ISSN 1998-5509

# MedeTel

## GLOBAL TELEMEDICINE AND eHEALTH UPDATES
## KNOWLEDGE RESOURCES




ISfTeH
International Society for Telemedicine & eHealth
NGO in official Relation with WHO

**www.medetel.eu**

Vol. 4, 2011

Editors: Malina Jordanova & Frank Lievens

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**ISfTeH**
International Society for Telemedicine & eHealth

*Publisher*

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# Preface

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

With 133 papers from 47 countries, the book presents a collective experience of experts from different continents all over the world. Papers reveal various national and cultural points of view on how to develop and implement Telemedicine/eHealth solutions for the treatment of patients and wellbeing of citizens.

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

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

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

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

Yet, it is necessary to underline that:

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

- Chapters and papers in each chapter are listed alphabetically;
- The original style of the authors was respected as much as possible;
- In the content, after the title of papers a maximum of 3 to 4 co-authors are listed, while the rest are marked as “et al”;
- “How”, “Where”, “When” and especially “How Much” – are only part of the questions that authors are trying to answer.

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

Enjoy your reading!

Editors

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

# Content

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

# AAL Open Association Manifesto

Francesco Furfari[1], Francesco.Potortì[1], Stefano.Chessa[1], M.-R. Tazari[2], M. Hellenschmidt[2], R. Wichert[2], J. Gorman[3], A. Kung[4]
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AAL - promising but problematic

The abbreviation "AAL" stands for Ambient Assisted Living [1] and is about making smart use of technology to support well-being in the preferred living environment for people who might otherwise find this difficult (e.g. infirm or very elderly people who want to continue living in their own homes). Research in the area is motivated by socio-political issues of the ageing population, and offers a promising approach with potentially wide-reaching benefits. It involves many ICT-related R&D disciplines in an application field that has attracted much attention. Several initiatives have emerged to tackle the challenges involved [2-4], and significant incremental progress has been achieved on many fronts. But a major AAL breakthrough, leading to a standardized approach and thereby to widespread adoption, is still not in sight. A way of doing things that has general acceptance and can almost be assumed, like the Apache Server is in the web world, is missing in the world of AAL.

Why have there been no AAL breakthroughs? From an R&D perspective, part of the answer is to be found in fragmentation of research efforts in the area of AmI (*Ambient Intelligence* [5] - also referred to as Ubiquitous and Pervasive Computing [6,7]). AmI is the key research discipline that underpins the domain of AAL, and many innovative ideas and approaches have emerged from research projects, conferences etc. in recent years. The field has matured over time – but so far with no converging conclusions.

From a market perspective, there are two obstacles. The first arises from the lack of technical convergence: this leads to development of very different technical solutions that are difficult to compare, so there is no baseline against which to assess user experiences in the types of scenarios

envisaged by AmI. It's hard to market something whose benefits you can't clearly quantify. The second obstacle is market fragmentation. The whole concept of "ambience" is all about making use of everything around you as part of a single overall solution. But today's commercial reality is that the growing number and types of devices around us (mobile phones, home theatres, games consoles, media servers, home gateways etc.) are treated as separate market segments – even though the devices themselves have the potential to interact. A paradigm shift is needed, but who will risk the investments and changes in business models needed in the absence of a precise model adopted by a large ecosystem of artifacts?

The concept of *co-opetiton* [8] - collaboration among competitors - has been put forward as a way to achieve commoditized infrastructures and been successfully deployed in some cases. But for there to be any chance of a real paradigm shift, a transversal cooperation over diverse market segments with the involvement of many stakeholders is needed. That is one of the key things that the AALOA aims to achieve.

## AALOA – an Open Association promoting AAL research, development uptake and impact

The subscribers of this manifesto consider that the time has come to do something about the problems hindering progress in the area of AAL. We believe that this is something that transcends individual projects or organizations, and needs a long-term approach, with broad involvement from all types of stakeholders. This manifesto is intended as an invitation to join us in our mission, which is to:

- Bring together the resources, tools and people involved in AAL in a single forum that makes it much easier to reach conclusions on provisions needed to achieve AAL progress;
- Make sure that all technology providers, service providers and research institutions involved in AAL are either directly involved in AALOA or (as a minimum) aware of decisions it promotes;
- •Involve end-user representatives in all work of AALOA;
- •Identify key research topics in AAL, and reach agreement on prioritization of these;
- Design, develop, evaluate, standardize and maintain a common service platform for AAL.

Our mission is founded on a long-term technical vision. This will evolve over time, but gives an indication at the initiation stage of the direction in which we want to go. In our vision, ordinary hardware resources such as displays, keyboards and storage devices that nowadays need drivers integrated into Operating Systems (OS) will evolve into pluggable

networked resources. We foresee the emergence of new programming languages, based on resource and service discovery paradigms, facilitating the development of AmI applications.

There will be a shift away from the idea of developing applications that run on different PCs and OSs towards the concept of developing applications for "AAL spaces". Middleware [9] will be widely used, and help developers to identify the features available in the environment (sensors, other devices, services) and write programs which can exploit large classes of them effectively, without needing to know their actual whereabouts or be concerned with low-level configuration details.

This will involve more than just developing pluggable components: it will mean that developers will effectively be able to contribute to several distributed applications - without even knowing all of them beforehand. "AAL Spaces" will become the equivalent of today's PCs (in terms of widespread availability, standardization and acceptance) and new markets will emerge for software and hardware products, involving houses, cars, airports, hospitals and public spaces..

## Getting started: defining a reference architecture

The hardware specification of the original IBM PC of the eighties, when several independent manufacturers started to produce peripherals and compatible hardware thanks to the standardization of connector interfaces and the availability of specifications, was one of the key enablers that led to the ubiquity of PCs we know today.

One of the first tasks of the AALOA will be to do something similar for the AAL domain: define reference *architecture* to standardize the resources available in AAL environments, and how to integrate them. This will encourage the creation of new brands and the coalition of firms around new business opportunities.

## Your AALOA needs YOU

To achieve our mission, and contribute to bringing about this long-term vision, the subscribers of this manifesto started to incubate the AALOA – the Ambient Assisted Living Open Association. As its name suggests, anyone can join the AALOA, and this manifesto should be considered as a direct invitation to do so.

The AALOA can only achieve its mission if its membership represents a significant proportion of the people and organisations involved in AAL/AmI, in one way or another. We invite you to join the association, and to participate in its activities: to bring fresh ideas, to propose workshops and

projects and to contribute actively to the growth of the association. For details of how to join, please visit the web site: <http://www.aaloa.org>

The detailed organisational structure of the AALOA is in the process of being formalised in a set of statutes. These are still under development, and people responding to the invitation to join will have the opportunity to influence their development.

We envision a not-for-profit organization, with two boards that nominate common elective offices: a Governing Board following common best practices of open source communities and an Advisory Board composed of industry and user communities. The latter will be organized into working groups whose role is to advise AALOA's open source community about emerging technical and market challenges.The following challenges have to be addressed: the integration of innovation in platforms, the integration of transversal features, interoperability of interfaces, technology independence and finally the support of multiple business models.

## The Open Source policy

The importance of open source software in the industry has risen to prominence in recent years, especially in the development of software infrastructures. Closed, proprietary approaches become less attractive as standardised infrastructure software becomes a commodity: high development costs due to the complexity of such software, uncertainty due to the "winner-takes-all" effect and diminishing marginal returns make the market for infrastructure software a risky business. The open source approach, on the other hand, promises easier software maintenance, allows cooperation between competitors and helps spread production costs over a multiplicity of stakeholders [10-11].

## Call for project proposals

The association will be organised as a federation of projects, one representative of each project being a member of the Governing Board.

Proposals for new projects can be submitted to the Governing Board, whose main role will be their evaluation with respect to the association's mission, while still encouraging the emergence of diversity, and avoiding monoculture. Projects will autonomously organize their governance rules. Over time common rules suggested by practice may be formally adopted.

As one of the association's objectives involves building open source communities working on service platforms for AAL, projects related to software development are to be expected. But we emphasise that other types of projects are also welcome. The next section describes an example of one such.

We are setting up resources for building and managing projects. You can access these resources by submitting a project proposal with a list of individuals or organizations that support your project idea. Visit the web page at http://www.aaloa.org/projects for details.

## The EvAAL International Competition

EvAAL has been the first project proposed to AALOA promoters and it is a paramount for the AALOA purposes. In fact, an important action for the assessment of the research results in this area is based on the analysis and comparison of the existing solutions provided by the research community [12]. To this end, we intend to promote an international competition called EvAAL ("Evaluating AAL Systems through Competitive Benchmarking"). The competition is intended to raise awareness of and interest in AAL, and to spread knowledge about the state-of-the art to a large audience. To do this, we will issue an annual "Call for Competition Ideas", in which we will invite practitioners and experts to propose the topics and rules for that year's competition. The idea received will be assessed and possibly merged, before the competition itself is announced. The competition itself will invite people to compete by developing hardware/software artefacts supporting the selected topic.

Generally, the competition will be organized around one or several of the functions enabling AAL spaces, such as: sensing, reasoning, acting, interacting and communicating.

In order to stimulate the participation of PhD students, a cash prize will be awarded to the competition winner(s) each year. We would like this to be something significant, such as an amount equivalent to a research grant for one year at an international university. All participants in the contest will have the opportunity of publishing a peer-reviewed paper describing their system. For details about the contest please visit the EvAAL web site at http://evaal.aaloa.org and for subscribers list at http://aaloa.org/team/becoming_a_supporter

## Acknowledgments

The idea of forming the association arose from discussions between some of the institutions involved in the projects PERSONA and universAAL, funded respectively in FP6 and FP7 (the Sixth and Seventh Framework Programme of the EU), but similar ideas were also discussed by partners of other projects who had recognised the need for a common effort in the field of AAL/AmI, as well. Today, the Manifesto is a dissemination effort of the EU projects BRAID, MonAmI, OASIS, OsAmI-commons, PERSONA, SOPRANO, universAAL and WASP. The subscribers listed below are

people who support the ideas promoted by the Manifesto and are willing to participate in the life of the association.

In addition to the subscribers, there are few promoting organisations (details to be found on the Web site) that have allocated resources for carrying out the tasks in the incubation phase of AALOA, until its bylaws are finalised and the association itself is established as a legal entity. Nevertheless, more effort and voluntary contribution is still needed. Hence, we encourage you, as the reader of this manifesto, to get involved in this open process!

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# Android/OpenMRS: Integrating EMRS and Decision Logic Functionality within Mobile Applications for Healthcare Workers

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## Introduction

An important potential of the relatively new field of "mHealth" (mobile applications within healthcare) is the encoding of health algorithms, such as IMCI [1], within applications running on mobile devices. The use of such applications can facilitate the provision of consistently good healthcare in low-resource settings, which is D-Tree's mission [2]. The decision logic encoded may be arbitrarily complex, yet the resulting application will inexorably provide the health worker with the correct advice, assuming correct inputs. Such applications can be regarded as virtual medical assistants assigned the heavy deductive lifting which might otherwise be infeasible for a health worker whose training may have been rudimentary. The potential, we believe, is great, and the task of realising this potential has only relatively recently gotten underway.

What is already clear is that there is an important distinction to be made, from a technical point of view, between algorithms which assume access to patient history and those which do not, which we may here call "memoryless" algorithms. The class of memoryless algorithms is large and important: it is well-established that even simple checklists can play an important role in improving healthcare. But, similarly, the class of algorithms which reason about the specific patient and her medical history is also large and important. Ideally, we need to be able to provide the health worker with applications embodying both kinds of algorithm, as appropriate. This paper describes how we have addressed the technical challenge of creating a mobile application infrastructure which can support algorithms which reason with longitudinal patient data.

### *Open MRS*

For algorithms which require access to patient records, the software encoding the decision logic will need to communicate with a patient database of some kind, an essential aspect of an electronic medical records

system (EMRS). Typically, executing an algorithm (= performing a consultation) provides new information about a patient, and so the communication between the decision logic and the patient database needs to be two-way - the application needs to be able both to read and write patient data.

OpenMRS [3] is an open source EMRS explicitly intended for use in the developing world. It has been in development since 2004, is in use in many countries, and has an active developer and user community. It is therefore a natural candidate to provide our target patient database. It may appear natural to assume that we need phone applications to "talk to" an OpenMRS server to establish the integration needed (maybe the phone application must retrieve patient data before each consultation). However, since smartphones now offer gigabytes of storage and SQL databases, an alternative is to design a way of storing the patient database on the phone, limiting the communication needed between phone and server.

A key realisation in the development of our infrastructure was that it may be possible to use the very same data model - that of OpenMRS - on the phone and on the server: there is no better alignment than having identical data structures and in doing so, we would thereby have exploited several person-years design work on the data model for an EMRS. Our exploitation of the efforts of the OpenMRS team could go further though. We have adopted Android as the smartphone operating system of choice for our clinic-based applications. Android applications are written in a dialect of Java, the same programming language used for the core of the OpenMRS system. We appreciated that if we were to exploit the OpenMRS data model on the device, perhaps we could also exploit some of the API code which accesses the data.

This provides a blueprint for a substantial exploitation of key aspects of the OpenMRS system on the mobile device and it is a blueprint which we have executed successfully. The main technical challenges we encountered in doing so were two-fold. Firstly, not all libraries used by OpenMRS could be used on Android; secondly, performance was an issue - a phone is not a server - which necessitated the use of caching to establish a system capable of supporting usable applications. With this blueprint implemented, one has a platform, running on Android, with which one can programmatically read and write data to an OpenMRS data model.

## Integrating Decision Logic and EMRS data

Clearly, this provides one important layer for mobile applications able to reason with patient data. But how does the decision support layer communicate with the data layer? Within Android, applications may

seamlessly invoke each other, pass parameters in doing so, and receive values back to the invoker when the invoke completes. D-Tree has been using an open source Android application, ODK Collect [4], to execute decision logic. We have made minor modifications to ODK Collect to enable it to be invoked by Android/OpenMRS, which passes it appropriate patient data. When ODK Collect completes, a reference is passed by to Android/OpenMRS to permit newly acquired patient data to be captured in the database. Other decision logic applications could play the same role.

