few practitioners accept to work in a hospital department in charge of prisoners. However, prisons' administration has to offer an oral consultation to every prisoner upon arrival.

### **Telemedicine, a New Juridical Tool:**

For a few years, telemedicine has been developing in various medical fields (telecardiology, teleradiology,...). A law on telemedicine defined and framed this activity [2, 3].

The French Ministry of Health focuses on 5 priority targets for telemedicine [4]: Constant care in radiology, Management of cerebrovascular accident, Prisoners' health, Management of chronic diseases, Care in medical-social structures or care at home.

### **New Tools for Diagnosis**

Oral teleconsultation requires a specific tool: an intraoral camera (Soprocure®). A fluorescent device made of 4 blue LED with specific wavelength is used to diagnose dental caries [5-6] and gum inflammation without any dye solutions.

#### Organization of an oral teleconsultation

Asynchronous teleconsultations are preferred first because they are cheaper, easier to manage and because there is no vital emergency in oral health. Step 1: Nurses take pictures and videos of the patient's mouth and teeth with Soprocure® using 3 modes: Day light, Cario and Perio modes. Step 2: Data are sent to the server, Step 3: allowing the teleconsultation by the dentist who makes diagnosis and plans a complete treatment. He evaluates the dental emergency and proposes the type of dentist or intervention needed (regular, specialist, general anesthesia).

#### e-DENT Project

This "e-DENT" project has been submitted to the "Regional Public Health Agency of Languedoc-Roussillon" which supports the implementation of a survey involving 800 patients (100 prisoners, 100 frail people and 600 elderly people) for an amount of 110.000€. Twelve long-term care homes, three hospitals for frail people and a prison medical department were chosen as sites of investigations. Nurses will apply the camera protocol for each patient at first evaluation and after 4 to 6 months to compare dental status and check its improvement between both consultations. Teleconsultations are carried out by dental students of



Figure 1: Occlusal face of a molar «Day light mode» with Soprocure®

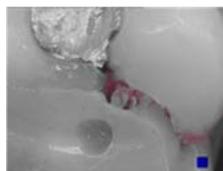


Figure 2: Occlusal face of a molar «Cario mode» with Soprocure®



Figure 3: Vestibular face of a lower molar, "Day lighth mode" with Soprocure®



Figure 4: Vestibular face of a lower molar "Perio mode" with Soprocure®

Montpellier public hospital and by private dentists. Patients and medical staff are thus informed about the treatment needed, and can organize more easily the dentist appointment. The practitioners are then able to plan care and to minimize transport costs for the patient or the dentist. We aim to take maximal benefits from this experimentation to get optimized improvement in oral health and hygiene among this type of population. That is why we are collaborating with ORAL-B (Procter & Gamble, Cincinnati, USA) to teach medical staff the importance of oral health and proper tooth brushing technique. For that experimentation ORAL-B will provide every patient with an electric toothbrush.

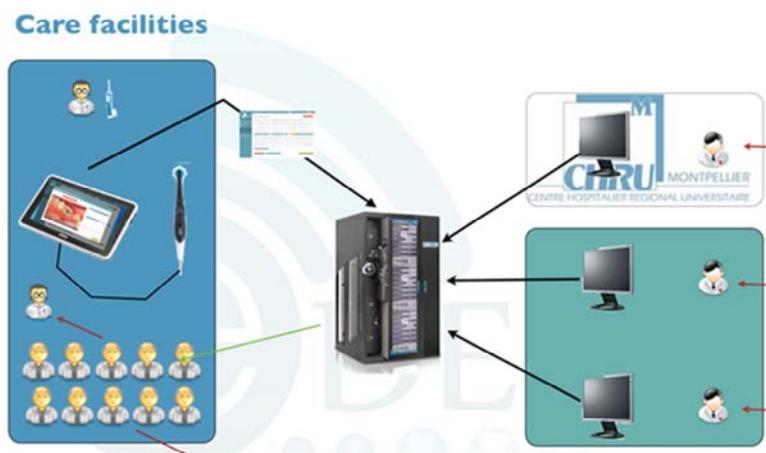


Figure 5: Flow chart of an oral teleconsultation

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# **Electronic Identity Systems for Physicians: The CPME eID Policy**

Birgit Beger

CPME (Standing Committee of European Doctors)

On 23 November 2013, the CPME Board adopted the CPME Policy “Ensuring the secure use of telemedicine and e-health applications in an integrated Europe - Towards a Common Policy Agreement on Electronic ID Systems for Physicians” ([CPME 2013/039](#))

The eID for physicians suggested under this policy is meant to facilitate the identification of physicians in cross-border situations by setting up common security standards that would be accepted as appropriate in the Member States where the policy is being recognised.

The presentation will aim at discussing the potentialities of the CPME eID policy and challenges ahead.

# Engera and EMSA, Medical Students, e-Learning and Voluntary E-Health Service: A Project Proposal

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***Abstract:* Engera African People Caring is a non-profit association founded and constituted by physicians and nurses as well as by volunteers which personally work in the field of healthcare and welfare in Ethiopia. Engera is contributing to the direct health action, to the formation of local personnel, to the construction of new health structures and to the restoration of already existing health facilities in remote villages of this area. EMSA, European Medical Students' Association, seeks to improve the health and quality of care of the citizens of Europe, by acting as a conduit for increased interaction and sharing of knowledge between European medical students in the fields of medical education, medical ethics, medical science, public health and European integration. Engera and EMSA are going to sign a memorandum of understanding which aims to the creation of a cooperation between the two associations in terms of promotion, sharing of human resources, fund raising and e-health project implementation. This e-health project aims to be a social experiment able to connect European knowledge and student human resources with African clinical reality and needs through the constitution of a platform for e-learning/tele-teaching, teleconsultation and empowerment of local voluntary health related personnel. The novelty of the project is in the involvement of medical students in an association which presently is almost based on the work of Junior Doctors.**

## Background and Rationale

Voluntary work has become a necessity to help people of the Third World to gain access to medicine and other help provided, since Africa is one the most exposed continent to different catastrophes because of its geography and social development.

ENGERA [1]: Engera means "bread" in Ethiopian language (Amharic). Engera African People Caring is a non-profit association founded and constituted by physicians and nurses of Florence Italy (A. Meyer Pediatric Hospital, S. M. Annunziata, Nuovo San Giovanni di Dio) as well as by volunteers which personally work in the field of healthcare and welfare in Ethiopia. Engera has been constituted in order to develop its own activities and invest funds collected in a direct manner, without brokerage of other institutions or national and international organizations. Engera was founded in 2007 in Florence, Italy and operated since many years in Ethiopia Gurage Region. Engera is contributing to the direct health action, to the formation of local personnel, to the construction of new health structures and to the restoration of already existing health facilities in remote villages of this area. The health and wellbeing of a person rely on several factors beyond sanitary field. According to this consideration Engera is searching to differentiate its projects in order to reply to the needs we are noticing in the areas under support.

EMSA: The idea to create a European organization gathering the medical students of Europe was born 20 years ago, at a students' symposium at the Catholic University of Leuven. Since this time, EMSA has grown and expanded its membership within Europe. EMSA currently has active Faculty Member Organizations in 26 countries throughout geographical Europe. Also EMSA is proud to have strong student partners and professional partners within Europe as well as outside Europe. EMSA's activities have been endorsed by the European Commission in 2005. The European Medical Students' Association seeks to improve the health and quality of care of the citizens of Europe, by acting as a conduit for increased interaction and sharing of knowledge between European medical students in the fields of medical education, medical ethics, medical science, public health and European integration.

Witnessing the importance of Telemedicine and eHealth nowadays, EMSA has, on December 2013 signed a Memorandum of Understanding with International Society for Telemedicine and eHealth [2], thus beginning a new chapter for itself and approaching the opportunity of being ambassadors of this new infrastructure among students and other organizations that need it. The importance of this memorandum is described on BlueMist on December the 8<sup>th</sup> 2013, as quoted [3]: "We do believe that the infrastructure of Telemedicine and eHealth is becoming an important link in the chain of Health System, providing an easier Practical Medicine and a better Health care for our patients all around the World. Telemedicine and eHealth is, in continuity, breaking the barriers and crossing the borders, bringing each day, closer to each other, every person that is involved in

Health System, thus we find it necessary to bring this new system, closer to our friends/students, so they can benefit from it intellectually and professionally. We are bringing closer the UP-TO-DATE Medicine to everyone. Together we can change the world!"-Jehona Krasniqi, the policy Making Officer and the Coordinator between EMSA and ISfTeH on Telemedicine and eHealth.

Telemedicine in remote and poor areas, especially tele-pharmacy, could help in the management of the local situations being also one of the greatest calls for help and support of Engera through the support of human resources and other materials needed, especially with the education needed towards the people who live there.

According to these concepts, and bearing in mind what Engera stands for, EMSA strongly believes that the setting of a system of Telemedicine and eHealth in Gurage area, would help doctors, who carry the Holy Mission of Medicine, Humanity and Health Education, into forwarding and improving their work.

So Engera and EMSA are going to sign a memorandum of understanding [4] which aims to the creation of a cooperation between the two associations in terms of promotion, sharing of human resources, fund raising and e-health projects implementation.

#### Aims

The constitution of a e-Health platform able to:

- Spread knowledge on the diagnosis and treatment of the main pathologies present in Gurage Region;
- Empower local health related personnel, volunteers and all the person in charge of the procedures;
- Create a virtual bridge between Europe and Gurage Region to assist clinical activities ensured by the present flow of doctors and students from Europe to Gurage region (teleconsultation);
- Ensure an e-learning for students about the main activities performed in the clinical centers;
- Support the fundraising of the project.

#### Methods

##### *Human Resource Pool*

EMSA and Engera have a human resource pool able to support several all the initiatives (clinical activities, e-learning, teleconsultation).

##### *Software*

Engera ([www.engera.org](http://www.engera.org)) has a crowd funding platform which can be used by EMSA in order to organize a diffuse fund raising through several events aimed in supporting the present e-health project. Engera website can host the software modules able to ensure the development of literature on local pathologies and system for remote teleconsultation and tele-teaching

### *Hardware*

We would like to launch a call through ISfTeH support and mailing lists in order to understand possible partners for the identification of the best system.

### *International cooperation*

We would like to verify the availability of WHO in order to support this project with Ethiopian institutions. Some contacts have been engaged with positive premises.

### *Fund raising*

EMSA and Engera social events in order to crowdfund through the Engera crowd funding platform

We are presently also searching for public and private sponsors in order to finance the project.

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# European Medical Mobility Project

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The European Junior Doctors (EJD) was formally created in Bad-Nauheim, Germany, in May 1976 as Permanent Working Group of European Junior Doctors (PWG). Since then, the EJD has become the European medical organisation with the most comprehensive national membership, representing over 300.000 Junior Doctors all over Europe.

The EJD's initial objectives include safeguarding the interests of the Junior Doctors in Europe, improving relations between its member organizations and narrowing the gap between the Junior Doctors all over Europe.

Since founding, the EJD has actively intervened in defending of the medical profession in Europe with the purpose of contributing to the development of Junior Doctors' work. From the beginning of the EJD's existence, it became evident that the Junior Doctors of the various countries have many similar experiences and are faced with the same challenges. Under the motto 'one country, one vote, one language' the EJD has managed to use the cultural, scientific and political diversity of the members in its favour. The EJD has made a considerable contribution to improve education and training of European Junior Doctors integrated in better European health systems for the benefit of the community, whilst maintaining a satisfactory personal work/lifestyle balance.

As challenges that junior doctors face change gradually over time, it is the mission of EJD to serve as a flexible platform for European junior doctors and adapt to those changes. Junior doctors are witnesses of direct consequences of the European rules' effects on the healthcare systems, which are best described as the logical continuation of the strategy of Lisbon "to make Europe, in 2010, the most competitive knowledge and most dynamic economy of the world"; envision aged as the reign of free market and de-regulation.

In the medical field, this is reflected in the following: all available data point towards significant imbalance between the East and the West of Europe with massive migrations of health professionals towards Western Europe, North America and Australia; there are even extreme situations where some countries have permanently lost up to 50% of their nurses and up to 30% of their physicians in 10-year-period with serious consequences for their healthcare systems. Results of this could lead to a bipolar image:

fortunate patients will be able to move, to make the advance of the expenses and be reimbursed when they return back to their country and in other regions there will remain patients with modest incomes, in a degraded medical system with the rare health professionals who have not have migrated towards countries with more favourable working conditions. These two faces of medical mobility open many questions, many of which have not yet been answered in a satisfactory manner.

EJD performed a brief survey 2012 at the EJD Spring Meeting 2012 in Zurich, Switzerland asking the junior doctors to identify, among other points, both good and bad aspects of their training, and also to say what should be improved in training of junior doctors. While junior doctors were satisfied with possibility of having the free choice of country to work in, they didn't like restricted choice in location of training and limited flexibility in altering it, as well as the fact that it is difficult to achieve good work-life balance in their lives, and most were not satisfied with the amount of extra working hours, having to do working extra hours without payment and having working conditions restricting dedicated teaching time. One most common wish was to improve the opportunities in their training by simplifying the possibilities to do training in another city/country (international exchange/internships) for 3-6 months.

In light of this data, it was necessary to address these issues on behalf of European Junior Doctors and to try to facilitate some solutions. Working in this direction, one of the most prominent developments in recent years has been the launch of the European Medical Mobility Project (EMM) which was started as a European Junior Doctors (EJD) and European Medical Students' Association (EMSA) joint project.

The main goal of EMM Project is to facilitate training in the medical field within EU/EEA area through an online database with a regular update system. The EMM website will not only gather official information regarding junior doctors training and working conditions, but also encourage (through the EMM online forum) the sharing of personal and useful viewpoints between Junior Doctors. It is available without any extra costs to any visitor at the address <http://www.medicalmobility.eu>. Fig. 1 shows the screenshot of the EMM Project Website. Currently there is a complete updating of all the data available (scheduled to be complete by the end of the first half of 2014), as to provide most up-to-date information. For every country that has submitted the requested data to EJD, it will be possible to find information on professional recognition process, requirements and documents needed, deadlines and duration, internship, postgraduate medical training, existent medical degrees, working conditions and other information.



Hrvoje Vračić was born in 1979 in Zagreb, Croatia. After finishing Medical School, he became a specialist in internal medicine in 2010 and in cardiology in 2013, and is currently working in Zagreb, Croatia. He has been active in professional association since 2001, when he was a student, and has been in European Junior Doctors since 2008, now in second term as Vice-President.

Figure 1. The European Medical Mobility Webpage



# IT Support of Training in Cardiology: The EUCARDIA platform of UEMS Cardiology Section

R. Griebenow

UEMS (European Union of Medical Specialists), Cardiology Section

Mutual recognition of professional qualifications is regulated in the EU by the EU-Directive 2013/55, which is the revised version of the former Directive 2005/36.

This directive regulates duration of training, but leaves open content of training as well as competencies to be achieved.

Thus, UEMS Cardiology Section has defined the training requirements for the specialty of cardiology in the document UEMS 2012/29 Cardiology “Training Requirements for the Specialty of Cardiology”. According to the principles laid down in this document training has to cover the acquisition of knowledge, practical skills and professional conduct. Formative as well as summative assessment of knowledge is managed Europe-wide in cooperation with the European Society of Cardiology (ESC) and national societies, while the practical parts of training occur on a local basis. UEMS Cardiology Section offers EUCARDIA, an administrative platform for documentation of the trainees’ activities in the fields mentioned above. The main characteristics of EUCARDIA are.

- **EUCARDIA** has been developed by UEMS Cardiology Section and is run by EBAC (European Board for Accreditation in Cardiology);
- **EUCARDIA** is an administrative platform designed to give you an opportunity for lifelong documentation of your professional activities in the field of practical skills (logbook), knowledge (e.g. CME) and professional attitude (e.g. 360° appraisal);
- **EUCARDIA app** offers an easy way to document your activities in particular in the field of practical skills (logbook);
- **EUCARDIA** has been developed to support the European Diploma General Cardiology, but may also be used according to your individual documentation needs, even the use of single components (e.g. logbook) will be possible;
- **EUCARDIA** is not dependent on certain hospital IT systems and is thus ideally suited for use by an international community;
- **EUCARDIA** is not restricted to the training period or the specialist period of your lifelong working time, but you can start at any point in your career and use EUCARDIA from then on as long as it suits you;

**EUCARDIA** will initially be offered for free to all those who register **now**. For more information please visit: [www.eucardia.org/publicbeta](http://www.eucardia.org/publicbeta)

EUCARDIA will also be the basis for awarding the European Diploma General Cardiology to those who have fulfilled all requirements as detailed in the document UEMS 2012/29 Cardiology. It is our aim that this Diploma will:

- Support the professional career of the individual participant (either trainee or cardiologist);
- Increase patient safety and
- Facilitate professional mobility.



Prof. Reinhard Griebenow, MD, PhD, FESC  
UEMS Cardiology Section President

# Tele-health - From Pilot to Routine Care: Critical Success Factors

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Twenty-five years into the eHealth journey, developments are gathering momentum. Two thought leaders from EHTEL, Europe's leading pan-European eHealth multi-stakeholder forum, examine the progress made and urge people to get more involved. Three key topics are: current developments in eHealth; how telehealth in Europe is moving ahead; and other developments in eHealth – including the identification of critical success factors – that could bring further advances.

## Current developments in eHealth

eHealth is on a journey that has led from discovery to acceptance to deployment (EHTEL, 2011) [1]. Developments are now speeding up, and today's aims involve achieving a critical mass, expansion and further development.

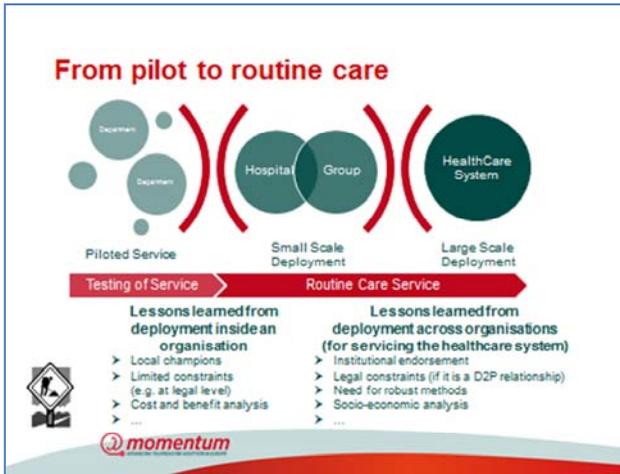
Massive contemporary endeavours, such as the English Whole Systems Demonstrators and its follow-up, 3millionlives, are paralleled by increasing numbers of large-scale initiatives in the telehealth and telecare fields throughout the European Union. Many European towns and cities, regions and, indeed, countries, both large and small, are focusing on more widespread deployment of technologies to support health and care. There are many rapid, small and large-scale changes in the various areas of activity that can be called 'eHealth'.

## Telehealth: An Example of eHealth Progress

Telehealth and telecare aim to provide good levels of service at a local level for general practices, other local practices, and local trusts. At times, they have implications too for regional or national levels of health and care provision.

In this context, the importance of guidelines to scale up eHealth services is of prime importance. Indeed, it has been observed that "there are more pilots in telehealth and telecare than in an airline company". In other words, it is a challenging process to take a service piloted at the level of an organisational department, with the support of innovative people, and to transfer it into routine care.

On telehealth, the Momentum project (<http://www.telemedicine-momentum.eu>) suggests that financial, organisational, communication, and change management issues have to be addressed by general practices, the local practice, and the local trusts concerned. Momentum indicates that scaling-up services at regional or national level means facing a higher degree of complexity. This is not only because of the increase in size and volume of the specific service. It is also because yet another set of challenges has to be addressed when scaling-up.



For a larger community of users, those extra challenges include legal and strategic issues, change management, communication, and market and procurement (perhaps even pre-procurement) issues. Methodologies and guidelines to help face these challenges will therefore be of prime importance to support the telehealth “doers” who are at the sharp end of the healthcare sector.

For each of these four domains, the Momentum community anticipates that it will be possible to stipulate a set of critical success factors that can help to scale up telemedicine services. Purely as examples: it will be necessary to determine what kind of legislation can play an enabling/inhibiting role. For certain types of telemedicine services, policy support will also be a pre-condition. From a market and economic perspective, the telemedicine service envisioned for scale-up will have to be recognised – and promoted – as an efficient way to deliver quality care. Additional success factors that are likely to be critical in terms of scaling-up are cross-organisation collaboration platforms, and coaching mechanisms,

to help “doers” address in operational terms all the challenges that affect privacy protection and security, procurement and system scalability itself.

### Future (e-) Health

It is important to look ahead towards a decade of new organisational directions in the health field. In 2011, EHTEL (2011) identified that:

*“Our aspirations for 2019 should include a much more common community care model, irrespective of funding sources, where information is an automatic by-product of the care process, e-health becomes just an integral part of care, and where IT and medical technology converge at the level of usefulness and value. Innovation has to be encouraged, rewarded and deployed, reducing not just ‘time to market’ for products and services but also ‘time to generate value’ in successful user deployments.”*

Perhaps this shift towards care – whether it is termed ‘personalised’, ‘integrated’, or ‘community care’ – simply reflects the fact that we are rapidly reaching a position in which the ‘e’ that prefaces eHealth is likely to disappear [2-3]. The end-result will simply be health, or care, that uses technology to produce good and effective results.

This journey towards widespread community care and health is expected to provide many benefits. Outcomes will include high quality care, health, and wellbeing. They will also bring hopes for ICT-based inter-generational support between older adults and young people, and a European socio-economic scene that will begin to thrive as a result of the production of new health-related goods, products, and services.

Societies in Europe and elsewhere will, however, still face considerable organisational, social, societal, and especially legal and regulatory challenges on the eHealth front. On a flat Earth [4], the relatively small continent of Europe will be faced by a new legal and regulatory context that is international, if not global.

### Conclusions

Dealing with these eHealth-related strategic, organisational, legal/regulatory, technical and market issues will pose people and societies on-going dilemmas. It is for this reason that we have to keep the drive going and get engaged. Initiatives like Momentum are crucial to this gathering of power, drive and energy in their work to identify the critical success factors that will ensure the large-scale spread of telecare and telehealth throughout the European Union.

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# **Social Media: The Junior Doctor's Network Perspective**

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Junior Doctors Network, World Medical Association

## Introduction

Web 2.0 and social media have had major impacts on modern society and keeps growing; celebrating its 10th birthday, Facebook, the world's leading social network, recently claimed over 1 billion active monthly users [1]. Social media has become a critical component of many individuals' lives, acting as a communication mechanism, for staying in touch with friends all over the world, fostering awareness and understanding. They even played a pivotal role in revolutions such as the recent "Arab Spring" and Ukraine's "Euromaidan" movement [2-3].

The World Medical Association (WMA) Junior Doctors Network (JDN) is an international forum for experience-sharing, policy discussion, project and resource development on issues of interest to junior doctors, residents, and interns. Its membership is comprised of Junior Doctors who independently join the WMA as associate members. Social media was identified early on as a critical component of the JDN's current work, beginning with the publication of a white paper on "Social Media and Medicine" [4] in 2011. Concurrently, the WMA adopted a policy statement on "The Professional and Ethical use of Social Media" by physicians [5].

## The Vast Outreach of Social Media

Social media has proven to be a Janus like figure for health care, serving as a very powerful tool to reach billions of people. Major healthcare and public health institutions employ social media to deploy and conduct community outreach and health promotion projects. Ad-hoc groups of healthcare professionals have also successfully used social media to advocate for changes to government policy [6].

Importantly, however, this new form of communication has not been without challenges for the medical profession. There have been well-publicized cases of physicians and trainees facing serious professional consequences for inappropriate actions on social media sites [7-8].

## Confidentiality and Social Media

The ability for social media to facilitate mass communication poses risks to the sanctity of the physician-patient relationship and the confidentiality of personal health care information. Given the central nature of these tenets to medical practice, physicians must ensure that they fulfill professional and ethical obligations on social media.

One study of a number of Facebook groups on diabetes management found that 13 percent of posts requested personal information from Facebook group participants [9]. Such information and photographs circulated through social media are at risk of being broadcast beyond the intended or appropriate audience, through errors, negligence or unilateral changes of settings. Physicians should carefully study these privacy provisions, bearing in mind their limitations, and ensure that they do not post identifiable patient information to any social media site.

#### Accuracy of Information

Access to information has become easier through the deployment of social media, but there are caveats. On one hand, an up-to-date stream of medical information is now available instantly at the fingertips of both patients and their doctors. On the other hand, it becomes even more important to critically judge the quality and relevance of this information. Such considerations have major impacts on the patient-doctor relationship.

Studies note that patients are now more likely to ignore traditional medical advice in favor of information from peers/and or similar patients [10].

This is of concern because patients' trust in physician competence and professionalism is critical to an effective therapeutic relationship. This trust is the basis for many patients to heavily base their decision-making on physicians advise, example or opinion. Therefore doctors should, to the extent possible, monitor their own internet presence to ensure that personal and professional information available there is still accurate and appropriate.

#### Boundaries in Patient-Physician Relationship

The rise of social media has led to ambiguity between physicians' professional and private lives. Information posted generally cannot be undone and has the potential to reach a worldwide audience. Thus, physicians and medical trainees should be prepared to confront professional issues around social media as early as possible, and empowered to use social media responsibly.

Physicians have been challenged by the omnipresent expectation of professional comportment. Even in their personal lives, they are often regarded as physicians, and the "honour and noble traditions" of the medical

profession have, at times, led physicians to be reprimanded by professional courts for misconduct arising outside of their professional practice [11].

With this in mind, the ethical guidelines on boundaries in physicians' personal lives and in the physician-patient relationship apply online, just as in any other context. Physicians should be aware of social media's potential to blur these boundaries while acknowledging and accepting the inherent risks.

### Conclusion

Physicians have strong basic ethical and professional obligations described in numerous codes of conduct, from the Hippocratic Oath of old to the WMA "Declaration of Helsinki"[12] (often called the modern Hippocratic Oath.) Such frameworks apply online just as much as they do apply offline.

More importantly, as social media and Web 2.0 continue to bring well-known professional and ethical issues into new light, they offer potentially powerful new tools to allow physicians to shape a healthier future for patients. JDN's white paper on "Social Media and Medicine" [4] as well as the WMA statement on the professional and ethical use of social media [5] offers valuable guidance for physicians wishing to do so.

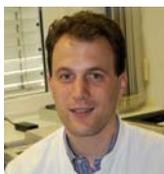
### Acknowledgment

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**International Telemedicine and eHealth  
Initiatives and Developments: ISfTeH Best  
Practice Examples**



International Society for  
Telemedicine & eHealth

# **Association for Ukrainian Telemedicine and eHealth Development - Report of Activity During 2012-2013**

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Activity of Association for Ukrainian Telemedicine and eHealth Development (AfUTEHD) during last 2 years are summarized as follows:

## **Clinical Telemedicine**

Development of methodology and approaches for a regional anti-tuberculosis network. Participation in creation of such network at regional level, evaluation of its efficiency, development of the good practice model for wide introduction at national and international levels.

During the first months of operation the network shows big number of teleconsultations, great improve of management and logistics, high level of end-users' satisfaction.

Participation in creation of a national teleoncology network linked main oncology centers in 6 regions. The current activity mainly focused on distant learning and teleradiology. Special evaluation of the network efficiency shows good level of end-users' satisfaction and allows to find ways for further development.

Both networks mentioned above had been created due to kind efforts and financial support of Rinat Akhmetov Foundation "Development of Ukraine", in cooperation with clinical establishments the Association supports the teledermatology platform which focused on patient centred care and interaction between primary and tertiary levels of a medical care.

## **eLearning**

The intensive distant learning course in telemedicine and eHealth had been performed in April 2013 for 1 and 4 years students in New Bulgarian University (NBU, Sofia, Bulgaria). The course includes 30 hours of videoconferences. The lectures were delivered to the students through the Moodle platform, adopted for NBU needs, and e-Works videoconferences software.

A digital textbook entitled "Information Technologies in Medicine and Healthcare" was published specially for the course.

#### Publications

4 issues of "Ukrainian Journal of Telemedicine and Medical Telematics" were published (in paper and electronic versions). Journal is indexed by Copernicus®.

#### Events

VIII and IX International Conferences "Telemedicine – Experience@Prospects" took place in Donetsk. Every year there are about 200 participants from 15-20 regions of Ukraine, EU and Russia also. Official web-site – <http://www.telemed.org.ua>

# Clinical Scenarios in Telepharmacology

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## Introduction

One of the great challenges of using IT in a professional medical environment is also optimization of roles and collaboration of different members of the health care team (clinicians and other professionals). In broader view it should not be forgotten that collaboration reflects not only inter-professional collaboration, but also necessitate active engagement of medical professionals, lay people, concerned family members and society as a whole [1]. In this study, we concentrate on the action of a pharmacist with computer-supported knowledge on drug prescribing, administration, pharmacodynamics, pharmacokinetics and drug-drug interactions.

## Methods

The scenarios for IT environment in simulation centre were prepared to test the usability of the pharmacological team and pharmacological software for different medical specialists via remote (telepharmacological) connection.

Three different teams/rooms that are shown on figure 1 were proposed:

1. IT control team for equipment and scenarios management;
2. Telepharmacological team for remote pharmacological consultations (available 24/7);
3. Clinical team with medical specialist and patient(s) in ambulatory environment or at home.

Telepharmacological team is able to access drug interactions' databases, prescriptions decision support software/systems and other databases (including information on dosage regimens in patients with renal and/or hepatic dysfunction, in pregnancy, breastfeeding women, elderly, pediatric patients; for drugs and medical devices dispensed in Slovenia) via common web interface. Only open-access databases like [www.CBZ.si](http://www.CBZ.si), [Drugs.com](http://Drugs.com), [Lexicomp](http://Lexicomp) (payable but nationwide available in Slovenia), [PharmGKB](http://PharmGKB) were

used [2-5]. If medical specialists are in doubt on which drug or therapeutic regimen to use in specific clinical situations, they are simply able to consult clinical pharmacologist on duty via safe and secure telepharmacology link.

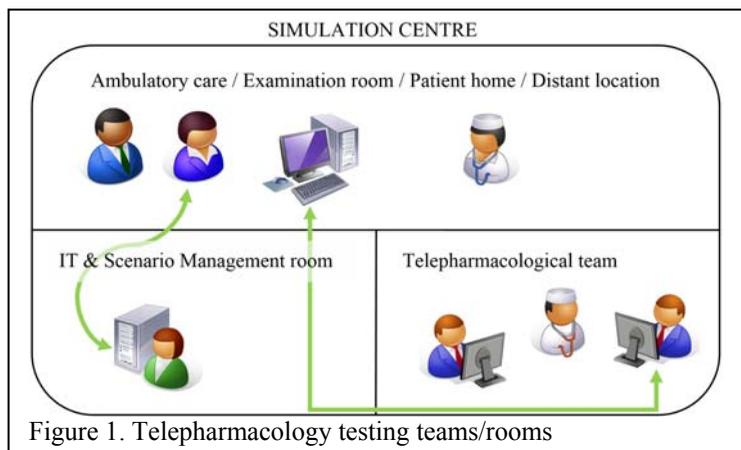


Figure 1. Telepharmacology testing teams/rooms

## Results

The basic installation at the simulation centre was made and two clinical scenarios were prepared for testing:

### 1. Atrioventricular Block Due to Digitalis Poisoning:

A 68 years old female patient is driven in by the paramedics and presented to the family physician with syncope and nausea. The patient appears confused and reports having nausea for about two days, with one episode of vomiting and later on losing consciousness for few seconds. Her medical records reveal history of congestive heart disease with prolonged atrial fibrillation, for what she is taking calcium channel blocker, beta blocker, diuretic and digoxin. On exam, the patient has a heart rate of 35/min, respiratory rate of 15/min and BP of 125/82 mmHg. The lungs are clear to auscultation, cardiac exam reveals bradycardia with irregular heart beat and normal heart sounds. The ECG shows a 2:1 atrioventricular block with heart rate of 35. Laboratory results reveal a serum digoxin level of 4.6 ng/ml, creatinine of 140  $\mu\text{mol/L}$  and potassium of 5.5 mmol/L. During the examination, the clinical pharmacologist was consulted via remote connection. Using decision support software, he/she simultaneously provides the clinician with possible drug interactions. While considering possible causes and further management, the patient is put on the monitor.

## 2. *Hypoglycemic Coma due to a Drug Interaction between Tolbutamide (Regular Dosing Regimen) and Aspirin (Overdose):*

The paramedics receive a call from a woman, who reports her 55 years old mother tried to commit suicide with ingestion of a box of Aspirin 500 mg (acetylsalicylic acid). After arriving to her home they find the patient comatose with intact breathing and palpable pulse. The paramedics provide basic supportive care. The patient's daughter reports her mother being depressed for a long time; otherwise, her medical history includes diabetes mellitus and angina pectoris on exertion. Her daily medication includes acetylsalicylic acid, diuretic, beta blocker and tolbutamide. This morning she supposedly ingested 15 Aspirin pills. Afterwards, she got abdominal pain with nausea and vomiting with progressively deteriorating mental status. Vital signs after examination revile pulse rate of 90/min, respiratory rate of 13/min and BP of 120/75 mm Hg. The patient is not responding to deep pain, the pupils are dilated but reactive to light, the limbs are flaccid with hypoactive tendon reflexes. The quick glucose test shows value of 1.5 mmol/L. The patient is started an intravenous infusion of 50% glucose. After arriving to the emergency department the laboratory tests reveal metabolic acidosis with serum salicylate level of 950 mg/l which implies severe intoxication. Clinical telepharmacologist who was consulted via remote connection partake the primary survey and later evaluates the patient's medication considering her clinical data. The pharmacological team also suggests possible drug interactions, which are the cause of the patient's condition in this case, and can also predict the progression of salicylate serum levels.

Telepharmacological functions of the system are full-duplex multimedia (audio, video and text) connection between end-user and telepharmacological team. All communications are recorded and stored for later supervision, analysis and educational purposes.

### Conclusion

Telepharmacology is making the availability of pharmacological knowledge much easier and optimal considering that common medical informatics standards are used. For evaluating the usability of telepharmacology in clinical practice, additional (qualitative) testing should be done with additional pharmacological software resources.

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Katja Jerenec was born in 1987 in Ptuj, Slovenia. In 2013 she graduated from Medical faculty, University of Maribor and started working as an assistant in the Department of Pharmacology and Experimental Toxicology at the same university. Her fields of interest are pharmacology and intensive care medicine.

# Development of a Mobile Application of Clinical Pharmacology for Dentists in Primary Health Care

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## Introduction

According to World Health Organization (WHO), more than 50% of medications are incorrectly prescribed, dispensed and sold, as well more than 50% of patients use them incorrectly. The majority of countries do not implement basic policies to promote medicines rational use. The situation is worse in developing countries, with less than 40% of patients been treated according to clinical guidelines in the public sector and less than 30% in private sector [1].

The “drugs rational use” is the opposite of this reality, it refers to "the need for the patient to receive the appropriate medication in the correct dose for an adequate period of time, with low cost for him and the community" [2]. For WHO the effective way to improve the use of medicines in developing countries primary care is the combination of education and supervision of health professionals, consumer education and ensuring adequate access to appropriate medications [1].

To capacitate Primary Health Care (PHC) professionals is possible to use different education tools [3]. Smartphones offer mobility, providing information access during the work routine, enabling constant updating for health professionals [4].

The Mobile apps are an important education resource and have the potential for significant improvement at the learning process [5]. Mobile devices have been widely used by health professionals during the care to find references of which drug use [6]. However, much of the information contained in these applications has not been validated yet, which does not allow doctors and dentists to indicate these applications use [7]. Besides in Brazil, there are no pharmacology applications designed for dentists.

In this context, this study aims to develop an application of clinical pharmacology for dental practitioners working in the PHC, to be used for consultation in smartphones for prescription of drugs.

## Methodology

### *Content Selection*

The content selection was according the available medicines list in the Brazilian public health system - National List of Essential Medicines (RENAME). From the RENAME was selected the drugs most commonly used by dentists in PHC to be inserted into the application. This selection was through a technique called Focus Group (FG), which aims to collect data through group interaction.

A group of experienced professionals in the subject characterizes the FG and it encourages the participants to formulate their questions through their own vocabulary, exploring aspects they deemed relevant on the issue.

### *Content Organization*

The drugs were classified into two main topics: pharmacological group and clinical area. In the application, the information for each drug can be access from both ways.

#### *Pharmacological Group:*

The content was separated by its pharmacological use by the dentist at the primary care dental clinic. Thereby, the following subjects are implemented in the application: antimicrobials, beta-lactam antibiotics, macrolides, tetracyclines, anaerobic flora, antifungal, antiviral, anti-inflammatory drugs, NSAIDs, nonsteroidal anti-inflammatories, anesthetics.

#### *Clinical Area*

This topic is intended for professionals who search for clinical dentistry product areas: endodontics, extractions, temporomandibular joint dysfunction, periodontics, special needs patient care, blood dyscrasias, dental prosthesis.