PeerSync

A patient does not always have consultations with the same provider, and a patient may be attended to by several providers within a single visit, so there is no point in that patient's data being stored exclusively on a single device. Data must be shared, also for aggregation and backup purposes. To this end, we've defined a synchronization algorithm called PeerSync which is both part of the Android/OpenMRS system, and is available as an OpenMRS module. This permits a phone to synchronize its data with an OpenMRS server. A group of health workers synchronizing with the same server can share their patients data with each other. Each phone has the same data as the server. The synchronization algorithm also works between phones, via both http and bluetooth. One consequence of this is that nurses in a remote clinic may share data and continue working effectively even where there is no connectivity with a central server.

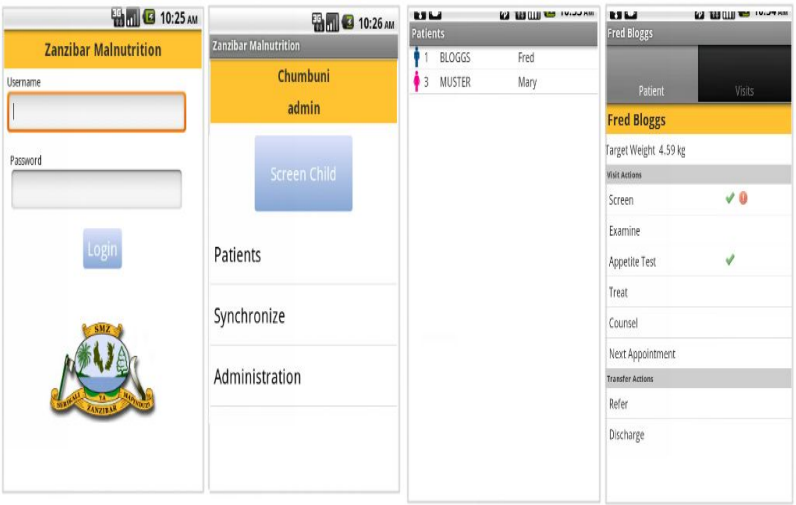

Figure 1

## Android/OpenMRS Applications

We have described a framework which can be used to create applications for health workers. The framework has the properties we need: patient data, decision logic, and the ability to seed the decision logic with patient data. Custom applications may now be designed and implemented quickly. Such custom applications typically add custom interfaces onto the data.

D-Tree currently has four custom applications running on the Android/OpenMRS framework. Figure 1 shows screenshots from one of them: an application to assist health workers in treating severe acute malnutrition among children on Zanzibar.

From left-to-right, the figure shows a login screen; a main screen which permits access to a health algorithm and a list of existing patients; a patient list, showing sex, age and name of patient; and finally a patient screen, showing tasks to be completed within a visit and a tab which shows health workers how the patient's weight has progressed over the visits to the clinic. The distinction between decision support system and EMRS is invisible within this application: they are seamlessly integrated.

Android/OpenMRS is open-source and can be obtained from https://bitbucket.org/androidopenmrs

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[4] http://code.google.com/p/opendatakit/

# Debian Med: Integrated Software Environment for All Medical Purposes Based on Debian GNU/Linux

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***Abstract:*** **Introduction into Debian Med and its use for medical practitioners and bio-medical researchers.**

## Introduction

The Debian Med project started in 2002 with the objective to bring free medical software into the focus of users. Those may be IT service providers for smaller clinics, the doctors themselves, researchers in pre-clinical environments or just skilled enthusiasts with an ambition to apply their talents to the biomedical domain. At that time, the communities in computational biology, medical imaging and medical informatics already had a number of high-quality Free Software solutions. Debian as a Linux distribution provided a solid foundation for bringing those products together. To assure complete coverage and harmonic integration, the Debian Med project was initiated to provide a software management infrastructure to improve communication among Debian package maintainers, *e.g.* to identify missing glue packages to translate data formats or to point out conflicts in the naming of binaries.

Over the past decade, the integrative Debian Med project has proven to have positive effects beyond the scope of Debian users. Many ties have been established between original software developers and Debian package maintainers. Large development teams started to upload their Debian packages directly. That communicated the experience of the developers back into the distribution and made medical software a constituent member of the Debian distribution.

The ideas behind the Debian Med generalized into the concept of Debian Pure Blends. Blends, such as Debian Edu, Debian Science, DebiChem (chemistry), Debian GIS, DeMuDi *etc.*, were created to provide a targeted appearance of the Debian distribution for different domains of applications. Today, Blend task pages complement canonical Debian package listings with additional information (*e.g.* scientific references) and also cover software products that are relevant for a given domain, but not yet integrated into Debian. A growing community with continuously improving

maintenance procedures eases direct contributions to Debian, thus preventing unnecessary fractioning of the open-source community, and allow for supporting customized versions of Debian, such as Debian Med, within the Debian ecosystem.

## Further reading

In preparation of the Med-e-Tel 2011 conference the Debian Med team prepared an extensive paper in PDF format that covers the content of the talk to be hold at the conference. In this paper we explain the advantages of including medical software in a large Linux distribution and what software just exists inside Debian. Besides a large coverage of main software in the field of bio-medical research[1] there are several programs supporting medical imaging[2] and specifically to handle DICOM images (i.e. Dicomscope [3]). The practice management system GNUmed [4], the pharmaceutical drugs prescriptor and interactions checker FreeDiams [5] belong to the set of medical practice software inside Debian [6]. The goal of Debian Med is to provide a complete work environment for all tasks in medical care and provide medical service providers with a hassle free installation procedure for any Free Software that can be used in medical care.

For the interested reader the paper which is made it available at:
http://people.debian.org/~tille/papers/201012_debian-med.pdf

Explains how Debian Med works, how the project is organized and how we try to serve medical practitioners and bio-medical researchers as best as possible by turning Debian GNU/Linux into the distribution of choice for any medical application. We are providing this collection of software in the hope that it will be useful for medical research as well as medical service provider who might base their business model on providing commercial support for Free Software in medical care.

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I was born in 1967 in Halle/Saale. I'm married and have one son. I was studying physics at the University of Halle / Wittenberg. Currently I'm working on the German Robert Koch-Institute as software engineer. In 1994 I started using Free Software, became a Debian developer in 1998 and started the Debian Med project in 2002.

# Improving Health Technology Management through an Internet Based Mobile Wireless Health Care Portal with a Web Questionnaire Processing System

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***Abstract:*** **This paper is meant to build a prototype of an internet based application capable of been developed in mobile health care services and will provide physicians infrastructure with which to view, record and update patient's medical record from a remote place in far away distance which ordinarily will neither be feasible nor possible it include facilities for integration for various health care organizations and systems needed to deliver health care services to anybody, anywhere and anytime. Also a web questionnaire processing system capable of being administered via the internet is within the coverage of this project. With this, it is possible to administer questionnaire on the internet and have it automatically processed on a click of button. Collectively the system when developed, will reduced expenses stress, time wastage and provide reliable, dependable, and maintainable and easily usable features for head care sector**

Wireless healthcare portal

According to Kenneth C.et al (2006) portal is defined as a web interface for presenting integrated personalized information from a variety of sources. Portals are significant since they are the prime real estate of the internet. In most cases, portal combined content and applications from many different sources and services providers. It can very in scope and in the service they offer, so naturally, terms have evolved to describe the different types of portals:

1. Access Portals is portal associated with Internet service Providers.
2. Horizontal or functional portal is portal that provides a range of services, search engines, directories, news recruitment, personal information management, shopping, etc.
3. Vertical portal covers a single function, e.g. news, industry sector etc

4. Geographical portal associations with a particular geographical location, like region, country, local; and it may be horizontal or vertical.
5. Marketplace portal is a portal that brings buyer and sellers together in a virtual marketplace, it maybe horizontal, vertical or geographical.
6. Media type portal is a portal that provides voice portal and streaming media.

The internet viewed on mobile devices for the wireless health care

The internet can be accessed virtual anywhere by numerous means. Mobile phones, data cards, handled game consoles and cellular routers allow users to connect to the internet from anywhere there is a cellular network supporting that device's technology within imposed by the small screen and other limited facilities a pocket-sized device, all the services of the internet, including email and web browsing, may be available in this way. Service and changes for data access may be significant, compare to home usage.

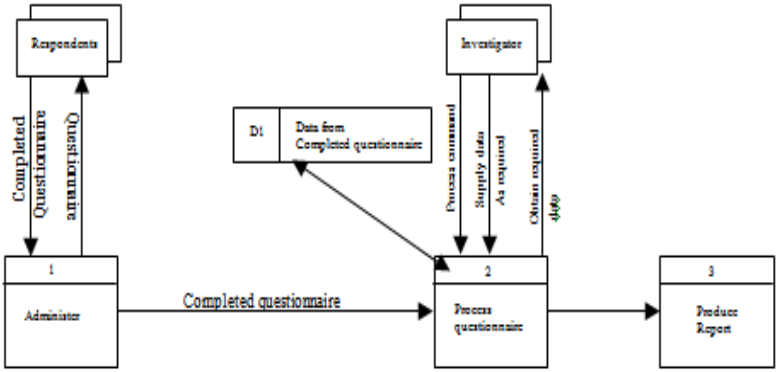
The following objectives formed the bases for this paper: To design and develop an internet-based Healthcare portal capable of being deployed in mobile healthcare delivery service. Secondly to build a mobile wireless health care portal that can easily be customized and extended to routine clinic services and to further the application of internet to a web questionnaire processing system by designing and developing a system protocol capable of processing submitted questionnaire data. It will allow the respondent to complete the questionnaire, submit same, and also provide facilities for subsequent processing of the submitted questionnaire accordingly.

The Significant of study:- is based on the fact the shifting winds of change in today's business environment have made information and communication technology vital component that keep an enterprises in context, in order to meet up the business goals. The role of internet and word web by extension cannot be over emphasized. Therefore this research paper ''an internet mobile wireless health care portal with a web questionnaire processing system would be useful to healthcare professionals, ICT expert, biomedical engineers, researchers, laboratory scientists, electronic health record officials and patients.

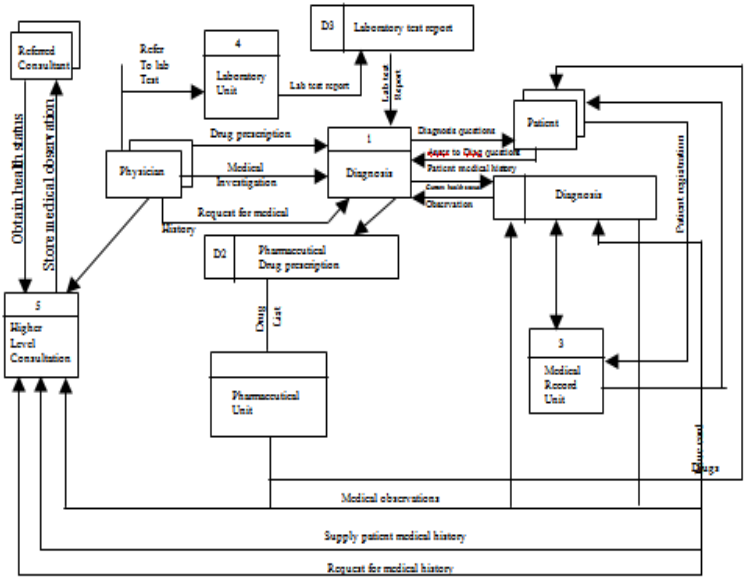
Mobility services portals

Mobility service portal provide the user with access to a range of innovation service. Whenever and wherever, the mobility portal will inform you, or just entertain you; Ralph, et al: 2001. This includes all applications

from gaming to mobile commerce. Service should be designed so that relevant elements of a service are available to a particular client device. For example, monitoring local traffic and weather, and providing personalized location-based marketing.




Wireless Health portal




Overall data flow diagram of the proposed solution

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# Open Health Assistant Platform and Innovative Business Models for Open Source

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***Abstract:*** **Open Health Assistant (OHA) platform was born as a monitoring tool for increasing the interaction between patients, care givers and practitioners, in order to reduce clinical hospitalizations and doctors visiting costs. During its evolution it has become a platform where other providers can deploy services and to achieve its major adoption, the whole platform is served using Web technologies; specially focus on mobile Web technologies. On the other hand, the platform has evolved to a care information manager where the user stores its wellbeing information (PHR, medical dates, etc.), and to a social interaction platform where users share information and care strategies. So, the platform keeps its initial spirit, but it is more aligned with end users needs. For third parties services integration, Andago keeps researching on interoperability technologies, and OHA offers some innovative business models to make it more attractive for services providers.**

## Introduction

The Andago project, Open Health Assistant (OHA) was born as an Open Source framework to integrate different services focused on healthcare management. The framework incorporates components and technological devices that facilitate patient attention and treatment. It also manages the relations between all the people involved in patient's health care. So, it can offer services for patients, practitioners, and carers.

All the services available are visualized on a web portal that based on context aware technologies, offers the right services and user experience depending on:

- Who is accessing to the framework (different services for different roles).
- How is the user accessing (mobile, TV or desktop visualization).

Thanks to the "web based" approach, the framework works on almost any internet connected device, from a mobile phone to a desktop computer.

Aligned with the World Wide Web Consortium (W3C) points[1], it offers Universal Access to Health and Well-being services.

Currently, services can be divided on different categories, but based on the kind of data they manage, we can divide as:

- Health status: services related with user medical profile, wellness objectives, Personal Health Records (PHR), vital signs monitoring, etc.
- Calendar and time management: services related with dates or alarms.
- Contacts and Social interaction services: as it has been said, the framework also manages the relations between the people that is using it.
- Location based services: some information could become relevant based on where the user is located.

*Health Status services*

Most of the information handled by OHA is health and well-being information. One example is the patient's Personal Health Record (PHR). It stores the status and evolution of the user well-being. The user handles the right to share that information with other users. For example, a practitioner or a relative could access to user profile to know how treatments are going on. On the other hand, monitoring services get data from biomedical devices or daily activities reports, to update patient's PHR.