#### *Implementation*

In the application accomplishment were prioritized usability and easiness to find the information. The application effectiveness depends on the dentist be able to quickly locate the desired information, through a nice and easy interface to use. Furthermore, the application is offline, allowing access to information even without Internet and in remote places, which is important in Brazil.

## Results

The content for the pharmacology application was developed in order to provide different medicine searches. The drugs division by pharmacological group provided rapid access to the drug researched and objective. Then, the drugs organization by clinical area provided fast access to specific drugs,

suggesting it for alternative drugs to be used. The focal group decided to implement the application items as an indication, contraindication route of administration, dosage, adversary reaction and drugs interaction. According to the procedure to be performed, the dentist can search the most commonly used drugs in that particular procedure.

## Discussion

The population, in general, has different health-related needs, so services and professions in the health field need constantly adaptation and education. This transformation is conditioned by the technological, scientific and social changes, and continuing professional education is essential in meeting these needs [8].

Recently, a wide variety of mobile devices has been developed, among them, highlight the smartphones. These devices have different processing capabilities and graphical interface that enable varied applications development. Seen it, the mobile devices use became an important tool for continuing education, allowing the scientific basis for professionals working in primary care. The smartphone can provide access to the best evidence to the dentist, at the time deemed necessary.

By the large Brazilian territorial extension, the mobile devices internet coverage, despite the expansion in recent years, is still limited. Thus, the use of an offline application allows access to information without the need to transfer data.

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# **e-Health – Can We Be Certain There Is No Environmental Impact?**

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## **Introduction**

At this time there is a perception that e-health tools and technology have no or insignificant environmental impact. This view is largely fueled by evidence that the time, space, material, and energy needed to create each individual ICT component has decreased by about three orders of magnitude in the past few decades [1]. Other authors suggest it has positive impact through avoidance of travel [2]. These are likely to be false claims, as they do not consider, for example, the entire life-cycle of the technology, nor the impact of the exponential growth of ICT use [3], nor ‘evergreening’ (constant replacement to upgrade)!

What has been written has, naïvely, often focused attention on the midstream ‘use’ stage (use, including repair, and maintenance), and ignored the other two stages that complete the ‘life-cycle’: 1. The upstream stage (resource depletion: e.g., extraction; production; packaging; and distribution), and 2. The downstream stage (‘end-of-life’ (EOL): e.g., re-use, recycling, or disposal of e-waste), and the water and energy use at all stages. This life-cycle reality has been described and illustrated in a published Environmental e-Health Model [4].

This paper briefly recaps key issues of environmental e-health, and then describes Life Cycle Assessment (LCA) approaches that may have value for assessing the overall environmental impact of e-health.

## **Environmental e-Health**

Factors that make environmental e-health a concern are many [4]. Modern ICT solutions are frequently touted as essential for ‘sustainable growth’, ‘economic growth’, and now (ironically) to adapt to climate change. Within the health sector, e-health (including m-health) is very much considered a solution to the world’s growing health concerns (even in the face of poverty and crippled health systems). These perceptions have fuelled, and continue to fuel, extremely rapid uptake (new technologies - including e-health solutions - are being introduced at an astonishing rate).

These technologies also use specific - often rare - elements and chemical compounds (resource depletion), some of which (e.g., cadmium, lead, arsenic, brominated flame retardants) can pose a toxic hazard if disposed of carelessly (e-waste). In addition water and energy use during up- and downstream activities is significant.

### The Way Forward

In the current climate of environmental concern, activities that ignore or fail to mitigate potential environmental impact are unacceptable! We have a responsibility to be aware of, research, and appropriately respond to, environmental issues. However, it is emphasized that the intent is *NOT* to discourage or curtail technological innovation, but rather to allow it to continue in an environmentally aware and responsive manner – a real technology innovation challenge! But to judge progress we must be able to measure and monitor impact; application of Life Cycle Assessment is one approach, and is described below.

### Life Cycle Assessment Approaches

Similar to e-health, Life Cycle Assessment is relatively ‘new’ with a history of application and maturation over the past 3 decades [5]. It has been defined as the “compilation and evaluation of the inputs and outputs and the potential environmental impacts of a product system throughout its life cycle”. The International Standards Organisation (ISO) has promulgated two standards, thereby providing a general methodological framework [6-7], but they also admit that “there is no single method for conducting LCA”.

Traditionally ‘Environmental LCA’ was the common practice, employing four methodological phases [5, 8, 9]: Goal and Scope Definition, Inventory Analysis, Impact Assessment, and Interpretation.

Newer approaches have arisen, and may be more suitable for application to e-health. For example, “LCA Light” rapid assessment which reduces the time required to perform an assessment; “Life Cycle Inventory” which quantifies ‘how much’ of things were used to produce one component (amount of energy, amount of water, amount of precious or toxic metals), “Life Cycle Energy Analysis” (LCEA) which accounts for all energy inputs, and “Life Cycle Sustainability Analysis” (LCSA) which broadens the typical environmentally focused LCA to consider the three dimensions of sustainability (people, planet, and prosperity) [6].

It is acknowledged the perfect LCA does not exist. Just how feasible is it to identify and quantify the environmental impact for every input and output for an entire product life cycle – from extracting raw material to proper disposal or recycling of every single sub-component? It is not feasible.

Furthermore, the ‘score’ produced by an LCA is relative (comparison to another organization is meaningless as the process is extremely dependent on the data and assumptions used, which will differ); it should be considered an internal yardstick, not a competitive tool. Like Pareto’s Principle, the goal is to get a good enough sense (80%) when expending only modest effort (20%).

Why then, with all this uncertainty, should effort be expended on performing LCAs? General opinion is that while performing an LCA may be difficult, the need to perform it will not go away. There is increasing pressure to understand and disclose environmental impacts of products. Also, going through the process of performing an LCA will build an organisations confidence, skills, and capacity, and provide a far better understanding of the products or services they provide. For e-health there are other principles at play. We know that each and every e-health application, each and every piece of e-health related technology (hardware or software), has environmental impact. This reality is being ignored. We must become aware of, and responsive to, our global social - and health related - responsibility.

#### Application of LCA to e-Health

A 2006 survey showed uses of LCA to be mainly for support of business strategy, Research and Development, product or process design, in education, and for labeling or product declarations [11]. No examples could be found in the literature of LCA approaches being applied to “e-Health solutions”, although application to mobile phones has been published in earlier Med-e-Tel conferences. However, as these LCA techniques have been applied to a diverse spectrum of settings (analysis of coffee machines, the impact of changing to a Mediterranean diet in the EU, and biofuel [5]), their adaptation to use within e-Health is reasonable.

#### Conclusions

Can we be certain there is no environmental impact of e-Health? Quite the opposite – we can be absolutely certain that there *is* environmental impact. The issue becomes – what is the ‘net’ impact. The best approach at this time is performance of Life Cycle Assessment. This is imprecise, and does not allow for definitive judgment. None the less, recent years have seen a huge change in public and government interest and opinion - there is now a tremendous focus on environmental issues, particularly climate change, water use, and energy use (each impacted by e-health). However, the e-health fraternity has paid no real attention to the issue of Environmental e-Health, their own contributions, or their responsibility to understand and

mitigate their impacts. The time is now for accepting and actioning this new field of investigation by those responsible for its causation. One approach is to consider and analyse environmental impact throughout the lifecycle of e-health initiatives. Tools are available and must be applied or adapted to determine the real environmental impact of e-health.

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# Impact of Information and Communication Technologies (ICT) on Health Care

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ICT has made a tremendous impact on health care. The most important are accessibility to health care services by citizens: cost reduction and improvement in quality of health care. The goal is to provide access for the citizen at any time and in any place. eHealth certainly provide such an access especially in remote areas where physicians may not be available. The development of mobile communications, teleconferencing facilities, multi-media capabilities of telecommunications and the internet has been of immense benefit in the health care delivery. By this revolution the differences between medical specialists, medical centres and patients have been limited. The improvement of the quality of care has been demonstrated in several medical disciplines e.g. cardiology. The transmission of ECG signal directly from the ambulance to invasive cardiology centre significantly improved Acute Coronary syndromes patient diagnostics and reduced time from the outset of symptoms to intervention.

ICT has an impact on education of both patients and medical staff. There are many www sites aiming at prevention of some common diseases like cancer, diabetes, hypertension etc. The effect of e-learning cannot be overestimated as far as medical education is concerned.

There are many e-learning courses and videoconferences on variety of topics. Some medical virtual Universities have been established. The best model of learning for medical science is blended learning. The contact with a real patient is a core of the learning process in medicine. The shift from medical services to prevention and health promotion can be observed in recent time and we suggest that ICT applications in health should adapt to new situation.

**Keywords:** eHealth; ICT; Accessibility

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# Language, An Impediment to Telemedicine Use in Africa?

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**Abstract:** In Africa, the development of words for technical terminology has been neglected in most languages and this may be a barrier to obtaining proper informed consent for telemedicine. The aim of this study was to determine whether translations from English to isiZulu, the dominant indigenous language of South Africa, of technological terms relevant to telemedicine and the consent process exist and are understood. **Methods:** Forty-one key words and terms were selected and translated into isiZulu. A questionnaire with the list of words was developed and administered in isiZulu to 54 patients at outpatient departments in four rural hospitals in Kwa Zulu-Natal involved in telemedicine services. **Results:** Comprehension of technical and ethical terms in isiZulu was poor: 4 people (7.4%) understood the word telemedicine, 5 (9.3%) video-conference, 5 (9.3%) electronic records, 10 (18.5%) the World Wide Web, 12 (22.2%) digital photograph and 18 (33.3%) the Internet. Only 19 people (35.2%) understood the word consent and only 4 (7.4%) understood both consent and telemedicine. **Conclusions:** Patients in this study did not understand technological terms in their mother tongue and validity of consent given must be questioned. With over 2000 languages in Africa, it is unlikely that the problem is confined to South Africa or isiZulu.

## Introduction

Many authorities and regulators require informed consent, be it written or verbal, for a telemedicine encounter [1]. For consent to be legally valid the patient must fully comprehend the procedures and acts to which they consent. Comprehension is improved if information is provided in the patient's own (first) language and informed consent forms are either written in or translated to local languages. Africa has over 2,000 languages and there are 11 official languages in South Africa. The National Health Act of South Africa [2] states that, "all users of the health care system have the right to be informed by a health care provider, in a language and manner that they understand." Although English is the dominant language of

business and government, only 35% of South Africans of working age are considered proficient in English [3].

Information communication technology has many complex words and terms, some of which are used in informed consent documents. The development of technical terminology in most of the 2000 indigenous languages has been neglected [4] and the lack of words in the lexicons of African languages may be a barrier to obtaining proper informed consent for either store and forward or synchronous telemedicine.

The aim of this study was to determine if language is a potential barrier to obtaining informed consent for a telemedicine encounter, by translating computing and technical terms which might be used in a consent form into isiZulu, the dominant language of our region, and then assessing whether these words are understood by patients in rural settings.

### Methods

Thirty-eight words about computer terminology and concepts relevant to telemedicine and three relevant to consent were selected. The 41 words were translated into isiZulu, by an IT technician, a surgeon, an isiZulu translator, and a teacher of isiZulu, all of whom are isiZulu first language speakers, and to an English speaking doctor who is fluent in isiZulu. Some words were not directly translatable and were transliterated or left in English if transliteration was not possible. Transliteration is the conversion of the word into a phonetically similar sounding word e.g. “monitor” to “imonitor”. Words were then translated back into English by the IT expert to ensure reliability. A questionnaire with the list of words was developed with three domains covering ICT use, ICT terms and ethics terms. These were further grouped into words that could be translated or transliterated and those that were not translatable into isiZulu.

Purposive sampling was used to select four rural hospitals that regularly participate in the regional telemedicine programme. Convenience sampling was used to select participants, from those waiting to be seen in the outpatients’ department. The questionnaire, interpretation and understanding of the 41 words chosen was administered and assessed by the isiZulu speaking IT expert. They were then asked if they understood the meaning of each word or phrase in isiZulu and of the untranslatable words in English. If they said they understood the word, they were then asked to explain the meaning of the word. Understanding of the words and terminology was reported with yes or no answers.

## Results

Fifty-four patients were interviewed in four rural hospital outpatient departments, of whom 39 were female. Their ages ranged from 18 - 65 years (mean 42 years). Most people lived in rural areas, with only 8 participants resident in the local town. Forty-five people (83.3%) used a cellular phone and only four (7.4%) used a computer. Of the eight words that could not be translated into isiZulu, 9 people (17%) understood them and were able to explain their meaning. The two words which were transliterated were email and monitor, which were not understood by 14 (27%) of the participants.

Few people understood words that are commonly used in informed consent documents such as telemedicine 4 (7%), video conference 5 (8%), or electronic records 5 (8%). The World Wide Web was understood by 10 (19%) and Internet by 18 (33%). Words related to consent were also poorly understood, such as confidentiality 16 (30%), consent 19 (35%) and autonomy 8 (15%). Only 3 (7%) of the participants, all of whom are computer users, understood the less common words such as encryption, firewalls and synchronous. The words and terminology understood by more than half of the participants are those also used when describing mobile or cellular phone technology and home entertainment systems, such as television 51 (94%), video 35 (65%), speakers 30 (56%), network 30 (56%) and microphones 29 (54%).

The 19 (35%) people who understood the word consent, were significantly more likely to understand the other words than those who did not understand consent. Only four people (7.4%) understood both the words consent and telemedicine.

## Discussion

The lack of comprehension of the words telemedicine, videoconference, Internet and email by patients is a problem, as using ICT to transmit health information does carry an element of risk [5]. This suggests that the formalistic requirement of informed consent set out in regulations will be impossible to meet in many instances [6].

When taking a sentence from the consent form currently used in KwaZulu-Natal for teledermatology consultations, "*I hereby give my informed consent for the use of telemedicine in my medical care,*" 65% of the participants did not understand the word consent and 91% the word telemedicine. Of all 54 subjects only 4 (7%) understood both words. This exemplifies the challenge of gaining legally valid and truly informed and comprehended consent for a telemedicine consultation. Does this mean that patients in our rural setting should be deprived of a telemedicine

consultation with a specialist because the stringent consent standards set in the developed world cannot be met?

The study highlights the problems that are faced when attempting to obtain informed consent from patients for a telemedicine consultation using standard consent forms that contain ICT terminology. A cornerstone of true informed consent is the full disclosure of all relevant information by the healthcare provider and understanding of this information by the patient. It also implies an understanding of the meaning of consent. Of concern is that 65% of patients did not understand the meaning of the word consent and 70% confidentiality. Whether this is a cultural issue or ignorance is not known. While the study sample is relatively small the participants were all potential users of a telemedicine service. Whether the same problems exist in other indigenous African languages is not known and needs further study.

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# Telepharmacy: A Brazilian Experience

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## Introduction

The construction process of the Brazilian Unified Public Health System (SUS - *Sistema Único de Saúde*) has considered the implementation of a series of strategies of organizational change in the production of services. In this context, it is important to highlight that the Brazilian Health Reform (*Reforma Sanitária Brasileira*) strengthened Primary Health Care, which became a strategic area of government policy aimed at resolving most health problems, thus reducing the need for hospital emergency services [1-2].

The formation of a unified and integrated Primary Health Care system in Brazil is a complex task for managers. Account must be taken of the great diversity of regional contexts with distinct differences in economies, culture and health-accessibility of the population between regions, as well as the significant increase in prevalence of chronic noncommunicable diseases that result in spiralling costs for medical assistance, if not prevented and treated correctly [6, 2].

Telehealth falls within this context as a support tool for the diagnosis and management of diseases. One of the areas of activity that makes remote pharmaceutical assistance possible is Telepharmacy, which promotes health assistance activities aimed at optimising medication and medicinal plant use through actions governing the prescription, dispensing and consumption; educational activities through continuing health education; and social activities aimed at providing pharmaceutical assistance to all, with an emphasis on remote and difficult to access communities, intending to reduce disparities and promote equity [4-5].

Telepharmacy enables both synchronous and asynchronous remote interaction between the pharmacist, the patient and the health professional. It is possible through pharmacotherapeutic interventions that consider the analysis of elements such as correct dosage, the influence of food, interactions with other medications and medicinal plants, the recognition of potential adverse effects and conditions of storage, intending to provide a formative second opinion, as well as to perform data collection for future pharmacoepidemiological studies.

## Objectives

To present and discuss the projects developed in the area of Telepharmacy by the *Joan Vernikos* Aerospace Pharmacy Laboratory, Microgravity Centre/PUCRS, located in the state of Rio Grande do Sul in southern Brazil.

## Methods

The results of the Telepharmacy assistance projects conducted in three remote Brazilian communities in the Alto Xingu-MT (2008), Manaus-AM (2010) and Palmares do Sul-RS (2012) regions were analysed using online questionnaires transmitted to a tertiary health centre. A human resources training tool in pharmaceutical assistance was developed in 2010 and the results presented. Additionally, a proposal was made for the creation of a platform for the interactions between medications of the Brazilian National List of Essential Medicines (RENAME- *Relação Nacional de Medicamentos Essenciais*) and the medicinal plants used by the general population.

## Results

### *Telepharmacy Assistance Project – Alto Xingu-MT*

A total of 111 patients were interviewed. Figure 1 presents the percentage of the population that used medications and those among them requiring pharmacotherapeutic interventions.

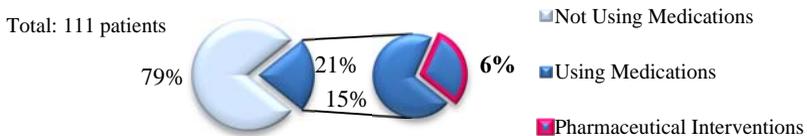


Figure 1

### *Telepharmacy Assistance Project – Manaus-AM*

A total of 49 patients were interviewed. Figure 2 presents the percentage of the population that used medications and those among them requiring pharmacotherapeutic interventions.

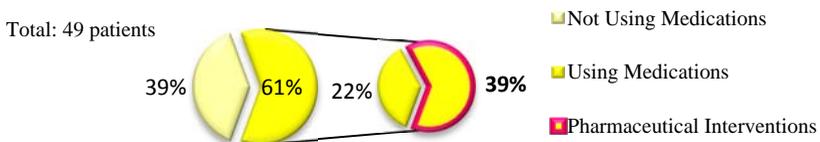


Figure 2

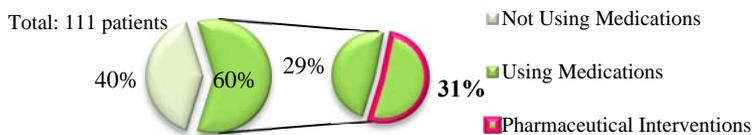


Figure 3

*Compiling Data from the Three Assistance Projects*

Figure 4 combines the data from the three assistance projects showing a total of 271 patients evaluated, from which 120 (44.3%) were taking medication. In 60 (22.1%) cases, a health support was given remotely in relation to the pharmacotherapeutic interventions used, which promoted a more effective use of the medication. As can be observed, interventions were necessary in 50% of the patients that were taking medications.

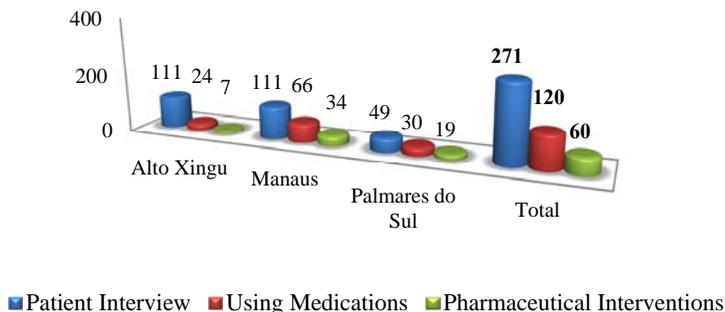


Figure 4

The results demonstrated that the number of patients taking medications in the project conducted in the Alto-Xingu was very small in comparison to the results from Manaus and Palmares do Sul. This was attributed to the fact that this region is very distant from any urban area. A limiting factor of the assistance projects of the Alto-Xingu and Manaus was the inability to identify the medicinal plants used by the populations under study, something that was needed to enable a comparison of the effects of these plants with the medications in use in order to evaluate possible adverse effects and interactions. It is believed that this limitation occurred as these regions are well known for their vast variety of plant species, which highlighted the need for the participation of a local botanical taxonomist for the correct identification of these plants.

A high percentage of medication use was observed in the last two projects, which is thought to be due to these being more urbanised areas that are following a national trend in an increasing prevalence of chronic noncommunicable diseases [5]. The Telepharmacy tool has the potential to identify aspects related to the irrational use of medication, contributing to the prevention of health problems secondary to the mismanagement of pharmacotherapeutic treatments. It is believed that this can improve patient quality of life and increase efficacy in the use of public resources in the health sector [4-5].

#### *Continuous Education and Training Programs*

Telepharmacy was presented as a pilot technological tool used with the objective of promoting technical and scientific training in the area of medications, medicinal plants and herbal medicines by encouraging academic research. In this way it surpasses the existent barriers between university knowledge and the professional reality through the training of health professionals. Therefore, the dissemination of knowledge found in the scientific literature contributes to the enhancement and redemption of traditional knowledge and consequently, adds to patient quality of life.

This project demonstrated that Telepharmacy can be used as an educational instrument in the health area with the potential to contribute to a better use of medications, medicinal plants and herbal medicines. These findings show the need to establish communication strategies to broaden the dissemination of data obtained in scientific literature research and field experiences. In view of this, an electronic portal is being development in order to overcome this shortcoming.

#### Conclusion

Telepharmacy is an essential tool for the advancement of pharmaceutical care, especially in remote and disadvantaged areas, by being an important contributing factor in pharmacotherapeutic guidance and by assisting in the construction of health knowledge.

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# **Promoting Telemedicine/eHealth Practice: ISfTeH Student Videoconference Session and Contest**

*Presented by  
the International Society for Telemedicine & eHealth (ISfTeH) -  
Student Working Group*



*Supported by MEDGATE, Swiss Center for Telemedicine*



# Development of A Wireless System for Measuring Ground Reaction Forces

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**Abstract:** **Introduction:** The development of a wireless system for the measurement of ground reaction forces can provide important information about human physical performance and the health of the locomotor system, as well as the magnitude and form of application of these forces on different surfaces. However, the majority of commercially available force plates have major limitations in respect of their lack of portability and ability to send data for interpretation and analysis using wireless technology. **Objectives:** To develop a portable, wireless system for measuring ground reaction forces permitting the real-time transmission of collected data by means of telemedicine. **Methods:** Research comprised of two phases: 1) Development and 2) Testing of the components that make up the system. **Results:** The developed platform combined structure rigidity and low weight, being composed of the following systems: signal conditioner - for amplification and filtering of signals; data acquisition device USB6009 - for analog-to-digital conversion of the signals collected by the data acquisition card. The communication module operated through Bluetooth connection. Preliminary testing demonstrated adequate connectivity of the force plate. Further testing is required to assess its sensitivity and accuracy. **Conclusion:** It is believed that this system is capable of the remote measurement of ground reaction forces, whilst still retaining portability. This system has potential for application in the areas of aerospace, clinical and sports biomechanics, allowing, for example, the evaluation of ground reaction forces during human gait studies in simulated hypogravity.

**Keywords:** Biomechanics, eHealth, Wireless, Force Plate

## Introduction

The development of a wireless system for the measurement of ground reaction forces can provide important information about human physical performance and the health of the locomotor system, as well as the magnitude and form of application of these forces on different surfaces. It can have a wide range of uses in the area of biomechanics, which aims to explain body movements in accordance with the laws of mechanics and physics in order to gain a greater understanding of human performance through modelling, simulation and measurement [4]. However, the majority of commercially available force plates have major limitations in respect of their lack of portability and ability to send data for interpretation and analysis using wireless technology. The motivation of this work was to develop a portable device that uses wireless communication to allow data transmission in real-time. It is believed that such a system could have the potential for use in the areas of aerospace, clinical, and sports biomechanics, enabling, for example, the evaluation of ground reaction forces during gait studies in simulated hypogravity.

## Objectives

To develop a device for measuring ground reaction forces that is both light and resistant, which makes it portable, whilst also being capable of performing real-time data collection and transmission via a wireless communication system.

## Methods

The study was divided into two main phases: 1) The development of the device itself and its wireless capabilities; 2) The testing of the components that make up the system.

A surface with dimensions 48cm x48cm x0.3cm formed of a matrix of 2304 resistive sensors was created. This resistive matrix was composed of 48 rows and 48 columns of interlinked sensors protected by a high resistance resin. It operated within international specifications and standards of protection and calibration, including properly adjusted strain gauge sensors and Wheatstone bridge. The maximum arrow criterion is a factor adopted to define the optimum thickness of surfaces so they do not suffer deformation greater than a specific value. In this case, the platform was designed with an assumed permitted maximum value of 0.01% of the maximum force (1200Newtons). The wireless communication system was based on a Bluetooth connection for data transmission. A series of tests were performed to guarantee that this prototype would comply with the required specifications.

## Results

The developed platform combined structure rigidity and low weight, being composed of the following systems: (a) signal conditioner - for amplification and filtering of signals; (b) data acquisition device USB6009 - for analog-to-digital conversion of the signals collected by the data acquisition card; and (c) the communication module operated through Bluetooth connection.

Figure 1 shows the developed platform. The platform weighed 4.4 kg with total dimensions of 70cm x50cm x0.4cm, made from aluminium 5052F. The platform surface had a specific mass ( $\mu$ )  $2.70 \times 10^3$  kg/m, Poisson's ratio ( $\nu$ ) 0.3333, modulus of elasticity (E)  $7.31 \times 10^{10}$  N/m<sup>2</sup>, and yield stress ( $\sigma_e$ )  $8.07 \times 10^7$  N/m<sup>2</sup>.



Fig. 1 – Platform prototype

The structure of the developed platform, as well as the electrical circuit and programs developed for the capture of signals all provided satisfactory results, achieving the proposed goal. The platform construction, conditioning circuit, and analog-to-digital conversion device, together with the wireless acquisition system allowed the fully functional implementation of the system. Preliminary testing demonstrated adequate connectivity of the force plate.

Data gained from a pilot experiment with data acquisition every 16 milliseconds enabled the formation of a spreadsheet with figures related to Time [ms], Strength [kgf], Maximum Pressure [kgf/cm<sup>2</sup>] and surface area [cm<sup>2</sup>]. Further testing is required, however, to assess its sensitivity and accuracy [1-3].

## Conclusion

It is believed that this system is capable of the remote measurement of ground reaction forces, whilst still retaining portability. This system has potential for application in the areas of aerospace, clinical and sports biomechanics, allowing, for example, the evaluation of ground reaction forces during human gait studies in simulated hypogravity.

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# Telehealth Commercialization: An Investigation into Store and Forward

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## Introduction

Health care systems across the world are facing sustainability issues created by increasing demand for health services, the aging population and the rise of chronic diseases as well as resource constraints [1]. Australia's 2012 annual health expenditure was approximately AUD\$130 billion or 7% of gross domestic product and treasury projections predict this will grow to AUD\$450 billion or 13% of gross domestic product by 2050 [2]. The challenge will be to reduce this increase in expenditure and gain proportionate value where the costs escalate. We should be aiming to buy the health care that improves patient outcomes, not health care that has the most activity [3].

Higher levels of quality in care cannot be achieved by adding more stress to our current health system [4]. McKeon elicits a number of recommendations for Australia to deliver more value from future health spend with a focus on increasing health research and development funding to three percent of government health expenditure. This renewed ambition should be intrinsically linked to Australia's health reforms and consist of a litany of collaborative touch points between a number of institutions [2].

As Figure 1 demonstrates, spending more on health per patient does not always equate to improved outcomes. For example, the Australian average life expectancy is approximately 82 years with a spend of \$4,900 per person, while the US life expectancy is lower at 78 years with a higher spend of \$8,400 per person [2].

Australia's health care industry is fractious with many stakeholders and historically has had a reluctance to invest in information and communications technologies to deliver health services to patients. However, supporting research and development is not enough [5] and technology on its own is not the solution. A visionary approach which transcends political agenda is required to ensure worthwhile, strategic objectives are pursued. Health care is poised for a change in course [6], with e-health driving the next breakthroughs in health care systems across the world [7].

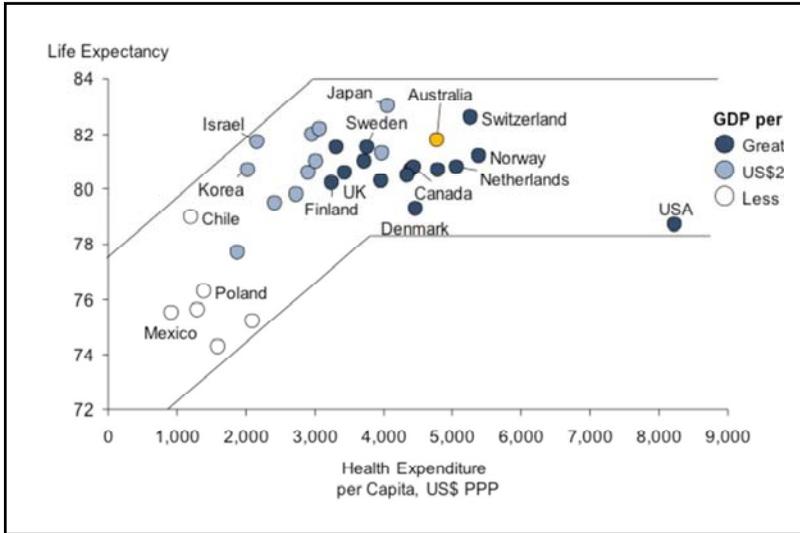


Figure 1. Health expenditure per capita compared with life expectancy.

Within the context of primary and secondary care in Australia's health system, an investigation into the factors affecting the commercialisation of store and forward (SAF) telehealth is carried out. The following objectives have been identified as having key importance to developing an understanding of this concept:

1. Investigate emerging SAF telehealth applications and resulting services;
2. Assess and critically analyse existing telehealth billing models;
3. Analyse what is required to run a national SAF telehealth system;
4. Explore e-health thought leaders' views on the potential and barriers for the widespread adoption of SAF telehealth; and
5. Formulate recommendations for policy creation supporting SAF telehealth.

Objectives 1, 2 and 3 are developed through the means of a comprehensive literature review. A series of semi-structured interviews with some of Australia's e-health thought leaders satisfies objective 4, while an analysis of the literature review and interview transcripts builds the basis for objective 5.

### Sustainability

“If it adds work, then it won’t be used...end-to-end service models are required as it has to be no more administratively difficult than the current model” - Quote from interview subject.

A comprehensive business model, including funding, would be needed to attract software vendors to develop applications to run the telehealth system. The environment would need to be streamlined and simple to use, as doctors will not have the tolerance for ongoing management of system configuration to allow consultations to take place. Further, the creation of a new environment would also address the interoperability challenges that currently exist. Currently, patient cases are sent around the medical community without standards, which makes dealing with high volumes problematic, potentially resulting in sub-optimal outcomes for patients. There are large numbers of new users required to reach the critical mass needed for a SAF telehealth system to be viable. A robust training and marketing campaign would be one way to overcome this issue.

The supporting software suite is a key component for the sustainability of SAF telehealth. Additionally, to enable these tools to work efficiently, associated systems like the National Authentication Service for Health need to be integrated. The creation of an end-to-end service model that is easier to administer than the current process is another factor that will promote the sustainability of SAF telehealth.

A suitable reimbursement model which considers the time involved from the GP and specialist is the cornerstone to the development of this new mode of health service delivery for private practice. It is conceivable that the public health system could move forward without the reimbursement issue being addressed but will still need the software and backend infrastructure in place. However, this builds an inconsistency across the health spectrum which erodes any chance of equitable access to services for the population. The ongoing funding of pilot and demonstration programs, while delivering some benefit to patients, restricts the progress of SAF telehealth as a sustainable health service delivery vehicle, due to the funding inevitably coming to an end, in many cases ending the program as well. Patients, particularly those in rural and remote areas will embrace SAF telehealth and will be excited to just have the option to not travel long distances to a metropolitan area for a short consultation. The challenge is to get payers, providers and patients inspired and aligned towards the same goal.

### Recommendations

In order to tie all of these pieces together, the infrastructure is needed to enable SAF telehealth to proliferate and this includes the right drivers,

policy and legislation, implementation and sustainability concepts. The underlying need for an appropriately featured electronic health record and information and communications technology network allows the system to physically function and this was cited by the thought leaders interviewed and as a significant issue to tackle.

For the sake of brevity, the recommendations from the live interviews and systematic literature review are listed in Table 1.

<b>Item</b>	<b>Policy and legislation recommendation</b>	<b>Detail</b>
1	Discrete elimination of the Medical Benefits Schedule requirement for "in-person" consultations for secondary care.	Eligible GPs will have the discretion to initiate a SAF telehealth referral when they view it to be appropriate.
2	Creation of a facility fee.	This will compensate the GP for time to prepare and transmit the referral to a specialist consultant. The patient's notes will be added to their electronic health record and referral will be sent to the specialist. The GP will be granted a nominal fee for this preparation and transmission.
3	Creation of an item number modifier for secondary care to identify SAF telehealth for specialist consultant events.	This may be a prefix added to existing item numbers and will identify that the care was delivered via SAF telehealth.
4	Development of information and communications technology standards for SAF telehealth.	This will ensure that all systems in the network are interoperable.
5	Development of standard operating procedures and protocols.	These outline steps to follow in order to maintain a high quality service such as acceptable response times.
6	Development of a national standardised training and certification program for primary and secondary care.	A comprehensive curriculum starting at university level and running throughout the careers of eligible clinicians. Administered by the medical colleges.
7	Governance and monitoring for efficiency and abuse.	Development of automated processes to detect fraud and abuse of the system to offer transparency of the use of new

		MBS provision.
8	Carbon credits for SAF telehealth.	Tax incentive for clinicians to avoid patient transport from remote areas to metropolitan centres.
9	Mandate SAF telehealth as a mode of health service delivery to be reimbursed by insurance companies.	Eligible patients will be able to claim their SAF telehealth specialist consultation fee from their insurance company.

Table 1: Recommendations derived from live interviews and the systematic literature review

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Anton Cush has over 15 years' experience in the health care vertical and is passionate about the intersection of health, technology and business. With a global management background in health technology organisations, Anton leverages business development and commercialisation knowledge to emerging health models, technology and services. Anton has an MBA from Queensland University of Technology and a Master of e-Healthcare from University of Queensland.

# **The Use of Tele-Education to Increase Access to Expert Lecture Support for a New Health Informatics Masters: Rwanda**

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## Introduction

Since 2010 Rwanda has hosted the regional E-health Center of Excellence funded by the Rockefeller foundation in collaboration with the government of Rwanda. The Center is currently hosting its first two cohorts seeking the Masters in Health Informatics. While the Center's local faculty provides the majority of the lecture support for the new program, visiting lecturers from outside of Rwanda must sometimes be leveraged to provide support where specialist knowledge is difficult to harness locally. One such area is Medical Imaging and telemedicine Module, where lecturers from outside Rwanda are teaching this module courses via videoconference.

The objective of this case study is to assess student satisfaction with a tele-education approach in combination with learning management system.

## Methodology

The teaching was done via videoconference and teaching materials were posted on Kigali Health Institute learning management system for student access. Among 22 students requested to fill the questionnaire 17 filled the questionnaire. Students were requested to provide their views at the end of their teaching and learning process.

## Results

88 % participants agreed that teaching via videoconference was comparable to face-to-face with regard to quality of learning experience. 82 % agreed that they would wish to follow another module teaching delivery methods. 94 % of the respondents agreed that the technical support and tutorial assistant are needed in remote training site. 88 % agreed that videoconference system should be integrated in normal teaching and learning activities. 100 % of participants have agreed that the quality of

audio and audio was good. 100 % participants have internet access at their workplace. 100 % participants have their personal laptops and their own modem. This type of teaching methodology has saved approximately \$ 5000 per month.

### Conclusion

Tele-education is an appropriate teaching methodology. In comparison to face-to-face teaching, students are similarly satisfied with the use of a high definition room-based videoconference.

Keywords: tele-education, health informatics, video-conference

# **Towards an eHealth policy: A Study about the Utilization of ICT in the Israeli Community Healthcare Delivery System**

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## **Introduction**

Information & Communication Technology (ICT) developments have benefited the healthcare sector in several important ways. They offer new ways to reach patients while providing a more efficient management of the healthcare system.

In Israel, the implementation of eHealth tools started in the early '80s with the building of data warehouses that enabled the compiling of the Electronic Medical Records (EMRs), the Personal Health Records (PHRs) and will be used for a future national program for information sharing. Being a small market with only 4 healthcare management organizations or sick funds, eHealth initiatives in Israel were built locally without any impetus from the government. However, the current government has demonstrated a great interest in in the last years.

The objective of the study is to analyze whether or not the implementation of ICT or eHealth has led to changes in patient empowerment, how doctors and managers perceive the evolving landscape, and other related questions. Additionally, the study is aimed at better comprehending the role of a national policy and to explore options for building such a national strategy regarding ICT in healthcare in the country.

## **Methodology**

The phenomenological research design was selected to conduct the study. The center of this design is to describe the phenomenon without a pre-existing framework and according to the people involved in the phenomenon. In this work, in-depth interviews were used to understand the phenomenon of the adoption of ICT in healthcare and its impact on different areas and stakeholders, according to the perceptions of different key informants.

The selection of participants was done a priori by building a purposive sample. Based on secondary sources, the possible different stakeholders that should take part in any implementation process of eHealth tools were

mapped. Subsequently, key informants were selected. Each of the individuals was contacted via email to request an interview. In most of the cases, the answer was positive. Furthermore, using a snowball methodology each interviewee was asked about other relevant people for follow-up interviews. The final sample included people from healthcare management organizations, hospitals, academia, patient's organization, physicians, government and private sector.

## Findings and Discussion

### *The Importance of eHealth*

The introduction of digital devices in the Israeli healthcare delivery system has changed the relationship between patient and physician, physician and organization, and organization and government. While it has been clear that the implementation of eHealth tools is beneficial, the interviews revealed that eHealth also presents some challenges and disadvantages.

According to the interviewees, time efficiency and better access to information anywhere/anytime are important gains for patients and physicians. The different applications for the computer and the mobile phones give the possibility for the patient to remotely check his lab results, schedule an appointment and manage administrative services, by using his PHR. eHealth has "activated" the patient. Accordingly, there is an increasing personalization of healthcare according to the patient's need. In addition, telemedicine and social networks have facilitated the sharing of the patient's health data with others having the same diagnosis and have increased the access to second opinions. However, a crucial aspect for patient empowerment is education. Reference [1] mentions that more education is related positively and age related negatively with the level of eHealth literacy. The authors show that populations with high level of eHealth literacy demonstrate higher quality of interpersonal relations with their physicians and better autonomy over their own health care needs. However, this empowerment brings with it certain disadvantages. As observed with other technological tools, eHealth can expand the digital gap and thus increase the inequality between different groups. As clearly stated by representatives of a patient's organization and other interviewees, digital gap and limited suitability are big challenges to all the stakeholders. For the organizations, it means that eHealth tools should complement current services (face to face, personal calls, phone appointment) and not substitute them. This obviously could have some effects on costs. For physicians, eHealth implies that they might modify their practice of medicine according to each patient's needs and disposition to technology, balancing the benefits

of eHealth with the patient-physician relationship where appropriate.

From an organizational perspective, one of the main barriers to implementing IT in healthcare are the healthcare professionals as they are very reluctant to adopt changes [2]. This was verified by some of the interviewees. The fledgling use of eHealth and access to information changed the way physicians work, the way they reach the patient. In some instances, this implementation saved time, whereas in others it created more work and a need for education in the new systems. While there are some advantages, the new technological characteristics could discourage an important population of physicians.

#### *The Implementation Process in Israel*

In Israel, the implementation process followed a clear progress from building a data infrastructure to giving access to patients. Only at a later stage did information sharing become an issue. Reflecting on aspects of Israeli culture, each organization developed its own system without any kind of coordination with the other. The result was that systems were not interoperable and future sharing of information presented a challenge which the current government is facing. Although every effort on the eHealth field does not need to be coordinated, the fact that every health organization shares similar goals of reducing costs, improving efficiency and improving data management suggests that an entrepreneurial network would have been successful. A top-down strategy facilitates the interoperability of systems and the exchange of information as all healthcare providers use the same or at least similar system. However, it depends on the government's direction, priorities, and bureaucracy. On the other hand, as is the case in Israel, a bottom-up strategy accelerates innovation as the competition advantage for being the most innovative is high.

#### *The Necessity of a National eHealth Policy*

While the perspective of the public sector is that Israel has a clear strategy on eHealth with the current management of the Ministry of Health encouraging different projects, from the findings it seems that there is no explicit national policy. Currently the Israeli healthcare system faces many barriers, described by the interviewees, which can slow the pace of eHealth development and implementation in the country. Among these barriers are the lack of research and regulation, the as-yet unknown cost-effectiveness of eHealth tools and the adaptation period of both physicians and patients. These limitations could be overcome with a national infrastructure for eHealth. The role of this national infrastructure should be to provide incentives for research, training human resources and users, build a national

policy agreed upon by all the stakeholders, and to advise the government on regulation and management of an eHealth country [3]. To coordinate the creation of this infrastructure should not be difficult in Israel as the number of the healthcare organizations is small and there is a common approach and direction. Though strong leadership is needed, it seems that today, both at the sick funds and at the government there is a good eHealth-oriented leadership. This contrasts with the situation before where the sick funds started implementing digital tools and the government was absent both as a regulator and policy maker.

### Conclusion

Being one of the first in describing the state of eHealth in Israel, this research provides information in order to understand and improve ICT services. The different experiences and perceptions of the key informants are a valuable input to policy and management discussions about the phenomenon. Additionally, the results suggest alternatives for future investments in these technologies, in particular, the importance of taking into account suitability aspects, and provide input regarding national policies. Building a national policy in the area could help to monitor the different initiatives and overcome some of the current barriers & challenges. At the same time, it highlights the need to perform further research from a user perspective and undertake a cost-benefit analysis.

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# Use of Teleradiology in Distance Education in Brazil, Latin America

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## Introduction

Brazil is a country of continental dimensions, with a wide range of health services that meet the population through public and private services. Teleradiology becomes increasingly an extremely important tool for improving the care for our population.

Brazilian Telemedicine University Network (RUTE) is a program supported by the Science, Technology and Innovation Ministry (MCTI). It is executed by the Brazilian National Research and Education Network [Internet2- Brazil] which provides bandwidth connection (10 Gbps) for university hospitals may connect among themselves and with other national and international research educational centers (Fig. 1).

National Education and Research Network (RNP) currently connects over 400 institutions Education and Research, connecting all Brazilian regional academic networks. RNP operating since 1991, today presenting a 280% increase in aggregate capacity, 15 states connect up to 10 Gbps, 9 up to 3 Gbps, Amazonas since Oct 2012 with 1Gbps, Amapa and Roraima yet less than 1Gbps; 320 institutions connected minimal 1 Gbps, 27.500 research groups connected and 3.5 million users [1-4].

## Learning Objectives

Demonstrate a Brazilian experience in the use of teleradiology for distance learning, research and improvement of health care services through Telemedicine University Network (RUTE), through the creation of a Special Interest Groups (SIG) in Radiology.

## Methods and Results

Telemedicine University Network RUTE establishment of the organizational and technological infrastructure: national coordination, advisory committee made up of telemedicine experts of the country's best teaching and research institutions and interest groups on specific health areas (SIGs). Until now, Brazilian Teleradiology SIGs include: Pediatric Radiology, Neuroradiology, Thoracic Radiology, Abdominal Radiology and Medical Residency/Specialization in Radiology (Figs 2-6).

Monthly virtual meetings include discussion on difficult cases for second opinion, classes to update and to refresh and seminars. The access is free with previous invitation through a specific mailing. Every meeting is recorded in order to be reused by the groups.



FIG.1. National Education and Research Network (RNP): Global and Regional Integration



FIG 2: SIG Pediatric Radiology

The connection for SIG's among the university hospitals is made through video conference demanding high speeds as well as specific equipment while web conference, connecting the universities with remote municipalities, uses just a computer with internet. To associate the two technologies the Telehealth Center of UERJ (State University of Rio de Janeiro) included an endpoint linked to a work station with a web server that transmits the videoconference's audio and video to remote points. The combination of both technologies was made through the capture of the audio using a sound board, and also of the video using a capture card, after what they are sent to a work station and distributed to the points connected to the web conference. The remote access to the web conference was made through a browser Web, that will demand only a browser and add in whose installation is going to be required at the first access to a virtual room of the web conference. In SIGs, videoconferences linking university hospitals in several Brazilian states (Rio de Janeiro, Sao Paulo, Parana and others), and also private institutions that are residents in Medical Radiology, are held



FIG 3: SIG NEuroradiology: videoconference Brazil-France



FIG 4: SIG Thoracic Radiology

monthly at no extra costs to the participating institutions.

SIGs in Teleradiology are now creating international networks of collaboration and integration for interactive education and facilitating multicenter research.



FIG 5: SIG Abdominal Radiology

### Conclusions

The Radiological SIGs represents a major advance for improving the comprehensive training of the radiologists and promotes the integration with the Brazilian and international medical entities.



FIG. 6: SIG Radiology and Medical Residency/Specialization in Radiology

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## **Mobile eHealth**

# Advanced Technology Services for Supporting Active Seniors: The Mobile.Old Project

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## Introduction

The remarkable increase of life expectancy is a successful story of humanity [1], but the demographic aging raises serious challenges for health care systems, family and society. The sweeping development of advanced technologies engendered a new innovative approach: the development of the second, non-human, complementary component of seniors' care, provided by smart technology apps and devices.

In Europe, the value of this type of care as a suitable answer to population aging is recognized and promoted through several programmatic initiatives. Among those, there are the third priority area of Madrid International Plan of Action on Ageing (April 2002) [2], the third pillar - "Active Ageing and Independent Living", of the Strategic Implementation Plan of the European Innovation Partnership on Active and Healthy Aging (2011) [3], and The Ambient Assisted Living Joint Programme (AAL JP) which financially supports cross-national research projects for supporting people with special needs through innovative ICT-based products, services and systems. Many research projects addressed people with special motor needs. Currently, the concern of providing smart, non-human support to active, independent seniors is equally evolving within many EU funded projects.

## The Mobile.Old Project and App

The MOBILE.OLD - Residential & Outdoor Services Advancing the Mobility of Older Persons project ([www.mobiledotold.eu](http://www.mobiledotold.eu)), aims at developing a smart app for seniors – a set of combined smartphone, tablet and TV-based services that are intelligent, multimodal and highly personalized, capable of supporting a crucial feature of healthy and active aging - the indoor and outdoor mobility (Fig.1). The project is financially

supported within the AAL Call 4. It is coordinated by LIFEtool gemeinnützige GmbH – Austria, and partnered by technical and end-user organizations from Netherlands, Romania, Germany, UK and Spain.

Methodologically, the MOBILE.OLD project applies the principles of iterative co-design by involving a group of voluntary senior end users as active participants to the definition of requirements, input on the design of the components, and prototypes testing within pilot trials where end-users test the services in real life settings.

The voluntary end-users group includes 80 mobile and independent old people, males and females aged 65 and over. The relatives of 12 of them were also included as informal caregivers. Most of them were users of conventional mobile phones with physical keyboard.

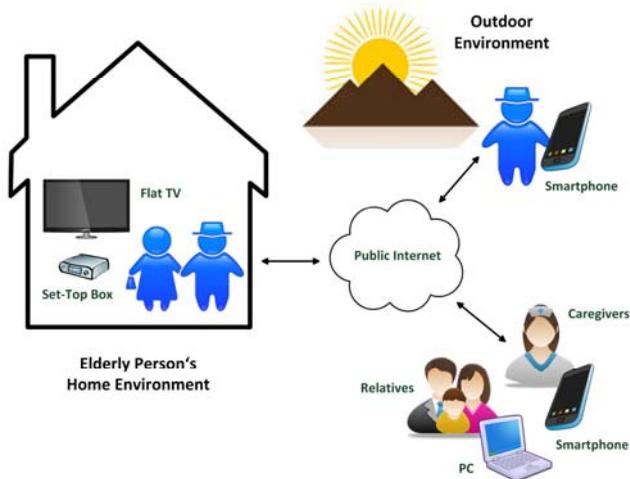


Fig.1. The Mobile.Old app architecture

A special attention was paid to the ethical provisions, in terms of informed consent, personal data protection, management of withdrawal request and exit strategies, and the setting up of ethical control instruments at the level of each of the four country pilots [4].

The involvement of the end-users in the various phases of prototype design, refinement and evaluation-validation is envisaged in Fig. 2.



Fig.2. End user involvement throughout the project

Based on the previous detection of the requirements expressed by the voluntary end-users, the Mobile.Old app was designed to provide ten services. The “Mobile.News” service offers quick access to the latest traffic news. The “Mobile.Activity” services allow the end-user to record, share and compare various walking routes. The other services are: “Mobile.Trip” (for travel route planning), “Mobile.Training” (physical training based on appropriate videos), “Mobile.Aid” (illustrated instructions for emergency cases), “Mobile.Checklist” (for organizing trips, shopping, medication etc.), “Mobile.Compass” (for orientation and navigation outdoor and abroad), “Mobile.Quiz” (play the digital version of the famous “Scavenger Hunt” game), “Mobile.Insight” (for exploring points of interest around the world) and “Mobile.Security” (safety during the traveling).

#### Main results

The Mobile.Old app prototype is currently at its final testing with the end-users within their own home, for duration of 21 days and based on a complex testing protocol elaborated by the consortium. The previous trials with 73 seniors (35 males and 38 females) showed that, despite the myth that older people are more reluctant to advanced technology apps, the acceptance of the Mobile.Old app, i.e. a complex set of ten services, is high. Almost all the old people in the end-users group proved interested in the Mobile.Old virtual companion and thus well motivated to proactively contribute to the accomplishment of project activities.

However, their interest of getting the services offered by the app was marked by the estimated intrinsic costs. Almost 2 third of the end-users were interested in buying various bundles of the services according to their needs, and only four participants would like to buy the services as one single application. For bundling, the most preferred services were “Mobile.Compass” (for 34 from the 73 voluntary end-users), “Mobile.News” (33), “Mobile.Trip”(32) and “Mobile.Training”(31), while for the other six services the preferences were as follows: “Mobile.Activity”(28), “Mobile.Aid”(28), Mobile.Security”(23), “Mobile.Checklist”(20), “Mobile.Insight”(20) and “Mobile.Quiz”(12),

where the end-users involved could imagine to pay in mean about 5 € per service.

Another lesson learned was that friendly interfaces, easy access and navigation through various functions and a good initial training with a human assistant are important prerequisites for the acceptance of a smart application by the seniors.

## Conclusions

Mobility is an essential feature of healthy and active ageing. According to [5], human mobility has physical, cognitive, psychosocial, environmental, and financial determinants. Impaired mobility due to a combination of such causal factors is frequent among the old people. If not counteracted through a personalized plan of interventions, impaired mobility will lead to functional loss, social isolation, higher vulnerability to various diseases, dependence and institutionalization [6]. The smart assistive devices and apps are proved to be valuable solutions for preserving or improving mobility, or successfully compensating mobility impairments.

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# **ASYSTED - Development of a mHealth Based Expert Support System for Ultrasonic Examination Performed by Laymen**

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To get access to professional medical diagnostics in time is not guaranteed worldwide. Especially in large countries with sparsely populated areas in locations of industry in remote areas or off-shore, the consultation of medical experts is often associated with life-threatening delays and significant costs for evacuation.

Ultrasonic investigations play an important role in medical diagnostics in emergency cases. But the lack of experienced examiners in the scenarios described above hamper the performance of ultrasonic investigations as an additional source of diagnostic information.

Telerobotic systems have been developed in the past to be able to perform examinations even from the distance. But these systems are quite expensive and thus not widely used.

To bridge this capability gap the German Aerospace Center in cooperation with the Austrian telemedicine solution provider SCOTTY Group developed a telemedical sonography support system which guides a non-experienced examiner when performing ultrasonic examinations. The system combines the transfer of the sonographic video data to a remote expert a video conferencing system and a signaling system visualizing the necessary movements of the ultrasonic transducer to be performed by the examiner.

ASYSTED (Advanced System for Tele Guidance Diagnostic) is an intuitive and cost-effective method for remote examination guidance and expert consultation. The system can operate ubiquitous (water, land, air) using satellite communications or other IP connections and can be used by unexperienced doctors or even trained paramedics.

ASYSTED is currently in a prototype stadium and has been patented and evaluated by physicians of DLR. In a next step it is intended to develop a system ready for the market together with the Austrian partners.

# Context-Based mHealth Applications Based on Mobile Web Services

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## Introduction

The technological advancement has enabled us to acquire and to maintain our own health monitoring system at comfort of ones' home. These mHealth applications consist on the one hand of various sensors continuously delivering vital sign data of the patient and on the other hand backend systems processing and presenting the data. Health monitoring is not limited to the current state of vital signs, but also on the change of health conditions during the past weeks, months or even years. Furthermore, vital data can be enriched with additional context information (e.g. location, movement, weather condition, daytime information ...) generated by connected mobile devices like smartphones. Such a mHealth system may generate a huge amount of data depending on the frequency of the carried out measurements, which may result in "Big Data" and even information overload [1]. The importance and the relevance of the collected data vary from user to user. For example a patients' general practitioner might be only interested in aggregated information about the patients' health status or data where vital signs have been drifted from the norm. He usually is not interested in the entire data pool provided by the sensors, especially not as part of his own IT-System. This brings us to our main research questions, "How can we achieve user- and context-based filtering of large and complex mHealth data sets?", "What kind of a system architecture facilitates ubiquitous on-demand data access?"

## Approach

To achieve the research objectives two technological concepts are used and integrated in the framework of our approach:

1. Mobile Web Services
2. Context Middleware

The use of mobile Web Services [2] addresses the request for a system architecture that facilitates ubiquitous on-demand data access. Using this technology, health related sensor data collected by the patients' smartphone will not be passed directly to the medical or nursing care provider, but only transmitted on request and according to the information needs (→ context middleware) using Web Services deployed to the patients' smartphone [3]. The actual storage and management of data is not done in the systems of care providers, but on a central server as a persistence component by the mobile Web Service.

Beside the positive aspect that healthcare service providers' IT systems are not "burdened" with the mentioned Big Data problem, the mobile Web Service idea takes significant advantages for patients. In terms of privacy considerations patients stay in charge of their personal health data. They can decide which data they want to share / communicate with healthcare providers or other institutions and which not. Additionally patient empowerment is enhanced. A patient gets authority of dispose and responsibility for his own health data management. Patient empowerment usually leads to increased patient compliance.

A context and filtering module works as a middleware between the user application and the mobile database. The mHealth application provides an interface to transfer filtered and contextualized data on demand to health professionals or other institutions, so the Web Service and the context module functions as a kind of proxy to the encrypted patients' data pool. The context component is based on a context model, which has to be defined application specific [4]. This means that the relevant context attributes, that are used to filter data and information, need to be derived from the information needs and context of use of the user. The context attributes refer to one of the following four context areas:

Health professional context	medical specialty, work experience, role etc.
Patient context	primary / secondary diagnosis, age, gender, patient history, clinical findings etc.
Process context	actual activity, previous / next activity or sequence etc.
Environment context	actual location, time, available sensors, devices etc.

### Application Scenario

One can identify several application scenarios where context-Based mHealth applications based on mobile Web Services provide a useful impact [3], [5]. The following describes one of those scenarios:

The central source of revenue for hospitals is the surgical area. Here the decision is made whether a hospital makes profits, or deficit. Therefore, usually all hospital processes are aligned to the optimal utilization of the surgical area. Any delay in the process or even surgeries that need to be canceled or postponed at short notice, cause a more or less considerable economic loss.

Prior to surgery, patients usually must follow certain rules of conduct and take or discontinue certain medicine for several days or weeks. Has he/she not done so (e.g. medication for blood clotting was not discontinued), the surgery needs to be canceled at short notice. This may lead to a potential underutilization of the surgical area and associated economic losses.

A 78-year-old female patient is to receive a new right hip joint. She suffers from a lighter hypertension and type II diabetes. At the same time she tends to water retention, which manifests in an abrupt increase in her weight. Normally hip replacement operations rank among "standard" operations with less risk. Because of the patients' secondary diagnoses, however, there is a significant surgical risk. Prior to the operation her risk factors must therefore be closely monitored. To shorten the period of rehabilitation after the surgery, the patient should move as much as possible in advance to the surgery and complete a specific exercise program to strengthen certain muscle groups.

Since a few months the patient owns a smartphone. At her last doctors' appointment 4 weeks before the surgery a mobile mHealth application for collecting and managing various sensor data (in this case: blood pressure meter, blood glucose meter and Bluetooth Scale), is installed and configured on her mobile phone. The data is provided via a mobile Web Service, which is also installed on the device. At the same time the female patient receives an introduction into a sensor package that will be handed out to her. Part of the mHealth application are also information films, in which she gets preliminary physical exercises paraded and will be informed about the risks and the progress of the medical intervention.

In the following 4 weeks, the female patient regularly measures her blood pressure, blood sugar and weight. This data is automatically enriched with location, time, and motion information from her mobile phones sensors (GPS, accelerometer, proximity sensor, etc.). Thus, noticeable measured values (e.g. increased heart rate and blood pressure due to sports activities) can be interpreted, according to the context in which they occurred.

The data is generated using the internal sensors of smartphones and possibly even enriched by data from external Web Services (e.g. historical weather data, additional information about the geolocation, ...). By using a feedback function, the patient may give feedback, for example how she felt during the exercise and the measurements. The logged feedback and sensor data can be queried by the hospital on-demand. When retrieving the data the hospital doctors can decide if they want to get all data or only aggregated data in terms of a status report (surgery possible / not possible). The surgical management can check at any time if the surgery will most likely be possible, whether a change in behavior of the patient is necessary or an adaptation of the surgical plan is required.

### Conclusion

The usage of vital data sensors as well as the access to the smartphones internal sensors facilitates a great variety of eHealth applications. But they also cause a potential information overload leading to a problem for users of these data (particularly doctors and nurses) due to very large amounts of data. The approach of context-based mHealth applications based on mobile Web Services proposed in this paper can make an important contribution to solve this problem. The application scenario underscores the high value contribution of the proposed approach.

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Prof. Dr. Marc Jansen holds a Masters degree in Mathematics and Computer Science and a PhD in Computer Science. His major research topics concentrate on the development of software for mobile devices and other distributed systems.



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# Mobile Medication Scanner

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## Introduction

Elderly persons (> 65 years) often use three or more prescribed medications [1]. Polypharmacy or polymedication (i.e., the use of multiple medications) can be appropriate, especially for multimorbid patients, but sometimes it is not as it can be associated with problems such as interactions between substances [1]. For the general practitioner – who in many European countries oversees the medication management of multimorbid patients [2] – it is often difficult to keep track of the current state of medication as also specialists prescribe pharmaceuticals and patients do sometimes change doctors.

The inclusion of the patients or informal carers in the medication documentation promises a great improvement of the situation as well as in patient compliance. Mobile Health (mHealth) tools seem to be the right approach for involving the users. E.g., some mHealth projects already have been realized to increase drug adherence [3]. However, the pharmaceutical packings in Luxembourg do NOT all bear a unique identifier such as the Pharmazentralnummer (PZN), for example. The PZN is a nationwide standardized identification number for pharmaceutical products in Germany and is included as a machine-readable barcode in the packing label. Hence, the missing computer-readable identifier in Luxembourg makes it cumbersome for mHealth users to add a new drug to the list and also dangerous, if accidentally wrongful entered medicaments are added.

Existing solutions (“apps”) commonly use the printed barcode on the packing for drug identification and sometimes give warning messages in case the active ingredient of the pharmaceutical in question has an interaction with other taken drugs. Rarely, the apps allow sharing the information via printout or sending an email.

In this paper we present the development and implementation of the Mobile Medication Scanner application for Android devices. This scanner enables the automated acquisition and administration of medicaments by simple “picture taking” of the medication packing. The collected information can be shared with relatives or health care professionals such as the general practitioner. We describe the necessary steps of image

processing and image improvement, the use of OCR-technology (Optical Character Recognition) and managing the information. Finally, an evaluation of user experiences is presented based on a usability test and questionnaire.

### System Design

To overcome the problem of drug identification with missing machine-readable identifiers, we use – besides regular barcode scanning functionality – optical character recognition to extract from user taken images of the drug packing.

#### *Recording Drugs*

After creating with the help of the camera of the smartphone a picture of the drug package, the user indicates the region of interest of the image in which the denomination of the drug can be found. Subsequently, the image pre-processing is performed, before the OCR can be started. In a first step, the image is transformed into a grayscale image. The second part consists of binarising the image using Sauvola's local threshold algorithm [4].

The resulting image can then be fed into an OCR library. It turned out, that modern smartphone hardware is powerful enough, to perform the whole process locally. In this setting, we used the tesseract-android-tools library, a branch of the Tesseract OCR engine [5] for Android-based devices. Besides the recognized characters, Tesseract also returns coordinates where it identified word boundaries, which helps in the further processing: in contrast to evaluating the recognized text of the entire image fewer errors arise in recognizing the individual words, because the accidental merge of several words to a single word is avoided. An example result of the subimaging process can be found in Fig. 1.



Figure 1: Subimaging

The result of the OCR can have many discrepancies, e.g. several words are combined into a single one, numbers are recognized as letters or vice-versa, disorders in the picture result in letters or numbers and so on. Due to this, we perform a postprocessing of the recognized text in which unnecessary symbols are removed. Table 1 shows an example of the OCR result and postprocessed text for further treatment.

Text from OCR	Postprocessed Text
*7 1 / 4 d 7/Tranxene® 10 m3 c ,;“ Harde Capsules Gölules Hartkapseln dikaliumc/oruzepaat c/urazäpu {e dipotussiq ue Dikaliumclurazepat aw	7 1 4.0 Tranxene 10 m 3 Harde Capsules Glules Hartkapseln dikaliumc oruzepaat urazpu dipotussiq ue Dikaliumclurazept aw

Table 1 Text from OCR and post-processed text

The recognition result is matched against suitable pharmaceutical databases and the final outcome is then displayed to the user in a form, where any errors are highlighted in color so that they can be corrected by hand (Fig 2). The CEFIP database lists all drugs that can be legally sold and purchased in Luxemburg. In order to improve the search speed, the elements of the CEFIP database have been transformed to a so-called bigram database. Using this database, all the words in the post-processed text are checked if there are matching bigrams. If a bigram is found in the recognized word, all the names in which this bigram occurs are tested on similarity to the recognized word. Using the bigrams database did speed up the search for the pharmaceutical by factor three. Pharmaceuticals with different dosage forms often bear the same principal name. Hence, we use dosage information to further limit the possible result set.

### *Managing Drugs*

Now, the user can save the recognized drug in specific lists, e.g. for oneself or for relatives, and specify reminders for intake. If the system recognizes interactions between active compounds, a warning is given to the user.

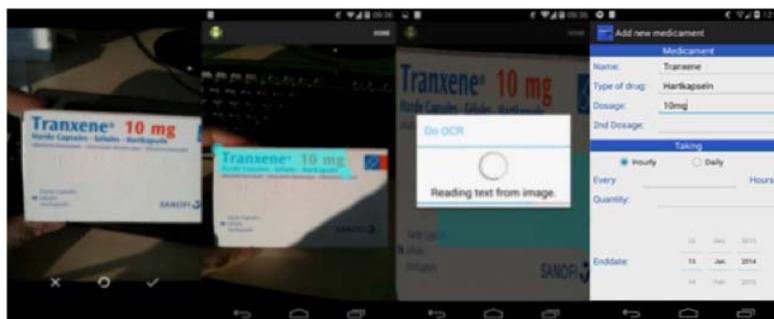


Figure 2: Workflow a) taking picture b) selecting ROI c) OCR d) edit.

The list(s) can be printed out or shared electronically via email with the general practitioner, for example. Also, PDF export functionality exists.

## Testing and Results

In order to assess the functionality, intuitive use and the design of the mobile medication scanner, the app has been used and evaluated by six subjects, aged between 23 and 61. Using the OCR for drug identification was easy to do for the participants and the design and workflows of the app conceived as very reasonable.

## Conclusion and Outlook

We described in this paper an OCR-based mHealth drug management solution that overcomes the obstacle of missing-computer readable identifiers on the pharmaceutical packing. Considering the currently developed nation-wide electronic health record for Luxembourg, we intend to review suitable standards, e.g. CDA, for sharing the medication information with GPs using the eSanté platform of Luxembourg.

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# MobileCare – Improving Preventive Medicine with a Mobile Telemedicine Model

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**Abstract:** This article presents results of a mobile tele-monitoring system focused on diabetes for elderly people. One of the important goals is to encourage prevention and health promotion through patient's interaction with the mobile tool, promoting information exchange and commitment to self-care. Patients are encouraged to take an active role in their healthcare. For example, a diabetic patient could periodically check his own blood sugar and adjust behavior, such as an excessive intake of sugar. Three groups were analyzed during one year of pilot: 30 patients with glucometer, 30 with default monitoring by phone, and 30 using the mobile system. The last group showed a process improvement by stabilizing the disease along the pilot duration.

## Introduction

Access to medical care is sometimes difficult for citizens living in distant and underserved areas. Recently, telemedicine has been helped by advances in mobile communication and the adoption of tablets and smartphones. Tele-homecare is already being implemented in Brazil to capture vital signs in a technology named MobileCare. Electrocardiograms, blood pressure, oximeters, thermometers, scales, glucometers, pedometers and spirometers are connected via Bluetooth to a tablet or smartphone that transmits information over a cellular network or the Internet to a cloud storage where a medical center has access and analyzes the data.

Using cloud computing, medical professionals can communicate with several medical centers if needed via Web services. They analyze the vital signs of their patients (visualized using Java applets), perform a diagnosis, send alerts to the tablet application, and even contact patients via teleconference — all of that using a Web browser at the medical center, which provides on-demand access to the main application in the cloud (based on the Java EE computing platform). The goal is not to replace medical consultation, but rather complement and expand the service.

As a recall to the importance of such systems, in 1985 there was an estimate of 30 million adults living with diabetes mellitus around the world.

This number grew to 135 million in 1995 and to 173 million in 2002 [1]. Currently, there are 371 million people with diabetes in the ages between 20 and 79 years. This number raises every year in practically all countries, and 50% of the people with diabetes do not even know their clinical condition [2]. 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 way, some works have already targeted this problem for elderly using home-based technological systems [3, 4].

We have run a pilot targeting diabetics over 12 months in Brazil: (1) 30 patients with a glucometer, (2) 30 using a default phone homecare service + glucometer, and (3) 30 using MobileCare. In summary, patients using MobileCare went ~30% less to the hospital than before, ~80% less in comparison to the 1st group and ~25% less upon the 2nd group.

### Methodology

The MobileCare system is composed of three main entities, as depicted in Figure 1: a) the mobile kit at patient's home; b) the cloud storage; c) the medical center, or health care center. Such modules are described below.

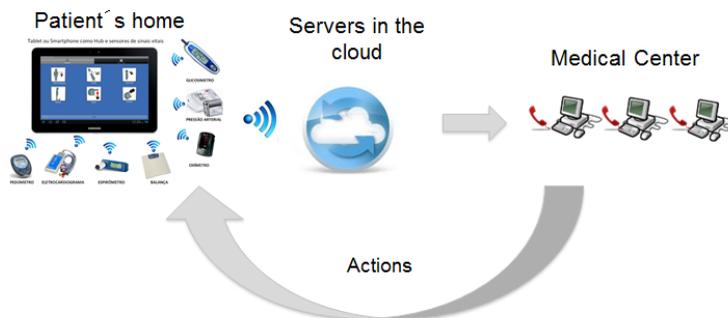


Figure 1. General view of MobileCare

#### *The Mobile Kit at Patients' Home*

The mobile kit in the patient's home is composed of a 3G / Wi-Fi tablet and a variable number of vital monitoring medical devices according to their chronic diseases. Electrocardiograms, blood pressure meters, oximeters, thermometers, scales, glucometers, pedometers, and spirometers are connected via Bluetooth to a tablet or smartphone that transmits information over a cellular network or the Internet to the cloud storage in which a medical center has access and analyzes such data.

In this case study, we used the glucometer for evaluating diabetes stabilization. Figure 2 (left) shows a glucometer attached to a device that converts the measurement to Bluetooth signal, sending it to the tablet. For instance, the interface is configured only for diabetes measurements, with only one icon on the screen. Figure 2 (right) shows a graph of the vital signs – in this case for glucose – in which patients can follow and verify the disease stability over time.



Figure 2. Use for tele-glucometer (left) and glucose graphics (right)

### *The Conducted Study and Patients Groups*

Based on an algorithm for RCT (Randomized Controlled Trial) [5], 90 Type 2 diabetes patients, ranging from 60 to 70 years old, were classified into three different groups:

- GC (Group of Control): received usual chronic disease management services only, which consisted of a call from a health center attendant once a month to check patients' stability;
- GI1 (Group Intervention 1): used an offline glucose-meter only (prescribed 3 measurements per week), being managed by the patient himself and a monthly call by the health center;
- GI2 (Group Intervention 2): used MobileCare, i.e., a tablet with Android 4.0 and a glucose-meter with a Bluetooth converter (also 3 measurements per week). These patients were monitored in real-time by the healthcare service provider.

These 3 groups were observed during a one-year pilot. The following characteristics were evaluated: glucose level, number of measurements along the year, and number of emergency and hospitalizations.

### Preliminary Results

Figure 3 shows the monthly average levels of glucose for the set of patients in GI2. It is possible to see that the levels dropped from 118 down

to 111 spontaneously. Targeting the other groups, there is no such a behavior since they do not send their glucose levels to the healthcare provider.

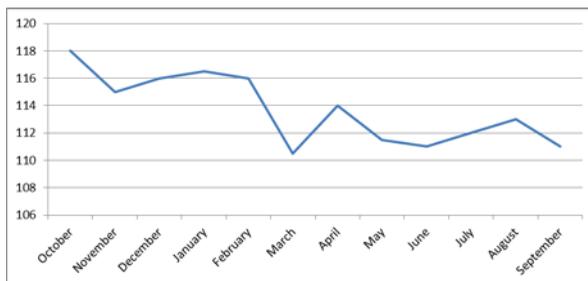


Figure 3. Mean value of glucose levels for GI2

Figure 4 shows the mean number of measurements of GI2 during the experiment. In the first months, the number of measurements presented some instability while the patients adapted to the system (learning curve), generating lots of “non-measurement” alarms in the healthcare center. The last months, patients did not need to be constantly reminded anymore. They had already internalized the need to make measurements regularly.

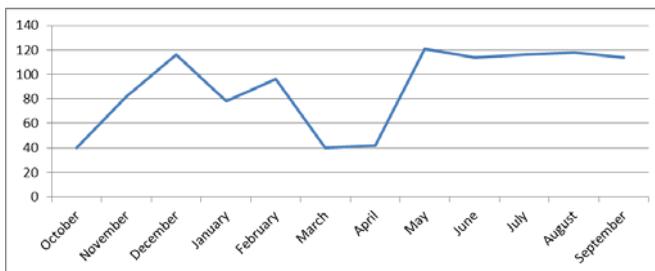


Figure 4. Mean number of measurements of GI2 along the year

Most alarms were triggered during typical vacation months (i.e., in Brazil, January, February and July). During this time, people get out of diet frequently. Besides, they travel more and do not measure their blood glucose levels regularly.

The average of GI2 patients’ age is 69 years old. This fact seems to have little influence concerning their adherence to the program, even though in most cases they had no experience of using a tablet.

One important result concerning the other two groups (GI1 and GC) is that less than 3% of the expected measurements were spontaneously

reported by GI1 patients to the “call center”. This can drive the conclusion that these people are under watched and need a higher consciousness of the disease, as was provided for the patients of the GI2.

Another important fact is that GI2 patients have gone 30% less times to the emergency room in the first nine months using the tablet when compared to the nine months prior to its use. They went to the emergency room 80% less when compared to GC patients in the same period of time. Besides, GI1 patients were hospitalized 25% more times than GI2 patients during the first nine months. GC patients were hospitalized 50% more times than GI2 patients during the first nine months.

### Conclusions

One of the important goals of using tele-homecare is to encourage prevention and health promotion through the patient's interaction with advanced technological tools. We have collected significant evidence that remote measurement of vital signals - using systems like MobileCare - can provide benefits not only to the patient, but also healthcare operators that can probably be able to reduce emergency as well as hospital costs.

Related to the diabetes pilot, only 17% of GI2 patients have left the program after the end of the one year experiment - 83% currently remain in the healthcare program. Remote regular monitoring led to earlier identification of more serious changes on the glucose level and also to earlier reaction by healthcare personnel. As a consequence, patients' measurements were brought back to acceptable levels sooner.

Of course, there remain data interoperability and security and privacy issues. Health information must be protected to prohibit unauthorized access to patient records, as well as to guarantee data integrity and make sure that transmitted data are not maliciously modified.