One of the platform's features is the possibility for creating what we call "care templates". These templates represent user's wellness objectives, and they are defined by a group of monitoring actions to achieve a target value. The user customizes her/his templates, and she/he can share the template with other users. For example, a user can define a template for keeping his weight in a specific range. To achieve it, he decides to measure his weight each morning for checking it is on the right range, to walk for at least two hours and to eat at least five pieces of fruit. He has some friends using OHA platform, and they all would like losing some weight. So the user can share this template with them, because they have similar objectives. It is the same approach to users that share music playlists because they have similar music tastes. From the medical perspective, practitioners or care givers could create "care templates" for their patients and they can use OHA platform as monitoring support.

Any of the examples mentioned before usually need to be integrated with third parties technologies. First of all, PHR data can be stored in different repositories (different hospitals, public PHR repositories, etc.), so we need standard data models and interchange mechanisms to guarantee PHR

interoperability and integration with OHA. On the other hand, monitoring services update the PHR, and they could get data from different devices (tensiometer, pulsioximeter, thermometer, weight scale, etc.). So, instead of using different communication protocols and data model, any device should use a standard communication protocol. To achieve this integration, OHA implements Continua Health Alliance guidelines to establishing a system of interoperable personal health solutions [2].

*Calendar services*

One of the most important eHealth services are those related with dates, appointments and alarms. Users need to know when and how often they have to take their medicine; practitioners need to know the treatment a patient is following and its time frame, when they have an appointment or practice.

OHA offers services for managing all these situations. But it also needs to integrate with third party tools. Users could already have their calendars stored in external services, so OHA offers integration tools to add these calendars to its calendar services. This way, for example, users can manage their appointments using their own calendar services, or the ones that come with OHA, without conflicts with their personal agenda.

*Contacts and Social interaction services*

Last, but not least important, we have to manage how framework users are related. There is already a basic user profile stored in OHA based on his personal data, PHR, who is his doctor, or which their patients are, etc. But, there is also a lot of types of interdependencies based on the information stored in OHA, like people with the similar diagnosis, location proximity, etc. All this information enables new relations between the users. OHA implements messaging and communication services to connect nodes of the social network.

But, users could already be members of others online social networks and OHA offers services to integrate with external social networks, always taking into account privacy, trust and security.

*Location based services*

A location-based service (LBS) is information accessible with most internet connected devices through the network and utilizing the ability to make use of the geographical position of the device.

LBS services can be used in a variety of situations in every previous mentioned service, like locating the nearest chemists, where the hospital is and how to get there, etc. So LBS is not just knowing where the user is (latitude and longitude coordinates), but knowing what is there, and how to

get there. So, OHA incorporates location information in most of the data it handles (contacts, dates, etc.) and services that integrate with third party Geographical Information System (GIS) distributed outside the OHA framework itself.

### Services integration

OHA as a framework is divided in several components that need to communicate with each other (internal integration), and with external services (external integration). For example, a doctor prescribes some kind of treatment to one of his patients, so he has to look for a drugstore to buy the medicine and check the daily treatment. First, there are several internal services that need to be connected (users management, appointments, alarms, etc.), but there is also information could come from external services (vademecum, chemists locations, etc.).

For integrating all these services, OHA uses a service-oriented architecture (SOA)[3]. First of all, every internal provider service (users, appointments, etc.) provides a way for consumers of services (social network services, agenda, etc.) to be aware of them. This way, OHA framework internal services could be deployed in other platforms developed by Andago. The same principle works for external services that are mainly data providers.

Using SOA it is easy to integrate new services or providers in OHA. The easiest way for aggregating a new provider is a subscription like model. For example, a medical insurance company could subscribe its practitioners list in OHA, a pharmaceutical company could add its drugs catalogue, etc. Other integration systems are based on service data model sharing, for example for sharing patient's PHR with external repositories.

As services and the framework itself grow in complexity, new integration mechanisms are needed. To improve services interoperability in OHA, an Enterprise Service Bus (ESB) is being integrated. An ESB consists of a software architecture construct which provides fundamental services for complex architectures via an event-driven and standards-based messaging-engine (the bus).The ESB under development for OHA incorporates SOA principles and allow for independent message formats. So, external services not based on SOA could be integrated in OHA easily.

### Ongoing and future work

One of the key points in OHA development is interoperability, in several ways:

- With biomedical devices, implementing Continua Health Alliance guidelines.

- With PHR management services, implementing Continua guidelines too.
- With third party services.

For the third case, we have implemented several integration technologies, and latest one is ESB. But, we have started some research and development activities focused on semantic based integration and interoperability.

The information that OHA handles represents knowledge that can be described by an ontology that defines the terms of the knowledge base, and the relations between them. There are several vocabularies that could be applied to build the ontology. For example:

- SNOMED CT (Systematized Nomenclature of Medicine -- Clinical Terms), is a systematically organized computer processable collection of medical terminology covering most areas of clinical information such as diseases, findings, procedures, microorganisms, pharmaceuticals etc [4].
- SIOC (Semantically-Interlinked Online Communities), is an open-standard machine readable format for expressing the information contained both explicitly and implicitly in Internet discussion methods, like social networks [5].
- FOAF (Friend Of A Friend) is a machine-readable vocabulary describing persons, their activities and their relations to other people and objects [6].

Once the ontology is built, services description would be based on it, and the interoperability wouldn't be syntactic based but semantic. Semantic web services are built around universal standards for the interchange of semantic data, which makes it easy for programmers to combine data from different sources and services without losing meaning. This would change OHA architecture to a Semantic Service Oriented Architecture (SSOA), that leverages rich, machine-interpretable descriptions of data, services, and processes to enable software agents to autonomously interact to perform critical mission functions [7].

## Innovating on Business model

On top of this platform, Andago is building a new complete platform for mass market deployed into a cloud computing infrastructure in order to reduce costs, decrease entry barriers and increase agility on new deployments. This platform will have a marketplace where third parties could deploy new services for the platform users. The marketplace will go from "care templates" to completely new services as a whole, with the price decided by the service provider. If the service is free, Andago will provide on the market it for free. If the provider decides to put a price for it, Andago

will charge a percentage of that price to the provider for each service provided. The business model is similar to those applications markets available in different mobile platforms, but it will not be tied to any hardware platform because it will be available in the Web.

On the other hand, the complete platform can be customized for an specific customer following the classical consultancy project service. So OHA can handle both business models, and we increase platform functionalities thanks to the R&D projects and pilots we are working on and aligned with the different funding programmes available worldwide.

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# Open Source Software and Linked Open Data Synergy Illustrated by Two Medical Applications

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***Abstract:*** **The Open Source movement developed a powerful platform of collaboration, integration of ideas and technologies between communities. The same approach has been deployed by the Data creating and publishing communities in the form of the Open Data. Healthcare institutes, governments, media companies and other organisations that hold collections of data are increasingly willing to make this information freely available to anyone who wishes to use it to create applications and services and contribute back to the community. By adding structure to the data sets, making them easily accessible using URIs and building associations between them, a web of open data is created, known as Linked Open Data (LOD). The content of LOD in the Bio-Medical domain is growing rapidly in strength and popularity both in research and industrial projects. In this article we examine the benefits gained from using LOD in medical initiatives: the Semantic Indexing for Medical Guidelines (SIMG) project and the PONTE EC FP7 project.**

## Introduction

The unprecedented growth in the understanding of diseases and their treatment is producing vast amounts of information that have large diversity in structure and are highly distributed. Such data sources include health records (EHR/PHR), medical treatment guidelines, medicine information and side effect records, clinical research papers and data stores. Accessing, managing and gathering the required information and processing it by health professionals or scientists is becoming increasingly complex but also vital for success in disease management, as well as progress in clinical

research activities. One solution to this knowledge management crisis is to improve the availability as well as the structure and interoperability of data sources. This paper will provide ideas and examples of applying open source technologies in synergy with the linked data approach to structuring and enabling access to information sources for clinical care and research.

How Open Source and Linked Open Data technologies come into play?

*Free/Libre Open Source Software (FLOSS)* community of the semantic web technologies and tools is already very large and develops and supports a rich variety of semantic web applications in various domains including the medical one. Many of these tools are by now well established and adopted in the semantic web domain. The benefits of using these tools, apart from availability, variety and great value of the solutions they offer, include also a good level of academic, commercial and scientific support from the community. Additionally most of these tools come with dual or suitable license for open source as well as more restrictive use.

Similarly to open source, Linked Open Data [1] communities are emerging in various domains including clinical care (PHR, openEHR), clinical research (PubMed, clinicalTrials.gov, GeneOntology), disease (Diseasome) and drug data stores (DrugBank,) and other medical knowledge bases [2]. The term Linked Data refers to a style of publishing and interlinking structured data on the Web. The basic assumption behind Linked Data [1] is that the value and usefulness of data increases the more it is interlinked with other data. Data interlinking and structuring is achieved by using RDF to structure the data, HTTP URIs to publish them and semantic references such as owl:sameAs[4] to semantically associate and link the data sources.

The information retrieving power of linked data lies in interlinking data sources that search engines can crawl them by following the links between them and provide expanded query capabilities over aggregated data.

Benefits to clinical care and clinical research activities: two success cases

*Semantic Indexing for Medical Guidelines (SIMG)*

The SIMG semantic search engine takes advantage of links between concepts found in a corpus of Parkinson Guidelines – using a technique called “query expansion” - to improve the experience of searching in Guidelines

The development of the SIMG system was based on open sources software. The Jena Framework [5] provided a mature OWL API and a SPARQL query engine, the Protégé[6] ontology editor and knowledge

acquisition system provided a tool to engineer the SIMG ontologies and the JSP framework provided the means to create the web content.

The SIMG search engine is based on two ontologies: the first one is built by identifying relevant terms in the considered guidelines. The second one is structured using subcomponents (Metathesaurus and Semantic Network) of the Unified Medical Language System (UMLS)[7]. UMLS has built-in support for querying its rich medical data collections: it uses its own Web Service based API. SIMG, even though it uses open standards and tools to perform query expansion, is currently bound to a series of queries and more importantly to a specific resource. With an LOD approach for the two subcomponents used in the search engine, providing links with external LOD sources, the search engine would be able to perform query expansion using semantic data-sources not currently included in UMLS.

*The PONTE EC FP7 project*

The PONTE project is aiming to improve the quality and efficiency of patient identification and clinical trials design for drug repositioning. PONTE is developing an infrastructure [8], where heterogeneous clinical trial systems are semantically linked with each other, with other clinical research information systems, with the electronic health records (EHR) in clinical care information systems and with drug and disease knowledge databases (Fig. 1). The semantic interoperability is enabled through the definition of a core data set covering the informational needs of each of these systems and the semantic representation of this information by forming pluggable ontology fragments that are linked with each other using Linked Data principles. As not all of these systems are open, PONTE system will provide information according to the access rights of each user, while publishing the open data sources to the research and development communities PONTE semantic interoperability platform, which is also based on open source

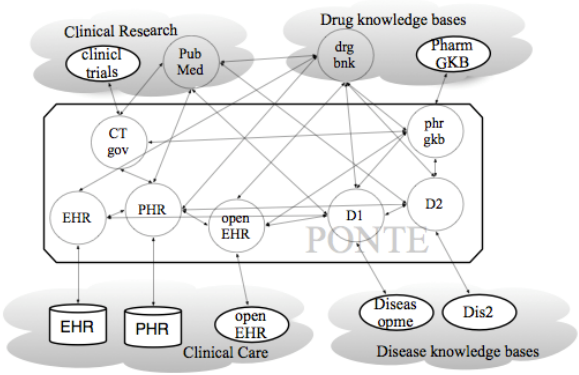

Figure 1. Linked Data in the Heterogeneous PONTE Environment

software of the semantic web, is abstract enough and designed so that it can be scalable. The platform can easily evolve and expand by including additional fragments to the PONTE ontology and linking more data sources with the linked data infrastructure. By using LOD, PONTE platform can perform more powerful search queries that retrieve precise information such as side effects of a drug in a dedicated drug data source (DrugBank) through querying, for example, a disease-oriented source (Diseasome).

## Conclusion

A large proportion of interoperability development between healthcare systems is based in open source semantic web technologies and tools. The semantic interoperability achieved with LOD based platforms, as shown in our example cases, PONTE and SIMG projects can provide very powerful information processing and querying tools to healthcare professionals and researchers. These LOD enabled tools can significantly help their work by providing a common way of publishing, structuring and interlinking heterogeneous medical information sources. Additionally LOD systems provide a publically available platform of information sharing that can be used for collaboration and support between a vast community of healthcare scientists and technology developers.

## Acknowledgements

The research leading to the results presented in this paper is carried out in the context of European Union's seventh framework programme PONTE project under grant agreement number FP7-247945. This work has also received partial funding from an e-Health project of the Walloon Region of Belgium, supported by the FEDER – European Union and the Walloon Region under the terms defined in the Convention n°ECV12020022296F.

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# Open Standards ICT as Interoperability Elements in Health Care Area

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## Introduction

While developing public services, the EU Member States have to be aware of the risk of creating new barriers if they select solutions which are not interoperable. As it has been stated in the Commission's work programme for 2010, the single European market is based on the cross-border public services which support the implementation of the EU policy and help to eliminate bottlenecks and to complete the missing links in the internal market. These kinds of European public services [10] are more and more often provided by electronic means. Ever more residents and enterprises make use of the single European market's freedom, extending their work or leisure activities beyond the borders of their respective countries. Without ICT-supported European public services and collaboration among public administrations, citizens are obliged to contact, or even to travel to, public administrations abroad to deliver or collect information or documents they need to work, study or travel within the EU. It also applies to the healthcare entities which intend to undertake business activity in more than one Member State. Various interpretations of information exchanged between persons, applications and administrations may jeopardise semantic interoperability. While exchanging information or when healthcare entities or residents want to make their medical information available to another healthcare facility or a GP in another Member State, legal, organizational, semantic, and technical interoperability become crucial [7,8].This area requires the development of works related to randomisation, anonymisation, and pseudonymisation techniques. Besides the needs to develop effective treatment methods, it is important to make use of such data in particular states and in the whole EU for statistical and epidemic purposes [11]. In Poland, there are a few institutions which deal with the analysis of epidemic data for statistical purposes such as

Healthcare Information Systems Centre subordinate to the Minister of Health.

Cross-border cooperation may be on various levels, may take different forms, and relate to various aspects of social and economic life. Joint actions may also be carried out under agreements between neighbouring states. This is how the cooperation between the Lower Silesia and Saxony has been developing. Currently, it is reaching the phase of developing common standards e.g. care over the elderly. Thus far the most institutionalised form of cooperation has been Euroregions operating under agreements between regional and local authorities, in some cases also with the participation of social and commercial entities. The aim of the cooperation is to undertake and coordinate mutually beneficial actions in the fields of economy, science, culture, education and to develop and streamline interactions between the residents and business entities. Currently in the EU global tendencies according to interoperability there exist technologies specific to the networked, distributed dimension of software and access to services and data. It will support long-term research on new principles, methods, tools and techniques enabling software developers in the EU to create easily interoperable services based on open standards, with sufficient flexibility and at a reasonable cost.

*Open standard of information Exchange*

There can be distinguished two types of standards: open standards and closed standards. Closed standards are the standards which are developed by a definite provider, cannot be used without their author's consent and are subjected to some patent policy or protected by law. As far as open standards are concerned, they are defined in a different manner [1, 2, 4] and among their characteristics, there can be enumerated the following: open standards created and developed through an open procedure available for all subjects; their specifications are publicly available; and their usage is completely legal and is not subjected to any technical or legal limitations. Additionally, the principal of technological neutrality is continually becoming more and more popular.

Another very important advantage is the extensibility feature of language and this extensibility can be viewed in two categories. Firstly, it is a resistance to changes in the structure of the XML message by the applications processing them. On the other hand because of the fact that XML is a meta language there is not a limited set of tags describing the data target. Data mining of medical events from the domain systems is the most important and most complicated and lengthy process occurring in the construction of analytical systems. Resistance to changes produced in the

structure of the XML file, it is a feature that has a significant importance in the case of analytical systems and especially in the design and development stages of exploration, transformation and loading of data. The amount and profile of data gathered in the FP7-ICT project require specialized work on standardization and interoperability to make the co-operating IT systems compatible, especially for subsystems responsible for further data processing. The addition of further requirements for distributed data exchange and integration using both mobile devices and collect diagnostic data from the eHR allow fast and universal access to data. These will build on the security guidelines for data storage and interchange in medical systems being developed by the existing project. To provide such a service, additional middleware tools should be used in the intelligent system for learning and reasoning in healthcare. It will be designed and implemented within the framework being developed FP7-ICT project [3,5].The problem is connected with separating personal data from clinical data to make medical data available to all clinicians in the EU with the use of common platform [7]. Ever more health parameters, conducted tests and the future individual therapy will depend on collecting much clinical information including detailed genetic testing. Such a collection of detailed tests concerning patients poses a threat never encountered before consisting in temptation to use it in multiple ways. To make the information serve mainly, if not exclusively, to develop science, efficient treatment, and prophylaxis, it has to be made available to a wide group of scientists and clinicians. The access to vast data bases collected on the basis of eHR individual accounts of all EU patients creates a possibility to apply mechanisms offered by the IT (processing of much aggregated data) and adjusting a therapy taking into consideration particular characteristics of a patient. In a few years it will be possible to think about manufacturing drugs adapted to the patient's type [8]. So as to make use of the vast information resources which thus far have been stored in paper form in teaching hospitals and thousands of scattered data bases of HIS systems, the following problems have to be resolved:

*Anonymised medical information*

Anonymising of medical information has a few aspects: legal, social, and technical. The social aspect pertains to the trust that the medical information being collected will not get into the wrong hands. The access to such information is tempting also for institutions operating on the healthcare market of commercial services including insurance institutions. The main idea is to develop techniques and methodology to assure privacy protection in publicly available statistical databases. A desired solution ought to reduce

the risk of the private data leak from statistical databases. It should also help database owners to make appropriate decisions, such as: Which form should available data take (fixed statistical data sheet, dynamically generated statistics, etc.)? What should be the scope of available statistics? What additional parameters should be taken into account? Data does not include any identifiers – for example name, address, full postcode, full date of birth or ID number. Although data are provided at an individual level, there is no way of establishing a link with the original clinical, identifiable record – in other words it is not possible to identify an individual.

*Anonymised-linked information*

This type of information cannot identify an individual directly, but a 'key' is available that enables the identity of the patient to be relinked to the data (by the person who holds the key). For example, personally identifiable data may be removed from a record but an arbitrary code maintains, from which it is possible to re-link the record with identifying data held in a different source. The coded identifier should be globally unique, and the key held under strict conditions. In cases where data relate to individuals with rare illnesses or exposures, or small or unusual populations, the likelihood of potential identification is increased. The OPEN eHR system infrastructure being developed in UE projects will aim to use the best available practice in providing linkage of data for researchers.

*Identifiable information*

This type of information contains personal data that directly identify individuals. The information from identifiable patient records will be used in FP7-ICT in two ways:

- By the patient's GP, during a consultation for providing decision support.
- After consent has been obtained for the use of personal data in research.

Where identifiable data is obtained with consent, the use of that data, storage, access and length of storage will form part of the information given to subjects prior to consent. Patient records may also be used as a starting point to identify potential participants for research. Potential recruits are then contacted to seek consent to participate in clinical trials or other research to evaluate new drugs, treatments and interventions. General practice records are particularly useful to identify representative groups of patients with a particular disease or condition, or representative samples of the general population. The use of TRANSFoRm to identify eligible subjects and then allow the clinical care teams to identify and contact the

patient, without breaching confidentiality, will be a major impact of FP7-ICT.

*How does Poland contribute to the interoperability area?*

The Centre for Health Information Systems (CSIOZ) is the Ministry of Health agency, responsible for development and running the health information system at the national level. Its tasks are: conceptualize, design and draft regulations for new IT systems in health, health statistics, standardization in the health IT systems, covering coding systems, data architecture and communication standards. The goals of these projects are focused on electronic patients records (eHR) and national medical registers. The Centre has competences in areas covering IT design, standardization and data protection, which are principal subjects of the „Electronic Platform for Collection, Analysis and Sharing of Digital Medical Records (eHR, ePrescription, web portal, Patient's Internet Account)" (budget 180M EUR, duration: 2009-14) will provide the access to appropriate data (eHR, data warehouses for DRG, diagnoses, and different repositories) and interoperability analyses. At present there is insufficient compliance at the level of individual data elements between HL7 RIM v. 3.0 (ISO/HL7 21731) together with the HL7 CDA and the standard CEN 13606/openEHR. The common rules and mechanisms for interoperability of eHR systems can be used as a candidate in the development of a common minimum set of medical data, which are to be respected by all the countries of the European Union in order to ensure the interoperability of their systems for e-Health. Development and implementation of such a minimum set of data is one of the tasks defined in valid for all Member States of the European Digital Agenda 2020. Thus, the project results will be highly useful with respect to this. It means great value in further research and practical applications, necessary for the development of the motion by the European Union, to enhance the competitiveness of the economies and improve the quality of the health systems of its member countries to improve the quality of life in the European Union, and to build pan-European, fully interoperable systems of type e-Health and m-Health. In medical data security area there will by proposed solutions based on a detailed expert analysis, the results of which will include pseudonymisation, anonymization and randomization mechanisms as well as standards in the newly-created field of mHealth. Working together on the Pan-European level makes proposed solutions possible to be adopted by the whole EU.

## Summary

In this work there are presented views of the authors who propose certain conceptions and ideas about ICT in medical area based on the authors'

opinions, observations and the need of introducing changes in the healthcare. Therefore, the paper indicates that practical and useful dimension of ICT, which permanently enter to the stage of implementation in very large projects which have had the most outstanding budgets, execution time, number of stakeholders and the estimated number of transactions in the history of Poland. The solution based on Enterprise Service Bus shall be the direction of integration. SOAP protocol shall be used to send communications created in XML. Formats being defined shall be described in XML Schema, services in WSDL, and business processes in e.g. BPEL. Newly designed systems and systems being integrated now shall be based on open standards in compliance with the definition included in the National Interoperability *Framework*. Pursuant to that definition it is accepted and managed by a non-profit organization and its development is carried out in the open decision making process. Moreover, its specification is available to everyone free of charge, there are no limitations in its application and all related copyrights or patents are irrevocably made available free of charge. A separate problem within the cohesion and interoperability of the projects such as The Electronic Platform of Storing, Analysis and Making Available of the Digital Resources of Medical Occurrences will accept of open formats within introduced ICT technologies and services.

It should be expected that by making anonymisation trustworthy, the confidence in making medical information available will increase and the issued concerning technical and legal aspects of Interoperability will be facilitated.

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# Teletrauma Procedures and Information Flow in a Regional Telemedical Network

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***Abstract:*** **Since 2009 we have been cooperating to develop the Wielkopolska Center of Telemedicine (WCT). WCT is an initiative aimed to develop an advanced ICT environment for the provision of telemedical services within the regional healthcare system in Wielkopolska. The pilot medical discipline for which this infrastructure is being developed is trauma. In this paper we present the results of our work concerned with the design of teletrauma procedures and information flow for the Wielkopolska regional telemedical network.**

## Introduction

Taking into account the importance of large scale telemedical platform deployment we began the construction of a regional telemedical network in the Wielkopolska province, Poland. The network is developed as the Wielkopolska Center of Telemedicine (WCT) within a project that will enable electronic communication in trauma between 26 hospitals in the province and Division of Trauma, Burns and Plastic Surgery of Poznan University of Medical Sciences (PUMS) and several other specialized clinical units with which this division cooperates in the treatment of patients with multiple injuries.

In this paper we present the objectives of the WCT project concerned with improving the quality of treatment in trauma through the use of telemedical solutions and discuss the information flow we designed for the planned teletrauma network. We present the teleconsultation procedures assumed for the Wielkopolska teletrauma network. Further on, we discuss how the information shared by the medical personnel during

teleconsultations can be post-processed and delivered to the hospitals participating in the network in the form of knowledge.

## Objectives

The major objective of WCT is to improve and standardize the communication between the hospitals in the region and the reference centers located in the Poznan, the biggest city and regional administration center. Standardization of communication between regional healthcare system actors based in an advanced telemedical system will allow increasing the safety of patients and better utilizing the scarce expert resources of the reference centers. In terms of the pilot discipline of trauma this telemedical system will replace the currently existing poor communication based on phone calls which results in negative effect on the diagnostic and therapeutic processes of patients with multiple injuries [1].

To improve the current situation we proposed to build an advanced teleinfrastructure that would link hospitals in Wielkopolska with the PUMS clinical departments. The main element of this teleinfrastructure is the platform for medical teleconsultations, which is assumed to allow the hospitals in the regions to consult the most difficult cases with reference units maintained by PUMS electronically. Such a medical teleconsultation will allow the hospitals to exchange patient data saved in digital form and express expert opinions concerning diagnosis and therapy. However, we believe that medical data carry a big value also outside of the diagnostic and therapeutic processes. To help post-processing of these data we designed a Medical Digital Library (MDL) as the complementary element of the Wielkopolska Center of Telemedicine teleinfrastructure to increase the impact a medical center like ours can have on the end addressees of medical services [2]. This kind of MDL allows storing anonymous medical information, process and analyzing it, and delivering it back to the hospitals in the form of knowledge within educational scenarios. This way, WCT can influence also the level of medical personnel competence in the region.

## Information sharing in the Wielkopolska teletrauma network

### *Teletrauma procedures*

The teletrauma network that we build will introduce a standardized way of communication through a medical teleconsultation platform founded around the business process management paradigm. This kind of a telemedical platform facilitates the introduction of standardized telemedical procedures for use by all network participants. They allow the first contact terrain hospitals to share the information concerning polytraumatic patients

with the reference center in order to receive an expert opinion on difficult cases. When necessary, the trauma expert responsible for the therapeutic decision within this teleconsultation can also further share the patient information with other specialists.

The teletrauma procedures mentioned above are the result of the regional healthcare system organization analysis in the area of trauma and competences of the PUMS clinical departments dealing with injury treatment. The basic teletrauma consultation allows the first-contact hospitals request a consultation from the reference center in order to receive an expert opinion on difficult cases. When necessary, the trauma expert responsible for the therapeutic decision within this teleconsultation can also further share the patient information with other specialists, such as for example a neurosurgeon. These additional opinions are provided based on a procedure similar to the basic teletrauma consultation, with the exception that the additional specialist cannot further ask for opinions of other specialists. The trauma expert initially selected to provide the consultation is the person responsible for the compilation of the final opinion provided to the hospital requesting support.

*Registry of Medical Cases*

The teleconsultation platform using the teletrauma procedures described above creates trauma health records. These health records may be analyzed and processed to extract knowledge. To this end we designed a Medical Digital Library (MDL) which allows copying and/or saving anonymized medical information resulting from the real medical cases. The medical cases information is saved in the base module of MDL, that is in the registry of medical cases [3]. Medical cases stored in the registry contain not only all information contained in the health record. These cases contain also information on their classification according to the designed classification standard based in well-known international scales.

Enabling MDL with a registry of medical cases in the teletrauma network enables us to create a regional, and in the future national, registry of trauma cases. Creating a system of trauma cases registration in Poland will open possibilities of injury epidemiology monitoring and acknowledging the community on treatment methods. The registry integrated with the teleconsultation platform allows extending the opportunities of sharing medical information within the regional telemedical network. Thanks to this we are able: (1) to educate on the basis of the existing cases, (2) to increase the quality of medical services through acquiring information about and discussing treatment methods used in various medical units across the region - as an introduction to building therapeutic standards, and (3) to

implement methods of artificial intelligence as decision support systems based on similar cases.

## Summary

In this paper we presented the teletrauma procedures and medical information flow we designed for the teletrauma network built in the region of Wielkopolska. The teletrauma procedures allow us to carefully define and construct a regional platform for the medical teleconsultations in trauma. However, the quality of this service may be increased even further with the post-consultation information transfer to a Medical Digital Library built as a second major element of the Wielkopolska Center of Telemedicine. This way it is possible to increase the end benefits for the patients based on improving trauma medical services not only through facilitating communication with the reference center, but also through sharing the medical information within educational scenarios.