### Acknowledgment

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# Smart Technologies for Seniors' Mobility: The MobileSage project

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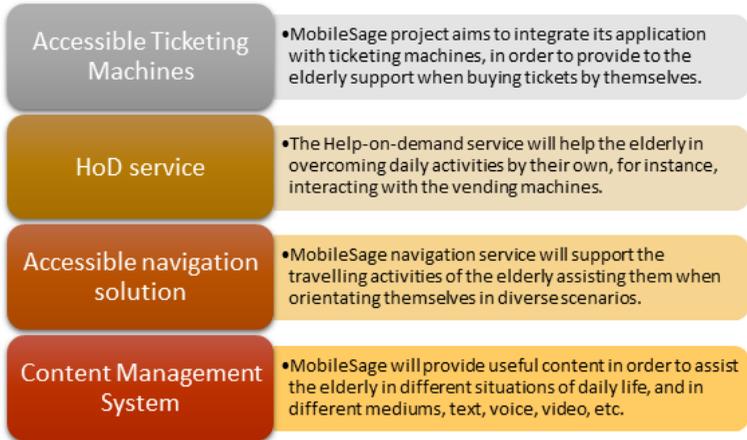
## Introduction

In individual terms mobility means physical mobility, social mobility and mental mobility, defined as the ability to function in a positive and creative manner. Mobility is fundamental to everyday life and to healthy and active ageing, while impaired mobility is associated with a variety of adverse health outcomes [1]. Older adults face various sensory, motor and neuro-cognitive changes, loneliness and reduced communication that progressively alter their quality of life. The sweeping development of advanced technologies strongly support the creation of smart devices and applications for supporting old people with special mobility needs through compensating their various physical and cognitive disabilities. A lot of multidisciplinary, multinational research projects are currently dealing with this issue. A particular category is that of seniors in good health state, mobile and independent, and more demanding customers than ever before [2], increasingly looking for useful, user-friendly and personalized ICT services to preserve their active and mobile life and to support them to stay active despite various minor impairments. The AAL-2010-3-050 MobileSage project “Situating Adaptive Guidance for the Mobile Elderly” (<http://www.mobilesage.eu>) aims at providing a timely approach and solution for this category of seniors.

## The MobileSage Project

The project MobileSage is co-funded by the AAL Joint Programme and National Authorities and R&D programs in Norway, Spain, Romania and United Kingdom. It addresses old people, with or without age-related sensory or mild-to-moderate memory dysfunctions. It aims at developing a smart mobile phone application – the MobileSage app - able to support the

indoor and outdoor mobility of seniors. Based on NFC or QR codes scanning and a series of cloud services these smart app offers two basic services: the Content Management Service (CMS) and the Help-on-Demand Service (HOD), able to provide INSTANT useful help IN YOUR SURROUNDINGS, like accessing ticketing machines or getting navigation AND QUICK INFORMATION solutions in diverse scenarios that we tested during the field trials with the end-users.



Thanks to CMS a user with multimodal Content may use a User Agent like a browser to gain access to the Content Management Service, provided as a Cloud Service on the Network (the Web). The user interacts with the Dialog Manager, which in turn controls the User Interface (Fig.1).

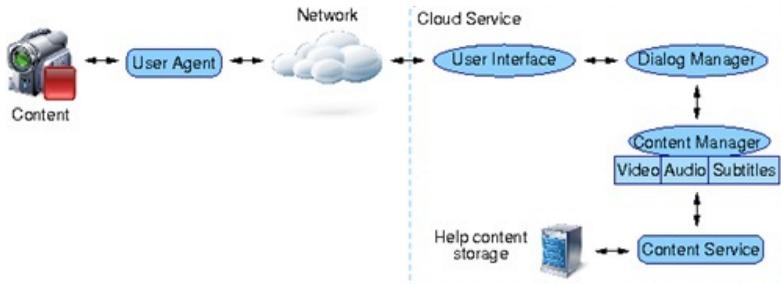


Fig. 1 The Content Management Service architecture

The Help-on-Demand Service (HOD), illustrated in Fig. 2, consists of two main parts, the Help-on-Demand Service provided by the Personal agent, and additional services provided by the network (Cloud services). It offers relevant, accessible, and usable content upon request, in the form of multimodal and personalized instruction and guidance, enabling people to help themselves.

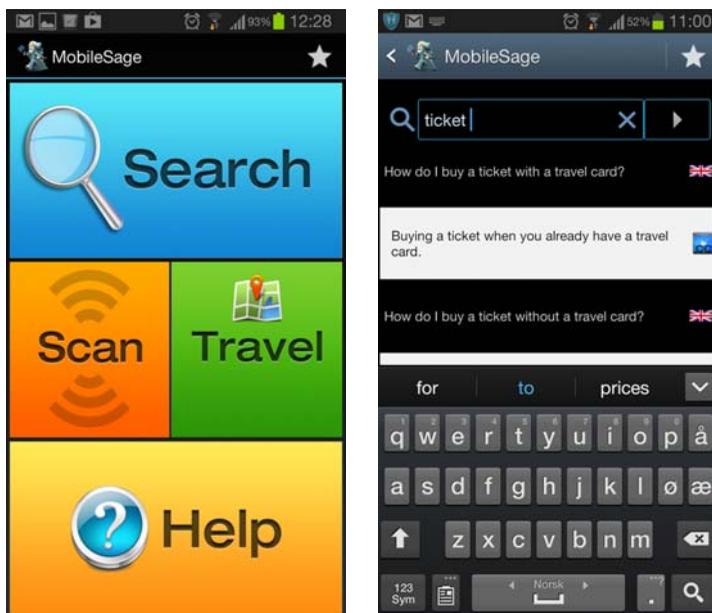


Fig. 2 Help-on-Demand main screen and ticket buying interface

The involvement of senior voluntary end-users, males and females aged 60 years and over, usually owners of conventional mobile phones, was crucial throughout all the phases of the project for end-user profiling, specification of mobility needs, system design, interfaces refinement etc. The end-users' feedback throughout the four trials of prototype testing was also capital for its improvement in terms of acceptance and usability. A special attention was paid to the related ethical issues (informed consent, management of end-user withdrawal and exit strategy, personal data protection, ethical control instruments within the three national pilots of the MobileSage project [3]).

## Results and Lessons Learned

The MobileSage project innovates in the area of supporting seniors to train, regain or compensate their indoor and outdoor mobility [4]. This support is equally important for old people carers [5]. In terms of acceptance, the general belief is that people become more reluctant to advanced technologies as they grow old. The field trials of this project revealed that including the several seniors with mild to moderate memory impairments from the group were interested in this kind of support, and that their reluctance is mainly due to stigma and the fear that they will be unable to learn how to use a smart device. The main requirements for a high acceptance are the user centered design, friendly interfaces, easy access to various functions of the application and a good initial training with a human assistant especially in case of people with cognitive dysfunctions.

In terms of estimated impact, beside the benefits for the seniors (help for self-help), the MobileSage app can substantially provide benefits to the society as a whole through lightening the burden of family members, care persons and other secondary end-users, as well as through facilitating the activity of tertiary end-users (like NGOs, policy makers etc.) dealing with seniors care. Also, by its philosophy and the solutions it provides, the MobileSage project meets the requirements and actions promoted by the The Strategic Implementation Plan of the European Innovation Partnership on Active and Healthy Aging, launched by the European Commission [6].

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# The Real Scientific Evidence of Prevention Health Apps

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***Abstract:* The widespread use of mobile phone applications in healthcare using embedded sensors is increasing at an exponential rate as they are widely used to measure and assess physical activity. Notwithstanding, developers of mobile phone applications do not scientifically document the calibration methods used, leading to considerable uncertainty as to the reliability of the measures and related assessments. Thus, this study describes calibrating a three-axis accelerometer, beginning with the raw data obtained from a sensor embedded in a mobile phone. The calibration unit covers problems of reliability, while values of the raw data involve validity problems. Researchers and developers of healthcare applications can use these results to increase reliability of future mobile phone embedded accelerometers. This study represents a valuable technical and social contribution, which gives rise to a scientific discussion on the actual reliability of healthcare applications based on accelerometer sensors embedded in mobile phones. Here, we present a ground-breaking study giving rise to a scientific discussion regarding the responsibility of application developers to disclose their calibration processes through scientific methods.**

## Introduction

Recently, the number of miniature sensors embedded or built into mobile devices is greatly increasing, which has created exciting possibilities for the development of applications intended to promote health self-care and self-control. Accelerometers are the preferred devices for measuring physical activity under free-living conditions due to their non-invasive nature, low cost and high sensitivity [1]. The increasing popularity of these customized applications and the means for keeping track of physical activities available in accelerometer-based mobile phone applications concerns researchers regarding the actual potential of these measures to improve physical activity and their impact on public health [2]. Likewise, the advent of these new procedures and data processing methods for measuring physical activity using a mobile phone creates a brand-new paradigm as to the “standard

pattern” used for the assessment of the level, intensity and frequency of physical activity [3]. There are very few clinical outcomes that have been scientifically documented and even less that have reported the side effects of these applications. Despite this fact, these applications are widely used and accepted by the society as a whole regardless of age, sex, health condition or fitness [4]. Reports on applications under the “healthcare and fitness” category show that they encourage people to engage in physical activities and keep an updated record of different measures such as amount of time spent, energy expenditure and level of physical activity, among others [5]. A critical aspect when analyzing the reliability of healthcare applications is a documented and scientifically accepted method for the assessment processes. Progress in the technology of wearable accelerometers has led to lighter and micro-sized designs that consume minimum energy, operate at high movement frequencies, and are self-operated and inexpensive [6]. These advances have allowed for innovative developments in Body Area Networks (BAN) including the incorporation of a mobile phone design based on high usability and wearability. According to an HIMSS-MobiHealth News report, there are over 7,000 applications available for the iPhone®, Android, BlackBerry®, Nokia®, etc. Applications for Android™ phones by Google™ are the most commonly requested, with more than 3 million downloads [9]. It is of particular interest for researchers that approximately 70% of all health-related applications for a SmartPhone are intended for lay consumers and only 30% for health professionals [4].

## System Design

### *Materials*

Each detection system has a three-axis accelerometer. The baseline system consists of the following: a Freescale® MMA7260Q MEMS accelerometer; a data acquisition NI USB-6008/6009. The target system consists of an MEMS BMA220 accelerometer manufactured by Bosch® Sensortec. The bandwidth of the target system, is used to setup the digital filtering (25-1500 Hz), with a resolution of 6-bit, which is embedded in a Samsung® Galaxy GT-I5000B mobile phone. The front side of the waist was selected as the ideal sensor placement for this study because it is close to the body’s center of mass and the trunk holds the greatest body mass regardless of gender, as shown in Figure 1.

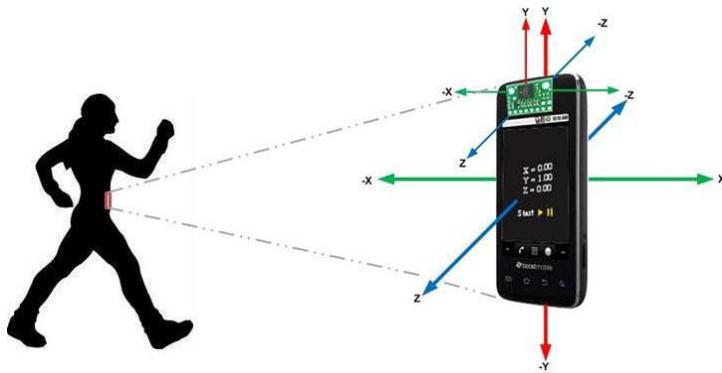


Figure 1. Sensor placement

### *Protocol*

Thirty volunteer subjects were recruited to participate in the study. They were healthy adults who did not suffer from any medical diseases and were not taking any drugs that might bias the results. Prior to beginning the test, anthropometric measurements (weight and height) and age of each subject were recorded. The laboratory study, referred to as aerobic resistance, consisted of walking and running on a treadmill, which was set to gradually increase speed from 3.2, 4.8 to 6.4  $\text{km}\cdot\text{h}^{-1}$ . Each subject repeated the workout three times for each speed with two-minute recovery intervals.

### **Results**

#### *Result: Impact of the Mobile Phone Placement*

Where the mobile phone should be placed is a wide ranging question whose answer relies on various factors such as ergonomics, movement flexibility, fashion, device size and weight, and safety. However, it is a decisive factor when it comes to assessing the results of any measurement related to physical activity. If measurements are taken in controlled environment such as laboratories, the optimum placement for measuring physical activity is studied according to each particular purpose. This is not the case when mobile phones are carried in the public, where placement depends on many other aspects such as gender (a high percentage of women carry the mobile phones in their purses, whereas men keep them in their trouser pockets), comfort, ergonomics, theft risks and appearance. Taking these into consideration, if the objective is to measure the level of physical

activity with an accelerometer embedded in a mobile phone while it is carried in a purse, the assessment will be underestimated.

#### *Result: Impact of the Body Mass Index*

An important fact in our study was the analysis of several applications that provide calculations of physical activity levels and calorie expenditure. These applications do not request basic user information such as weight, height and gender, whereas other scientifically validated models for calculating human physical activity depend on these variables for their results. This is explained by the fact that the subject with heavy weight exercise a "normal force" greater than the treadmill bands and the support foot during the impact, which results in the body recording a high acceleration produced by the greater impact force, which is explained by Newton's second Law. Thus, the greater the weight, the greater the impact force, the greater the biomechanical body stress and as a result, the greater the body movement reflected in the acceleration measure.

#### Conclusions

For the present study, we chose to work with cell phones because they are becoming indispensable in daily life and are carried nearly everywhere due to their sophisticated sensors, applications and functions.

The number of applications for assessing physical activity is increasing at an exponential rate, particularly those based on consumer specific needs or trends related to public health. The capacity of mobile phones to accurately measure physical activity has not been scrutinized. These applications often show unsupported measurements and calculations or lack the support of scientifically approved studies for disclosing, discussing and accepting the results.

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# **Chronic Disease Management**

# eHealth Care for Multidrug-Resistant Tuberculosis Management

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Threatens of multidrug-resistant tuberculosis (MDR-TB) is becoming the dominant form of tuberculosis in many parts of the world because of decades of inappropriate treatment on a global scale [1]. According information of WHO in 2012 an estimated 450 000 people developed MDR-TB in the world. It is estimated that about 9.6% of these cases were so-called extensively drug-resistant tuberculosis (a form of MDR-TB that responds to even fewer available medicines; it has been reported in 92 countries worldwide).

The accepted system of MDR-TB care is based on strict clinical protocols and special management measures. In most countries, decisions are made by a special medical commission (SMC): a primary diagnosis of MDR-TB has to be confirmed by the commission and only after that can a patient receive medications (sometimes this process takes a few weeks) [2-3]. During the subsequent two years of treatment, reviews have to be carried out every 2 months and any side-effects or complications have to be examined. This approach allows control and cure of the infection. In the Ukraine, the SMC meetings require all medical documents to be transported to a regional hospital for a few days.

A typical non-telemedicine meeting of the SMC consists of the following stages:

1. Delayed and unsecured transportation of all original medical documents and X-rays to the commission's head office (distance between hospitals 40-150 km),
2. Analysis of clinical cases with presentation of the patients by a casual medical practitioner,
3. Final decision making, documentation.

Such approach entails risk of physical damage, personal data leaks, besides the documents being unavailable for the local hospitals. During the

SMC's meetings, a local medical practitioner presents all the patients. This presenter cannot be well informed about all details of the patients from every hospital. Thus, the present system incurs delays and risks.

Some previous publications showed the potential role of the telemedicine in tuberculosis treatment and prevention [5-6]. We believe that complex of eHealth services and tools have the possibility to improve MDR-TB care and management [2].

Due to financial support and kind efforts of Rinat Akhmetov Foundation for Development of Ukraine an anti-tuberculosis eHealth network was created in the Donetsk region of the Ukraine. It connects four local centres for MDR-TB treatment (Kramatorsk, Mariupol', Shakhtarsk and Gorlovka), one regional anti-tuberculosis hospital in Donetsk (the headquarters of the SMC, regional MDR-TB expertise and treatment centre) and the Donetsk National Medical University (which provides certification and teaching for telemedicine, network monitoring and efficiency evaluation, general and technical support). The official opening of the network took place on October 4<sup>th</sup> 2013. The telemedicine network allows electronic document exchange, storage and tracking, direct communication with attending doctors and even patients, and epidemiological monitoring (Fig.1).



Fig.1. The telemedicine meeting of the SMC in progress

The closed high-speed network (100 Mbit/s) was constructed especially for the purpose of anti-tuberculosis telemedical work. Desktop videoconferencing is used, and the software provides support for DICOM images (<http://www.e-works.com>).

The web portal of the network (<http://www.itub.dn.ua>) allows access to the videoconferences. An electronic health records (EHR) system was specially

created for the network (created on the a2-platform (<http://www.a2.dn.ua>)), which is available via a separate link. This system allows not only electronic work-flow, but automation of working processes, task and documents control, actions logs and protocols (Fig.2).

A typical telemedicine meeting of the SMC comprises:

1. Uploading of medical documents and images into the secure EHR system,
2. Analysis of clinical cases, including image review via teleradiology where required,
3. Presentation of patients by a local attending doctor via videoconference,
4. Videoconference with individual patients, if required,
5. Final decision making, documentation.

The non-telemedicine process described on the first page can be compromised at any stage due to the absence of crucial data, documents or information, or if an attending doctor or a patient is not available. This process has serious in-built time delays which cause negative clinical, financial and epidemiological effects. The telemedicine process, on the other hand, does not have such time delays. Any document or person can be involved in a meeting of the SMC within a few minutes. Electronic workflow and teleradiology means that transport of paper documents can be avoided. Personal data can be protected much more effectively.

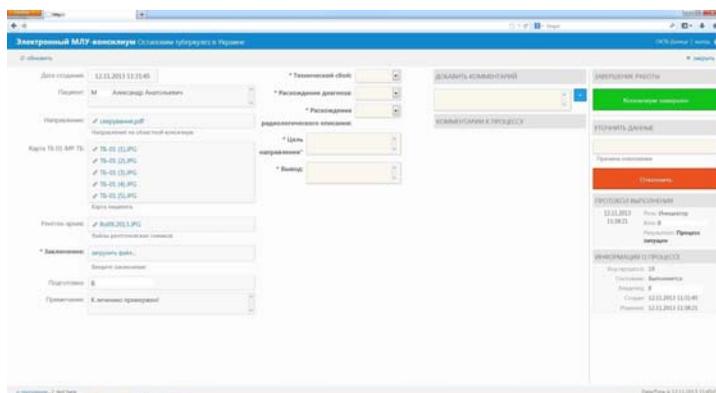


Fig.2. Electronic health records system which allows to automation of working processes

During the first two months of operation, there were up to 300 telemedicine sessions in the network. After 1 months of network operating local administrative improvements (e.g. integrating the telemedicine

meetings into the official SMC schedule, and guidelines for the hospitals involved) have been done. We studied 277 patients for whom full clinical and other related data were available. The patients (202 males, 76 females) had a mean age of 39 years (range 2-90). The main reasons for a teleconsultation were: primary confirmation of diagnosis and approval of treatment (32%), monitoring of treatment at Stage 1 (53%) and at Stage 2 (3%), final control (6%), management of complications and treatment interruptions (6%). We found that the diagnosis was changed in 12,3% of the telemedicine cases, but there were no time delays. All patients receive medication very quickly.

We are focused on technical quality and diagnostic possibilities of the Network, so classical indicators had been evaluated [4]:

- Performance Acceptability Ratio (PAR) for total (Gross PAR (G-PAR)) and non-critical (Net (N-PAR)) technical fails,
- System acceptability (Ac) for digital X-rays (ratio: number of readable X-rays received/total number of transmitted X-rays).

The system acceptability for digital X-rays takes 0,9, this value can be defined as good. From the technical point of view the telemedicine system operates rather stable according values of G-PAR - 99% and N-PAR - 80%. Thus, the main quality indicators show good efficiency of the Network.

The eHealth became a part of a routine work of tuberculosis hospitals. The special-purpose anti-tuberculosis network for telemedicine appears very successful in its first few weeks of operation.

#### Acknowledgment

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# Evidence for Person-centeredness in Telehealth Research Involving People with Diabetes

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***Abstract:* This paper describes the second phase of an ongoing bibliometric study of telehealth research for evidence of person-centeredness, using the concepts of respect, benefit and justice in the sense of fairness. Studies involving people with diabetes provide the data for the study. Phase one of the study explored a convenience sample of 14 studies for evidence of the three person-centeredness concepts, and generated a framework with 17 items. Phase two began with a literature review from 7 databases (e.g. PubMed); 23 studies met the inclusion criteria. A content analysis of these studies improved the proposed framework for person-centered research. Phase three will focus on dissemination of the framework to telehealth researchers.**

## Introduction

This paper describes phase two of a bibliometric study of person-centeredness in telehealth research. A pilot study, an exploratory review of 12 papers published in 2012 describing telehealth research involving diabetics [1], was followed by phase one which used a larger convenience sample of 16 single-study telehealth research papers, from 2011 and 2012, involving people with diabetes. The phase one study purpose was to draft a framework for person-centeredness in telehealth research involving human subjects, which could be developed and disseminated to researchers [2].

The framework used three concepts important to human subjects research and drawn from ethical treatises, specifically, the UNESCO Universal Declaration on Bioethics and Human Rights [3], the Helsinki Declaration [4] and The Belmont Report [5]. The three concepts are respect, benefit and justice in the sense of fairness. Sub-concepts that represented each of the three concepts were drawn from the phase one study sample.

Reasons for using research involving people with diabetes in this multi-phase study were two. First, the number of papers representing telehealth research is large and growing steadily. Papers can be found in telehealth research and in other professional journals. Second, diabetes is of increasing concern worldwide, with people with Type 1 or Type 2 diabetes requiring greater health care resources in most countries of the world. According to the International Diabetes Foundation, there are 382 million people living

with diabetes in 2013 and that number will increase to 592 million by 2035, an increase of 55 percent [6].

Person-centeredness can be distinguished from person-centered medicine, personalized medicine and patient-centered care. Person-centered medicine has been re-invigorated in the past several years, based on 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 [7-8]. Personalized medicine has been defined as “the ability to determine an individual's unique molecular characteristics and to use those genetic distinctions to diagnose more finely an individual's disease, select treatments that increase the chances of a successful outcome and reduce possible adverse reactions” [9]. Patient-centered care focuses on the diagnosis and treatment of illness or injury during episodes of care. Patient-centered care envisions competencies learned by patients, physicians, other health care providers and health care systems [10].

Person-centeredness in health care includes diagnosis and treatment but it also allows for advice-giving and provider reassurance with engaged listening. Person-centeredness helps to ensure that people with health care needs are assessed for their readiness to listen and learn and are included in all aspects of care. Providers from any number of disciplines consider the person's mental and physical health, beliefs and values, cultures and socio-economic realities, while also integrating the science and clinical expertise relevant for the anticipated or actual needs, risks or problems [2].

The purpose of this paper is to describe a bibliometric study of telehealth research involving people with diabetes to further develop the proposed framework for person-centeredness in telehealth research. The goal is to improve the experience and value for telehealth research participants.

## Methods

A formal literature search was completed using 7 databases and Google with inclusion criteria of ‘2012 to present, in English, and non-pediatric populations. After the search, new papers fitting the search criteria were identified by the librarian and provided for review. The literature search resulted in 46 papers that involved people with diabetes. Of these, 23 were de-selected for not fitting the study criteria. The remaining 23 papers were then subject to content analysis guided by the proposed framework for person-centeredness in research [2].

## Results

Ten countries were represented in the study sample: Australia, Belgium, Denmark, Italy, Japan, Kenya, Sweden, Taiwan, Turkey and USA. Designs

of the 23 papers represented randomized-9, quasi-experimental-2 and descriptive-12 research. Ethics or institutional review was reported for 16 studies; in 2 studies there was no notation of review. In 5 studies the authors noted that the protocol had been described in previous publications and neither ethics review nor participant consent were noted in the papers examined for this study. Participant consent was noted in 14 papers, not noted in 3, and in one study, the nurses, but not the patient participants, were consented. The proposed framework from the prior work had 17 person-centered sub-concepts for the concepts of respect, benefit and fairness. This framework served well to guide the content analysis in the present study. Based on the bibliometric synthesis, sub-categories were supported, revised, merged or deleted.

The revised framework has 11 sub-concepts as follows. Respect: use 'participants' rather than 'subjects' or 'patients'; include participants or matched persons in design of materials or interventions or both; have participants set own goals or design own self-management plans or both; include 2-way communication applications in study protocol that give active support and social interaction opportunities; use culturally and linguistically appropriate methods including people doing the interventions. Benefit: consider assessing QOL pre- and post-study and participant satisfaction post-study; include families, decrease time needed and transportation costs, given motivation and feedback during and at end of study; consider reimbursement for travel, consider money or gift for participation. Fairness: offer participation to the population that meets inclusion/exclusion criteria and avoid implying that person is a second-choice; have persons other than researchers make first contact with potential participant; provide useful material to non-intervention group for education or self-management or both.

### Discussion and Conclusions

This study set represented ten countries, giving greater generalizability to the analysis for person-centeredness. Compared with the pilot and phase one study sets, almost all of the studies reviewed in phase two indicated ethics review and informed participants' consent. Six studies indicated the use of existing bodies of knowledge by using a theoretical or conceptual framework to guide their protocols.

The revised framework is more succinct, with 11 sub-concepts rather than 17, making it perhaps more useful for telehealth researches. When indicated, sub-concepts were merged or deleted. The framework content for person-centeredness includes, but is not limited to, this study set. Thus the continuation of some of the sub-concepts in the revised framework, even if

noted to be found only in some of the Phase 2 studies, is based on the data from the pilot study, phase one study and this second phase bibliometric study. The frequency of each sub-concept depended on what was written in the articles. For example, the use of diabetic self-management could have been inferred from many of the studies but only those that mentioned the concept specifically were noted.

The framework is intended to bring to telehealth researchers a wider appreciation of how the people that serve to populate human subjects research can be participants fully engaged in the research process. Support for the framework is drawn from the principles emanating from respectfulness, beneficial aspects of human involvement and society's concerns for just and fair treatment in health care and human interaction.

This paper has presented the revised Framework for Person-centeredness in telehealth research. The next phase in this work will be to disseminate the framework with the goal of encouraging purposeful application and documentation of the concepts of respect, benefit and fairness as people are asked to serve as participants in telehealth research.

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# Introducing the ISfTeH's Chronic Disease Management Working Group

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## Introduction

The so called “Chronic Disease Management” approach wants to achieve two clear goals: a better life for chronic patients and a better use of healthcare resources. That can be done by implementing a sound organisation and standardised procedures, as well as taking advantage of the more and more rapidly developing ICT applications. This ISfTeH Working Group aims to promote the cooperation among professionals, companies and institutions with different viewpoints, approaches, expertise and cultures in the field of Chronic Disease Management.

## Vision

The shift towards new models of homecare can generate a better quality of life for the patients and a more sustainable use of the available resources.

## Mission Statement

ISfTeH's Chronic Disease Management Working Group mission is employing ethics, technology and multidisciplinary expertise to achieve measurable outcomes on chronic patients' wellness and healthcare cost containment.

## Main Goals

### *Finding a Consensus about Terminology and Fields of Application*

The lack of a clear consensus about Disease Management's meaning and goals [1] makes researchers and professionals' job quite difficult. It also prevents a reasonable comparison of the outcomes from different projects and experiences. Another issue we should consider is about the focus on “managing chronic diseases” vs. “supporting chronic patients”. Through this new working group, we expect to propose a unique definition generated by different viewpoints.

*Focusing on the Real Needs and Expectations of Patients and Payers*

Is there still sense in funding “pilot trials” to check if DM really works? Can we answer this question with a “pilot trial” on a limited number of patients, during a limited period of time? Considering that a healthcare model needs to be clinically effective and cost saving, we expect that this working group’s members may give innovative and unconventional suggestions about this important issue.

*Building an Interactive Web-Site Aimed to Receive and Spread Consistent Information*

On of the most ambitious end significant goals for this working group is the start-up of a database, accessible to all professionals working in this field, providing information about skilled people, ICT resources, in-progress experiences and achieved outcomes related to chronic disease management.

*Sharing Opinions and Suggestions*

Are the healthcare providers, the institutions and the society ready for a healthcare model shift? Do we agree that “*One of the problems is that we are applying new technology to a broken model of care, instead of using technology to facilitate a change in the model of care?*”[3]. May cultures, languages, local lifestyles generate a barrier to the diffusion of new models of healthcare? We expect this working group’s members to share their opinions and propose creative suggestions to make this step toward the future easier and smoother. For this purpose, we plan to start a blog on the working group’s web site. Such blog would be open to all professionals dealing with telemedicine and happy to share their opinion about several issues, as specified in Table I.

Table I

<b>Issues to be treated in the working group’s BLOG</b>
1. Disease Management’s definition, purpose and goals
2. Promoting the healthcare model shift
3. Disease Management’s models suitable for different cultures and organizations
4. Boosting and supporting multinational/multispecialty projects and experiences
5. Tools and procedures aimed to measure the projects’ outcomes

6. Disease Management's guidelines for different pathologies
7. Standards for data protection, collection, transmission and storage
8. Quality of medical devices and software applications.

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# Key Determinants in Adoption and Sustainability of an m-Health Self-management System

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***Abstract:* Self-management is becoming a new emphasis for healthcare systems around the world. The new generation of mobile technology (e.g. smartphones) has made it possible for many healthcare-related applications such as patient customization, real-time monitoring, etc. Moreover, self-management of chronic disease has become a focus due to potential healthcare savings, and to provide more effective care. But there are many different problems with adoption of new health-related intervention systems. Providing online and mobile decision support to manage patient health and to provide better support for chronically ill patients is a new way of dealing with chronic disease management. In this study, an m-Health system that supports self-management interventions including the care provider, family and social support, education and training, decision support, recreation, and ongoing patient motivation to promote adherence and sustainability of the intervention are discussed. A proposed theoretical model for adoption and sustainability of system use is developed, based on UTAUT2 and IS Continuance of Use models, both of which have been pre-validated through longitudinal studies. The objective of this paper is to identify and resolve issues surrounding the successful adoption and more importantly sustainability of use of an m-Health system which will result in commercially sustainable self-management support for chronically ill patients with or without disabilities.**

## Introduction

With the recent boom of information and communication technologies (ICT), m-Health has become an attractive application area. The abundance of smart phones, tablets and similar communication technologies have provided potential in a variety of areas in healthcare for many different functions [1]. On the other hand, Self-management's major goal is to improve patient quality of life, health status and behavior, in a normal setting such as the patient's home [2]. Successful implementation of a self-management project can result in less utilization of healthcare system resources [2], achieving a major goal of reducing cost of care. However,

there are some important technological as well as human factors that may complicate this process [3]. Further, sustainability in usage is another important factor in any m-Health project. Based on several reports [4] an m-Health project should have specific standards for accessibility, trust levels, and sponsorship to provide support and to ensure sustainability.

Although cost reduction is important in successful commercialization of any type of m-Health project, its ultimate success depends upon successful adoption and sustained use of the system by patients. Therefore, the major research question to be answered is: “what are the key influential factors in the successful adoption and sustainability of an m-Health project?” In this paper, we define health self-management and its related tasks and interventions in more depth. Then we explore the potential obstacles and other factors that are important in the successful adoption and continuance of use of an m-Health system.

### Patient Health Self-Management

Patient health self-management is a complex task that has four internal components [5]: **1) Self-monitoring**: includes the continuous and ongoing assessment and monitoring of the symptoms of a certain, as well as other important factors (e.g. weight, sleep) at any place other than a clinic (e.g., home, workplace, etc.) [6]; **2) Self-care**: which includes the following inter-related behaviors: Complying with prescribed medication and non-prescribed remedies, symptom monitoring, dietary adherence, alcohol restriction and smoking cessation, exercise and weight loss and preventive behavior [7]; **3) Adherence**: includes a specific behavior of patients who accept and follow special treatment regimens ordered and prescribed by their physicians [8]; and **4) Decision Support**: includes supporting and assisting patients in decision-making activities by compiling useful information based on raw data, treatment guidelines, acceptable ranges for patient vital signs (heart rate, blood pressure, blood sugar, etc.) and other status indicators (body weight, etc.). It also includes providing knowledge regarding the specific problem or set of related problems, which eventually helps patients to make better decisions [9].

Further, there are three external components that help patients in a supportive and sustainable manner, including: **1) Family and community support**: active involvement of at least one family member in the disease management and treatment process can be the key to achieving successful psychosocial intervention [10]. Furthermore, community support (relatives, friends, etc.) can also be an important factor in providing help and support for chronically ill patients. Moreover, community support also seems to have a modest positive relationship with chronic illness self-management

[11]; **2) Education and training:** A direct relationship has been found between a person's current health status and awareness, health literacy, and his/her ongoing and related decision-making. In particular, increased awareness of the complications of a health problem are related to improved decision-making [12]; **3) Sustainability elements:** defined as, sustainability is: "*the continued implementation of a practice at a level of fidelity that continues to produce intended benefits,*" [13] therefore becoming a desired goal for successful interventions.

The role of nurse practitioners as well as the use of Chronic Care Model (CCM) could have beneficial effects on processes of care and clinical outcomes [14]. Furthermore, a recent study [15] provides two categories of barriers and facilitators, as well as some recommendations: **Barriers:** 1) patient concerns about use of medication, 2) provider concerns about use of psychotherapy, 3) increased workload for clinic staff, 4) delay in receiving outcomes data, and 5) lack of resources to sustain the program. **Facilitators:** 1) patient benefits: improved clinical outcomes, quality of care received, access and satisfaction; 2) provider benefits: increased awareness and reduced anxiety, and 3) clinical benefits in the form of reduced costs of care. **Recommendations:** 1) changes in communication patterns among providers, 2) specific changes in procedures, 3) changes in resources, and 4) changes in clinic organizational cultures. In the current study, special attention is paid to the use of CCM, nurse practitioners, community support, family care partner support, educational & training tools and programs to ensure adherence and sustainability. The barriers and facilitators of sustainability (discussed above) are also taken into account. Attention is given to the motivation of patients to continue adherence to their treatment plans. Three new components: online social media, recreational games and simulations, and reward systems, are especially designed to increase the motivation of patients to adopt and to continue using health self-management.

**Online Social Networks:** Research shows that almost three quarter of Americans used the Internet on a daily basis and, among the applications used, after e-mail and search engines, the most popular online activity for adults was using social media and searching for health related information on the Internet [16]. Therefore, using social media as a channel for health promotion seems to be promising.

**Entertainment Components:** Games and simulations can have positive learning and motivational outcomes in various situations. There are several success stories in the design and implementation of serious games [17]. Further, in the case of patient motivation, if game play is self-motivating and successful, it promotes the achievement of specific learning and

recreational outcomes [18]. Further, it is anticipated that entertaining videos can also have a good motivational influence on patients with chronic conditions to use the system [19].

**Patient Reward System:** rewards and incentives provide a strong motivation for behavior change. Financial reward on the other hand is even more effective in that sense [20]. Therefore, a type of reward system is incorporated into our proposed system in order to provide real financial incentives for the patients. Patients will collect points by regularly using the system and these points will be converted to gift cards, movie theater tickets, etc. when they reach a certain limit.

## Discussion

While effort and performance expectancy appear to be strong predictors of *UTAUT 2* in initial acceptance of an information system [21], user satisfaction is stronger than these factors in the *Continuance of Use* model [22]. Although, all three are still important factors in predicting satisfaction itself [22]. Further, initial acceptance attitude is based mostly on cognitive beliefs (i.e. ease of use, usefulness) which are potentially formed through second-hand information (e.g. media, friends) that could be biased, unrealistic or inaccurate. However, satisfaction and usage intention is grounded in first-hand experience with the system [22]. As a result, both cognitive beliefs and satisfaction should be taken into account when studying pre- and post-acceptance of an information system.

Moreover, another key determinant in continuance of use intention is *enjoyment* of using a system which certainly raises the level of *motivation* of users to use such systems. There are various studies performed on the concept of enjoyment in various disciplines and a range from cognitive to physical enjoyment was developed in three dimensions [23]: **Engagement:** where attention is focused on some activity, with higher levels of attention being associated with higher levels of enjoyment; **Positive affect:** that could be designated by feelings (e.g. pleasure, happiness, etc.) and emotions; **Fulfillment:** of some need or desire, although this need may not have been previously realized consciously[23].

The main hypothesis in this research is that sustainability elements including recreational elements, online social network, and patient reward systems combined with support elements including continuing education & training, family and community support and decision support as well as providing feedback to patients that help them monitor their status regularly, can be significant factors in successful chronic disease self-management and its long term sustainability. It is expected that positive results of this nature would be useful to healthcare system policy makers by

demonstrating a significant impact on world's health care through improved self-care and management of patient chronic diseases, better communication among the health care team, reduced need for family physician appointments, reduced hospitalization and emergency room visits for patients, as well as improved cost-effectiveness.

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# mHealth in Chronic Disease Management: Case Study of a Mobile-to-Mobile Delivery Model

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**Abstract:** The United States health system in its current architecture is unsustainable. New care models that capably address chronic disease, 75% of the health dollar, are imperative. A 24-month pilot study investigated a novel mobile-to-mobile e-visit application in the care of established patients in a primary care practice from January 2011 to December 2012. Care was provided within the patient-centered medical home model for minor and some moderate acute illness, as well as, chronic disease care in the second year. After 471 consecutive cases, clinic productivity increased 15% and per-capita costs declined 15%. The results suggest that a mobile-to-mobile delivery model provides a new generation of telehealth that can be effectively translated into the medical home. Mobility increased quality of experience for patient, provider, and practice - all the while, safely rendering cost-effective access to care to the United States largest driver of health costs, chronic disease.

## Introduction

The United States health system in both its organization and delivery is unsustainable in the current architecture [1]. It is simply too costly to continue in its present manifestation [2]. One major cost driver is the disposition and delivery of chronic disease care.

Patients engage the health system for both acute and chronic disease care via primary care medicine. Starfield, et al., documented that within primary care, an established medical home relationship provided the best outcomes and lowest cost of care [3-4]. However, traditionally, telehealth has not generally been practical within the medical home, as it was designed to engage geographically isolated patients with medical specialists in a manner that attempted to recreate the office-based encounter. Current commercial technologies have built upon the non-medical home structure to provide care of minor acute illness; however, such a delivery model provides limits for the effective disposition of chronic disease care, as brick-and-mortar follow-up is not possible for complications and ongoing care.

In an effort to address the need for efficient and cost-restrained access to medical care, a mobile-to-mobile telehealth delivery model may offer some

unique advantages. If conducted in a manner that could engage primary care medical providers, it would make the medical home relationship amenable to the model; and, if proven safe, might address the care of stable chronic disease care.

## Methods

### *Study Design*

As the mobile-to-mobile model represented a unique delivery method at the initiation of the study, the first year was devoted to the treatment of minor acute care in an effort to evaluate safety and reliable clinical care. The second year addressed some moderate acute care, as well as, designating 20% of cases for the care of stable chronic disease. Chronic diseases addressed included minor changes in the management of diabetes, hypertension, thyroid disorders, minor cognitive diseases, gout, and dyslipidemia.

### *Sample Selection*

We used a convenient sample selected by the physician that represented about 25% of the regularly active patients in the medical practice. The physician was a primary care physician located in rural, South Central Kentucky, U.S.A. Care was provided from January 6, 2011-December 31, 2012, representing two years of continuous clinical care.

### *Architecture of the Delivery Model*

Established patients of the practice were placed in cohort with their medical home physician. They completed a cursory past medical history online that included demographics, medical allergies, ongoing problems/care, current medications and significant surgical history. Twenty-four hour access was provided from either a mobile device or computer; and, a visit was initiated after a HIPAA-secure login and review for any change in medical history.

The patient was directed to complete an online, logic-based interrogation engine. They were provided an option to add unstructured comments and up to five photographs. The history was formatted into a traditional HPI, and then added to the stored past medical history and submitted to the physician. The physician reviewed the case, completed assessment/plan, and submitted a prescription, if appropriate, to the pharmacy from a mobile device. A unilateral option to contact the patient by phone or video was possible. A care plan with encounter-specific education was returned to patient and medical record. Average provider turnaround was less than four minutes.

## Results

The practice completed 471 mobile online encounters over the 24-month period with no reported safety events or adverse outcomes. Encounters increased 53% from year 1 (188) to year 2 (283). The mean patient age was 41 years with a variance from 16-90 years old. Most online encounters were conducted by women 1.7:1, with 95% (447) occurring before 10:00PM, and 81% (382) after clinic hours of operation. The average encounter time was less than four minutes for each encounter.

Patients were served in twelve Kentucky counties with an estimated sphere of influence of 4,300sq mi. Five of the counties are designated by the United States government as rural, Appalachian, and thus, special needs. Care was also delivered to patients in four states outside of Kentucky that included: California, Florida, Alabama, and Tennessee.

In the study's second year, 20% of cases (57/283) were designated chronic disease care. There was an increase in the clinic's productivity of 14.92% from baseline defined as the increase in capacity of the practice to deliver care. Also, there was a reduction in per-capita cost of care of 14.93% (\$191.76/\$225.42) based on federal tax return filings of annualized expenses of the practice per active patient base.

## Discussion

A literature search conducted before the initiation of the study did not reveal any prior art in a mobile-to-mobile delivery model of clinical medical care. Therefore, it was necessary to engineer and develop a web-based software architecture to provide this degree of freedom for patient and physician. The fiscal development was accounted for using a separate corporate structure. To overview the study and provide counsel, we enjoined a regional academic partner, the University of Kentucky; and, a dialogue continues presently as we evaluate the ongoing experience of the delivery model.

There were two important nuances that were integral to the success of the delivery model. The first, and most influential, being the ability to drive the physician's response time to less than four minutes per encounter—the functional limit to what we believe will engage a provider to maintain care both during and after clinic hours of operation. In effect, this alone, allowed telehealth to become practical within the medical home relationship between a physician and their established patient. The second being that the engineering allowed the physician the freedom to dispose of each encounter as they deemed appropriate—be it an asynchronous e-Visit, and e-Visit augmented with telephone communication, or a face-to-face video encounter.

An increased clinical efficiency, and flexibility in the disposition of care, allowed the primary care physician to remain engaged; and, ergo, maintain the medical home patient relationship. It is this established relationship that permitted the mobile delivery model to address more complex care than present generation telehealth models. Well-established clinical relationships are particularly important in the care rendered for chronic diseases. In stable chronic disease, the physician is commonly used as an analyst, educator, and motivator; the diagnosis is not in question and fine-tuning of an established regimen is, generally, the requirement. Mobility simply allows such care to proceed in a more cost-effective and effective manner for the health system.

In summary, this case study demonstrates the safe clinical care for some stable chronic diseases using a novel mobile-to-mobile delivery model. The mobile construction for both the physician and the patient represents a new generation of online telehealth - one available to primary care and specialty providers, alike.

Mobility allowed the medical providers and patients to retain access to care maintaining their established clinical relationship. The delivery model fulfilled the conscience of the Triple Aim by providing care to more patients, using fewer resources, under an umbrella of increased access. Moving forward, new and efficient delivery models such as those demonstrated by this case study, will be a necessity for the United States health system to make the care for chronic disease both available and affordable.

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# Patient Inclusion in a Diabetic and CHF Telemedicine Services - The United4Health Slovenia Experience

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## Introduction

The General Hospital Slovenj Gradec (GH-SG) and the Healthcare Centre (HC-Ravne) of Slovenia are participating in the largest European R&D project regarding number of patients involved in a telemedicine (TM) to date [1]. The project, called United4Health, aims to spread a telemedicine model and evaluation criteria developed within the Renewing Health EU project [2] to countries that have not yet introduced telemedicine services. Among 34 project partners 15 will pilot the model in their regions in 10 EU member states - offering telemedicine services for at least a year to almost 15.000 patients with CHF, diabetes, COPB or hypertension. In Slovenia that will be GH-SG and HC Ravne. 400 patients with diabetes and 200 patients with CHF will be enrolled into the project pilot.

Slovenia so far has not yet established any home telemedicine (business-to-patient) service, so the Slovenian partners in United4Health are pioneers in the area. There are several tasks that at once need to be addressed when setting up a telemedicine service. The project team has been challenged by telemonitoring technology, issues concerned with patient inclusion, changes in the treatment processes and in the organisation of workflows.

Patient related actions are presented in this paper which are rarely described in the literature but would be helpful to those who plan to set-up a telemedicine service without purchasing an external expertise.

## Telemonitoring and Support Tools

In the project diabetic patients measure their blood sugar by a glucometer (Fig.1) on one day in a week. They provide a whole day profile (6 measurements). CHF patients take daily weight, blood pressure and oxygen saturation measurements using corresponding mobile measuring devices. Each patient uses a smart mobile phone that serves as a mobile gateway. Data are transferred from the measuring devices to the gateway via Blue-tooth and then over a mobile network to a telemedicine service centre at GH-SG. The technological solution was provided by Health Insight Solution [3]. The gateway and the measurement devices are matched and personalised prior being provided to the patient.



Figure 1: Patient taking blood sugar measurement using mobile telemedicine solution.

#### Patient Inclusion

The most challenging task for the project team has been patient related issues. Within the project the process of patient inclusion has been determined and all related documents have been prepared. Although patient selection criteria were designed by the U4H project members (amended from the Renewing Health [RH] project criteria), the inclusion of 600 patients has been a challenge for GH-SG and HC-Ravne due to low number of suitable patients covered by the SB-SG hospital. Diabetic patients (400 needed) fulfilling the project inclusion criteria have been recruited out of 1,200 patients registered in the region. The CHF patients (200 needed) have been recruited out of 700 patients registered in a database of the SB-SG hospital. The recruitment process started in Feb2014 and will last 6 months. Patients, who meet mental, cognitive, social and other conditions, are personally addressed and invited to participate in the study at their regular 6 months visits to the doctor. They receive a formal invitation document explaining their role and potential benefits they and other patients may gain. Those who agree are invited for scheduled training on use of the telemedicine service. If they decide to participate, they give written consent, obtain instructions for telemetric measurements and are provided with user manuals for the equipment. Individualised telemonitoring equipment is provided to the patient with instructions for use in potential emergency

situations and regarding service termination. All patients have an initial interview where their personal data are collected. At the end of the project or at a termination of participation, a user satisfaction interview will be undertaken.

#### Personal, Medical and Telemedicine Data Management

Two databases are kept within the project. The first contains data on telemetric measurements and the second contains patient related data: their personal data, medical and social status, as well as data that would enable assessment of social/medical benefits of the United4Health project for them and for the Slovenian national healthcare system. For the moment the databases are not linked automatically. A web portal was designed enabling patient database management. It contains patient related documents and training materials. Data kept in the hospital CHF patient registry have been used as a key source for the patients' database. Data for recruited diabetic patients are manually entered into the database. Virtual data servers hosting the databases are located within the SB-SG hospital data centre. This assures an adequate security level for sensitive medical data.

#### Healthcare Service Workflow and Organisational Changes

Telemedicine services when introduced to an existing healthcare delivery system usually influence dramatic changes to the service workflow and organisation [4]. The existing workflow process of patient treatment in SB-SG hospital has, however, been only minimally adjusted to integrate the new telemedicine service. Major changes, although potentially required were put aside because the telemedicine service is a pilot and not, therefore, 'mainstreamed'.

Regular visits to a specialist have not been omitted. Patients retain the ability during such visits to report their experiences of the new service. A mobile team of field nurses is planned to visit those patients who are willing to cooperate but do not feel capable of managing the telemedicine devices by themselves.

Additional training and regular education seminars were introduced for patients in order for them to gain the necessary skills for the telemedicine measurement at their homes. Their caregivers also participate the training.

An additional medical response scheme has been introduced that responds to requests for intervention generated by the telemedicine system (though monitoring of the measured data values) and where requested by patients through the telemedicine centre. For emergency cases the established intervention and care system pathways are used, viz. a visit to an emergency unit or to a specialistic outpatients department.

Some adjustments were needed in the system of glucometer strips availability for the diabetic patients. As the United4Health project uses advanced glucometers with Bluetooth communication, the corresponding strips are provided to patients by the project staff. The traditional distribution route through the pharmacy network is, therefore by-passed. Reimbursement of the costs for the glucometers and the strips at the National Health Insurance Institute is made only for eligible patients.

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# **Receiver Operating Characteristic (ROC) Analysis: Better Way to Evaluate Remote Monitoring Programs in Chronic Disease**

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## **Background**

There is a need for a more rigorous method to validate and quantify evidence-based value for RM systems. This foundational study applies the process of Receiver Operating Characteristic (ROC) analysis to evaluate utility and predictive value of a Disease Management (DM) model that uses Remote Monitoring (RM) devices for Chronic Obstructive Pulmonary Disease (COPD).

## **Introduction**

ROC analysis is an engineering approach widely applied in medical testing but methodology has not been evaluated for its utility in RM. Classifiers (SPO<sub>2</sub>, BP, Pulse), optimum threshold and predictive accuracy are evaluated based on patient outcomes.

### **Materials and Methods**

Parametric and non-parametric methods are used. Event-based patient outcomes include in-patient hospitalization (IP), A&E (accident & emergency) and home health visits (HH). Statistical analysis tools include Microsoft Excel® and MedCalc® version 12© 1993-2013 to generate ROC curves and statistics.

## **Population**

Persons with COPD monitored a minimum of 183 days, with at least one in-patient (IP) hospitalization within 12 months prior to monitoring.

## **Data Source**

Retrospective, de-identified patient data from a UK National Health System (NHS) COPD program. Data sets include biometric readings, alerts and resource utilization.

## **Results**

SPO2 identified as a predictive classifier, with optimal average threshold setting of 85-86. BP and pulse are failed classifiers, areas of design are identified that may improve utility and predictive capacity. Cost avoidance methodology was developed.

#### Discussion & Results

Results can be applied to health services planning decisions. Methods can be applied to system design and evaluation based on patient outcomes.

#### Conclusion

Validates use of ROC in RM program evaluation.

Keywords: remote monitoring, evaluation, disease management

# Scaling Up, the Future of Telemedicine and Health Management

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## Introduction

In the healthcare industry, "management" is a magic word that blankets all manner of excuses and that often fails to address basic issues such as "disease education", which is the axis on which healthcare should be balanced. There are as many definitions of disease management as there are disease management programs. The confusion is perhaps rooted in a fundamental paradox: In disease management, we really should try and manage patients, not diseases.

Health is more than just the Absence of Disease...

In the last 20 years there have been hundreds, if not thousands, of "pilot" healthcare management programs all over the world. Most of these programs have failed to have any significant lasting impact on the cost of delivering healthcare solutions because they have been centered around a small cohort of patients and have been dependent on specific funding that does not reflect the economic realities of any healthcare system. These pilot programs also fail to understand that in the management of a specific chronic disease, it should be the patient who is managed, rather than his disease. A patient who is suffering from a chronic disease is defined by his lifestyle, as his disease is part of his everyday life, and as such it is his life that must be managed, rather than just the symptoms of the disease.

In current health management programs, if specific funding is given to a specific pilot program to prove that health management reduces the cost and burden of a specific pathology, it is more often than not a distant reflection of the economic or social reality of the patient who is being managed.

Medical professionals, treating one patient at a time, have to focus on the unique needs of each individual patient. Many medical professionals are still at odds with health management programs, using the contentious argument that standardized guidelines promote a "cookbook" approach to patient care that cannot account for the variation and complexity they encounter in the examination room.

The challenge for health management programs is to find a practical way to implement standard guidelines with the flexibility for doctors to tailor-make plans for the needs of individual patients. Measuring and analyzing

patient-centered data can help meet this challenge. This will be best achieved with devices that can send results directly to medical practitioners, should the devices become affordable as a tool for healthcare management.

Medical professionals are more likely to support health management methods if they allow for doctors to consider the needs of individual patients. And vice-versa patients are more likely to benefit from health management if guidelines can be tailored to their specific circumstances and experience.

Armed with clinical and patient-centered data, doctors can design and implement structured plans matched to the individual needs of their patients. Hence, health management need not be viewed as an inflexible "cookbook" approach to healthcare.

The single most important step for doctors treating pathologies is to enlist their patients as partners in their own healthcare. Home health management has proven to be a great added tool to help medical professionals understand the pathologies of their patients and give the medical practitioner a much clearer set of information on the evolution of a patient's pathology. For example, blood pressure values obtained by home measurements are several mm/Hg lower than those obtained by office measurements with home blood pressure values of around 125/80 mm/Hg corresponding to clinic pressures of 140/90 mm/Hg; Home blood pressure measurements also provide numerous values on different days in a setting closer to daily life conditions than the doctor's office. It also favorably affects patient's perceptions of their "hypertension" problems and improves adherence to treatment.

Good communication between the physician and the patient lies at the core of the successful management of pathologies such as hypertension and diabetes. Clear information about blood pressure and diabetes, about risks and prognosis, about the expected benefits of treatment and about the risks and side effects of treatment is essential for satisfactory life long control of pathologies.

Recent advances to telemedicine and technology have come to the fore in the last three years. New ranges of "connected health" devices using mobile platforms are now commonly available and are seen by many in the health management industry as a future panacea for health management. However, there are still many obstacles to overcome before these devices become suitable for long-term health management programs.

These "connected health" devices include blood pressure monitors, medical scales, glucometers, activity trackers and other such devices that translate the signals of the body. These devices all link seamlessly to tactile devices such as smartphones or tablets which then translate the results into a meaningful format for the user to give him a better understanding of his

pathologies. These devices allow the user to measure, track and share his results with his medical professional or healthcare management program. At first glance they seem perfectly adapted for healthcare management programs.

There have been over the last three years, since these devices have been readily available, at least 20 new pilot programs for health management using these new “connected health” devices. However, most, if not all, of these programs will never get beyond the pilot program stage as they are still centered around “pilot” funding instead of economic reality.

The bare facts are that these “connected health” devices are too expensive in manufacturing costs to be useable for any large cohort of patients. A large cohort of patients using connected healthcare devices could significantly affect the cost of health management; however the economic investment needed for these programs to be rolled out beyond the pilot phase is too large for the programs to be applied for large cohorts of patients.

The current “connected health” devices use such communication protocols as Bluetooth and Wi-Fi to send the results to smart platforms such as mobile phones or tablets. The use of these communication protocols (Bluetooth and Wi-Fi), as well as the use of these smart platforms, makes the devices in question much more expensive than traditional devices, and the overall direct cost saving on the management of pathologies such as hypertension or diabetes is not in rapport with the actual cost of the devices.

So the current “connected health” management programs find themselves in a quandary. On the one side are devices which are perfectly adapted from the technological point of view, as the devices are user-friendly and allow results to be seamlessly sent to a management platform, and on the other end the devices are too expensive to use in large cohorts of patients.

What is needed?

Although “connected health” devices, such as the ones offered by iHealth (<http://www.ihealthlabs.com>) a Silicon Valley startup, are perfectly adapted from the user-experience point of view, a new generation of devices is needed that will use cheaper communication protocols so that health management programs worldwide using these devices can move beyond the pilot program phase and scale up their programs to include large cohorts of patients.

All managed healthcare programs should have a common goal. They should focus on an integrated, pro-active approach to delivering healthcare services to patients who have a particular disease to achieve good outcomes at the most reasonable cost.



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## **eRehabilitation & ePrevention**

# **E-Psychotherapy: Awareness, Usage and Challenges among Nigerian Psychotherapists**

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## Introduction

Recent strides in information technology and opening of new communication channels have aroused new dimensions in psychotherapy. Telecommunication technologies have been used to provide support to individuals in crisis, supplement psychotherapy and increase treatment compliance and motivation among individuals with a history of psychopathology. e-Psychotherapy has been useful for screening and assessment of individuals with known psychopathology and provision of education and training to mental health professionals and the public in general [1].

The use of technology in psychotherapy has been apparent in some form or another for the last six decades [2]. As far back as 1950s, Dr Joyce Brothers used radio to reach millions of listeners and provide services to those in need. Walker [3] pointed out that interactive video therapy, where client and therapist were connected by television for the counselling session, began at the University of Nebraska in the 1950s.

Telephones have been employed for suicide hotlines and 24-hours counselling. E-mails and list serve are used for personal and professional communication as well as for consultation, supervision, referral, and professional development and internet websites are employed in counselling, marketing, advertising and various forms of therapeutic services [4].

e-Psychotherapy is today, a fast growing means of providing psychotherapeutic services to men and women all over the world. Chang [5] indicated that over 100 million Americans have sought help or mental health information online. In practice, online mental health services, e-Psychotherapy inclusive, may never replace face-to-face psychotherapy. It is clear that it is prolific, easy to handle, cost effective and of course has come to stay based on recent technological developments. As technological breakthroughs daily emerge and are accessed, e-Psychotherapy significantly changes from providing cliental services through e-mail to chat rooms and live sessions web-cam applications such as Skype or ichtat [6] which can be easily and freely downloaded from the internet, making it cost effective.

e-Psychotherapy also known among others as Cyber therapy, online psychotherapy, cyber-consultations, cyber psychology, and telehealth, is similar to traditional face-to-face psychotherapy although each participant may live in different geographical locations and time zones. e-Psychotherapy has been found useful in the management of depression, suicide, eating disorders, attention deficit disorder, panic disorders, post traumatic stress disorder, and grief among others [7].

The advantages of e-Psychotherapy are numerous. It is convenient for both psychotherapist and client and as such occurs without a cumbersome synchronizing of a psychotherapist and client schedules [2, 8]. Again, e-Psychotherapy eliminates many barriers associated with a face-to-face psychotherapy such as inability to access a therapist's office due to geographical location or a disability [9]. The problem associated with time or timing is removed because both parties can respond at their convenient time [7]. In most cases, the weekly schedules often prevalent with the traditional face-to-face psychotherapy do not apply in e-Psychotherapy which makes it possible for more frequent and less expensive interaction. Both client and therapist can easily refer to any part of their psychotherapeutic sessions since they are automatically documented [7], though this often creates the problem of confidentiality. e-Psychotherapy has been found effective in reducing anxiety, avoidance, and stigma among clients living in communities where mental health illness and services are stigmatized. It affords clients anonymity which lacks in face-to-face psychotherapy [8] though this has its peculiar problem for instance, when a client discloses intentions of self-harm, harm to others or child abuse [2].

Viewing from the windows of the disadvantages of e-Psychotherapy, some variables are convincingly visible. There is a relative lack of "presence" in the therapy sessions. According to Efstathiou [10], it is seemingly difficult to establish the fact the other person is present. Again, the therapist finds it difficult to build rapport and show genuine positive regard with the client [7]. Mathias & Denson [11] and Bradley et al [7] via their independent works submitted that e-Psychotherapy denies the therapist the opportunity of assessing a client's non-verbal behaviour which helps the former in probing, assessment, identification of incongruence and direction. Rummell & Joyce [4] referred e-Psychotherapy as "buyer beware market" because of those who may pose to be therapists in the process may not be. Hence, only licensed or certified psychotherapists can uphold ethical standards. In practice, not all psychological cases can easily be handled via e-Psychotherapy. The cases of suicidal or crisis clients are not best handled in this regard [11], especially when the clients do not provide accurate contact information [4].

Despite the numerous advantages associated with e-Psychotherapy and its seemingly global acceptance, not much seems to have been said about it in Nigeria as a result of Nigeria's peculiarities in ICT and telecommunications. Hence, this paper aimed at evaluating the awareness and usage of e-psychotherapy among Nigerian psychotherapists. Again, this paper examined the challenges facing the proper adoption of e-Psychotherapy among Nigerian psychotherapists and those seeking mental health services in Nigeria.

### Methodology

A population of 50 practicing psychotherapists drawn from eight universities and three hospitals within the South-East Nigeria were used for the study. They comprised males and females, within the age bracket of 28 and 60 years and those who have been in practice between 3 to 25 years.

Face-to-face and online interviews were employed in eliciting their responses as per their awareness, usage and challenges of e-Psychotherapy. 60% of participants showed awareness while 40% indicated non-awareness of e-Psychotherapy. 36% of participants also reported having used e-Psychotherapy while 64% showed non usage.

### Discussion

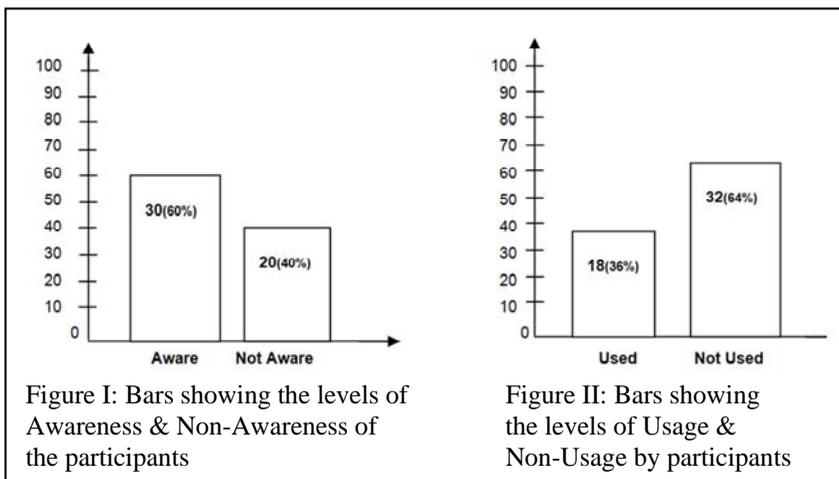
Though 60% of the participants showed awareness of e-Psychotherapy, 64% of non-usage of it indicated the under listed challenges expressed by participants.

Many of the psychotherapists said that their inability to use e-Psychotherapy hinged on network failures and inadequacies presently prevalent in Nigeria, inability to access the facial cues of clients necessary for probing, and low literacy level of clients most of whom are not ICT compliant. Some of these claims are in line with the views of [11] and [7]. Others expressed the non-steady internet connections and services, the "unreal" nature of the e-Psychotherapy, difficult or absence of mental state examination, non control of physical environment and deception in client's voice and sound surrounding therapy sessions. Yet others viewed e-Psychotherapy to lack confidentiality necessary in the therapeutic process, high cost of network services/facilities in Nigeria and clients' lack of awareness of the process.

Be it as it may, the 36% of the participants who are presently in use of e-Psychotherapy were of the views that the process is convenient, easy and cost effective.

### Results

## Bar charts showing awareness and usage levels of e-psychotherapy



### Conclusion

The awareness of e-Psychotherapy among practising psychotherapists in the South-East Nigeria is high but the usage of the modality is very low. Their challenges notwithstanding, with consistent technological developments and assessment, improvement in power, networking and global interactions, Nigeria would soon cue in.

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# Investigations on Veil Psychology for Telemedicine System Acceptance in South Punjab, Pakistan

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## Background Information

Mayo hospital is the oldest and biggest hospital of Pakistan with the capacity of 2300 beds. There are more than 40 departments in it and it is attached to King Edwards Medical University (KEMU), one of the most prestigious and oldest medical learning institutes of Asia established in 1870. At Mayo Hospital telemedicine project was launched by the Federal Ministry of Information and Technology in 2008 and it became operational in 2009. The Department is one of the three hubs established in Pakistan. Mediated hurdles in inter personal communications between experts at hub and patients at remote were responsible creating clinical issues in tele consultations which need to be analyzed.

The veil hijab, niqab, chadar or burqa is an expression of the invisibility of women on the street. The shape type and application of veils and covers may vary from community to community. Historically influence of old Arab, Iranian and sub continental communities established different concepts and limits of veil. In Pakistan south Punjab has the unique culture, as it shares historical, social and cultural values with Arab, Iranian and sub continental cultures. It is because of this reason all types of veils are practiced in this region [1]. Veil is always affected by every type of political and non-political pressures and movements due to lack of resources, poverty and cultural restrictions. Adoption of new technologies like internet, ATM & touch phones etc, which is a complex phenomenon, is most of the times easy for males of upper & middle class but for females the situation is different due to psychological factors linked to veil [2]. The present studies were focused on the instrumental constraints of veil in which communication between the expert at hub and patient at remote is affected by veil [3]. In general shyness is the most common factor while

communicating with non-family male and is higher in front of camera [4]. It is a serious concern which hinders with social interaction and has attained the status of clinical issue [5]. The present studies highlight the nature and intensity of communication problems at consultant's hub. Discussion of the psychological spectrum and solution of the issues are complex one which requires extensive studies. This study was conducted to enhance the Quality of the telemedicine system and gather information about the living standards and cultural hindrances.

### Investigation Protocols

*Information collection and feedback system:* The information was gathered from patients and operational staff at remote station through informal discussions, formal tele meetings and questioners. Operation staffs at 8 remote centers were trained to fill up the questioner in the light of site specific norms and customs. Patient views and feedback on questioners were filled after making informal discussion with the patients. These questioners mainly focused on gender, age, financial group, type of family head system, particularly female dominating figure or heading over the female members of the family, her influence in the micro ecology of the family and her family views, satisfaction level of the services and satisfaction from the consultant.

*Distribution of structured questioner at Hub:* A structured questioner was distributed among the tele-consultants at Hub stations in which they were asked to record what kind of hindrances they faced at hub during consultation like sound quality, language issues, patient behavior, issues due to veil and pressure groups exerting pressure on patients.

*Psychological observations at both ends :*A team of clinical psychologists was included in the final phase of the study. They were asked to observe both patients at remote end and doctors at Hub station. The specialists observed the irritation level of doctors and patients at both ends, doctor relationship at Hub and Remote workstation, language issues, psyche level of the patient, pressure groups, female patient behavior with doctor & system administrator and veil psychology of patients.

### Results and Discussions

From 2008 till 2013 cultural psychology of 7452 patients (3369 Male and 4083 female) at 7 DHQs were studied through structured questioner and informal discussions. Information related to the socio economic, cultural background, living conditions, and the medical problem and satisfaction level of the patient was gathered through the questioner (table1). Parameters of patient satisfaction, fear factor associated with new technology, irritation

levels of patients, facial expressions, and domination factors associated with patients were recorded by the psychologists.

Table1: Patients observed for veil issue

Station	Total Patients	patients with veil issue	Went without consultation	Patients with reservation
Gujrat	889	19	2	17
Rajanpur	1089	141	34	107
D.G Khan	881	86	18	68
Jhang	428	28	3	24
Khushab	384	31	2	29
Attock	372	13	2	11
Sahiwal	40	40	0	0

#### Issues Recorded due to Veil

During the live tele-consultation sessions we observed that the veil in one form or another is creating problem during diagnosis. The doctors at hub have experienced irritation, voice distortion, misleading, and murmuring. Especially in dermatology and psychiatry consultation veil created age issue and facial expression. In medicine and surgery consultations veil created hurdles in body investigation. In presence of dominant female the young patient does not remove her veil without permission (table 2). All these issues are invisible from the consultant and cannot be communicated unless lip movement is visible but due to veil communication gap between patient and doctor rises.

Table 2: Issues recorded due to veil

Station	Freq.	Issues recorded due to veil during consultations				
		Voice Distortion	Murmuring	Irritation	Time wastage	Misleading diagnosis
Gujrat	19	3	2	5	2	5
Rajanpur	141	34	23	19	14	17
D G Khan	86	26	19	7	7	9
Jhang	28	5	9	1	4	5
Khushab	31	2	1	7	12	7
Attock	13	0	1	3	5	2
Sahiwal	40	0	0	0	0	0

#### Problems Observed Due To Veil during Consultation

Due to the cover at the face consultant cannot hear the word correctly, murmuring sound and repeated questions irritate him. This results in wastage of time, resources and misleading to a wrong diagnosis. Sometime the doctor irritates from repeated inquiry and wants to get rid of the patient. During the psychiatry consultations the consultant have to record facial expression on the patient but due to the veil the doctor do not get the desire information. Some patients refused to remove their veil in front of camera and went without consultation (table 3).

Table 3: Frequency specialties suffered due to Veil Issue

Age group		13-20	21-30	31-40	41-50	51 & above
Consulted without veil issue		1731	1032	926	318	73
Frequency of veil issue patients		142	94	46	26	9
Specialties affected due to veil issue	Dermatology	118	76	31	19	7
	Psychiatry	8	9	5	3	1
	Medicine	16	7	7	3	0
	Surgery	0	3	3	1	1

#### Fear Factors for Veiled Women in Tele-Consultation

Fear is the dominant factor recorded for not removing veil during consultation. Fear was associated with security, religious, misuse of images and pictures, social, shyness, cultural, mistrust on system administrator, presence of dominant figure and above all camera Phobia. This Phobia required answers to the questions like: who is watching? Is someone recording me? Guaranties of privacy and the authority sitting at other end? (table 4,5)

Table 4 : Factor dominated the veil issue

Station	GUJ	RJP	DGK	JH	KSH	AT	SW	
Frequency of veil issue	19	141	86	27	31	13	0	
Factor which dominated the veil issue	Religion	3	23	19	1	4	4	0
	Security	2	18	11	2	7	3	0
	Mistrust on staff	6	21	23	8	11	4	0
	Dominate / interpersonal factor	5	47	19	12	4	2	0
	Camera phobia	2	26	9	3	3	0	0
	Society phobia	1	6	5	1	2	0	0

Table 5: Veil Issue age group

Age group	13-20	21-30	31-40	41-50	51 & above	
Consulted without veil issue	1731	1032	926	318	73	
Frequency of veil issue patients	142	94	46	26	9	
Social group	Poor	83	46	23	11	2
	Mid Class	37	36	16	4	1
	Rich	22	12	7	11	6
Did not consult	23	18	12	7	1	
Consulted with reservation	119	76	34	19	8	

### Addressing the Issue

Veil is a cultural, social and religious subject which cannot be changed, modified or amended. During the consultations it was observed that veil was practiced by every social class. The department of telemedicine and DHQ Hospitals assured security of female patients, protection of patient data. System administrator was made responsible for any leakage, misuse and theft of the data. He was also responsible for the privacy and honor of the patients. Separate clinics of dermatology, psychiatry and medicine were arranged in which female doctors were called for consultation. Presence of female investigator was ensured at remote stations during clinics. Briefing was given to religious heads in the area about the utility, convenience and advantages associated with the system and assured them that religious and cultural values shall be protected and honored. They were requested to propagate and develop a positive understanding towards the system and in

the minds of masses. Problem of voice distortion and faint sound can be solved by sophisticated and high-tech videoconferencing equipment.

It was difficult enough to set successes indicator concerning veil issue. Therefore in consultancy with various types of patient, doctors, system administrators, follow ups of veiled women were recorded as successes indicator at remote end while at resource hub inclusion of more specialties were considered as administrative success indicators.

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# Should We Plan A Service Delivery Alternative When Implementing A Telerehabilitation Approach?

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In-home telerehabilitation (H-TELE) was found non inferior to face-to-face home visits (H-VISITS) in a multicentre randomized clinical trial performed recently with patients who underwent total knee arthroplasty (TKA).

Patients of both groups had a comparable functional recovery 4 months after hospital discharge as demonstrated by the WOMAC questionnaire and various tests (6 min-walk test, stair test), knee range of motion and strength. However, some participants of the H-TELE group had to receive face-to-face visits during the intervention period.

The goal of this presentation is to analyse the reasons that justified the use of face-to-face visits in patients of the H-TELE group and to determine if alternatives to telerehabilitation should be planned in the future implementation of such an approach.

In our study, 205 patients (mean age:  $66.0 \pm 8.3$ ) were randomly assigned before hospital discharge in the H-TELE group ( $n=104$ ) or the H-VISITS group ( $n=101$ ). Patients of both groups received the same rehabilitation intervention (16 supervised exercise sessions) over the first 2 months after hospital discharge and were evaluated 4 times by a blind evaluator: before TKA, at discharge, 2 months and 4 months post-discharge.

Almost all patients (100 out of 101) of the H-VISITS group received most (75% or more) of the planned H-VISIT sessions (mean $\pm$ SD:  $16.0 \pm 0.2$ ). A lower but still large number of the patients in H-TELE (88 out of 104) received most of the allocated TELE sessions ( $14.8 \pm 2.5$ ) although 21% ( $n=22$ ) of them received also some home visit sessions ( $2.3 \pm 2.2$ ; range 1 to 10) in combination with H-TELE sessions.

The documented reasons for visiting TELE participants at home were: poor internet connection or persisting technical problems ( $n=6$ ), delayed technology installation ( $n=12$ ), abnormal profile of knee recovery ( $n=3$ ), unavailability of clinicians ( $n=2$ ), anxiety of the participant ( $n=1$ ).

Our results support the non-inferiority of in-home telerehabilitation however, in few occasions and for some participants, face-to-face visits may be necessary. It is therefore recommended to plan for alternatives in the future implementation of telerehabilitation intervention.

Keywords: Telerehabilitation, Total knee arthroplasty, Homecare

# Telemedicine: A Success Story of Assessment and Rehabilitation of Psychiatric Patients in Rajan Pur District of Southern Punjab, Pakistan

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## Background

In Pakistan mental health rehabilitation facilities are limited to big urban centers. Unfortunately, the existing hospital-based psychiatric services are poorly utilized. Two to three psychiatrists per million of population are available who are confined to large cities despite the fact that majority of our population belongs to the rural areas [1]. Because of social stigma attached with the psychiatric patients and popular misconception about mental illnesses the society and even the family members sometimes abandon their loved ones [2]. Most of individuals with mental disorders do not use health services for their mental disorders. In developed countries with well-organized health care systems, 44 - 70% of the patients with mental disorders do not receive treatment. In developing countries the figures are even more startling, with the treatment gap being close to 90% despite the fact that four of the six leading causes of death are due to psychiatric disorders (depression, alcohol-use disorders, schizophrenia and bipolar disorder). There is an enormous gap between the need for treatment and available resources [3]. Psychiatric problems in Pakistan are increasing due to growing injustice, poverty elevation, violence, insecurity, terrorism, economical problems, political uncertainty, unemployment, gender discrimination, unhealthy lifestyle, physical ill health, stressful working conditions, genetic factors, unrestricted urbanization, disruption and loss of protective family networks. Sinking of 42% of the individuals below poverty line is dangerous and alarming condition [4]. In view of the poverty, low health and education budget and high cost of medicine are huge economic burden on the patients which are major factors contributing towards rapid increase in mental illness in Pakistan during the last 15 years [5]. In spite of living in 21<sup>st</sup> century, many patients are at mercy of Quacks, faith healers and Shrines who are consulted for cure of mental problem and mental satisfaction. These Quacks and faith hailers have strong marketing network [6]. The brutality and inhuman treatment of psychiatric patients

commonly prevails with them. Patients are chained, raped, beaten, burnt and scared on their body, with can lead to death. On top of this family members are not allowed to interfere during treatment [7].