## Acknowledgment

The work presented in this paper is supported by a grant from Iceland, Liechtenstein and Norway through the EEA Financial Mechanism.

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# universAAL – An Open Platform and Reference Specification for Ambient Assisted Living

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***Abstract*: A challenge of the future is "ageing well at home" assisted by technology, while maintaining a high degree of independence, autonomy and dignity. In the future there will be a high demand on AAL applications which should fulfill different needs of user groups and daily living scenarios. To speed up the development process and to make the applications more adaptive and flexible to special user needs a common middleware with standardised interfaces would be desirable. Because of this the platform and the stakeholders should be built around an open-source middleware, which operates as an interconnection layer to the operating system and as basis for applications and services. The open source approach can be essential to initiate a community of different stakeholders and to reuse software components with a common understanding on the implemented standards. The paper introduces the universAAL FP7 project which is the biggest running AAL platform project with exactly the objectives mentioned. The paper will introduce the approach of using OSGi and semantic services to build an open, adaptable and distributed AAL service environment.**

## The universAAL project

The universAAL project has defined a process consisting of four iterations for producing an open platform along with a standardized approach for making it technically feasible and economically viable to develop AAL solutions. So far the development of software frameworks and platforms for smart AAL solutions has been funded several times in EU

project as well as national projects [1]. Unfortunately most of the projects have been ended as proprietary solutions and/or died after the project end. For a success of a wide spread and common AAL platform it will be necessary to promote in a early project stage the outcome and results and support their evolution and maturation. A community of all stakeholders interested in AAL application must be created and brought together. The key to success might be the release of the solution as open source including an environment where the developers and deployers stakeholders can work together. This could also create the market to new business models in the field of AAL. To provide the middleware and also software application modules as open source to the community, is a big advantage for projects and a subsequent use of the project results as well, as it may ensure the usage of the platform and the consistency of the developments beyond the project runtime and can help to establish the community around. Of course such a platform must have a very simple architecture to be easily integrable in AAL ecosystem and adaptable for any application (also beyond AAL) and must support and integrate as many standards as possible.

The universAAL project will not only bring up a combined reference platform based on the findings of FP6 and FP7 AAL platform but also provide with an uStore (online store) and Developer Depot (a developer site) an environment for all the universAAL stakeholders – AAL application developers, AAL Service Providers and End Users – Assisted Persons and their caregivers.

## Seamless Integration and Interoperability

For the platform it is important that devices can be integrated and also removed in an easy way, similar to plug-and-play. Mobile devices in such an environment can be smart phones, body sensors, portable audio players etc. All this devices and application can be a part of the ambient environment and must be able to switch on and off respectively can fail to restart without having a disturbance of the overall functionality of the system. The technology and the architecture used will guarantee a continuous operation. This characteristic of the platform will be solved thru OSGi container. The whole platform is in that way software service oriented with a distributed functionality and intelligence with a continuous operation. These technologies will also lead to an improved dependency and versioning management, modularity and security. In OSGi and in the universAAL platform bundles will be the units of modularization, deployment and execution. The bundles are providing the services one to another. There is a decoupling of service providers which will provide their services in the uStore ready to be downloaded and to be deployed inside the

framework and the service requester searching for new service interfaces to provide new functionalities. Different service provider can register their service interface and can be bind to the service requestor. This leads to an automatic handling of service dependencies. The service requestor can switch to another service provider providing the appropriate interface and functionality on the fly. The service mechanism has the advantage that the components can be used to create composite applications and therefore new functionality out of existing functionality.

A problem with the service requestor and service provider binding is that both have to agree on the same service interface. That means the service provider has to provide the exact same service interface that the service requestor is looking for. In an adaptable and extendable service platform this can be a problem. The solution is semantic services. With semantic services an ontology based mapping between artifacts of service requesters and service providers is possible. The mapping can be performed based on input and output parameters, service requests and service profiles, pre/post conditions as well as mapping between choreographies or automatic composition. For AAL or other applications the benefit for developers is that no a-priori agreements between the developers of service requesters and service providers is required. This will also guarantee a better interoperability. Although semantic services are the key to a decentralized evolution of technology and applications a strict matching for some services especially for basic services components can be useful. The universAAL platform is therefore offering semantic "fuzzy" matching, strict matching as well as direct service calls to prevent match making at all.

The universAAL platform is the solution for a distributed application development. Also as OSGi is originally developed to run on one JVM, universAAL will bridge the communication between applications on different nodes. The universAAL middleware is hiding the distribution and all applications on different nodes run as if all of them are in one device. The universAAL middleware is on top of the OSGi layer and the protocols used are UPnP, Bluetooth and r-OSGi. Due to processor power and device architecture OSGi cannot be installed on every device as well as JVM does not exist on every device. The solution are adapters. The middleware on OSGi devices has different adapters integrated which allow the connection of ZigBee or KNX non-OSGi devices, which are mostly single sensors. There are different possibilities for universAAL running on device nodes. For example on Android systems an OSGi can be ported to the Android layer and on top of the OSGi the universAAL middleware can be installed. As option two the universAAL middleware is directly ported to the Android

application environment. Similar scenarios are thinkable for other operation systems/application environments.

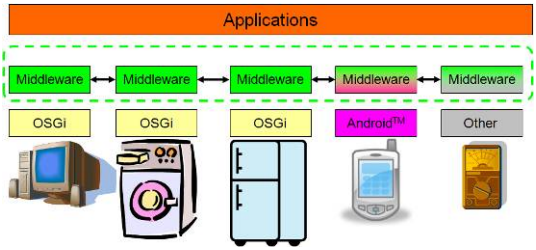


Figure 1: The universAAL distributed middleware

## Conclusion

The excerpt of the described platform and the technology used has shown that the usage of open standards and frameworks can facilitate simpler and more open software architecture for applications in the field of AAL. Several novel technologies are available in the field of software development and are already widely-used in the AAL domain (e.g. OSGi, Maven, SpringDM, semantic services). Ongoing developments especially in the open source community allow early integration of these technologies to facilitate important requirements like security, modularity and expandability. Furthermore one should emphasize the possibility for an adoption of the platform to use open-source architecture. This aspect will be especially supported by the modular architecture of the platform and the usage of technologies for software development as described above. Moreover the standardized integration of sensors and devices is another reason not to be neglected.

## Acknowledgment

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 247950.

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# Cost Effectiveness of Telehealth Solutions

# A Business Case For European Early Genetic Testing Using an Adaptive Knowledge Platform in Translation Medicine

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This paper discusses the application of an adaptive technology platform for early genetic testing in Europe. It results from a collaboration between Professor Christine, who created a technology startup called endepusresearching (www.endepusresearchinc-com) in Cambridge USA and Dr Michael Liebman, CEO of Strategic medicine, positioned in the translational medicine space with a technology in early genetic testing for breast cancer. Diagnostic was identified as a potential area for application of economic and business models using ENDEPUS researching statistical methods combining implicit and explicit financial information for prospective payment systems in various types of health care financing systems. Some modules of these statistical methods were the result of research projects both in Europe and the US, especially from ENDEP/biomed projects funded by DG research (EU) and AHRQ funded projects (US). Method: a series of qualitative interviews were performed across the healthcare eco-system concerning early genetic testing in some European health systems and added to findings from previous evaluation projects on biopharmaceutical policies from the endeplux think tank (www.endeplux.org) . The sustainability of a translational space involving US and European technologies is reviewed under the cooperation framework signed between NIH and EU DG research. A business case is developed on Luxembourg actors: private and public laboratories, clinicians, hospitals, payers, quadripartite decision makers and patients. Results: the current political decision making process on health care reform in Luxembourg provides a country business case for the feasibility of an adaptive platform such as the one proposed by the consortium with Strategic Medicine in the field of early genetic testing. The new economics resulting from such platforms challenges the constrained environment for Public , private laboratories and partnerships, the restrictions imposed by governmental agencies, alliances between stakeholders such as the medical

profession and laboratories: such early technologies are clearly identified as a key benefit to the system over time but a major challenge for short term returns. A significant gap currently exists in applying the technologies so that a concrete and beneficial action plan can be developed. Moreover, the lack of education of many GPs may require that lab directors provide more often interpretations of diagnostic test results to the medical profession, thus potentially biasing decisions and actions based on the tests. Their experience also diffuses now over the borders, especially in similar linguistic geographical areas. Conclusion: the business case provides a useful discussion of the barriers for identification and prioritization of new diagnostic and therapeutic development on the scientific side as well as the induced change in the political priority setting of health care financing.

# A Framework for the Assessment of Teleradiology in South Africa: An Eastern Cape Case Study

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***Abstract:*** **This paper focuses on the Teleradiology System in the Eastern Cape, South Africa. The purpose is to provide an assessment of the implementation of the system and a framework towards the enhanced utilization of the system. A comprehensive literature study is conducted to find a broad perspective on the factors involved when teleradiology is implemented. Four barriers to the sustained implementation of teleradiology are identified, namely technological, organizational, behavioural and economical barriers. These barriers are discussed with regard to the literature and then the broad perspective is narrowed by applying the literature to various aspects of the Eastern Cape system.**

## Introduction

South Africa is ranked as one of the top countries when viewing the percentage of GDP (Gross Domestic Product) that is allocated to Health Care. Yet, health care in the country remains a great challenge, and the burden of disease is increasing, together with population growth. Health care faces challenges which include poor management, over-utilization of hospitals and importantly significant shortage of health-care professionals.

The problem is that the past decade has seen numerous telemedicine initiatives being introduced in the country, with little sustainability and low utilization rates. The initiatives being introduced need to be monitored and evaluated to ensure the sustained implementation and complete adoption of the telemedicine systems in the country. The purpose of this paper is to provide an assessment of the implementation of the system and a framework towards the enhanced utilization of the Eastern Cape teleradiology system.

The Eastern Cape accounts for approximately 14.4% of the South African population and is the fourth richest province when measuring the total current income, but in per capita income terms, the province is ranked eighth [1]. The infrastructure also markedly weakens as the distance from the economic centers increases. It is these characteristics - the per capita

income and the unique geographical distribution - that support the idea that telemedicine could be an important component to ensure healthcare distribution in the province where the transport infrastructure is not supportive.

## Methodology

Four barriers to the sustained implementation of teleradiology are identified, namely technological, organizational, behavioral and economical barriers [2]. Fig.1 is a cause-and-effect-diagram that gives an overview on the issues investigated. This application follows a visit as part of a project team from the Medical Research Council of South Africa and the University of Stellenbosch in June 2010 to monitor and evaluate telemedicine in the Eastern Cape. Research was done using surveys, interviews and observations and valuable exposure to the system was obtained.

## Results and discussion

*Technological Barrier*

The Eastern Cape project is considered one of the largest PACS (Picture Archiving and Communication System) projects worldwide with the aim to connect 27 governmental hospitals. A project of this size requires a connection network that enables the teleradiology processes and workflow adequately. With the system being operated in public health care, a governmental environment, certain bureaucratic rules and procedures exist which must be adhered to.

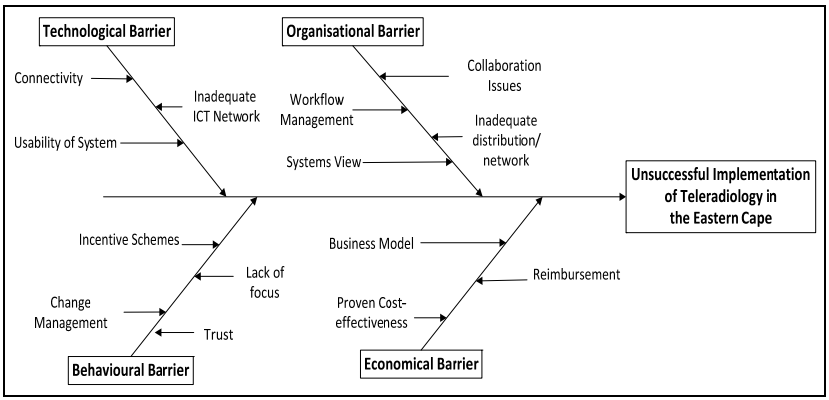


Figure 1: Causes for the unsuccessful implementation of teleradiology in the Eastern Cape

SITA (State Information Technology Agency) is an organization with the aim to consolidate and coordinate the use of Information Technology in

governmental organizations. As the teleradiology system under assessment is driven by the Department of Health and implemented in state hospitals, legislation has prevented the service provider of the system to install their own networks, and the SITA network is used as connection between the remote hospitals and the data center.

A proposed solution is the elimination of the connection requirements between the data center and the remote radiologist by appointing a dedicated radiologist at the data center. This would result in a smaller communications network and available funds would be focused on the connection between the remote hospitals and the data center.

*Organizational Barrier*

Although the teleradiology system falls under the greater organization of the provincial Department of Health, the individual hospitals are also classified as organizations. The unique organizational problem of telemedicine, is that due to the referral process, workflow and information has to progress across the boundaries of the organizations; the two organizations (hospitals) thus collaborate.

While the individual parts of teleradiology seem to be working at an acceptable standard in the Eastern Cape, it is projected that it is the integration of the different parts that is causing problems to be experienced with the implementation thereof. “Systems thinking are an effective approach to foster deliberation across diverse disciplines and stakeholders.” [3]. The shift from an object-based reality to a network-based reality (adopting a systems view) will be an ongoing challenge for health care leaders [4]. These systems thinking approach needs to be applied to the situation to a certain extent to enable progress in the greater telemedicine network in the Eastern Cape between different stakeholders.

*Behavioral Barrier*

In South Africa, public health care is run by government, and the government is the employer of all health care servants. This creates problems with regard to the development of incentive schemes and the introduction of remuneration for telemedicine. This in turn leads to a lack of motivation from the clinicians to make use of the system. It is proposed that the lack of incentive, especially at the referral site, is one of the major problems for the failure of telemedicine in the Eastern Cape. Specialists are more inclined to finish reports at their own hospital where there is more tangible pressure from the clinicians for quick diagnosis and reports than the intangible request for reports from the electronic telemedicine system. In addition, private radiologists receive a greater fee for service at their own firms and therefore these are priority.

*Economical Barrier*

In the Eastern Cape, radiographers at most hospitals were aware of the benefits related to the digitizing of images. This does however not imply that the cost-effectiveness of teleradiology has been proven and accepted by the users. The clinician's view is however contrasted with that of management; in healthcare, especially the public sector, a manager's concern is providing quality service at the lowest possible cost. It is proposed that the economic barrier to telemedicine implementation implies that knowledge regarding cost-effectiveness need to be created for the management of the different hospitals to ensure adequate support from the authority figures in the organizations.

## Conclusion

It is anticipated that the project will contribute to the available literature on the sustained implementation of teleradiology and telemedicine in a developing country such as South Africa and provide decision makers and managers of telemedicine in the Eastern Cape with an original view on the system and a framework towards the enhanced implementation of the teleradiology system.

## Acknowledgements

The authors wish to thank the Medical Research Council and Stellenbosch University for their support. The Department of Science and Technology is thanked for their funding contribution. The Department of Health Eastern Cape (Telemedicine) is acknowledged for their support and advice.

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# A Multi-Dimensional Visual Map for the Measurement and Comparison of Telemedicine Systems

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***Abstract:*** **The purpose of this paper is to propose a multi-dimensional framework for the visual mapping of a multitude of telemedicine systems. A selection of South African public sector telemedicine projects is used to demonstrate how this framework can be used for the measurement and comparison of telemedicine projects.**

## Introduction

Despite many attempts to develop generic frameworks and measures for the effective implementation of telemedicine, no consensus has been reached about the most effective methods and methodologies to measure the effectiveness of telemedicine systems. A hypothesis is that the multi-dimensionality of telemedicine contributes to the difficulty to measure the effectiveness of telemedicine. For example: the effectiveness of a mobile phone campaign to create HIV/AIDS awareness in a the public health sector of a low income country would be measured differently than the effectiveness of tele-operation procedure performed between two state of the art hospitals in a ,"first world" setting.

The purpose of this paper is to propose and demonstrate a multi-dimensional framework for the visual mapping of any telemedicine systems.

## Methodology

*Developing the multi-dimensional visual map*

In their conclusion to a systematic review on telemedicine research, Bashshur *et al.* [1] criticized the fact that the body of empirical research in telemedicine focuses on specific applications, rather than integrate systems of care. Others [2-4] support this notion that the economic, technical, societal, governmental, legal and organizational systems context of a telemedicine application should always be considered. Their frameworks were used as point of departure in the development of the multi-dimensional

framework presented in this paper. A set of dimensions and associated scale for each was developed for purposes of this study. Furthermore, Khoja's [2] eHealth Readiness questionnaire was added to include these five dimensions of eHealth readiness. The challenge was to define and scope these dimensions and scales so that the mapping of any telemedicine system can be accommodated.

*Demonstrating this use of this map*

The dimensions and scaling was converted into an online questionnaire [5] and administered during a telemedicine workshop that was attended by 16 representatives from the provincial departments of health (DoHs) and 2 representatives from the private health sector of South Africa. All questionnaires were completed at the same time in the same computer room. Whilst the questionnaires were completed, certain cavities in the dimensions and scaling was identified, discussed and recorded. Thirteen responses to Khoja's questionnaire [2] from a previous session were also added to the data set.

## Results

It is not the purpose of this paper to provide an in depth report on the status quo of telemedicine in South Africa, but rather to demonstrate the potential value of a visual multi-dimensional map. Fig. 1,2,3,4 and 5 is a selection of visualization possibilities, followed by a discussion on each.

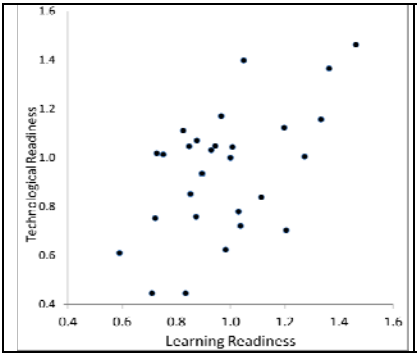


Figure 1: 2D visualization to compare technological and learning readiness [2]

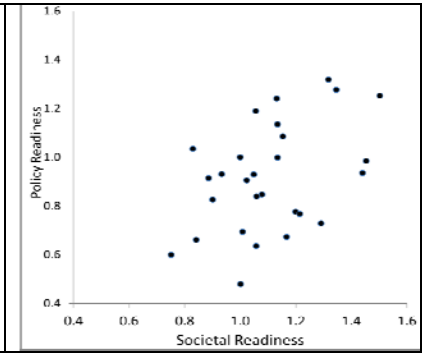


Figure 2: 2D visualization to compare policy and societal readiness [2]

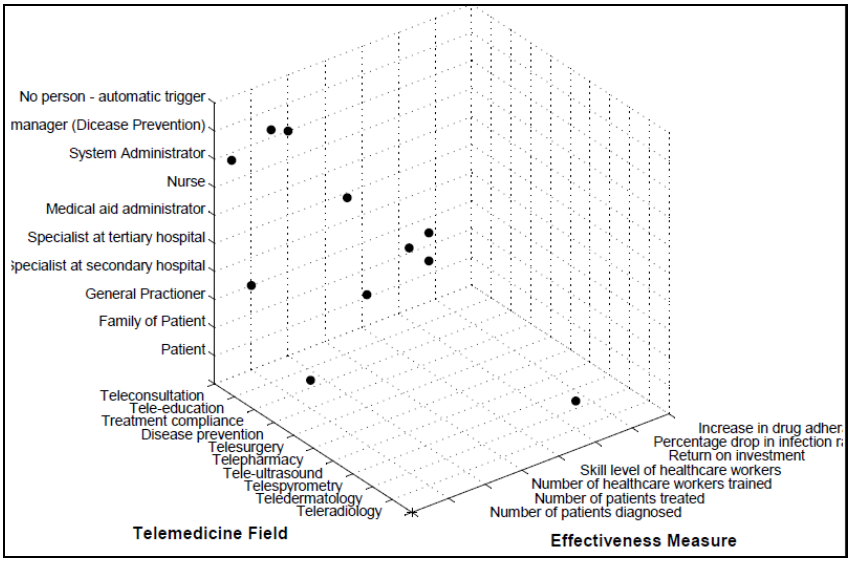


Figure 3: 3D Visual map comparing Measures, TM-field and Triggers

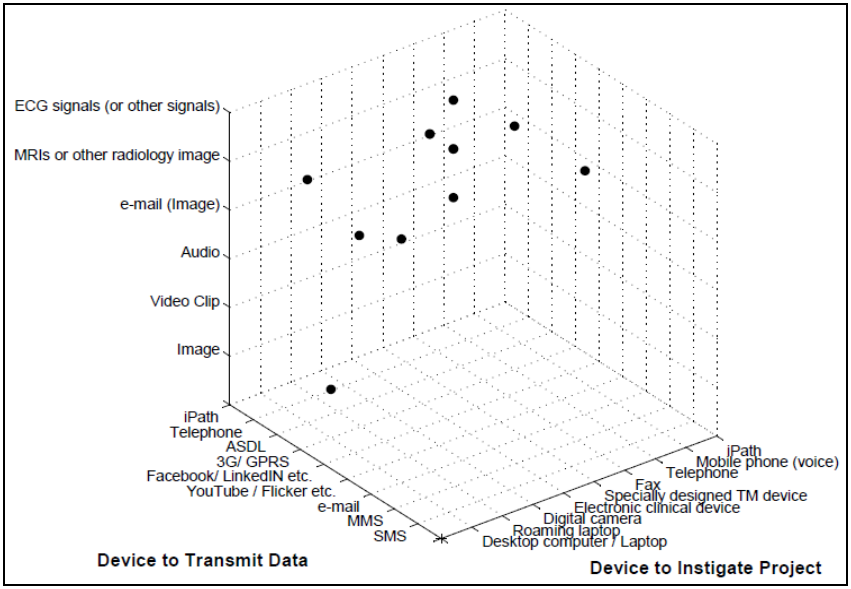


Figure 4: 3D Visual map comparing Device, Transmission and Data

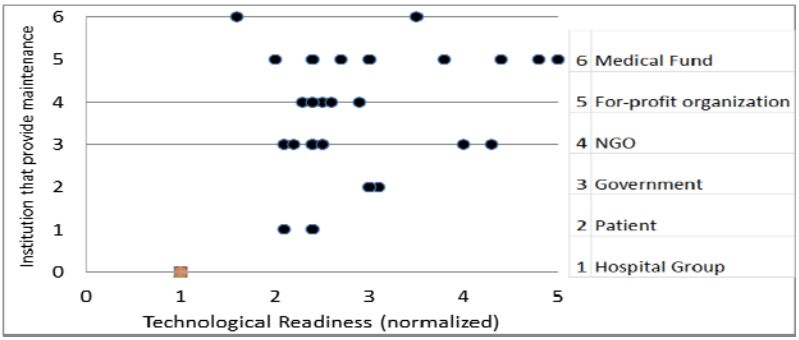


Figure 5: Technological Readiness (Khoja, 2007) vs. Institution that provide maintenance

## Discussion

Fig. 1 and 2 visually shows significant correlation between the normalized values of pairs of e-Health Readiness dimensions. No other pair showed the same extent of correlation. Fig. 3 and fig 4 shows the benefit of three-dimensional visualization. In this way, clusters of projects can be identified for further investigation and certain trends can be identified through visualization. These figures are also included in this paper since they represent 6 of 12 dimensions and their scaling. Fig. 5 demonstrates how trends between e-Health readiness and other system attributes (e.g. the institution that provide the maintenance) can be shown visually.

## Conclusion

This is the first iteration towards a generic multi-dimensional map for telemedicine to be used in South African and hopefully other low income countries. Future iterations should consider focus group feedback, include a larger data set and contest the validity of this framework and define inter-dependencies within other contexts.

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# An Economic Framework for the Use of Telehealth Systems in the Diagnosis and Treatment of Autism Spectrum Disorders

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***Abstract:*** **In this paper we review health care system problems related to the increase in the prevalence of and service availability for autism spectrum disorders. Based upon a supply and demand model, we identify the potential for telehealth systems to address them. This paper holds implications for policy makers considering implementation of new telehealth programs for insurance coverage.**

## ASD Prevalence in the Unites States

ASDs are a group of lifelong neurological developmental disabilities characterized by atypical development of verbal and nonverbal communication, impaired reciprocal social interaction and restricted and repetitive patterns of behavior, interests and activities that profoundly affect the way a person comprehends, communicates and relates to others[1,2]. The term ASD has been used to include the Pervasive Developmental Disorders classified in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM-IV-TR) under these five diagnostic categories: autistic disorder, Asperger's disorder, pervasive developmental disorder-not otherwise specified (PDD NOS), childhood disintegrative disorder (CDD) and Rett syndrome. In the last two decades, there has been a dramatic increase in the number of Americans diagnosed with ASDs [1]. Reference [1] states that 1 in every 110 American children now carries a diagnosis of autism and related disorders, including 1 in 70 boys. On average, this represents a 57 percent increase from 2002 to 2006, and a 600 percent increase in the past 20 years [1]. In the US the lifetime cost of caring for one individual with ASD is estimated to be $3.2 million

[3], and each year, $35 billion is spent to care for all Americans with autism [4]. Government policy leaders suggest a necessary investment of at least $1 billion annually in ASD research, listing autism among the top three health priorities along with heart disease and cancer [4].

## Factors Affecting the Demand and Supply for ASD Services

The demand for ASD services depends upon ASD prevalence. The increase in ASD prevalence has been attributed, in variable proportions [1,2] to two sources: an increase in the risk for developing ASD (due to genetic, environmental, or other factors), and better identification secondary to increased community awareness, and enhanced clinical recognition, resulting in earlier identification and intervention, as well as the widening of the diagnostic criteria. In addition, previous studies [2] have shown that ASD prevalence is associated with education-related spending (via the association of the latter with better-trained educational staff who can recognize the problem, and more and better trained in-school specialists who can provide screening), educational and familial resources, a lower proportion of impoverished subjects, and access to medical resources (such as the availability of pediatricians). States like Maryland and Indiana that spend more on education have also developed Medicaid programs for reimbursing ASD services [2]. Fig. 1 summarizes the factors that contribute to the ASD prevalence increase and the links between this increased prevalence and education spending, reimbursement programs and the potential of telehealth-based system to address the gap between the supply and demand for ASD services.

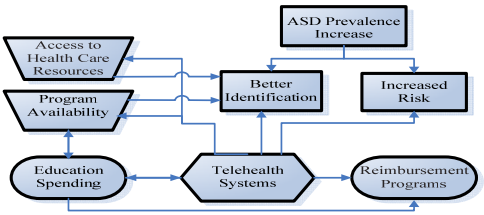


Figure 1

In the USA appropriate screening, assessment, and services delivery to children with ASD, are expensive, unavailable in many communities, and compounded by an insufficiency of professionals adequately trained in the

diagnosis and treatment of ASD [5,6]. In theory, one way to address the increasing demand and costs of service is to implement large scale telehealth systems, to enhance access to health care resources and treatment program availability. Currently only a few such systems are being discussed for implementation in the US [6-7].

A Demand and Supply Framework for the Use of Telehealth Systems

Fig. 2 represents a generalized market for ASD services, following the laws of supply and demand. Given the presence of third-party reimbursement (from government and private insurers) and the asymmetric nature of the information (limited availability of close substitutes) characteristic of this market, the demand curve on Fig. 2 tends to be relatively inelastic (relatively steep). Families have a tendency to move to metropolitan areas where services are available at smaller costs for them [2], by virtue of reducing travel requirements. The presence of telehealth systems can ameliorate asymmetries making demand more elastic (Fig. 3). Due to barriers to entry that control the supply of child psychologists and psychiatrists in general and Applied Behavior Analysis practitioners in particular, the supply curve tends to be inelastic (steep).