Rajanpur is the headquarters of Rajanpur District, located in the extreme southwest part of Punjab, Pakistan (29:06N, 70:19E). It has a population of 1.1 million of which 14.27% are urban [8]. 38% of people live below the poverty line and 69% people earn dollar a day. Literacy rate is below 34% [9]. Rajanpur has a district headquarter hospital and three tehsil headquarter hospital with a total staff of 56 doctors among which only 12 are specialists in their respective fields [10]. There is no Psychiatrist available in this district or its catchment area. Due to poverty, illiteracy and non-availability of medical facilities, majority of the population consult Faith healers, Hakims, pirs, Faquirs and witch doctors.

### Telemedicine in Rajanpur

In area like Rajanpur where availability of doctor is a big issue, telemedicine system is a great convenience for the poor. The system became operational in 2009, connecting Mayo Hospital hub with 7 DHQ Hospitals including Rajanpur. More than 12000 patients were provided free of cost medical treatment and advice of which 615 were psychiatric patients. High number of tele-consultations and success are due to vast catchment area of the district, comprehensive propagation of the telemedicine system by the health authorities, district government and ordinary masses, availability of free and high quality medical advice and treatment.



Fig 1: Rajanpur District and its catchment area

### Telepsychiatry Services to Rajanpur

Tele-psychiatry can provide cheap but quality mental health services to deprived areas [11]. A comprehensive tele-psychiatry clinic was initiated with the collaboration of department of Psychiatry Mayo hospital Lahore. In the beginning response was slow but gradually the number increased (table 1). During 2008-2013 six hundred and fifteen patients belonging to Rajanpur and its catchment areas including adjacent districts of Rahimyar khan, D.G. Khan (Punjab), Dera Bughti (Baluchistan) and Jacobabad (Sindh) provinces were treated (see Table 1).

Table 1: Tele-Psychiatry consultations at different remote stations

on	Consultation year wise				
	2009	2010	2011	2012	2013
Gujrat	-	3	1	7	-
Rajanpur	76	116	173	109	141
D.G. Khan	9	12	3	7	-
Jhang	5	7	1	3	1
Khushab	-	-	12	5	2
Sahiwal	-	2	-	-	-
Attock	-	-	3	15	7
Total					

In clinical sessions feedback on social and cultural practices, background and significant factors was also collected which contributed in the origin and acceleration of disorders in the population. The most significant factors which contributed in creation and acceleration of the disorders include poor economic condition of the people, social and cultural conditions, extreme religious believes, inequality, fear of life security, injustice and alarming rate of drug dependency.

Table 2: Factors responsible for psychological disorders in Rajanpur

Problem / issue	Factors which were helpful in acceleration and creation of problem								
	Security	Genetic	Right violation	Acquired	Fear	Discrimination			Others/ unknown call
						Gender	Injustice	Economic	
Schizophrenia	0	3	0	15	9	3	0	2	19
Drug Depend	154	0	8	31	7	3	8	31	27
BPE	2	0	13	3	7	3	1	4	16
Conversion & Hysteria	2	0	5	3	7	8	1	1	2
Psy. Dep	7	2	17	4	11	7	3	9	18
Epilepsy	0	14	0	9	0	0	0	0	11
Amoyness/ anxiety	3	7	11	7	7	11	2	13	17
Nerv. Break down	0	0	2	4	4	2	1	1	3

### Disorders Recorded Through Telemedicine System during 2009-2013

During the 4 years of telepsychiatry clinics 615 psychological disordered cases were recorded from Rajanpur district and its catchment area. The cases were recorded in patients from rural and urban background. All the social and economic groups were affected. Schizophrenia, depression, brief

psychiatric episode, epilepsy, conversion and hysteria. Information about disorder, gender, social group, history of problem, factors associated, family environment and patient satisfaction level was checked and recorded through a questioner which was filled by guardian/ attendant at end of clinic.

### Consultancy Plan for the Psychiatry Patients

Since its establishment telemedicine system at Mayo Hospital launched an extensive telepsychiatry program with the department of Psychiatry Mayo Hospital Lahore on the request of Medical superintendent DHQ Hospital Rajanpur and city district government of Rajanpur. First psychiatry case was registered on March 3, 2009. Two days a week were fixed for psychiatry clinic in which 3 consultants were present. The patients were registered at remote end and where doctor took the history of the patients for record and presented it to the psychiatrist at hub. Consultant had full liberty to interact with the patient and his/her attendant. Separate case studies of the patients were made and treatment consisting of Pharmacotherapy, Family education and Counseling were given.

Table 4: Distribution of mental disorders in different socio- economic groups

Problem	Tot. frequency	Gender		Social Group			Belong to	
		M	F	Poor	M. class	Rich	Urban	Rural
<b>Schizophrenia</b>	<b>51</b>	<b>22</b>	<b>29</b>	<b>14</b>	<b>17</b>	<b>20</b>	<b>13</b>	<b>38</b>
<b>Drug Depend</b>	269	263	6	126	82	61	112	157
<b>BPE</b>	49	17	32	11	23	15	18	31
<b>Conv. &amp; Hysteria</b>	29	13	16	7	13	9	10	19
<b>Psy.Dep</b>	78	43	35	24	31	23	32	46
<b>Epilepsy</b>	34	11	23	9	12	15	11	23
<b>Annoyness/Anxiety</b>	71	42	29	17	34	20		
<b>Nerv. Break down</b>	17	11	6	3	9	5	45	26

### Success of Assessment & Rehabilitation

The success of telepsychiatry clinics at Rajanpur was mainly due to the availability of trained staff & doctors at hub and remote stations, formulation of a comprehensive plan and its strict follow up and ability of staff to extract information about patient's disease history, socioeconomic background & family environment.

The consultant classified the disorder in to Mild, Acute, Sever(S) and rare occurrence classes and records were maintained and were reminded to follow up the patient's improvement as treatment of Psychological disorders is lengthy and sometime continuous. The success indicators for the program including family response of the patient, community response and the sign

of improvement recorded by consultant were positive for different disorders. Over all recovery level for the patients was 45 to 50 percent which was very significant achievement.

Table 5: Improvement level of Psychological disordered patients during 2009-13

Improvement %	Freq	Gender		Disorders							
		M	F	Schizophrenia	Drug Depend	BPE	Conv. & Hysteria	Psy. Dep	Epilepsy	Annoyance	Nerv. Breakdown
0-10 %	9	7	2	4	12	1	0	3	7	5	0
11-20 %	37	24	13	3	45	3	3	7	3	3	2
21-30 %	73	51	22	9	42	4	2	24	8	22	1
31-40 %	260	181	79	5	67	9	7	14	13	16	4
41-50 %	123	96	27	12	27	13	11	9	1	9	6
51-60 %	72	62	10	11	27	11	4	11	1	5	1
61-70 %	11	5	6	5	38	6	2	3	1	9	1
71-80 %	5	2	3	2	11	2	0	7	0	2	2
Total	615			51	269	49	29	78	34	71	17

### Conclusion

Stated facts clearly manifest an urgent need of looking into other methods of treatment. In the West, desperate struggle and concurrently fast growth of the telecommunication industry gave birth to a magnificent mode - Most telepsychiatry projects and programs have been reported from the developed nations like America, Australia, Canada, and certain European countries. In the developing nations, telepsychiatry has emerged initially as an offshoot of telemedicine and is still at a preliminary stage. Through the system betterment and rehabilitation programs can provide education, better understanding towards psychological disorders.

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# **Will a 6-week Telephone-based Physiotherapy Intervention Improve Quality of Life in Patients with Knee Osteoarthritis?**

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## **Introduction**

Knee osteoarthritis (OA) results in poor quality of life (QoL).

It has been documented that the concept of tele-medicine which refers to the use of communications and information technology for the delivery of clinical care may be done simply over a telephone or may be as complex as using satellite technology and videoconferencing to do a real-time consultation [1]. Thus, the practicability and usability of tele-physiotherapy in developing nations like Nigeria needs to be ascertained using the available, affordable and relevant telecommunication. Tele-physiotherapy, which involves the use of telecommunications technology as a medium for therapeutic care appears not to have been explored among patients with knee OA.

## **Aim**

This study was carried out to investigate the effect of a 6-week telephone-based physiotherapy programme on QoL of patients with knee OA.

## **Materials and Method**

Fifty randomly selected patients with knee OA were assigned equally into two treatment groups; Clinic Group (CG) and Tele-physiotherapy Group (TG). The CG received thrice-weekly physiotherapist administered osteoarthritis-specific exercises in the clinic for six weeks, while the TG received structured telephone calls thrice-weekly at home, to monitor self-administered osteoarthritis-specific exercises.

Participants' QoL was assessed using World Health Organisation Quality of Life-Bref Scale (WHOQoL-Bref). Assessment was done at baseline,

second, fourth and sixth week of intervention. Data were analyzed using ANOVA and Independent t-test.

### Results and Discussion

The mean ages of CG ( $54.96 \pm 7.81$  years) and TG ( $56.04 \pm 7.40$  years) were not significantly different.

Within group comparison showed significant improvements in TG and CG's physical health domain of WHOQoL between weeks 0-4, 0-6, 2-4 and 2-6.

The TG's psychological domain of WHOQoL showed significant differences between 0-4 and 0-6 weeks, while the CG's psychological domain of WHOQoL showed significant differences between weeks 0-2, 0-4 and 0-6.

There were no significant differences in TG and CG's social relationships domain and environment domain of WHOQoL across baseline, 2nd, 4th and 6th week of intervention.

Between-group comparison of CG and TG's showed that there were no significant differences between CG and TG's physical health, psychological and social relationships domains of WHOQoL across baseline, 2nd, 4th and 6th week of intervention. However, there was significant difference in the environment domain.

### Conclusion

Six-week tele-physiotherapy improved QoL in patients with knee OA, comparable to clinic based treatment. Thus, tele-physiotherapy should be incorporated into the rehabilitation programme of patients with knee OA.

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An extensive version of this study has been accepted for publication in the International Journal of Telemedicine and Applications.



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# **eHealth Implementation & Organization**

# Do We Really Know What We Mean?

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## Introduction

Communication involves sending and receiving of messages, or transferring of information, from a sender to a receiver through some form of communication channel. For this to work, one of the requirements is absence of differing interpretations of the message or information. This, in turn, requires consistency in the definition of terms in an accepted vocabulary. e-Health depends upon communication. But when interacting with one another ‘do we really know what we mean’?

The term “e-Health” has been widely accepted, but nearly a decade ago there were at least 51 ‘definitions’. Inconsistency in terminology and definitions for e-health and related terms leads to misunderstanding, inefficient action, and perhaps wasted resources. It can render futile any interaction or consultation among healthcare providers, policy makers, and other stakeholders.

To understand more about the practical need for common consensus of (and consistent use of) clear terms within e-health, a ‘definitions exercise’ was performed. The goal was to assess understanding of some common terms used in health and e-health. Analysis of the resulting data showed little consistency or alignment between ‘participant definitions’ and ‘gold standard definitions’ for the selected terms, highlighting our predicament.

This paper is a simple but powerful illustration of the importance of a common, consistent terminology, and of the need for clear and simple definitions for that terminology.

## Methods

In one exercise, 35 e-health proponents attending a conference were asked, with verbal consent, to ‘define’ six common health-related terms: *population*, *urban population*, *total mortality*, *contact with a medical doctor*, *doctor*, and *cross-jurisdictional*. Their responses were then compared to that of ‘gold standard’ definitions of the time (e.g., indicators used by Stats Canada - [www.statcan.gc.ca](http://www.statcan.gc.ca); or Health Canada - [www.hc-sc.gc.ca](http://www.hc-sc.gc.ca)). Results were analysed through identifying ‘keywords’ from the

'gold standard' definition, and plotting as histograms the occurrence of these keywords in participant definitions. The proportion of participants who included one, more, or all of the keywords was used to judge understanding of the need for inclusion of these terms in their response in order to be clear and complete.

## Results

Not all participants provided a definition for all terms in this time limited, 'closed book' exercise. Analysis of keyword content showed considerable discrepancy between personal and 'gold standard' definitions. The discrepancies were sufficient to render meaningful communication around these topics difficult, or even misleading.

For example, according to Statistics Canada, *population* is defined as "the number of people living in a geographic area by age and sex". Key terms were considered to be number, people, living, area, age, and sex. Approximately 89% of the participants included 'people' only, 49% included some form of geographic term (not necessarily 'geographic area'), while 50% included both 'people' and a geographic term. About 40% defined population simply as a 'number' of 'people' present. No participant accurately replicated the desired definition. *Urban population*, defined as "people living in urban areas", was similarly poor. Key terms were considered to be: 'people', 'living', and 'urban area'. In responses, 86% included 'people', and 43% included 'living' in their definition. Only 17% met the standards of the definition, including all key terms.

*Total mortality* was a challenging term for participants. The accepted definition at the time was "A crude count, rate, or death rate per 100,000 population for all causes". Key terms were considered to be count or rate, death, per 100,000 population, and all causes. The majority of participants (77%) included in their definitions only 'death' and 11% included 'rate'. Only one out of thirty five participants managed to define *total mortality* in a manner close to the accepted definition (included 'death' and 'all causes', but stating per population).

Although conceptually simple, the definitions of '*contact with a medical doctor*' and '*doctor*' also proved difficult. These terms were chosen to indicate how much knowledge participants had about health service providers and those primarily responsible for health care delivery. The accepted definition of *contact with a medical doctor* was "the population aged 12 and over who have consulted a medical doctor in the past 12 months". Key words were: population, 12 and over, consulted, medical doctor, and 12 months. Approximately 71% of participants had unclear

responses and only 17% included the term ‘medical doctor’. Most were unaware of the age limit and time frame in which contact is necessary.

The definition for *Doctor* was “general or family practitioners per 100,000 population as of December 31<sup>st</sup> of the reference year”. Key terms were: general practitioner or family practitioner (or equivalent term), per 100,000, and any term indicating a defined time period. About 86% of participants showed no signs of clear knowledge of the definition for ‘doctor’. However, an interesting phenomenon observed in the responses was the inclusion of some reference to the level and type of education of the person. This was a major and common theme. About 60% of the responses were based on the level of education (e.g. PhD, MD, certification, or clinical specialty) that can classify a ‘doctor’.

Perhaps the most difficult definition exercise was for *cross-jurisdictional*. Literature findings showed no formal definition (in the e-health context) for this word (i.e., excepting dictionary and thesaurus definitions). A definition for *inter-jurisdictional* e-health was located [1], which made reference to *cross-jurisdictional*. The common perception, and accepted definition, was that *cross-jurisdictional* represents an ‘interaction between two identifiable administrative entities’. Almost all of the participants had unclear definitions for *cross-jurisdictional*. Most identified the term as activities, services, regulations, or policies effective across geographic locations. The proportion who barely met the study definition criteria was under 4%.

## Discussion

Technology is an essential component of e-health, however, it is not the core. This lies in the skills, experience, enthusiasm, and knowledge of the people involved. As a result, having available a consistent terminology is crucial to effective communication between stakeholders both inter- and intra-jurisdictionally.

e-Health has the potential to cross many borders or other barriers in a single event, which is why uniformity within words exchanged is central to building a strong and sustainable foundation for each e-Health strategy, policy, project, or other intervention developed. *Doctor*, for example is a term that is widely used. Yet, this study shows the amount of uncertainty that exists amongst stakeholders. It is reasonable to assume that poor or inconsistent use of terms can lead to unpredictable outcomes in any interaction. This is a lesson learnt many years ago in the field of ‘semantic interoperability’ between health information systems. We seem not to have learnt the same lesson in our interactions between other ‘information systems’ – human beings.

## Conclusion

e-Health involves many stakeholders from many backgrounds, areas of expertise, cultures, and languages. The need to meaningfully and accurately communicate within and between stakeholders is crucial to the success of e-Health strategy, policy, and individual interventions. This can only occur through mutual understanding which, in turn, can only occur with existence and use of common terminology for e-Health.

The “use of ICT for health” (i.e., e-health) now spans decades. Perhaps we would have made, still could make, much more progress if we all spoke – and understood – the same ‘language’. It is perhaps time that a recognised international entity rise to the challenge, and provide the world with thoughtful, considered, and consensus-based *descriptive* (not *stipulative*) definitions – or even simply agreed descriptions – of common terms to aid global adoption and interaction of e-health solutions. Is this a role for the ISfTeH?

## Acknowledgment

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# **eHealth Service Experience and Care Models: Building a Parameter Framework for Their Design and Implementation**

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## **Background**

eHealth services with state-of-the-art technologies have the potential to assist patients and healthcare professionals in better managing therapy, help patients understand their disease, support self-management and reduce healthcare costs. These potential benefits can be unlocked through new experience and business models that facilitate their design and implementation. Our research develops a parameter framework that aligns experience and business modelling.

## **Research Objective**

This paper identifies parameters that enable developers to determine the impact of eHealth systems in terms of personal, experienced quality of health life as well as organisational quality of labour and cost-efficiency. We draw on a socio-technical perspective incorporating eHealth service design, implementation and use.

## **Method**

Through qualitative inductive research that aligns two 'research by design' methodologies this paper identifies bridges between: (

- A) 6 cases from the experience design method and
- (B) 6 cases from the business model design method.

The experience design method creates current and envisioned patient and health professional experience journey profiles of eHealth systems.

The business model design method employs visual modelling of actor profiles, transactions and value attributes in health network organisations.

## **Result**

A parameter framework, to be used in eHealth service design and implementation, that integrates (A) experiences in the context of use and (B) care model innovation. Parameters bridging the methodologies are:

actor and interaction profiles and impact criteria for personal quality of health life and organisational quality of labour and cost-efficiency.

#### Conclusion

The framework contributes to and innovates in the area of eHealth services design and implementation. It is intended to serve for analysis and design of positive interaction experiences and effective transaction modelling in eHealth services.

Keywords: eHealth, Experience modelling, Business modelling, Service design, Implementation

# Enhancing Bluetooth Connection Establishment Delay in Inquiry Procedure

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## Introduction

Bluetooth, which is a low-power radio technology, is widely used by the components of WPAN such as mobile phones, computers, medical devices, etc.

Bluetooth operates Frequency Hopping Spread Spectrum (FHSS) by dividing the 2.402-2.480 GHz band into 79 frequency slots with each slot being 1 MHz wide and hopping pseudo-randomly among these different frequencies every 0.625  $\mu$ s [4]. This FHSS medium access technique provides allocation of a larger number of users in the same frequency band with less collision. But it necessitates two processes called as inquiry and paging for two devices to attain the same frequency hopping sequence and start to exchange information.

Bluetooth specifications state that the inquiry procedure lasts for 10.24 seconds. The discovery time of the specific node does not affect the duration of inquiry procedure, because it is unchangeable. This means that even if the specific node is found in one second, the devices have to wait for 10.24 sec to complete the inquiry procedure. Moreover, the inquirer and inquiry scanner may choose exactly different frequencies. In this case, these devices do not succeed in coinciding at the same frequency, which causes a probability of failure discovering a specific node. The probability of connecting to a specific node can decrease to 89% depending on the number of nodes in the environment [5]. This means that the devices have to wait for another 10.24 seconds with a probability of 11%. This failure is caused by collisions and frequency synchronization (FS) delay.

In this article, our aim is to examine the Bluetooth inquiry procedure and introduce a new method that improves connection time. We investigate the connection establishment delay of a single piconet for different random back off delays and for different number of total nodes in the environment.

## Background

Communication between the two Bluetooth devices is only possible after the devices discover each other. The steps followed by Bluetooth in this discovery phase are called Inquiry procedure, which consists of inquiry and

inquiry scan states. A device in inquiry scan state listens at a single frequency for the Inquiry Access Code (IAC) packets sent by an inquirer in order to establish a connection. In inquiry state, the device chooses 2 trains, each of which composes of pseudo-randomly arranged 16 frequencies selected out of the 79 frequencies. A single train must repeat  $N_{\text{inquiry}} = 256$  times. At least three train switches are needed. The inquiry state duration,  $T_{w\_inquiry}$ , is given by the following equation in the specifications [3].

$$N_{\text{inquiry}} \times 16 \text{ frequencies} \times 4 \text{ trains} \times 0.625 \mu\text{s} = 10.24 \text{ s} \quad (1)$$

In inquiry scan state, the device chooses a train with 32 frequencies long and listens at a single frequency for 18 timeslots. For every 18 timeslots, the listening frequency changes. When the inquirer and inquiry scanner coincide in the same frequency simultaneously, the inquiry scanner receives the first IAC packet from the inquirer. The inquiry scanner which gets the first IAC in the first frequency match, returns to standby mode and waits for a Random Back-off (RB) delay which is between 0-1023 timeslots. When RB delay expires, the inquiry scanner returns to the inquiry scan state again and wait for the second coincidence to receive the second IAC packet at a different random listening frequency. The inquiry procedure is completed when the inquiry scanner responds with a Frequency Hopping Sequence (FHS) packet in this second coincidence. There are two factors, which have direct effects the connection establishment delay negatively. If the frequencies of the inquirer and inquiry scanner cannot coincide at the same slot during the Frequency Synchronization (FS) delay, lasting for 0-20ms, the inquiry scanner returns to standby and all steps are repeated. This frequent repetition of the procedure is the key reason that increases the connection establishment delay, which occurs when the inquirer's train does not include the new random listening frequency of inquiry scanner. The second scenario is that train selection may cause to connection establishment failure. The 32 frequencies of two trains picked by inquirer and the 32 frequencies of the train inquiry scanners pick might be completely different. In this case, these devices can never establish a connection because of not coinciding at the same frequency.

#### Proposed Method: Frequency Freezing

The inquiry procedure defined in the Bluetooth specifications introduces a large delay, which hinders usage of Bluetooth technology in mobile applications. This new method not only enhances the discovery time but also solves the problem of low probability of connecting to specific nodes by an improvement in the inquiry scan state. This method is based on not

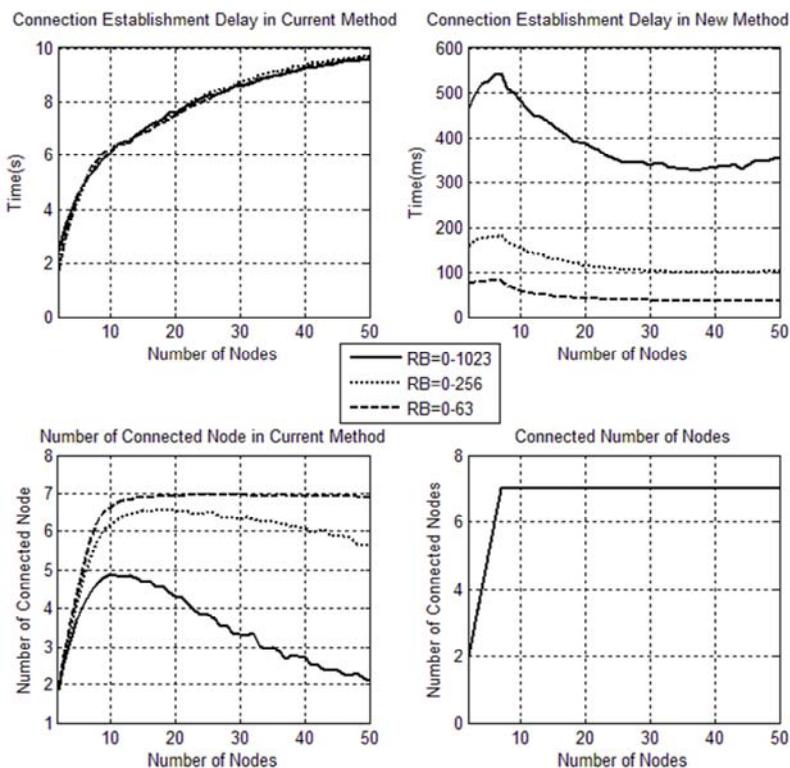


Fig 1. Simulation results

changing the frequency at which first IAC packet is received until paging procedure begins.

In inquiry scan state, the inquiry-scanning device switches the frequency every 18 timeslots and uses 79 frequencies instead of choosing a train that is 32 frequencies long. In this article, we propose a new method that introduces a frequency freezing function to the inquiry scanner. The frequency freezing function freezes the frequency upon reception of the first IAC packet and switches the frequency otherwise. It is certain that the chosen train of the inquirer includes the listening frequency of the inquiry scanner and the second IAC packet is received in the duration of 0-10 ms (0-16 timeslots) of FS delay.

### Simulations and Results

We examined the connection establishment delay of a piconet and the number of connected nodes for different number of devices ranging from 2 to 50 and different RB delays (0-63, 0-255, 0-1023) with our self-developed Bluetooth connection establishment simulator in C/C++.

In the simulation scenario, a node assigned the master role is trying to discover different number of slaves in the simulation duration of 10.24 s. The goal is to connect to at most seven slaves. The output of the simulation consists of the total connection establishment delay of the seven nodes in the environment. The first seven connected slaves were analyzed in order to obtain the connection establishment delay of piconet, not specific seven slaves. In addition, the output values of the simulation are the average of 1000 trials in order to avoid the individual variations of each trial.

We developed the simulator under such assumptions that all nodes are at the same distance to the master node, the channel is noiseless, the nodes consist of one master (inquirer) and varying between 2 to 50 slaves (inquiry scanner) and the inquirer connects to the first discovered 7 nodes and creates a piconet. The inquirer and all inquiry scanners start the process synchronously. We used the uniform random number generator function (RAND) of C/C++ to generate pseudo-random sequences in FHSS and the RB delay values.

The following figures illustrate the total connection establishment delay, number of connected nodes and the total number of collisions experienced during the 10.24 sec simulation duration to set a piconet.

In Fig. 1, the comparison of average connection establishment delays of seven nodes for specifications and frequency freezing method are given for different RB delays. It is clear that the connection establishment delay can be reduced to 40-350 ms in frequency freezing method, while it reaches over 10 sec in the specifications. If the RB delay window is reduced to 64 timeslots, the connection establishment delay, which is approximately 40 ms, becomes much lower whereas the delay is about 350 ms for RB delay of 1024 timeslots.

The key reason for this dramatic difference of the connection establishment delays is that the inquiry scanner remains at the frequency that the first IAC packet is received. It provides that the second IAC is shared during FS delay. Hence, the connection is established in the first attempt.

Furthermore, unlike specifications, the Frequency Freezing method also enables the master to discover all slaves in environment whereas the number of the connected slaves decreases to approximately 2 for the 50 nodes in specifications. Collisions, FS delay, inefficient train selections of inquiry and inquiry scan devices are the reasons for this failure. The

Frequency Freezing function provides solutions for the problems FS delay and inefficient train selection. In frequency freezing method, establishing a connection before FS delay expires and the coinciding at the same frequency of inquiry and inquiry scanner devices are guaranteed by remaining at the same frequency that the first IAC received and inquiry scanner's hops among 79 frequencies.

On the other hand, in the figure, there is no difference between the number of collisions in both methods for the number of nodes among 2 to 10. However, a significant difference in the range among 10 to 50 nodes is observed. While the number of collisions reaches almost 7 for 50 nodes in specifications, it reaches approximately 20 for 50 nodes in frequency freezing method. Even if the difference of the number of collisions is significant, the connection establishment delay is much more efficient in frequency freezing method due to the very low inquiry procedure delay. It was observed from the simulator that setting up a piconet may last more than inquiry procedure duration 10.24 s in the current system. However, it is guaranteed and lasts less than 40-350 ms for different number of devices and RB delays in frequency freezing method.

### Conclusion

Discovery of Bluetooth devices and creation of a piconet defined in the specifications last very long by Bluetooth, as we have shown in our simulation results. Creating a piconet lasts from about 2 s up to 10.24 s. Furthermore, even if the connection is established in shorter than 10.24 s, these devices have to wait for 10.24 s in order to complete the inquiry procedure [3]. We have introduced a frequency freezing function to the inquiry scan procedure, which is shown to decrease the connection establishment delay significantly whereas diminishing the probability of unconnected slaves. In this method, the duration of device discovery is shorter and lasts about 80 - 550 ms for 2-10 nodes, 40-350 ms for 10-50 nodes with different RB delays. Therefore, the inquiry process that lasts 10.24 s is redundant. The total connection establishment delay values from the simulation indicates that even if 50 nodes are in the environment, the master can establish a connection with all 50 nodes in less than 2 seconds. These simulation results of total connection establishment delay provide a chance to shorten the redundant inquiry process delay by removing the failure of device discovery.

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# **Inter-Organizational Process Collaboration and eHealth: Theoretical Perspectives**

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## Introduction

This article provides a review of literature and theoretical perspectives on inter-organizational collaborative business process management (cBPM) and suggests implications for eHealth research. eHealth is process intensive and involves inter-organizational collaboration where responsibility for patients shifts across many organizations in most countries. As a result, inter-organizational cBPM is necessary for coherent and efficient production of health care services and quality of patient treatment. We conducted a systematic literature review involving four research questions used to describe the research so far and to identify gaps and further research opportunities. We indexed the article after the contexts or areas of concern that was studied, eHealth and others. We identified a total of 50 articles where 30 were published in journals and 20 in conferences. 11 of these 50 articles reported studies from an eHealth context [1].

Studies at earlier phases of cBPM involving initiation and implementation dominate, and most studies adopt the perspective of cooperation where collaboration is seen as largely free from competition and conflict. In analyzing the research from the inside and outside of the eHealth context, we identified research gaps as well as research opportunities that can form the basis for new research in the eHealth context. Finally, our study has implications for practitioners who should be aware of the balance between cooperation and competition. Our review contributes to forward the research in eHealth on inter-organizational collaboration within the broader area of business process management. By summing up the status of research within eHealth we were able to identify several research gaps and based on research findings from outside of eHealth we suggest opportunities for future research in cBPM in eHealth. Our findings suggest that collaboration in eHealth poses relational challenges that are more important for process improvements than in other contexts. The results have implications for future research as well as for practice in this important and growing area of interest.

## Background

Collaboration within business process management (BPM) has gained increased interest from researchers in the last decade and can be considered “a customer-focused approach to the systematic management, measurement and improvement of all company processes through cross-functional teamwork and employee empowerment” [2]. BPM has evolved as a synthesis of Business Process Reengineering and Total Quality Management [3] involving an all-or-nothing redesign of business processes, and continuous improvement, customer orientation, employee involvement, and other benefits [4, 5]. cBPM as a subfield of BPM is defined here as coordinated initiatives that involve actors from inside or outside of an organization as a legal entity, as opposed to non-collaborative BPM where individuals conduct non-coordinated efforts to alter business processes [6].

Despite the growing interest in cBPM, there is a gap in the literature as to the importance of context for successful cBPM including the inter-organizational context where BPM is coordinated between separate legal entities, two or more. As a result, uncertainty exist as to how general cBPM research can inform collaborative efforts in highly specialized contexts as the health sector, where demographic changes pose new challenges in elderly care and forces collaboration in the production of healthcare services in most industrialized countries. eHealth can be defined as the application of Internet and other related technologies to improve the access, efficiency, effectiveness, and quality of clinical and business processes utilized by healthcare organizations, practitioners, patients, and consumers to improve the health status of patients [7]. Clearly, for these improvements to occur collaboration between different actors involved in producing health care services is important. This explains the purpose of this study and the need to sum up the research on cBPM as a basis for further conceptualization and research within the eHealth context.

Understanding and succeeding with cBPM in inter-organizational contexts, as in the health sector, are believed to be particularly difficult, representing an increasing relational challenge for many organizations [8]. Issues may be due to politics [9], culture [10] or factors related to “people” [11] and the “soft side” of organizations [12] which are even more elusive or blurred concepts in the inter-organizational context. While many researchers acknowledge the importance of collaborative BPM across organizational borders, few studies have systematically examined the research on this phenomenon. The general driving forces for improved processes and better performances in eHealth are seemingly the same as in other sectors, but as illustrated by its special safety and security

requirements the health sector might experience specific success factors that might require special and different attention over a cBPM project lifecycle.

### Discussion and Conclusions

The literature has analyzed success of cBPM using a variety of perspectives with an overweight of explanations related to effectiveness commonly expressed as types of quality, and then efficiency as types of performance. There is a marked difference in the perspectives on success depending on the sectors studied. In general, studies from the public sector are more often concerned with satisfaction of involved stakeholders representing quality of services, and less concerned with efficiency and competitiveness. An emerging process perspective on eHealth with its emphasis on value creation will challenge the deeply rooted functional perspectives with emphasis on control.

The perspectives taken in understanding cBPM vary in the literature. For example, Niehaves, et al. [13] introduce governance theory [14] as a lens to understand BPM networks where network is synonymous with cooperation as opposed to market where competitive forces are active. In line with Niehaves et al. [13], most studies have adopted a perspective where collaboration in the inter-organizational context of BPM is seen as largely free from competition and conflict. Some notable exceptions exist where competition is studied as a barrier to collaboration. Competition as a barrier may extend from an individual level, to become an inter-organizational challenge. Due to the life critical nature of eHealth, such barriers can become a major problem for society.

Our literature review concludes by identifying three gaps that should be addressed in future studies. The first gap is related to the dominance of management theories at the organizational level of analysis. Less frequent are studies utilizing perspectives at the individual and inter-organizational levels of analyses for explaining successful collaborative behavior. We believe this scarcity of studies could be related to an implicit assumption made in some studies that collaborative BPM is characterized by cooperation and harmony rather than conflicting or shifting interests either at the individual or corporate level. Some studies have introduced the perspective of cooptation to address this issue at the organizational level but few studies have investigated how conflicts can develop and hinder successful cBPM as a result of conflicting interests at the individual and inter-organizational or network level. As a consequence, the nature of cBPM might appear less complex and challenging than in reality. Research might not have been able to fully understand the nature of cBPM, and the implications suggested for the management of cBPM do not contain

solutions to these issues and possible problems. Future research could bridge this gap and improve the ability to inform management by adopting the perspectives of cooptation [15] to identify possible pitfalls to cBPM also at the individual and inter-organizational levels of analysis. By adopting the concept of cooptation future research should be better able to identify the multitude of forces along the continuum between cooperation and conflict where competitive or political forces operate. We believe that cooptation is particularly relevant in describing the challenge of collaboration in BPM in general and for the inter-organizational context in particular. Of particular interest is how the nature of cooptation might influence the nature of cBPM in different contexts, for example from public health care to private small and medium-size companies.

The second gap in the literature can be identified by adopting a process perspective on cBPM from initiation, via implementation to renewal or termination. The majority of studies in the reviewed literature have analyzed the two first phases of initiation and implementation, and there is a scarcity of knowledge as to what challenges and success factors are active in the later phases where collaboration has matured, or whether success and the factors influencing success are different across these life-cycle phases of cBPM. Future studies should compare the nature of cBPM across phases and contexts to identify similarities and differences, with implications for identifying important success factors to each phase as well as relevant advice to management.

Our review identified a wide variety in theoretical approaches used so far. A unified theoretical framework is missing, and could stimulate further theoretical development in the field. This is thus the third gap. In search for such a framework we believe that the marked similarities between e-business and cBPM could serve as a starting point. Studies of value creation in E-business (e.g. ref. [16]) is inter-organizational and has a process focus [17], covering many of the similar challenges as in inter-organizational cBPM without the specific focus on successful collaboration. We believe in a mutual interaction between these two streams of research, stimulating both further researches on inter-organizational collaborative business process management as well as e-business.

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# ‘Needs Assessment’ – What, Why, and How?

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## Introduction

Both the literature and e-health proponents opine that any e-health application must be ‘needs based’. Yet a literature scan showed these same sources are unclear on what constitutes an e-health ‘Needs Assessment’, and provide no clear guidance on performing one. Literature scans linking ‘telemedicine’, ‘telehealth’, ‘m-/Hhealth’, or ‘e-/eHealth’ with ‘needs assessment’ revealed confusion. Studied aspects included ‘assessment’ approaches for evaluation of implemented solutions, reference to readiness considerations prior to implementation, and some ‘needs assessment’ initiatives in specific settings. No models or frameworks for determining the potential need of an e-health intervention pre-implementation were found, although traditional health related needs assessment is described [1].

A sound Needs Assessment is an essential prerequisite for any undertaking, especially for e-health which is an opportunity cost in the health sector and potentially detracts from support of traditional healthcare needs. Performed correctly, a Needs Assessment will ensure any technology solution is objectively identified and carefully considered through collection and analysis of solid evidence, rather than subjectively ‘identified’ through projection of perceived personal or collective beliefs or political desire.

To aid description, a hypothetical setting is presented, a research paradigm is adopted (with formulation of a sound and guiding research question viewed as critical to the process), and a simple and logical 6-step process is outlined.

## Hypothetical Scenario

Consider a rural sub-national region (State, Province, Canton, etc.) which already has a number of disparate telehealth ‘applications’ but only a few ‘services’ in place (e.g., teleophthalmology, telemental health). Even these are erratically provided and localised, with limited - and often unused - infrastructure (inconsistent connectivity; telehealth videoconference units and peripheral devices) scattered across the region, and no significant infrastructure available (e-health strategy, policy, training programs, etc.).

## Formulating a Research Question

A Needs Assessment can be performed adopting the ‘research process’ (performing a series of actions or steps in an optimal sequence to answer a clear question). The research question to be answered is paramount. This will vary according to the specific setting but, regardless of the specifics, it is essential that a *simple, clear, and focused* question be developed – this acts as the key-stone for the Needs Assessment study.