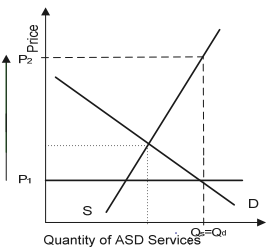


Figure 2

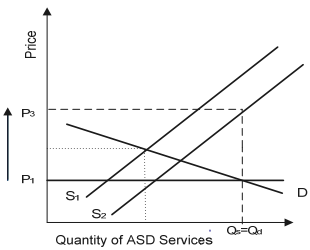


Figure 3

The above theoretical framework enables us to consider the potential impact telehealth systems have to (a) make supply more elastic (more responsive to price changes), and especially in the presence of underutilized providers, to (b) allow supply to increase in capacity, by shifting the supply curve to the right (Fig. 3). In both graphs the amount of third party reimbursement is the difference between the price received by health providers ($p_2$ in Fig. 2, and $p_3$ in Fig. 3) and the price paid by the patients ($p_1$). In the USA third parties contribute about 80% of all spending on ASD services. Telehealth systems have the potential to lower this spending, as

shown in Fig. 3, as well as increase the number of services provided. If telehealth program implementation per unit cost is smaller than the cost savings obtained after implementation, given by $p_2 - p_3$, it is beneficial from a societal standpoint to invest more in telehealth technologies than in the traditional delivery of ASD services.

## Future Work

From our theory-driven approach, we will test the hypothesis that the central control and administration of telehealth services should make its distribution to ASD users more economical and efficient. Future work includes formative and full economic evaluations of telehealth practices in the state of Georgia, and make comparisons across the US and internationally.

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# Analysis of Business Models Use Cases for eHealth in Europe and in Japan

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***Abstract:*** **This paper reports our findings on business models in rolling out e-health/wellness services. The study aims at suggesting a suitable positioning for a telecom operator in the overall value chain. More than 15 existing successful services spanning Europe and Japan were studied under the ongoing "Orange-NTT research partnership on e-health". Our main contributions in this paper are (i) development of a novel 4-blocks value chain representation, (ii) identification of the key success factors for such services.**

## Introduction

ICT for healthcare and wellness is currently being considered as the next big opportunity for data connectivity to influence human life and bring in revenues for the operators. The objective of our study on business models was to provide a good understanding of what role a Telco can play in the value chain, which partnerships have to be established, which kind of innovative technological and organizational solutions have to be installed and what business models will ensure the success of the operations.

To fulfil our objective of analyzing 15 different use cases, a common methodology was necessary to describe the business models.

## Methodology

To analyze the various use cases, we used

- The nine basic building blocks of Osterwalder business model canvas [1] to describe the value proposition and the revenue generation. This method [1] has been proved to be a powerful tool for describing, analyzing, and designing business models.
- The Porter matrix and PEST analysis to describe the competitive context. The Porter matrix is well described in [2].

- A new way to simplify the presentation of the Value Chains, which is described below.

*Our Approach: A new 4-blocks value chain representation*

The traditional 3-blocks value chain contains three types of actors as ‘Service receivers’, ‘Service providers’ and ‘Paying authorities’ [3]. In our novel 4-blocks approach, we divide the ‘Service providers’ block into (pure) ‘Health service providers’ and ‘Technology for Health Services providers’ (Fig. 1) to accommodate the specificities of health domain.

For validation, we superimpose the 4-blocks value chain representation on some existing value chains (Fig. 2). Such a representation helps to understand existing value chains [4] (the Czech EHR), and [5] (the Swedish e-Prescription). In addition, the methodology also helps to simplify the construction of new value chains.

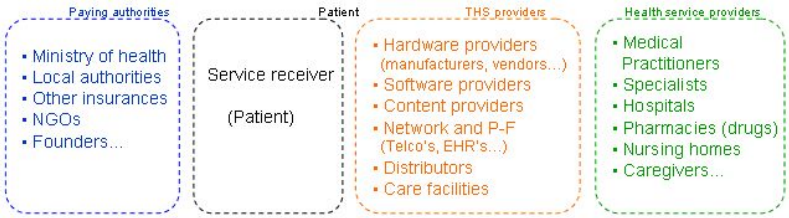


Fig.1. The 4-blocks value chain

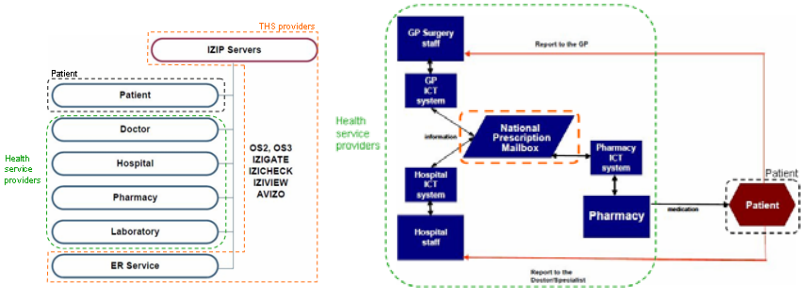


Fig.2. Validation of the 4-blocks approach [4] (left), [5] (right)

## Analysis of the BM use cases

In this paper, we will describe only one of the following 15 use cases.

- European use cases: E1-Belgium vaccination database solution for children - E2-Sweden & Spain Teleradiology - E3-Denmark Health Data Network - E4-Swedish ePrescription - E5-Czech EHR

- Orange use cases: O1-SORIN Remote monitoring solution for cardiac patients – O2-Shared Medical Imaging – O3-Columba bracelet Teleassistance – O4-Mobile Teleassistance – O5-Voluntis DIABEO diabetes Telecare solution
- NTT and Japan use cases: N1-Creative Health [6] - N2-Tele-health Guidance service - N3-Wellness Support - J4-Karada Manager - J5-SCCJ Pocket Karte.

*Analysis of one use case: the 02- Shared Medical Imaging (SMI)*

In mid-2010, Orange Business Services won an RFP from Greater Paris Area Hospitals whose objective is to host a service for medical images storing and handling.

The aim of 02-SMI service is to industrialize the process of handling medical images and, at the same time, do savings benefiting from the economy of scale brought by mutualizing the infrastructure between hundreds of hospitals. The Hospital is connected to the OBS network and Data centre through Fibre optics, and the medical imaging applications are available in Software as a Service mode, on a pay-Ratio rate basis.

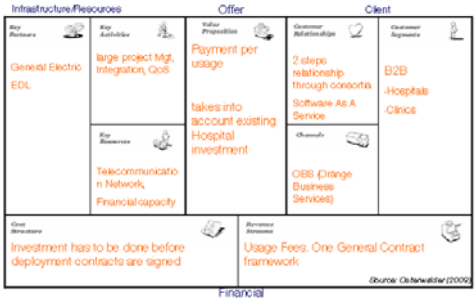


Fig.3. Business model of the French Shared Medical

*Imaging Service using Osterwalder canvas*

In Fig. 3, the Business Model has been represented using Osterwalder canvas depicting the solution specificities and the roles played by the actors.

In Fig. 4, the Value Chain has been represented using our methodology. Among numerous key success factors, from a 'before' and 'after' comparison, we observe that pre-existing chain (pre-existing clients, providers, distribution channel), no disruption to existing medical practices etc., greatly help to deploy a eHealth solution like the dematerialization of prescriptions.

*Key success factors for a Telecom Operator*

As seen in Table I, a Telecom Operator should emphasize on the following.

- Choice of valuable partners with key activities and key resources
- Having the Network and Platform management legitimacy

- Assurance of privacy and confidentiality in a shared environment
- Ensuring appropriate interoperability with respect to the Standards
- Ability to define and precise the right role for each partner
- Ensuring appropriate infrastructure and distribution channels

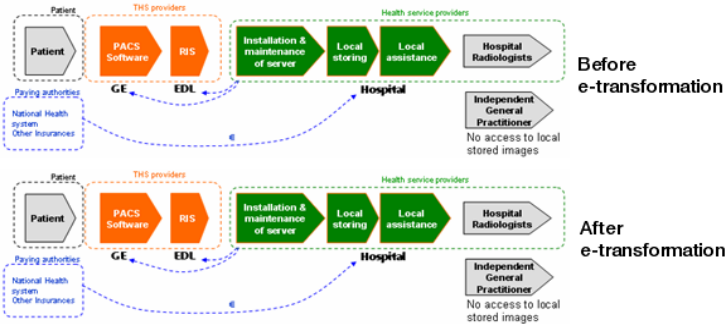


Fig. 4.Value chain of the French shared Medical Imaging Service

Table I - Key success factors for the operators

| Key success factors / Service | E1-Vaccination database | E2-Teleradiology service | E3-MedCom Danish Health Data | E4-e-Prescription | E5-Electronic Health Record (EHR) | O1-Monitoring solution for services | O2-Telemedicine Shared Medical Imaging | O3-Columbia Transient Telassistance | O4-Mobile Telassistance | O5-DIABEO & Orange | N1-Creative Health | N2-Tele-health Guidance service | N3-Wellness Support | JK-KODI Kornada Manager | JK-SCCI Pocket Keeper |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Government/organization legitimacy | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | | ■ | | | ■ |
| A free service for the patients | ■ | | ■ | ■ | ■ | | | | ■ | ■ | | ■ | ■ | | ■ |
| A better service for citizens | ■ | ■ | | | ■ | | ■ | | | | | ■ | | | ■ |
| In-house expertise | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Partners' expertise | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Network and Platform management legitimacy | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Secure transmission | | ■ | | ■ | ■ | ■ | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ |
| Pre-existing distribution channel | | ■ | | | ■ | ■ | ■ | | ■ | ■ | | | | ■ | ■ |
| Appropriate standardization/interoperability | ■ | ■ | ■ | ■ | ■ | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Cost reduction | ■ | ■ | | ■ | ■ | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Incentives for patients | ■ | | | ■ | ■ | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Limitations/ risk factors** | | | | | | | | | | | | | | | |
| Geographically limited Organization | ■ | | | | | | | | | | | ■ | | | |
| Complexity | | | | ■ | | | | ■ | | | | | | | |
| Regulatory barriers | | | | | | | ■ | | ■ | | | ■ | | | ■ |
| Internal competition/interference | | | | ■ | | ■ | | ■ | ■ | ■ | ■ | | ■ | ■ | |
| Dependence of the system to a single company | | | | | ■ | | | ■ | | | | | | | |
| Modifying existing medical practices | | | | | | | | ■ | | ■ | | | | | |
| High cost of system and/or operation fee | | | | | | | | ■ | | | | | | | |

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[4] http://www.ehealth-impact.org/case_tool/data/binary/852125c47942361d7a8baf7acee89d92.pdf
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# Cost-Benefit Analysis of Tele-speech-language Therapy

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***Abstract:*** **We built and maintained a videophone based system to provide tele-speech-language therapy, over 2 years, for children with articulation disorders. In this paper, we discuss the economic feasibility of our system.**

## Introduction

We maintained a videophone based system to provide tele-speech-language therapy, over 2 years, for children with articulation disorders. The research suggested that the system and tele-therapy was effective in treating articulation disorders [1]. However, this research was grant-funded. Therefore, to sustain the tele-therapy without a research grant, we calculated the total cost of the tele-therapy and estimated the cost of face-to-face therapy.

## System outline

A speech therapist (ST) at an office site provided therapy to patients in a public health center at a remote site. The sites were connected through the Internet, and voice and video communication was possible via video-phone (Skype®). We used Virtual Private Network (VPN) and Virtual Network Computing (VNC) software to ensure a secure connection and user friendliness. When the PCs at both sites are turned on, VPN and virtual local area network connections are established automatically by PacketiX VPN™. VPN provides tunneling and encryption packet transmission for secure connections. Then, the PC at the remote site can be operated remotely, and equipment can be attached at the ST site using VNC software. This system (Fig. 1) is secure and user-friendly for patients [2].

## Cost of tele-therapy

We calculated the total cost of the tele-therapy. The left-hand column of Table 1 presents the tele-therapy cost details.

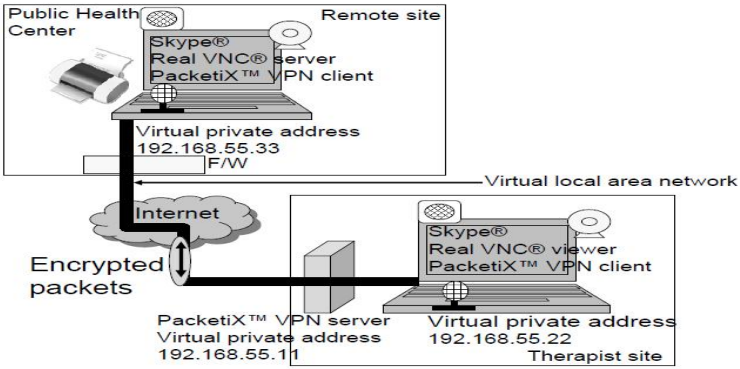


Fig. 1 System details

*Equipment and software*

To determine the initial cost, we consider the cost of the equipment and software used. The total cost for the server hardware for PacketiX™ VPN 2.0, server software (ST site), client software (both sites), Windows PC (both sites), web camera (both sites), microphone and loudspeaker (remote site), and head-set microphone (ST site) amounts to 3,436 EUR. Skype® and VNC (real VNC™ Japanese version) are free software.

*Maintenance cost*

The maintenance cost is only an initial cost for setting up our system. The transfer cost of some equipment from the ST site to the remote site is 60 EUR. Maintaining the equipment and updating the software at the remote site can be done through VPN and VNC software from the ST site itself.

Typically, the maintenance cost includes the cost for training staff to operate the equipment. However, in our system, operation at the remote site involves only the turning on of power. Therefore, there is no cost for training to be included. In fact, when the public health nurse (PHN) at the remote site had changed during our research term, the new PHN did not require additional training.

*Line cost*

Our system requires a high-speed Internet connection (more than 1 Mbps) for the transfer of video images and monitor images by VNC [3]. We therefore used optical fiber cable and Asymmetric Digital Subscriber Line (ADSL) internet connections. The fee for an optical fiber cable Internet connection at the ST site was 100 EUR per month and that for an ADSL Internet connection at the remote site was 30 EUR per month.

*Public health nurse (PHN) wage*

A PHN is required to attend the therapy sessions at the remote site, to help the patient and ensure patient safety. Their average wage per session is 10 EUR.