Given the scenario above, the primary desire may be to simply confirm the correct e-health (here telehealth) solutions are being implemented for the prevailing health priorities in the sub-national region. With this perspective, a suitable research question might be: ‘What are the Regions health priorities, and are current telehealth initiatives addressing them’?

### Recommended Steps

Six (6) steps are proposed to ensure adequate data collection, analysis, and knowledge transfer to inform and encourage evidence-informed action by decision-makers based upon the results of the Needs Assessment. Recommended steps are briefly described below:

1. **ASSESS the setting.** It is necessary to understand what you have to work with in terms of capability - services, infrastructure, and infostructure. Applying a ‘situational assessment’ approach is recommended as this encourages consideration of socio-economic circumstances, environmental conditions, determinants of health, the legal and political setting, stakeholders, known health needs of the population, available literature, any previous assessments / evaluations (what – if anything – has changed), and the overall vision for e-health (or proposed initiative). Various tools can be used, such as PEEST [2].
2. **IDENTIFY and MEASURE needs.** It is necessary to identify key stakeholders (individuals and organizations) with a high interest or clear role in the research question, and to do so in a structured and precise manner. ‘Stakeholder mapping / analysis’ [3] will allow you to identify key stakeholders, and ‘document review’ [4] may provide basic insight to their roles. But to gain a clear understanding from stakeholders of the real health needs of the region, and what telehealth initiatives and capacity is available, requires more participatory approaches. To do this it may be necessary to conduct a survey, or perform Key Informant Interviews (KII) or Focus Groups [5]. As the process unfolds it is important to differentiate between health issues that ‘need to be addressed’ versus those that stakeholders would ‘like to address’ or ‘want to address’.

3. **RECOGNISE process and gaps.** Process Mapping and Gap Analysis will be required for this step [6]. Process Mapping is a problem solving approach that provides a visual representation of a process (formal and informal) as a step-by-step diagram. Two workflow maps should be developed – the ‘As Is’ (current process - perceived health needs and current e-health solutions) and the ‘To Be’ (anticipated future state - having aligned health needs and e-health initiatives). Veracity and accuracy of detail is critical.  
‘Gap analysis’ occurs when the two process maps are compared to identify differences. There may be alignment, misalignment, or missed opportunity for alignment between health needs and e-health initiatives, and these can be identified through the gap analysis process.
4. **PROPOSE solutions.** Given all of the foregoing knowledge, it is now possible to determine whether new or revised technological solutions are required to address identified health needs or fill gaps, and if so what solution(s) is(are) required. It may be that current e-health solutions are not the most appropriate ones, or that technological solutions are not required at all.
5. **UNDERSTAND cost vs benefit.** The key term here is ‘understand’. Rather than formal economic analyses (e.g., Cost-Benefit Analysis) it is recommended that Cost Consequence Analysis (CCA) be applied. CCA has been said to better address the aims of decision makers, and to be easier to understand [7]. In CCA all direct and indirect costs plus a list of different tangible and intangible outcomes of all alternatives are presented separately. There is no conversion into uniform monetary terms, but review of the findings can lead to greater consideration of often intangible social and health issues.
6. **INFORM decisions.** All of the insight gained from the previous steps is valuable for decision-makers in making ‘evidence-informed’ decisions. But in order to do so, the evidence must be presented to the right audience in the right manner. Knowledge Translation (also termed Knowledge Transfer) approaches are essential, but must be undertaken in a planned manner, and using the correct tools. Lavis’ framework for knowledge transfer is recommended [8].

### Conclusion

This paper has presented a simple and logical 6-step process by which to perform a Needs Assessment. Although applied to the hypothetical scenario described, the approach can be adapted and used for any e-health initiative. Doing so will ensure investment is made only in e-health solutions for which an evidence-based need exists. Application of this approach might

reveal discrepancy between ‘planned’ or ‘current’ and ‘needed’ e-health initiatives, allowing realignment to be made.

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# **Perspectives of Biologists, Epidemiologists and Geneticists Controversies in Sciences and Health Systems' Reforms**

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In the upcoming trends showing increase of the Global Burden of Diseases (e.g. in dementia, World Alzheimer reports or UN declaration on NCDs), urgent needs have to be addressed in order to help policy makers in dealing with societal costs of diseases.

Recent technologies help in particular to detect and prevent mild cases of cognitive impairments or to integrate more and more individualized genetic traits and pedigrees in genomic medicine. However, scientists disagree: recent study results from population base studies use population imaging (Breteler et als, 2011) versus integrative genomics approaches (e.g. Rhinn's 2013 and network biologists). Other controversies in asthma genetics between molecular biologists (Vercelli, 2011) and geneticists (Weiss et als, 2009) lead to different predictive disease modeling and impact assessments of aging and environmental modifiers.

This contribution will highlight some implications for governance of health systems, using current debates on evolution of these major fields of science, their possible translation for use in clinical practice, especially with new IT delivery systems and forecasts on medical services and expenditures.

Keywords: scientific controversies, health system reforms

# Potential Business Models for Innovative ICT Platform of eHealth Services

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**Abstract:** The recent widespread of innovative ICT eHealth services platform at the international and transnational levels confirms their market booster position in structuring the emerging eHealth sector. Indeed, such platforms can provide different types of both medical and social services packaged in a “bouquet”. The integration of ICT platforms in the medico-social sector brings interesting opportunities in terms of economic and social benefits (medical cost reduction, better health care, enhanced coordination and data sharing amongst stakeholders etc.), but also risks, causing economic, human and ethical barriers. While many studies have identified key success factors for these projects, this paper proposes to move forward and study what are the possible sustainable business models for Innovative ICT Platform of eHealth Services. In the light of digital economy and through microeconomics theory, this paper offers potential solutions to deal with various types of contracts and pricing models, related to revenue structure models. However, the potential models discussed may be difficult to transpose to the ICT eHealth sector since its specific nature (confidence, ethics) needs to be taken into account.

## Introduction

After the widespread development of ICT in organizations and in everyday life, their recent introduction into the medico-social sector is leading to an emerging sector (ICT & Health). In France, this market trend is emphasized by the ageing of the population and the related increasing public health expenses. In order to overcome geographical remoteness and medical desertification, ICTs are able to transform health systems by reducing costs and improving health care through enhanced coordination

and data sharing amongst stakeholders [1]. On the downside, the development of French ICT medico-social sector faces human and ethical barriers but also organizational, change management and return on investment questions. Problems related to the definition of new eHealth Business Models are addressed: value proposition as well as financial, coordination, interoperability, legislation, data security, pricing or reimbursement issues [2]. While many studies have identified key success factors for eHealth projects, this paper proposes to move forward and study the possible sustainable business models for the frequent case of Innovative ICT Platform of eHealth Services and offers potential solutions to deal with various types of contracts and pricing models, related to revenue structure models.

### Methods

From a theoretical point of view, the business model of the platform has a generic value. From an economical point of view, an analytical decomposition of the platform is possible. Firstly, we consider the platform and its partners as a single block, connected to the environment by financial flows. Secondly, we analyze the type of links connecting the platform to each partner. As a result, the platform business model can lead to: a vertical integration of economical partners on the upstream and the downstream of the platform value chain or the constitution of an integrated sector with agreements similar to subcontracts or the emergence of a meta-mediation and an oligopolistic market control. In the light of digital economy and through microeconomics theory, this paper discusses potential ICT platform pricing models and contracts, related to revenue structure models.

### Discussion

The platform added value consists in service mediation, integration and coordination by platform partners. Free access to the platform or “entry fees” may be applied to platform beneficiaries. They can subscribe to a set of services packaged in a “bouquet” and so, a group pricing is applied, following the “triple play” offer of telecom network providers. This pricing model is even more suitable in the case of eHealth services based on the use of telecom networks since their marginal cost is close to zero. If the entry fees are limited or inexistent, the use of medico-social services is billed to their beneficiaries as “user fees”. The two pricing models presented above may be adapted if third party financers’ subsidies are granted to depended individuals, service providers or to the platform. In addition, if the needs and resources of the beneficiaries are taken into account then third degree price discrimination is applied.

The structure of an integrated medical and social ICT market may be considered as a two-sided market [3], the platform matches the demand and the supply. The optimal price couple formed is determined by the positive cross network externalities of the two sides i.e. the participation of one side increases the participation of the other side, depending on the billing of entry and user fees conditions. The platform service users (depended individuals and their caregivers) are on the *subsidy side* because their number is the main value source for the *money side* (service suppliers).

Concerning the revenue structure models of ICT platforms, several models are proposed; all share the fact that services are free for the final user. Different financial bases of business models are transposable to the medical and social sector only if its specific nature is taken into account. Therefore, confidence is a key element of the health sector and ethics becomes a more sensible and demanding element when dealing with fragile or ill individuals.

The subscription model is frequently used in the medical and social sector for the platform entry and use fees. The advantages of a “triple play” offer as a particular form of subscription models are: it is already largely used for digital services; it is suitable for medical and social services because of their medium and long term delivery (e.g. remote monitoring); it may be associated to other financial sources. However, the disadvantage of this subscription model is the consumer’s long lasting imprisonment feeling together with the irreversibility of ageing, illness and disability, more stigmatizing than short term pricing.

### Conclusions

Today, ICT platforms of eHealth services represent an integrating model that tends to emerge. Based on digital economy and through microeconomics theory, this paper proposes structuring solutions in terms of pricing models, contracts and structure revenues adequate to the specific nature of the ICT medico-social service sector.

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# Telemedicine Services over EPON – a Study on Authentication and Key Management Mechanisms

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## Introduction

Telemedicine is an emerging medical service based on the great development in the information processing and communication technologies. Data communication is an important part of the entire telemedicine system, which is responsible for exchanging medical data and transferring diagnose records between the health care providers and the remote patients. A key feature of telemedicine system is security due to the legal requirements for protecting personal data. Our work aims to identify the security challenges and potential solutions in the optical access network regime.

The Ethernet Passive Optical Networks (EPONs) have been deployed widely in many countries around the world providing substantial capacity and long transmission ranges. One of the major obstacles for telemedicine over EPON solution is the high security demand. Thus, it is imperative to design and enhance secure communication protocols for these networks.

In this paper, we discuss on the potential threats and vulnerabilities of EPON system for the provision of telemedicine services. We present a security framework utilizing EAP authentication protocols. The threats are analyzed and ranked according to three aspects: likelihood, impact, and risk.

The remainder of the paper is organized as follows. The network model is proposed and potential security risks are discussed. The authentication methods are presented.

## Telemedicine Service over EPON

### *1. Proposed Telemedicine Communication Structure over EPON*

The term telemedicine is defined as the development and assistance to the health sector, from health care providers to the patients. To support data communication, a general network model is proposed for the telemedicine communication system over EPON (as shown in Fig. 1). The telemedicine service provider is hosted by the hospital or healthcare center. Medical data is transferred through the core network and access network, which are owned and administrated by the network operators.

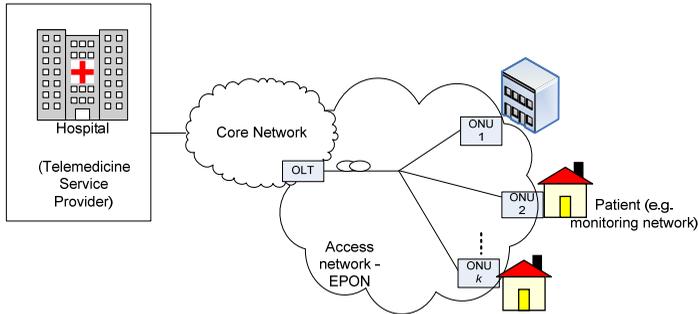


Fig.1: Network model of telemedicine communication system over EPON

Applications and research projects are launched to develop telemedicine solutions with high concerns on security and privacy mechanisms required by applicable personal data protection legislations. Due to the diversity of network technologies, there is no standard or framework to offer end-to-end guarantees to the patient's information for the entire telemedicine communication system. Therefore, the security aspect of EPON is important to the level of security in the whole system.

## 2. Risks and Threats with EPON for Telemedicine Services

Security depends highly on the configuration of network architecture. Unlike a peer-to-peer network, where a trust between a server and a user is normally existed, EPON system with a point-to-multipoint structure is vulnerable to intruders. In EPON, downstream traffic is broadcasted and upstream bandwidth resources are shared by multiple users. Besides, we cannot assume a fixed topology, because the registration of ONUs is dynamic and an ONU may leave or join the network at any time. The potential threats, eaves-dropping and Denial of Service (DoS), are possible occurred due to the point-to-multipoint topology [1-2].

**Eavesdropping:** ONUs can receive all downstream traffic by simply disabling the address/ID filter and freely receiving data destined to other ONUs. Since it is difficult to detect such an attack at OLT, a malicious ONU can eavesdrop traffic without being noticed and interrupted for 24 hours per day.

**Denial of Service (DoS):** the upstream bandwidth is distributed among several users. Each ONU needs to transmit in upstream direction by complying with the as-signed timeslots. If a misbehaved ONU on purpose transmits outside the schedule, it can consequently cause collision with the ongoing transmission from a legitimate ONU, and even worse, it can block the channel with large amounts of traffic.

## Authentication and Key Management in EPON

To enforcing message confidentiality and integrity, strong authentication and access control mechanisms should be in place in order to prevent fraudulent accesses by unauthorized intruders in a network. Authentication protocol is to verify an identification of a node as a valid member in the network. EPON topology is open and dynamic. In the upstream direction, an authorization and authentication mechanism is required to ensure the communication reliability and to avoid the impersonation from illegal masquerading users. A new ONU must be mutually authenticated during the auto-discovery process.

In the latest EPON standard, IEEE 1904.1-2013 standard [3], ONU authentication and secure provisioning are presented based on two Extensible Authentication Protocol (EAP) methods: EAP-MD5 and EAP-GPSK. EAP is developed to work on the data link layer and provides a framework for a variety of authentication methods such as MD5 and GPSK. Within the EAP framework, three entities (Supplicant, Authenticator, and Authentication Server) are involved in the authentication process. In the telemedicine over EPON system, the supplicant is a user connecting to ONU, authenticator is the OLT, and the authentication server is a Remote Authentication Dial-In User Service (RADIUS) server.

The MD5 is known as simple with very light and fast processing. The principle is in a challenge-response principle. The implementation of EAP-MD5 in EPON system is shown in Fig.2 [4].

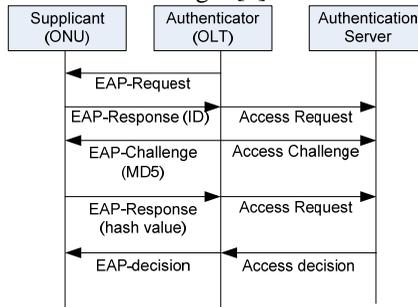


Fig 2: EAP-MD5 authentication in EPON

The GPSK authentication method uses symmetric cryptography and relies on a pre-shared key to obtain mutual authentication between the authenticator and supplicant. The keys used to compute Message Authentication Code (MAC) at the OLT and ONU are both derived from a Key Derivation Function (KDF), which based on a long-term pre-shared key. Both the server OLT and the peer ONU are authenticated by using the MAC key code. The

implementation of EAP-GPSK in EPON system is described by five messages exchanged between OLT and ONU.

- Message 1: OLT -> ONU: identity (ID\_olt), a random number (RAND\_server), and a list of supported ciphersuites (CSuite\_List).
- Message 2: ONU -> OLT: identity (ID\_onu), a random number (RAND\_onu), a repeat of received parameters of the OLT, the selected ciphersuite (CSuite\_List\_select) and MAC\_onu that is computed based on all the transmitted parameters.
- Message 3: OLT -> ONU: The OLT verifies the received MAC\_onu code and the consistency of parameters. In case of successful verification, the EAP server computes a MAC\_olt over the session parameter and returns it to the peer.
- Message 4: ONU -> OLT: The peer verifies the received MAC\_olt code, and consistency of parameters. If the verification is successful, ONU replies with a message that can optionally contain the peer's protected data parameters.
- Message 5: OLT -> ONU: the OLT sends an EAP Success message to indicate the successful outcome of the authentication

In order to analyze EAP methods, three aspects: Likelihood, Impact, and Risk are discussed. The Likelihood examines the technical difficulties for an attacker to perform a threat. The Impact evaluates the consequences of a threat. The Risk indicates the required efforts to prevent a threat. EAP-MD5: It has only two roundtrip times and there is no mutual authentication. Due to the simplicity of the authentication method and encryption algorithm, threats are likely to occur with high impact. EAP-GPSK: It provides mutual authentication and with enhanced key generation algorithm. Compared with MD5, it increases the difficulties for the malicious users and reduces the likelihood level.

### Conclusion

In this paper, we propose a telemedicine communication system based on EPON technology. We have discussed different security and privacy aspects in EPON, including both the risks and solutions. One important element in the security design, authentication and key management, is studied and explored in details. As future work, we plan to develop a framework for the end-to-end telemedicine communication system.

### Acknowledgment

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# **eHospital**

# **A Qualitative Case Study to Evaluate the Organisational Aspects of a Telehealth Service Introduction in a Greek Hospital**

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## **Introduction**

Telehealth has been proposed as one of the solutions to the challenges faced by healthcare systems with aging populations, increasing numbers of patients with chronic conditions and decreasing supply of human resources [1]. However the digital innovation in healthcare has been slow to take hold, due to regulatory complexity, interoperability issues, cost effectiveness and reimbursement for telemedicine services, poor integration of telehealth services in existing health services [2-4]. To this direction the large scale Randomized Control Trial (RCT) Study RENEWING HEALTH [5] aiming at implementing large-scale real-life test beds for the validation and subsequent evaluation of telehealth services in 9 regions of different EU Member States or Associated Countries.

The objective of the present paper is to present the evaluation the organisational aspects of the introduction of the telehealth services at the outpatient department of the Regional University Hospital of Larissa, in Central Greece within the context of the Renewing Health project. The service trial was running from 2011 to 2013 to patients with chronic diseases, including Chronic Heart Failure (CHF), Chronic Obstructive Pulmonary Disease (COPD) and Diabetes type 2.

## **Participants**

The participants of the study included volunteer personnel (directors, physicians and nurses) of the outpatient hospital departments where telehealth service was introduced, after signing the informed consent form.

## **Methods**

From the various approaches of qualitative research (Narrative Research, Phenomenology, Grounded Theory, Ethnography, Case Study) that of a

Case Study [6] was selected as the most appropriate since the objective of the research is the in depth analysis of a specific case.

In addition in relation to the organization aspects, the telemedicine services are expected to have an impact on, the methodology used for the assessment was based on MAST - A Model for Assessment of Telemedicine applications [7]. The overall framework of MAST included a broad view and analysis of the factors and areas to consider and account for when introducing and implementing telemedicine in an existing healthcare setting (Clinical and Patients Reported Outcomes, Technological aspects, Economic Evaluation, Organizational aspects). In relation to organization aspects, the telemedicine services are expected to have an impact on:

- Work processes aiming to provide results demonstrating the changes in the work processes through optimal utilisation of resources or not;
- Collaboration relations – internally or with external parties – which will lead or not to an improved course of treatment and a better continuity of care, by introducing telehealth.

In-depth, semi-structured interviews were conducted for the assessment of the organizational changes in the outpatient departments due to the introduction of the telehealth services. The interviews were semi-structured and thus followed a series of predetermined subjects that were recorded on tape. A professional interviewer was hired for conducting the interviews. The interview guide was composed after close review of the literature. A number of preset topics were decided to be tackled via the questions of the interview, covering the major aspects of the organizational challenges telehealth services are facing after carefully reviewing the literature. The interviews were analysed using content analysis [8]. Triangulation of data was based on the available quantitative data.

## Results

### *Work load and Time Management / Workflow Modalities*

The staff expressed increased time spent and work load that they were able to handle due to the fact is not scaled up. Some of them expressed that the extra office hours' responsibilities due to telehealth could be a productive investment on the long term in the case the readmissions of patients would be avoided due to telehealth. However it seems that the workload will be increased for the outpatient department of the CHF due to the various parameters included in the telemonitoring.

### *User Engagement in the Design of the Telehealth Service*

Most of the staff expressed the need for involvements of the health professionals in the design of the technology or in the procurement phase.

The need of increased involvement of the health personal in the re-design of the health service during the implementation was made clear and the need of change management with active participation of the management team of the hospital/health authority was identified as an important factor for the successful deployment of a telehealth service. Some of the staff members mentioned that the programme paves the road for a closer and more direct cooperation between the team, benefiting the patient. In the diabetes outpatient department, this cooperation was achieved through meetings discussing the program's progress.

### *Training*

Training of the personnel in the use of the application and practicalities of the technology was identified as a key component of the provision of telehealth services. As it was mentioned "health professional are used in introduction of various type of new technology in their daily practice, however the industry and the managers have to ensure proper training and ongoing service support".

### *Regulatory and Legal Aspects*

In general no major liability (risk of technical failure or error leading to elevated health risk) concerns from the use of telehealth services were raised by the health care professionals, with the exception of the cardiology department since telemedicine has certain diagnostic capabilities and the health pathologies may have dramatic conclusions. Some concerns were raised over privacy Issues (of confidentiality and consent of the patient) and security (regarding transmission, storage and retrieval of clinical data) and the need for proper management of these challenges.

### Acknowledgment

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# Applying a Computerized Care Pathway Orchestration System in the Hospital

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## Introduction

The hospital world faces increasing challenges in terms of quality of care. In response to these challenges, clinical pathways are growing in popularity. They consist in coordinated sets of objectives, decisions, actions, data and resources implemented by a multidisciplinary team to ensure quality care to a specific class of patients [1].

Continuous monitoring of care pathways is an important factor for their sustainability, their dynamic evolution and their improvement [2]. But it is also a huge work for the pathway coordinators who must collect data, compute indicators, and generate reports. Computerized pathways can automate this monitoring. It results in significant timesaving and the ability to obtain real-time feedback. A required feature of computerized pathways is an advanced level of integration with other IT systems in the hospital to avoid duplicated data entry.

We present the implementation of such a system for orchestrating care pathways in a mid-sized Belgian hospital with a significant oncological activity.

## Aims

The first goal of the project was to relieve coordinators from repetitive and tedious tasks like checking appointment dates, tasks completion and indicators computation. We try also to improve staff awareness and collaboration by showing and disseminating the progression status of patients in their pathways. We want to increase staff motivation and self-improvement by giving immediate feedback about quality and performance.

The last but not the least goal was to react faster and if possible proactively in case of failure or variations in the course of some pathways.

### Functional Features

We elicit five main functional areas for pathways monitoring and orchestration: define, inform, alert, evaluate, and integrate.

*Define:* The tool helps caregivers and support team to define pathways models and manage their evolution. Therefore, we developed a structured visual editor and a language for pathway description. This language was able to express numerous concepts like: activities, decision, and roles... useful to describe care pathways. This editor was also able to generate the complete structured documentation of the described pathways.

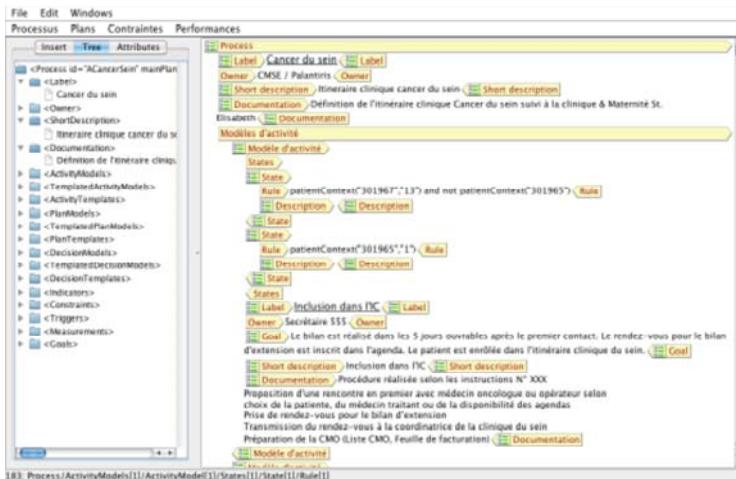


Fig. 1: The structured visual editor

*Inform:* The tool informs the multidisciplinary staff about the progress of patients in their pathways. To make things visual, it offers interactive timelines and flowcharts updated in real time. The tool also monitors the therapeutic decisions taken for the patient and adjusts the pathway accordingly by pruning unnecessary activities.

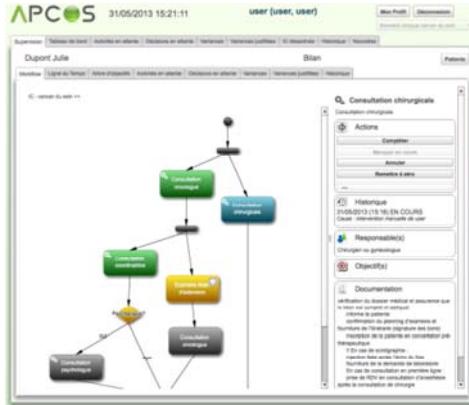


Fig. 2: Visualizing a clinical pathway as an interactive chart

*Alert:* The tool alerts responsible people in case of failure or variation from expected course of a pathway. To this end, the tool compares continuously the real route of the patient with the ideal route defined by the pathway. In case of variance, the system automatically warns the involved caregivers. Users have the possibility to justify and document variances. This information is useable during retrospective analysis of the pathway. The tool offers also various checklists and reminders to help the pathway coordinators with their job.



Fig. 3: Variance detection, checklists and reminder management

*Evaluate:* The tool evaluates the pathway course by continuously assessing practices and giving feedback to staff members. Therefore, it proposes dashboards of various indicators computed for individuals or groups of patients. It shows also goals trees with evaluated achievement levels.

Goals are related to target values of transversal indicators within a pathway, like for example pain management, patient comfort and wellness...



Fig. 4: Indicators dashboard and goal trees

*Integrate:* The tool is integrated with other hospital IT systems to avoid repetitive data entry, to provide accurate monitoring and to trigger external actions like appointment requests or prescription of paramedical acts. The integration is based on an extensible library of bidirectional connectors. The tool is accessible from mobile and desktop clients. A fast switching mechanism exists for accessing the tool from the medical and nurse record.

#### Successes

After two years of development, the system orchestrates daily the care of more than 400 oncological patients. The systematic identification of variances has revealed practices that would possibly harm patients. These practices have now almost completely disappeared. The coordinators are relieved from tedious administrative tasks. We estimate that the saving in time is about a half man-year per monitored clinical pathway model. By functioning all around the clock, the system provides a level of real-time monitoring unattainable by human beings.

#### Challenges and Conclusions

Automatically monitoring full pathways is a technical challenge. The coordinators still currently monitor some sections manually, because full interoperability with some IT systems is not yet completed. However, the usage of the system as an electronic "logbook" already offers significant benefits such as tasks and check lists management, calculation of indicators, instantaneous dissemination of information to other caregivers and automated triggering of alarms and actions.

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François Roucoux is a medical doctor and a software engineer passionate about what innovative technology can bring to the quality of care and improvement of medical practices. When he does not develop medical software, he conducts research about the orchestration of critical processes at the Louvain School of Engineering.



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# Design and Implementation of a Hospital Database Management System (HDMS) for Medical Doctors

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The paper “Design and implementation of a Hospital Database Management System (HDMS) for Medical Doctors” is aimed at designing and implementing an automated system that will alleviate the problem of handling patients data in a hospital.

The researchers were motivated to embark on this project because of the inherent problems of the manual system of hospitals file management. This manual system has so many problems associated with it such as insecurity of files, poor file retrieval and inefficient file update. And this problem in most of our hospital management has lasted for some decade which this paper wants to handle.

This project examines an existing information system of Our Lady of Mercy Hospital, Owerri and designed an automated system that can help Medical Doctors and those who handle the hospitals’ data to perform their work more effectively and efficiently.

The System would be developed with a Window, Apache, MySQL and PHP (WAMP) software. The HDBMS would be a web application that runs in a computer network. It would provide easy and fast access to stored data as needed by different users with security against unauthorized access. Any authorized user can add, delete and update data into the database based on their user-assigned-role. It would equally have the facility to give a unique identity for every persons and stores the details of every patient and the staff automatically. It includes a search facility to know the current status of each room in the hospital. A user can search availability of doctors and the details of a patient using the system. The interface is very user-friendly.

**Keywords:** Implementation; Database

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# Hospital Information Management System for the Armed Forces of Nigeria

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***Abstract:* The proposed Army Hospital Information Management System is a Network Based Electronic Medical Records Implementation with the aim and objective of unifying new and existing military medical facilities of the Armed Forces of Nigeria under a structured central database for easy dissemination of medical records and data for diagnosis, treatment, monitoring, research and general hospital services in the capacities of both clinical and non-clinical activities piloted by the Nigerian Army Medical Corps.**

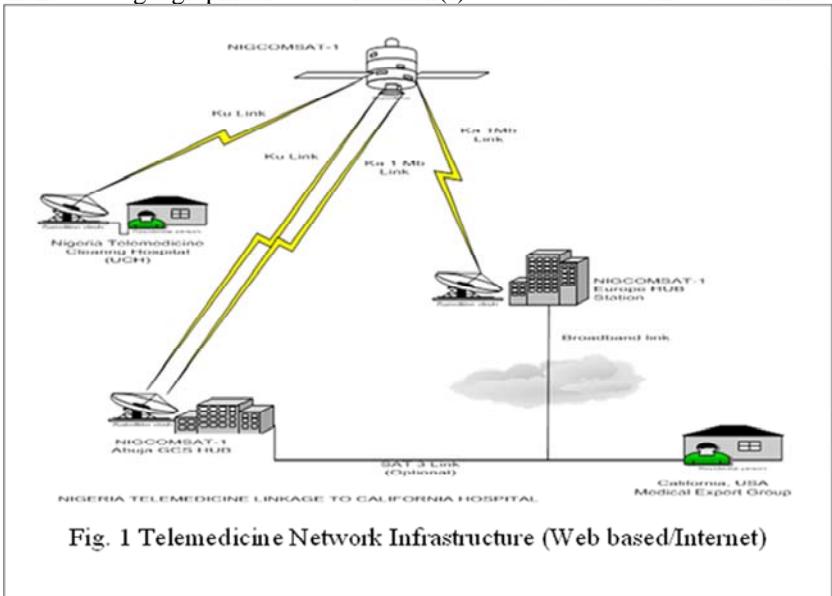
## Introduction

The Nigerian Army Medical Corp (NAMC) today has at least one medical facility in almost all the states of the federation and in some cases more than one, rendering selfless healthcare services to its troops and citizenry as the people (citizens) trust the Army to protect them being the duty of the Army to protect the sovereignty of the people in the nation thereby creating mutual respect and responsibility. Hence there is an urgent need for the NAMC to convert its paper medical records into digital formats so as to interlink all its medical records within these facilities to aid quality and professional healthcare provision such as telemedicine amongst others at its barest minimum cost being government owned and subsidized. This can be achieved with the development and deployment of a locally driven Electronic Medical Records (EMR) software.

## Methods

An EMR software modified according to the current trends in the healthcare industry would be built from the ground up. It will be a user friendly multiuser Feature-Rich, Microsoft windows SQL based electronic hospital management system capable of interoperability tendencies with other platforms to aid healthcare researches, learning and services. This will be followed with the harmonization & upgrade of existing paper health medical records into paperless (i.e., electronic formats) to enhance module

simulations such as 'Medical Records, A&E, Patient Consulting, Billing, Pharmacy, etc. Furthermore, a properly structured Network Infrastructural Architecture would be put in place to effectively and easily transfer medical data within the medical facilities both internally (Intranet) and on the web (Internet) as displayed in the figures below preferably on a satellite constellation platform. It should be noted that whilst some of our medical facilities are already equipped with a telemedicine center, there would be need to upgrade other facilities as well as build some new fixed/mobile stations in areas applicable and as deemed fit to suit the overall goal of providing everyone (troops and citizenry) with accessible medical service regardless of their geographical location(s) at all times.



To fully optimize this service and integration, Training and familiarization of selected healthcare workers initially with EMR functionalities would be a must.

### Results

Upon successful deployment and implementation, this would not only strengthen the health system but would also improve healthcare outcomes which is the ultimate goal of every healthcare sector development efforts. Also, it will without doubt save time and money; eliminate geographical constraints; reliability with an SQL database framework; feasibly dynamic and upgrade-able with new information technology trends; Academically, it

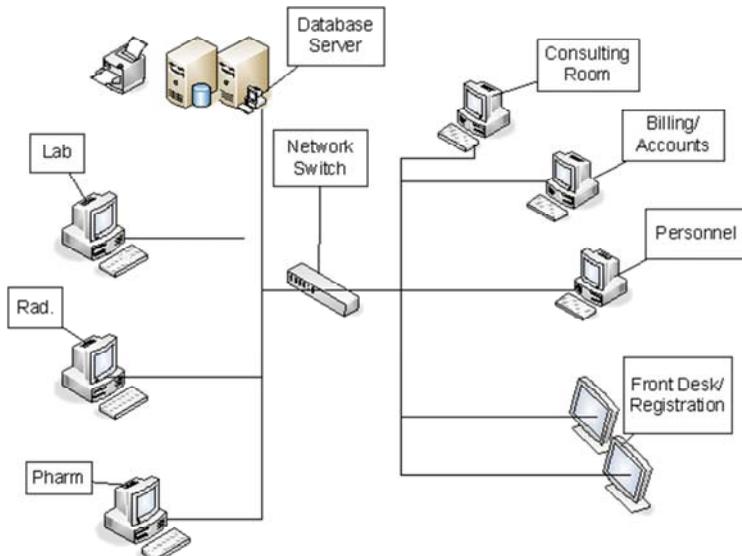


Fig. 2 EMR Module Integration Network (Preferably Intranet)



Fig. 3 Typical Display of the Army-HIMS Registration Interface

will enhance eHealth initiatives and programs both in the capacity of

knowledge transfer and research in general amongst other useful and productive benefits.

#### Likely Barriers/Pitfalls

1. Resistance to adopt paperless data storage;
2. Power supply;
3. Issues of confidentiality;
4. Adoption of unified software.
5. Adoption and access of Technology (ICT) in workflow areas.
6. Availability of Satellite Infrastructure.

#### Conclusion

It is the duty of every government to provide basic amenities for its citizens to help improve their lifestyles and at the same time allow an avenue for socio economic improvements (Stimulated Market and Business Development). The adoption of an EMR system within our medical facilities would not only help to improve these qualities, but would also support transparency and generate income for all parties involved. To achieve this, i.e., Implementation, advocacy and development; a ‘steering committee’ would be instrumental alongside a ‘National eHealth Strategy’. Also and most importantly, troops away on mission would have access to their vital medical records when needed (immediate rescue response to emergencies) via the database/databank center(s) once established.

Without doubt, the initiation and practice of EMR for Telemedicine and eHealth would help bridge the gap between providers and end-users in terms of but not limited to;

1. Acquisition of infrastructure and knowledge transfer which would be relevant in our academic and medical institutions such as the Nigerian Military School (NMS), Nigerian Army School of Medical Sciences (NASMS) and the Nigerian Defence Academy (NDA) to name a few;
2. Help build a national capacity;
3. Access to Professionals in field;
4. Linking/Networking with existing ‘Global Telemedicine Networks’;
5. Access to evidence based proof/solutions.

#### Acknowledgement

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# **Satellite Based Medical Support - Solutions for Medical Emergency Management in Rural Areas**

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Mobility in dense populated regions and rural areas differ in various aspects. From the medical point of view distances between patient general practitioner and medical specialist are much longer in scarce populated regions. To get access to medical care or expert knowledge could take hours or even days depending on the conditions for travel. This applies especially to of shore locations and illustrates the need for the implementation of telemedical services to improve access to medical care.

From the technical point of view the telecommunication infrastructure in rural areas very often is restricted to satellite communication especially of shore. This restricts e-health services in rural areas to villages and small towns providing 3G or 4G mobile networks or WiMAX covered areas. Outside these locations in the outback or hinterland or of shore mobile satellite communication is the only e-health capable communication infrastructure available.

Against this background the Institute of Aerospace Medicine of the German Aerospace Center, specialised in research and development in e-health, and the SCOTTY Group Austria, a manufacturer and provider of satellite communication technology well established in the telemedical scenario, started a close cooperation. Utilizing synergetic effects of competence in technology development on one hand and medical expert knowledge in the realization and evaluation of e-health projects on the other hand the two partners offer e-health service integration adapted to the customer's requirements and intended care models.

# **Teleconsultation in Trauma Care and Oncology: Cross Enterprise Access to CT & MRI Images in DICOM Quality**

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In cooperation with the AMC University Hospital based in Amsterdam, The Netherlands, a web based teleconsultation environment ([www.imagehub.nl](http://www.imagehub.nl)) has been implemented. Via the ImageHub medical images (e.g. CT and MRI) are directly available to doctors located in other locations for teleconsult in the original DICOM-quality. The images are accessible via the browser through a secure environment. Through the same infrastructure the images can be made anonymously available for research.

## Case: Oncology Expert Panel

A patient has been diagnosed with pancreatic cancer in a general hospital. In order to select the appropriate treatment option, the MRI and other relevant information is provided to an expert panel of surgeons and radiologists via the web based ImageHub. The experts are located in various University Hospitals across The Netherlands. Based on the feedback from the experts the appropriate surgical procedure is decided.

## Case: Teleconsult in Trauma Care

A patient has been admitted to a general hospital with a complex trauma. A CT-scan has been taken. Given the complexity of the trauma, the responsible surgeon wants to consult a specialist in an University Hospital. The surgeon in the general hospital sends an invite by e-mail to the specialist in the University Hospital. The specialist logs in to the webbased ImageHub and has direct access to the CT-images in DICOM-quality and other relevant information. Based on the consult from the specialist the appropriate treatment is decided.

In case the patient is transferred to the University Hospital the CT-scan and other relevant information is already available upon arrival of the patient. Based on the scan the treatment can be prepared optimally. Once the patient arrives in the University Hospital, the medical surgery will start directly.

**Keywords:** Teleconsultation, Trauma care, Oncology, cross enterprise, CT, MRI Images, DICOM, expert advice

# What is the Impact of Physician Secondary Telephone Triage on Emergency Department and Office Visit Utilization?

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## Introduction

Telephone triage is primarily nurse directed. Physician secondary triage occurs when the triage process involves a real time second opinion from a physician, and this process has not been well studied. At Mayo Clinic Rochester, where a nurse directed triage is used, there were concerns that the triage process resulted in an inappropriately large number of emergency room visits and urgent outpatient appointments.

This study examines the impact of physician secondary triage on a primary care nurse triage call center.

## Methods

During November 2013, nurses used ExpertRN decision support software when gathering clinical data and forming triage recommendations from incoming patient calls. Recommendations for emergency care, office visits, or physician advice were reviewed and modified by physicians, who could access to the electronic medical record and talk to the patient.

We measured potential ED visits saved, and redirection of care from office visits to home care.

Physicians, nurses, and appointment coordinators were surveyed about satisfaction with the process.

## Results

Nurses logged 1008 symptom calls. Nurses gave 60 (6%) recommendations for emergency care, of which 45 (75%) were redirected to lesser acuity by physicians. Of patients triaged to lower acuity, one patient (2%) was subsequently admitted for a related condition. Nurses recommended 512 (51%) office visits and were indecisive for 293 (29%) calls. Eleven physicians logged 775 of these calls, and recommended visits

for 372 (48%), home care for 403 (52%), labs or tests for 105 (14%), and prescriptions for 133 (17%). Nurses recommended home care or protocol treatment for 116 (12%) without secondary triage. Medical care and service delivery was judged by physicians and nurses as equal to or better than usual care, and they favored continued implementation of secondary triage.

### Conclusion

Secondary triage redirected calls away from the ED and office visits. Staff satisfaction with secondary triage was high. Further study is needed to look at patient-centered outcomes to assess whether or not patients sought emergency or office care outside the triage physician recommendations.

Keywords: utilization, decision support, interprofessional, service

# **Lessons Learned from National eHealth Initiatives**

# **Development of an Effective e-Screening Tool for Dyslexia Based on Auditory and Visual Perception**

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## Introduction

Internet plays an important role in sharing information and spreading knowledge in today's world. It provides several opportunities all over the cognitive approaches for children. The research has been carried out with a motive to develop awareness and an online screening tool for Dyslexia [1].

This paper examines in provision of a special testing tool for the individuals who have deficits in auditory processing. Identifying whether the student is dyslexic or not, is not that easy, unless they commence to write, spell and read. Abnormal mismatch negativity was seen in the dyslexia group in response to the change in tone frequency. Students with dyslexia often get confused while listening to audio or reading, due to their problem in understanding and recognizing the letters. They are generally judged as slow learners because they do not follow what has been taught by their teachers and so the number of drop outs at school level increase every year.

Dyslexic students can be identified by performing an online screening test which has been categorized to different sublevels based on their grades. The fundamental objective of this research is to develop a screen based online testing tool to identify the dyslexic students who have deficits in auditory processing and employ a suitable learning technique. The screening tool includes various assessments for diagnosis with respect to the auditory issues. The Research is basically designed for children in the age group of 5-12. The result of the test would attest whether the student has temperament or possibility of dyslexia. Dyslexia is not a sign of poor intelligence or laziness. It is also not the result of impaired vision. Persons with dyslexia simply have a neurological disorder that causes their brains to process and interpret information differently [2]. The assessment also includes analysing a Child's social and academic behaviour. Parents and teachers are provided with a set of questions that has been framed to retrieve their defects. The score sheets are matched up with the students' test scores and the intensity of dyslexia is identified for further management. Hence a Dyslexic Student will have excellent mastery skills and with little assistant they can become Global thinkers [3]. Hence, when

Dyslexic children are given proper rehabilitation they can become global thinkers with exclusive skills. Various researches have been conducted in developing a screening tool to diagnose Children [4]. Our research is all about developing a successful internet based screening tool for diagnosing children who struggle with the disability in order to achieve cognitive expertise.

### Overview of the E-Screening Tool and Architectural Framework

Before developing the tool, the architectural framework of the tool and UML diagrams were prepared to visualize, specify, construct and document software system for RU-Lexic Tool, thereby making software development process more efficient.

The Screening tool has been developed for diagnosing students with dyslexia. For screening a particular student/child, the Assessments is based on inputs received from Parents, Teachers and Student/child him or herself. Home page has a pop-up menu for assessment. Parents, teachers and child have LOG IN separately. Once logged-in, the Assessments for Parents and teachers has list of questions about their ward. These questions are helpful for understanding the social behaviour of a particular child. Every child who logs in, choose their category with respect to their age/ standards. The figure 1 shows the overview and architecture of the screening tool.

The main components of this online software testing tool are:

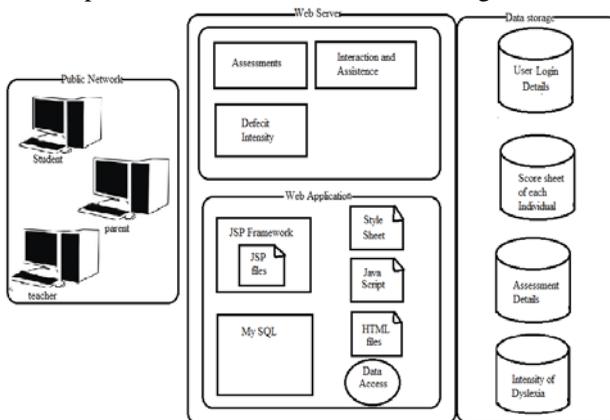


Figure.1. Overview of the e-Screening tool

#### *User End for Teacher, Parent and Student*

Each student is provided with a separate LOG IN ID and password. They have to be assisted by their Parent/Teacher in order to aid them in selecting

their grades and navigate between questions. At the end of completing test, the score sheets based on their answers are stored in the database. The parents/teacher who assists the child should also answer a set of questionnaires which comprises of Yes/No/Not sure questions that is used to assess their child's behaviour. Based on the score generated by the student, parent and teacher the tool gives the intensity level in terms of percentage which describes whether the child is Dyslexic or not.

### *Assessments*

Children are categorized based on Age/ Grade/ academic levels. The Assessment and the test questions that are framed are accumulated in the database and the marks allocated to each questions will help to calculate the intensity level of the student in terms of percentage. The webpage

cannot increment to next page unless the question is answered. This is done so as to assure that the Teachers, Parents and Children answer all the question so that the assessment will be perfect.

- *Parents' Assessments*

The web tool has set of questions a Parent need to answer to know their child's intensity of Dyslexia. The Questionnaire was developed both in English and also in regional Language - Tamil. Since this helps in knowing the cause of dyslexia and probability of occurrence based on various facts like birth, illness, behavior, Child's developmental milestones (walking/talking, etc) and so on.

- *Teachers' Assessments*

The web-tool has assessments for teachers based on the behavior of the student both socially and academically, like does the child confuse and reverse letters/words while reading/spelling (E.g. b/d; dog/god; form/from)?

- *Test for Students*

Children were often found to have various difficulties, including problems with visual-spatial organization, receptive and expressive language, phonology, attention, and in some cases, auditory processing disorders. Various tests for 4 grades ranging from age group of 5 to 12 years have been framed for both auditory and visual categories.

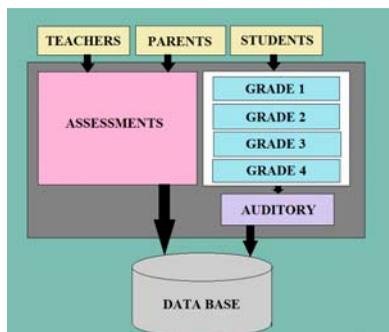


Figure 2. Architecture diagram

Children are categorized with their academic levels since the tests are framed in such a way that a normal child can answer however a dyslexic child finds it difficult. The questions were framed based on their grades and contents as available in “Samacheer Kalvi” which is the Board followed in Tamilnadu. The age level and the grade standards are categorized with respect to the grades as mentioned in the following table.

Table 1 Grade Categories

GRADE	CLASS	AGE
GRADE 1	I,II	5 to 6 years
GRADE 2	III,IV	7 to 8 years
GRADE 3	V,VI	9 to 10 years
GRADE 4	VII,VIII	11 to 12 years

The questionnaires for Students, Parents and Teachers were developed from the inputs from Education Psychologists, Inputs from Teachers from regular school and Special education schools, Books and reference materials listed.

*Database*

Database is used to stores all user related details and retrieve it when essential. The user details constitute about the user’s Register details, their LOG IN, Password. The Parent/Teacher who assisted the student while taking the test and also their assessments will also be sustained in the database. Once the student completes their test and submit, a final score sheet will be exhibited after matching up with Parent/Teacher score who assisted the child. Whenever the user wants to retrieve their details they can look into their scores by signing in with the user ID and password. When a student is answering the questions, the time taken to answer a question is also stored in the database. This may also be useful in analysing the level of dyslexia.



Figure 3 Home page of the R-U-LEXIC tool

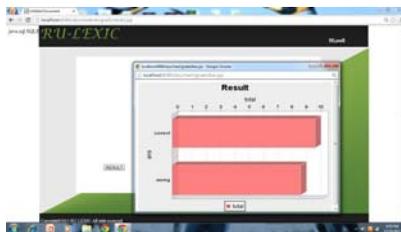


Figure 4 Bar-chart diagram illustrating final scores of the student Assessment

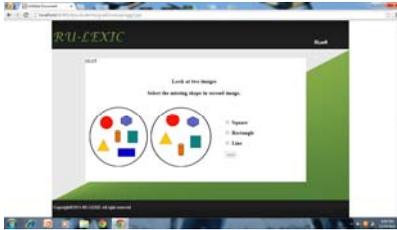


Figure.5 Student assessment page of the R-U-LEXIC

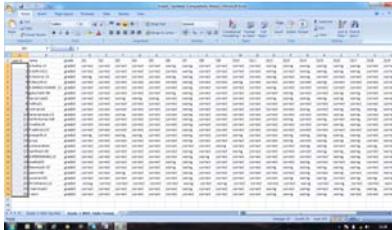


Figure.6 Database that as imported as excel file for a grade3 Student Questionnaire

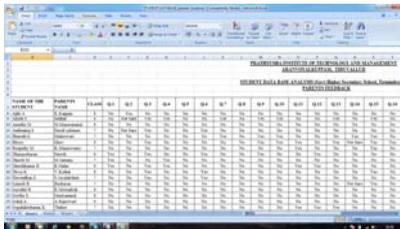


Figure.7 Database that as imported as an excel file for a assessment by Parent

## Application Development Tools

The tool RU-Lexic has been developed using various tools such as Apache Tomcat 6.0 as high end server and SQL Server 5.5 is used as database. NetBeans IDE 6.8 has been used for developing dynamic web pages for tests and assessments using JSP code. Tools such as Microsoft visual InterDev 6.0 and Adobe Dreamweaver CS5 are used for designing the web page. Adobe flash professional CS4 is used in tests for video comprehension and to display videos in the test. IBM Rational Rose Enterprise Edition suite has been used for illustrating the functionality of the project. The various questions in the assessments for a teacher/parent are structured from making a research where a Dyslexic child will struggle in their regular work in order to analyse their social behaviour. Test contents are based on the Children's academic standards with four

different grades levels on the syllabus, "Samacheer Kalvi" which is the system followed in Tamilnadu.

## Implementation

The system developed was put under test cycle. A trial test with 50 entries for students, teachers and parents were done. After completion of all the questions by the parent and teacher, the web tool displays the result for every user to analyse their level. The results are displayed in the form of

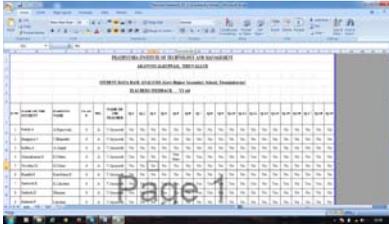


Figure.8 Database that as imported as excel file for assessment by Teacher

that as imported as an excel file for a grade3 Student Questionnaire The figure 7 and 8 show the database that as imported as an excel file for a assessment by parent and teacher

### Inclusion and Future Work

This research has been made to test the auditory and visual perceptions of a child who has a probability of having dyslexia. Based on the architectural design and UML diagrams an intelligent and efficient tool for screening dyslexic children has been developed. Currently the screening tool is designed for assessing the visual, auditory perception of the child. Tests for analyzing the tactile-kinesthetic perception of the child have to be developed. Based on the level of disorder, a set of suitable rehabilitation tools have to be developed. The validation and reliability of the tool is also done. The whole system is developed on an eLearning platform, so that the system can be accessed at any time through internet.

### Acknowledgment

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# Expert Tele-Fitting Mode for Cochlear Implant Recipients

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## Purpose

In a telefitting method an experienced audiologist from the cochlear implant clinic provides fitting service for the patient in distant, cooperating polyclinic. Teleconference equipment provides audio and video connection while remote desktop application allows taking the control over the distant computer and performing all necessary measurements.

This method proved to be a reliable alternative for standard fitting, but it does not save work-time for a clinician and is not a way to cope with the growing number of patients.

In expert telefitting mode the idea is to involve less experienced support specialists from cooperating clinics in basic tasks and to leave the decision making in the hands of experts performing their duties via telemedical solutions.

The aim of this work is to present the concept and preliminary data showing outcomes of the new telefitting mode.

## Material

The study group consisted of randomly selected patients: 6 children (age 7-16 yrs, mean 11,2) and 7 adults (age 17-64 yrs, mean 44,7) with CI experience ranging from 18 months to 16 yrs.

The control group consisted of randomly selected patients: 9 children (age 3-14 yrs, mean 8,8) and 5 adults (age 21 - 36 yrs, mean 27,2) with CI experience ranging from 6 months to 8 yrs.

## Method

Each patient in the study group underwent expert telefitting procedure: local ENT, structured interview, free field audiometry, local objective and psychophysical measurements. Then a Remote Expert interpreted the results

and created a new map. The controls underwent standard telefitting consultation.

### Results and Conclusions

The expert telefitting mode seems to be comparable to the standard telefitting mode in terms of patients' satisfaction and appreciation of the results. It allows substantial saving of time of experienced specialists, and in this way may lead to the reduction of cost. These advantages complement benefits of the standard telefitting mode: saving of time, money and effort for the patient, better access to specialists, educational value for less advanced staff.

Keywords: teleaudiology. telefitting. cochlear implants.

# Teleaudiology Net between World Hearing Centers (Kajetany, Poland) and Africa, Asia and Europe

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Telemedical solutions are more and more popular in present medicine.

Otorhinolaryngology and audiology specialties give possibilities to fulfil procedures in diagnostic and rehabilitation procedures. From many years the teleaudiology net in Poland has been working. It consists of 20 centers where patients could have fitting of cochlear implants speech processors. It allows for patient to save money and time. Another gain is the condition of each patient. Especially children are more relaxed and not exhausted after long travel to Kajetany. The network gives patients the ability to move more efficiently and more effectively through the process of rehabilitation.

After the success in Poland we have started the cooperation with different centres in other continents. Such example is Odessa in Ukraine where there is cooperation with Black Sea Center of Hearing and Speech "Medincus". There is possibility to diagnose patients with complicated ear diseases with videotoscopy and objective hearing assessment (for example ABR).

In Bishkek Kyrgyzstan we have organized the first telefittings as well as ABR assessment.

In other countries there were hearing sceernings in children, performed with automated database analysis. Coded data were sent and there was feedback information to centers which took part in research.

Similar project was realized in Tajikistan.

In Africa another project is in progress, connected with screening and assessment (Senegal and Ghana).

As a sum up we claim that telemedicine is very good way of support less experienced centers where during such consultations there is high possibility for education of local specialists. We always respect local laws and restrictions.

Keywords: teleaudiology, cochlear implant, hearing screening

# The Moscow – Russian Regions-2 Telemedicine Project

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## Introduction

A fifteen-year experience of developing and implementing telemedicine technologies in Russia has seen successes and failures while promoting the achievements of modern medicine to the most remote communities [1-6].

In the second half of the 90-s the telemedicine project *Moscow - Russian Regions* helped to open first telemedicine units in a few big regional hospitals. Further development of the project guided by the Russian Association for Telemedicine (RAfT) made it possible to establish telemedicine units almost in all major regional hospitals [2].

This report focuses on the main factor of success of this and future telemedicine projects – namely on the principle "do it with us."

We believe that the new initiative of the Russian government aimed at providing the Russian people with better access to high quality healthcare services (in other words bringing healthcare facilities closer to patients in any part of the country) could benefit from the experience of the first telemedicine project and use it while upgrading rural medical stations (RMS). Though RMSs form the basis of the Russian healthcare system (there are about 40000 RMSs in the country) today they have the most limited capacities.

In order to efficiently reform RMS work we offer to use a low-budget but innovative solution based on continuous interaction between RMSs and the country's best clinics.

Our suggestion is an attempt to use the experience of Russian telemedicine that has formed good basis for the reforms.

As with the successful telemedicine project launched in the second half of the 90-s, we outline our proposals within the new project *Moscow - Russian Regions-2*.

“Why do it now?”

First, with use of the latest informational and communication technologies there is a real possibility to establish a network of “virtual” medical offices in any part of the country. Practical solutions to implement this idea are based on extensive domestic and foreign experience of

conducting telemedicine consultations and tele-lectures for healthcare professionals.

There has been gained considerable experience of organizing consultations for physicians through teleconsulting units established at regional hospitals. Such units allow a doctor of a major medical center of Russia or another country together with the patient's physician to thoroughly examine the patient and choose further treatment [4].

Telemedicine consultations made a step forward with development of mobile videoconference units. Installed in diagnostic trains and ambulances these units helped to acquire invaluable experience of providing healthcare at a distance. One should remember that often medical professionals have to work in drastic conditions of natural or man-made disasters.

Reliability of modern telecommunication and information technologies enables to timely provide medical services, as evidenced by practical teleconsultations.

Secondly, Russia, like most countries with large sparsely populated areas, faces shortage of healthcare professionals and their uneven distribution in regions and hospitals.

In spring of 2012 Tatiana Golikova, Minister of Health and Social Development, focused the public attention on a severe shortage of health workers.

"Russia lacks 152.8 thousand doctors. Outpatient clinics are short of 187.5 thousand health workers, while in hospitals, on the contrary, there is a surplus of doctors equal to 34.7 thousand people. We could try to solve the problem by retraining the staff of inpatient facilities, but overall the problem is insoluble," - said Golikova.

According to the minister, the greatest shortage of doctors is in pediatric oncology (almost 100%), rheumatology (84.5%), pulmonology (84%), general practice (49.5%), dietetics (almost 100%).

At the same time there is an oversupply of medical professionals in dentistry (202%), ophthalmology (100%), surgery (60%), traumatology and orthopedics (54%), otolaryngology (22.6%).

The Health Ministry also reported that hospitals and out-patient clinics are severely short of nursing and paramedical staff. According to Ms. Golikova, this shortage amounts to 800 thousand people. "This figure is threatening and should make us feel scared," - summed up the Minister.

In eastern regions of Russia most communities have less than a thousand inhabitants. For these people medical services are provided through RMSs staffed by paramedics. Therefore, in such conditions the most important is to be able to give early diagnosis and prescribe treatment at the first stage. This target is unlikely to be achieved without help of qualified experts.

This leads to the third conclusion: only digital technologies that have replaced previous generation of medical diagnostic devices provide real opportunities to work with patients at distance at the highest professional level.

In previous articles we have already described capacities of modern low-budget diagnostic devices designed to remotely exam patients. The list of mandatory diagnostic equipment for RMSs (approved by the Decree of the Russian Ministry of Health and Social Development, dated May 15, 2012, # 543n) points to the following conclusion. The market of medical equipment offers a number of competitive devices for primary diagnosis that have USB digital output to interface with a PC. The available devices entirely cover the mentioned list of equipment. It is worth mentioning that the most expensive but the best in terms of functionality is a electrocardiograph plate that has interface for 12 branches (instead of 3 or 6, as given in the standard) [4-5].

This review of conditions required to promote modern medical services in the most rural areas allows to say that there are informational communicative, human, technical (medical equipment) preconditions for the implementation of this complex program.

#### Telemedicine Consultations Are A Tool That Enables To Provide Equal Access to High Quality Medical Services

The telemedicine project *Moscow – Russian Regions – 2* has started due to a huge gap in intellectual, technical and financial means of big cities and rural communities. We believe that big cities should undertake a mission to promote high-tech medical diagnostic services into remote areas of the country. However, it should not be a charity project – on the contrary it should help the cities to benefit economically in many ways.

The regions need technical support. Therefore, the cities should focus on establishing diagnostic units for Rural Medical Stations (RMSs) that can be managed remotely. The core of such a unit can be an average laptop with access to the Internet. The laptop is connected to a block that (at the first stage) serves as an integration platform for diagnostic equipment listed in the above-mentioned order N 543 dated May 15, 2012 (see Table I).

The integration platform incorporates existing diagnostic devices and more importantly provides more possibilities to examine the patient with use of new equipment or upgraded software [5].

The telemedicine project *Moscow – Russian Regions* showed that new technologies are better applied on similar or completely compatible equipment.

Name of equipment	Required quantity, units
Portable electrocardiograph with 3 or 6 channels	minimum 1
Tonometer to measure blood pressure on peripheral arteries with BP cuff - to measure blood pressure of kids, including under 1 year olds *	minimum 1
Phonendoscope *	minimum 1
Portable analyzer for blood glucose with test strips	minimum 1
Portable express analyzer for cardiac markers	minimum 1
Stopwatch timer	minimum 2
Medical thermometer	minimum 5
Scales for adults	minimum 1
Scales for infants under 1 y.o.	minimum 1
Obstetric stethoscope	minimum 1
Portable cholesterol express analyzer *	1
Portable spirometer (with disposable actuators)	1

Therefore, an RMS set of diagnostic devices should be prepared together with a doctor's working station and be able to reflect data from diagnostic tools, and allow the doctor to control accuracy of their application. This is why video conference is a crucial part of the "virtual" medical office. Just a few years ago good videoconferencing equipment was an unrealistic dream both for RMSs and district hospitals. Today the market offers a wide range of hard and software solutions that transmit excellent images through the Internet with the use of inexpensive web camera with HD quality. About five years ago, by order of Russian Association for Telemedicine (RAfT) Russian specialists simulated inexpensive video conferencing equipment similar in terms of its functions to equipment of the world's leading manufacturers and fully compatible with it. It proves there are no technical problems for production of such equipment.

In the same time in order to complement the mentioned videoconferencing equipment there was developed a set of diagnostic devices that overall complied with requirements for RMS equipment. This set was used during the round-the-world cruise made by a Russian yachtsman helping to monitor the athletes' health and proving its user-friendliness and reliability. All necessary manipulations and data

transmission were made by the yachtsman, who hadn't previously had special skills to do the job.

As for communication channels between RMSs and doctor at a distance, experience gained while implementing the *Moscow – Russian Regions* project could be of use too. Then telemedicine consultation centers (TCC) were established at locations where applicants had received confirmation they would get a communication channel with the required bandwidth. Very often the carrier operators regarded TCC equipment as an opportunity to offer the region new high quality communication channels while getting a great tool to advertise their innovative solutions. Given the number of RMSs in Russia it won't take long to find a number of locations that have access to good communication network. At the same time marketing technologies can help raise awareness about advantages of virtual medical offices in terms of better access to high quality medical services provided by the best Russian hospitals to people in remote areas.

Evil-eyed attitude to the neighbor's success in achieving a target that is under state control helped a lot to launch the Moscow-Russian Regions telemedicine project. In particular, it established favorable implementation conditions such as modernizing communication channels and encouraging local medical professionals to learn new innovative solutions.

At times some specialists didn't want to get involved into the project as they were afraid they wouldn't look unprofessional compared to more qualified colleagues from big hospitals [6].

To overcome such difficulties there could be useful RAfT experience in establishing equal conditions while preparing all participants of telemedical examination.

The said practice suggests starting from personal acquaintance of RMS personnel and a doctor from the regional clinic and further step-by-step discussion of their cooperation during the examination. It is very important that the patient feel positive about new level of medical services while the doctor together with a local paramedic (nurse) conducts a comprehensive exam and give recommendations for treatment.

We should remember that doctors also gain new working experience and learn to use new diagnostic equipment together with RMS personnel. In big hospitals this process goes very smoothly especially if some healthcare professionals have already participated in telemedicine projects and currently help to train their colleagues.

We won't focus on the procedures of virtual exams: the sequence of telemedicine consultations including applied tools and devices has been described many times.

Digital diagnostic equipment helps to reduce percentage of medical errors as, for example, it enables to simultaneously listen to the record of stethoscope signals and see the image of the device on the patient's body. In this case real-time consultation of one or more experts increases quality of diagnostics.

The more sophisticated diagnostic tools are the more specific are consultations. The applied measures help to reduce costs of initial examination– both for the hospital and the patient.

This article doesn't cover the following important issues:

- In-home telemedicine that could be interpreted as help given at a distance to patients that have skills to monitor their health using diagnostic tools and transmitting data to the doctor;
- Economics of medical exams at a distance including difference in cost of conventional and digital diagnostic tools and devices;
- Cooperation between owners of medical facilities while organizing collaboration at the regional healthcare level.

These issues will be discussed individually in other publications.

### Summary

Making summary of the proposed project it is important to remember that its launch is beneficial for the cities as they get orders to produce diagnostic sets for RMSs. It expands workload for medical personnel that provide services at “virtual” divisions and creates more opportunities to hold postgraduate courses for RMS medical personnel.

Municipalities get qualified doctors that regularly upgrade their qualifications as well as an opportunity to continuously improve qualifications of local medical staff due to the mutual work with doctors from big cities and medical trainings in “virtual” universities.

This article covered two important topics: experience of implementation of telemedicine technologies in modern healthcare and description of objective preconditions that make it possible to provide high quality medical services to patients in any Russian location on the basis of innovative technologies. We understand that there are and there will be new solutions aimed at improving medical services that are different from the ones we offer.

But the most important thing is that it will be beneficial for the Russian citizens that will have a better access to medical services provided at the highest professional level.

We believe that Russian experience of using telemedicine technologies can be useful for countries that are also trying to provide equal access to

high quality medical services but have limited funds to implement this target.

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# The Realization of PrimCareIT Project in Belarus

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Condition of human resources determines the efficiency of healthcare system activity, i.e. quality and accessibility of the rendered medical aid to the people. However, there is an evident lack of human resources in healthcare sector due to the peculiar demographic situation, outer migration, inner migration and attrition connected with retirement, disability and death.

In 2012 there was a project initiated to solve the problem of human resources in the European Union “PrimCareIT – Counteracting brain drain and professional isolation of health professionals in remote primary health care (PHC) through tele-consultation and tele-mentoring to strengthen social conditions in remote BSR”, where Belarus was one of the partner countries.

The main aim of the project was to counteract brain drain and professional isolation in sparsely populated areas for more equal access to PHC in the Baltic Sea Region.

South Ostrobothnia Health Care District, Finland was the lead partner of the project. There were 7 countries participated in the project: Finland, Germany, Lithuania, Latvia, Estonia, Sweden and Belarus. Belarus was represented by two partner organizations: State Educational Institution Belarusian Medical Academy of Post-Graduate Education, Minsk and Ostrovec Central Regional Hospital, Grodno oblast.

Within the framework of PrimCareIT project in Belarus 4 outpatient clinics were equipped with new telecommunication technologies, General practitioner’s (GP) training center was created, eLearning seminars were carried out focusing on tele-mentoring and tele-consultations systems.

One of the analytical aspects of the PrimCareIT project in Belarus included the research according to the method of the focus group. The aim of the research was to study the problems of the brain drain and professional isolation of the healthcare specialists and the perspectives of tele-medicine development in Belarus. There were 10 experts, specialists in organizing and rendering of PHC, who participated in the discussion on the problems

of shortage of healthcare personnel and the ways to solve these problems.

6 males and 4 females took part in the survey. The average age of the experts counted  $51,1 \pm 2,3$  years, employment history in the healthcare sector -  $29,5 \pm 5,2$  years on average. All the experts had the highest degree in their major medical specialties. They were represented by 2 professors, Doctors of Medical Sciences, and four associate professors Candidates of Medical Sciences. There were 4 experts who worked in the healthcare management authorities, 2 – in the educational institution, 1 – in a state polyclinic, 2 – in rural healthcare institutions. Four experts hold the position of managers, 3 – deputy managers and 3 – heads of the structural divisions.

The term of “brain drain” was defined by the experts as the immigration from the countries of highly qualified specialists to foreign countries or the outflow of the specialists from the healthcare system to the other socially more attractive sectors. All the experts (10 people) indicated that the problem of brain drain should have been first of all considered on the republican level. The majority of the experts (9 people) pointed out that the problem of brain drain also occurred in their regions (organizations). 1 expert stated that there was no such a problem in his region.

Experts noted the following main reasons for brain drain: underpayment of a medical specialist, lack of social protection of a medical specialist, low rating of doctors among the population, inefficient labor management of medical specialists. The majority of the experts considered economic factor as the main factor influencing brain drain.

The increase of dissatisfaction with the healthcare system by the people was marked as the most serious consequence of brain drain. They also marked the decrease of PHC and specialized medical care accessibility.

The experts considered it important to increase social protection of doctors, prestige of the profession of a doctor, improve organization of work of a medical specialist to counteract the brain drain.

The term of “professional isolation” was defined by the experts as the limited opportunities for medical specialists to improve their qualification and professional communication.

The experts named the following main reasons for professional isolation: lack of accessibility to IT, lack of possibility to improve one’s qualification abroad, and lack of cooperation with the specialists from the other regions and countries.

Among the consequences of professional isolation the experts pointed out decrease of the quality of the rendered medical services to the people, decrease of the prestige of a doctor’s profession, increase of brain drain and dissatisfaction with the healthcare system of the people.

All the experts were absolutely sure that the development of IT would

help to decrease the level of brain drain and professional isolation of medical specialists. Tele-consultations and tele-mentoring were defined by the experts as the most effective IT in medicine.

Financial and organizational problems were considered by the experts to be the main obstacles to the implementation of IT solutions. In the experts' opinion, for the efficient implementation of tele-consultations into doctor practice in Belarus it was important to equip working places of the doctors-specialists with the modern computer technologies, to develop and adopt legislative and regulatory base on tele-medicine.

The experts named on-line consultations using high quality communication channels in emergency cases as the most perspective form of tele-consultations. They also pointed out such forms as video-conferences and the postponed off-line consultations.

Respondents noted that distance learning was the most acceptable during the specialists' qualification improvement and self-education process. The experts mentioned that for the efficient implementation of eLearning it was important to implement regulatory bases on the forms of distance learning, to equip working places of doctors-specialists with modern IT solutions and to improve the qualification of mentors in terms of eLearning issues.



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**Winner  
of the 2013  
ISfTeH Student Videoconference Session**

# TELEPHARMACY - Pharmaceutical Care – An Assistance Project

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**Abstract:** **Introduction:** In line with new Brazilian Health System policies, medicinal plants that may interact with prescription medications can officially be used alongside conventional therapies. Brazil is a continental sized country with remote regions that lack good ready access to drug related information. Telemedicine and Telepharmacy services can help fill this gap in provision. **Objectives:** (1) to evaluate the interaction between medications and the culturally influenced patient habit of drinking different herbal teas in the region of Palmares do Sul, RS, Brazil, and (2) to promote a more holistic approach to patient health care through the use of digital information and communication technology. **Methods:** Students and a pharmacist from the School of Pharmacy, PUCRS visited the main health care unit of the city (receiving site) for a period of 3 days to collect data through planned interviews (questionnaires). The acquired data (questionnaire responses) was inserted into an electronic patient record. The information was protected by password and sent for remote evaluation by a pharmacist (delivery site). Results regarding the interactions of medications and herbal teas were encrypted and then sent by e-mail to the health care professionals of the receiving site. **Results:** A total of 49 patients participated in this study. Interventions were suggested by the remote pharmacist in 39% of cases, due to possible interactions and/or the presence of adverse effects. **Conclusion:** The number of pharmaceutical interventions used emphasized the importance of telepharmacy as a tool to increase patient care. It can also improve the quality of life of patients by guiding them in the use of a better combination of medication and commonly consumed herbal teas.

## Introduction

The use of plants for therapeutic purposes is a part of Brazilian culture strongly influenced by the diversity of ethnic and indigenous groups [2].

The National Health Surveillance Agency - ANVISA aiming to recover and enhance traditional knowledge regarding medicinal plants officialised the prescription of herbal medicines to be used in conjunction with conventional drug therapies [1][2].

Brazil is a country of continental proportions with many remote regions, and as such there may be a lack of ready access to drug related information in some areas. In this context, Telemedicine and Telepharmacy services can help fill this gap in provision [3]. It enables virtual contact to take place between health professionals, patients and pharmacists, providing an exchange of information [1].

Two laboratories of the Microgravity Centre/FENG, PUCRS, the Joan Vernikos Aerospace Pharmacy Laboratory and the Telemedicine Laboratory, conducted a telehealth project in the city of Palmares do Sul, RS, Brazil, in 2012, with the use of telecommunications platforms, mobile systems and biomedical engineering tools [5][4].

### Objectives

The aims of this assistance project were (1) to evaluate the interaction between medications and the culturally influenced patient habit of drinking different herbal teas in the region of Palmares do Sul, RS, Brazil, and (2) to promote a more holistic approach to the health care of patients through the use of digital information and communication technology.

### Methods

Students and a pharmacist from the School of Pharmacy, PUCRS, visited the main health care unit of the city of Palmares do Sul for a period of three days to collect data through planned interviews (questionnaires). The acquired data (questionnaire responses) was inserted into an electronic patient record that was developed exclusively for telehealth projects (Fig. 1).

The information was protected by password and sent for remote evaluation by a pharmacist (delivery site). Results regarding the interactions of medications and herbal teas were encrypted and then sent by e-mail to the health care professionals of the receiving site (Fig. 2).



Fig. 1 - Access to Software

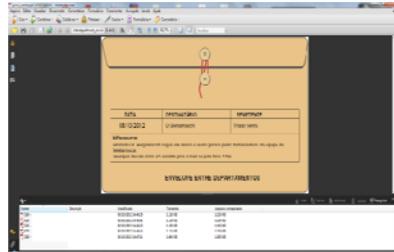


Fig. 2 - E-mail

### *Patient interview*

The triage interviews were performed individually, allowing a better interaction with patients. The data collected was: 1) physiological variables (blood pressure, weight and height); 2) medical history including pre-existing and chronic diseases; 3) history of daily food consumption; 4) intake of teas and coffee; 5) medication use (dosage and intake schedule).

### *Data acquisition*

The data obtained from the interviews was inserted and stored using the telehealth software developed by the Telemedicine Laboratory. The information was protected by password.

### *Data transmission*

The data transmission was carried out using a laptop computer. An internet connection was not always available in the communities being visited and in such circumstances the patient data was stored on a MySQL database for subsequent transmission to the Telemed PUCRS server upon internet availability.

### *Information Analyses*

The Medscape, Drugs, Healthline and Umm databases were used to perform the analysis of the patient data.

### *Expert second opinion*

All suggestions and opinions regarding possible interactions of medications and herbal teas resulting from analysis of individual patient data were encrypted and sent via e-mail to the health care professionals of the receiving site.

## Results

A total of 49 patients participated in this project, 29% male and 71% female. Interactions between medication-medication and medication-herbal teas were considered.

Of those patients interviewed, 61.2% used medications; 22% used herbal teas. A total of 16% presented medication-medication interactions and 4% presented medication-herbal tea interactions.

Suggestions related to these interactions were given in 39% of cases.

### Conclusion

In accordance with the findings of this study, the number of pharmaceutical interventions used suggests the importance of telepharmacy as a tool to enhance patient care, especially in remote areas that are commonly deprived of health specialists.

Virtual pharmaceutical attention showed positive results and has the capacity to improve the quality of life and life expectancy of patients through proper guidance on the use and combining of medications and commonly consumed herbal teas with therapeutic potential.

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