## Cost of face-to-face therapy

We estimated the cost of face-to-face therapy if the patients were to visit the nearest ST office that provides services for children with articulation problems. The right-hand column of Table 1 presents the cost details. These costs include a round-trip fare for a 2-hour ship and tram journey costs 23 EUR and our estimation of the opportunity cost for the parent accompanying the patient, in terms of loss of wages for 2 hours, to be 36 EUR. Therefore, face-to-face therapy is estimated to cost 59 EUR per therapy session.

## Results

The initial cost and maintenance cost amount to 3496 EUR. If this system is renewed every 5 years (60 months), the monthly cost will be 58 EUR. Therefore, together with the monthly line cost of 130 EUR, the monthly system cost will be 188 EUR. Face-to-face therapy, however, costs 49 EUR per session (subtract the PHN wage of 10 EUR per session of tele-therapy from the face-to-face therapy cost of 59 EUR per session).

## Conclusion

If 19 sessions are held every month and each patient is charged 10 EUR per session as a system maintenance fee, the income from and cost of the system balance out. As this is not an impossible figure, continuation of this system can be considered.

As the Internet connections were separate from the institution's networks at both the sites, we had to pay a line fee for our therapy sessions. However, since we have installed VPN software, we can access the Internet through the institutions' local area networks. This will save the line cost.

Table1 Details of cost for tele-therapy (left) and face-to-face therapy (right).

Cost for tele-therapy

| Equipment and software | EURO |
|---|---|
| VPN hardware and software | 1,364 |
| PC (remote site) | 818 |
| PC (ST office site) | 909 |
| Web camera | 164 |
| microphone | 27 |
| speaker | 109 |
| headset | 45 |
| skype software | 0 |
| VNC software | 0 |
| Total | 3,436 |

| Maintenance cost | EURO |
|---|---|
| Initial setting cost | 60 |
| Total | 60 |

| Line cost (par month) | EURO |
|---|---|
| ADSL (in remote site) | 30 |
| Optic (in ST office site) | 100 |
| Total | 130 |

| PHN wage [4] par session | EURO |
|---|---|
| Wage of half an hour * | 10 |
| Total | 10 |

Cost for face-to-face therapy (estimation)

| Travel cost (round trip) par session | EURO |
|---|---|
| Ship | 20 |
| Tram | 3 |
| Total | 23 |

| Parent's opportunity cost [5] par session | EURO |
|---|---|
| Wage of two hours * | 36 |
| Total | 36 |

* Caluculated from average yearly wage
(yearly wage/8hr. × 20days ×12months=hourly wage)

## Acknowledgment

This work was supported by the Japan Society for the Promotion of Science (JSPS), Grant-in-Aid for Scientific Research (KAKENHI) for Young Scientists (B) 20700436, and France Bed Medical Home Care Research Subsidy Foundation research grant 2008.

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# Cost-Effectiveness of a Telepsychiatric Service Delivery to Autistic Children

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***Abstract:*** **Telepsychiatric service delivery for Autism Spectrum Disorders is a recent trend in Georgia, USA. Utilizing a formative economic evaluation platform, we evaluate the charge-to-cost and cost-effectiveness ratios of a telepsychiatric service delivery to autistic children under the Marcus-GPT telemedicine program, and briefly discuss the implications of this service delivery model for the major stakeholder groups compared to the traditional in-person care model.**

## Economic Evaluations of Telehealth in Autism Spectrum Disorders (ASD)

Full economic evaluations of the use of telehealth in pediatrics and tele-psychiatry are currently in their embryonic stage. A full economic evaluation analysis calls for both costs and consequences of alternative uses of health care resources to be identified, measured, valued and compared [1]. We reviewed methods of full economic evaluation and found Cost Effectiveness Analysis (CEA), Cost Utility Analysis (CUA), and Benefit-Cost Analysis (BCA) to be the most popular ones, differing in the way benefits are measured. While the cost evaluation component of a full economic evaluation is the same across the three methods, the measurement of economic benefits varies. It consists in identifying program goals and objectives and finding appropriate program specific outcomes in CEA, combining these specific outcomes into a broad generic outcome measure using a utility approach in CUA, and if BCA is chosen, it requires the use of monetary conversion factors to translate the generic outcome into a dollar figure. For outcomes that cannot be grouped under the generic measure - nonclinical and non-ASD specific outcomes commonly found in economic evaluations of telehealth based programs (i.e., time and avoided travel related benefits) - monetary conversion factors need to be found and applied separately, before a total monetary economic benefit can be estimated.

There are several reasons why the practice of telehealth in the early diagnosis, management and treatment of ASDs needs to be considered as an

alternative method of service delivery and economically evaluated against the traditional in-person care model. Recent epidemiological studies that have examined autism spectrum disorders have consistently provided prevalence estimates in the (60-70)/10,000 range for all disorders combined [2]. The uncontestable increase in ASD prevalence in the last two decades [3] has raised significant public health concerns, given the shortage of trained specialists in the treatment of ASDs. Recent systematic reviews of telepractices used to treat people with ASDs report successful implementation and positive outcomes [5]. Moreover, telepsychiatry is usually reported as less expensive for patients when the cost of travel and lost employment time are considered [6]. Last, formative economic evaluations of ASD telepractices are important in both determining the feasibility and assessing societal costs and benefits of the use of telehealth based systems in the early diagnosis, management and treatment of ASDs, regionally, nationally and worldwide.

## Cost-Effectiveness of an ASD Telepsychiatric Service Delivery in Atlanta

Telepractice in ASDs is a recent phenomenon in Georgia. Atlanta, Georgia's largest metropolitan area, is home of the Atlanta Autism Consortium, which includes the Marcus Autism Center, Children's Healthcare of Atlanta, Emory University, Centers for Disease Control and Prevention, Georgia State University, Georgia Tech and University of Georgia, with the potential of becoming the USA's capital of early screening and treatment for children with autism [7].

In 2009 Marcus Autism Center, a multispecialty clinic in developmental disorders in Atlanta began a telemedicine program in conjunction with Georgia Partnership for Telehealth (GPT) consisting of telepsychiatric services to patients with ASDs. The Marcus-GPT telepractice requires a dedicated office at Marcus with a desktop computer, a Tandberg unit with camera, phone and printer. It is run by a child psychiatrist and patient scheduling is administered by Children's Healthcare of Atlanta (CHOA) and GPT staff. The types of services offered include screening and initial diagnosis, and follow-up treatments, consisting of behavioral management strategies, medication management and brief psychotherapeutic interventions. After the teleconsultation, the psychiatrist develops a plan including prescribing medications, mailing out screening tools and behavioral checklists, developing behavioral strategies and discussing the findings and follow-up plan with the patient and/or caregiver.

Table 1 summarizes our formative economic evaluation platform from the provider's perspective. Average gross amount billed per visit is about $431

Table 1: Marcus - GPT Telemedicine Performance, June - August 2010

| | June | July | August | Total |
|---|---|---|---|---|
| Nr. of Business Days | 22 | 21 | 22 | 65 |
| Total Visits Billed | 103 | 101 | 80 | 284 |
| **Telemed. Visits Billed** | **8** | **7** | **3** | **18** |
| **Percent Telemedicine** | 7.8% | 6.9% | 3.8% | 6.3% |
| Total Revenue | **$3,350** | **$3,100** | **$1,300** | **$7,750** |
| Deductions | -$2,204 | -$1,997 | -$758 | -$4,959 |
| **Net Telemed. Revenue** | **$1,146** | **$1,103** | **$542** | **$2,791** |
| Total salaries | $954 | $903 | $519 | $2,377 |
| Benefits | $204 | $193 | $111 | $509 |
| Salaries and Benefits | $1,158 | $1,097 | $631 | $2,885 |
| Miscellaneous Expenses | $90 | $96 | $238 | $424 |
| Direct Clinical Expenses | $1,248 | $1,193 | $868 | $3,309 |
| Indirect Expenses | $674 | $644 | $469 | $1,787 |
| **Total Expenses** | **$1,921** | **$1,837** | **$1,337** | **$5,095** |
| **Charge/Cost** | **0.6** | **0.6** | **0.41** | **0.55** |
| **Gross Revenue/Cost** | **1.74** | **1.69** | **0.97** | **1.52** |
| **Cost-Effectiveness 1** | **$240** | **$262** | **$446** | **$283** |
| **Cost-Effectiveness 2** | **1.17** | **1.07** | **0.63** | **0.99** |

over the three month period, which covers all costs incurred and allows for an average profit of about 34%. However, due to standard 36% managed care contractual adjustments and 60% Medicaid deductions applied to a large percentage of ASD population, net tele medicine revenue is significantly reduced. From the client's perspective, such deductions represent gained benefits. Generally speaking, from the payer's perspective (e.g., Medicaid) insurance coverage represents costs to society, a portion of which is carried out by the provider in the form of contractual adjustments and deductions. From a societal approach - the combined perspective of the provider, client and payer stakeholder groups that only accounts for net costs and net benefits (not transfers from one group to the other) -

contractual adjustments and deductions are transfers from the provider to the client via the payer. From the provider's perspective, in June-August 2010 Marcus-GPT telepractice has incurred losses (respectively $775, $734 and $795 each month) in terms of the charge/cost ratio, which on average has been $0.55 in net revenue for each dollar of delivery. These results would make the sustainability of Marcus-GPT telemedicine program questionable, if Marcus Center did not rely on donors and other grants to subsidize their service delivery. Incurring losses for Marcus, a not for profit organization, with no primary profit maximization goal, for both in-person and telepsychiatry practices is common, given its mission of serving children with developmental disabilities across the state of Georgia.

However in terms of the gross revenue/cost ratio, in both June and July gross revenues exceeded total expenses, in August the ratio was close to 1, and on average this ratio was $1.52 in gross revenue for each dollar of delivery. From here we can conclude that there is room to improve the feasibility of the Marcus-GPT telepractice, either by increasing billing fees, or adopting different contractual adjustments and Medicaid deductions.

Under the assumption that both tele and in-person psychiatry for people with ASDs produce the same clinical outcome of interest, a cost-minimization analysis can be performed [1] when comparing the two service delivery models. Such an analysis could limit the telehealth effect to the production of *access*, while defining the cost structure as a trade-off between gains from reduced travel related cost, lost work time, etc., and expenditures on information and communications technology and personnel [8]. To complete our formative analysis we need to evaluate the size of this trade-off, which will favor the use of telehealth in the presence of high barriers to access and specialties that require less expensive technologies, such as the case in telepsychiatry [8]. In comparison to the in-person model, telepsychiatry brings the additional benefit of *access to service*, which in most cases would be impossible without telehealth. In the presence of severe data limitations at current time, we view *access to service* and its corresponding total number of patient *televisits* as the outcome of interest in conducting a simplified cost-effectiveness analysis of the ASD telepsychiatry versus the in-person service delivery model from the provider's perspective. In comparing total expenses per unit of effect, that is, cost per televisit conducted, we find our first cost-effectiveness ratio, which exhibits an increasing trend from June-August, averaging $283 per visit. Alternatively, comparing the number of televisits per unit of cost we derive our second cost-effectiveness ratio. The unit cost chosen was $280, corresponding to psychiatrist's per hour net billing rate for each new patient televisit. This ratio exhibits a decreasing trend, averaging 1 new visit per

$280 spent. To complete our formative evaluation, in addition to the running costs shown in Table 1, we need to add annuitized and discounted monthly set-up costs on equipment, installation of telecommunication lines and any training costs to our average cost-effectiveness measure of $280.

Last, in comparing the tele vs. in-person psychiatric delivery models from a societal perspective we can evaluate the cost savings resulting in the telepsychiatry model from less lost work time, travel time and expenses, etc., per each telepsychiatric visit conducted. If cost-savings exceed $280 plus the per televisit portion of annuitized and discounted monthly set-up costs, telepsychiatry is more cost-effective than in-person delivery. Based on data availability, future work includes sensitivity analysis and identification of threshold levels in terms of number of televisits needed for the Marcus-GPT telepractice to be (a) cost-effective on its own, and (b) more cost-effective compared to the in-person service delivery.

## Acknowledgment

The authors thank Marcus Autism Center for providing the data. The contribution by W.F. Lawless is based upon work supported by, or in part by, the U. S. Army Research Laboratory and the U. S. Army Research Office under contract/grant number W911NF-10-1-0252.

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# Early Evaluation of Emergency Telemedicine Consultation Cost in Ubonratchathani Province, Thailand

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***Abstract:*** **Ubonratchathani health care system has been implemented consultation via real time telemedicine system since November 2010. The main purpose of this system is to improve quality of referral critical patient care in ambulance. There is a network of telemedicine, which measure blood pressure, oxygen saturation, pulse and ECG during transfer between 20 community hospitals and tertiary care hospital. At tertiary hospital, the telemedicine consult has been established for monitoring vital-sighs and ECG during transfer and also get some consultation from community hospitals. This system is operated by nurses and then consulted to specialist or emergency physicians. The administration committee of referral system would have economic evaluation to start or stop this project especially inter-hospital consultation. The purpose of this study is to evaluate emergency telemedicine consultation system for a value of cost by Activity Based Costing: ABC. ABC is used to evaluate cost in this system. The ABC analysis is calculated by capital cost, material cost, and labor cost. Total cost consists of direct and indirect cost within consultation unit. The cost driver was a number of critical patients in the period of study. Results: There were 501 emergency consultations in December 2010.The capital cost, consisted of telemedicine devices and location for consultations was 3396.76 euros, material cost was 705.45 euros, labors cost was 2204.16 euros and indirect management cost approximate 20% of total direct cost was 1277.97 euros (approximate 20% of total cost). The cost per case consultation was 15.11 euros. The emergency telemedicine consult intervention for critical patients during transfer is effective and not expensive. But in the future studies should be investigated which patient benefits from emergency telemedicine consultations. The quality of critical care**

**during transfer has been benchmarked to standard of care. The pitfall was detected and the solving effected to patient outcome.**

## Introduction

For developing country, the cost benefit was realized because the health care professionals were encountered to the consequences of budget restrictions and the pressure of providing for quality and safety of patient care. The Ubonratchathani Administration Referral Committees established the referral and consultation system and needed to a pilot evaluate cost control for use of resources and quality of care based on holistic approach focusing on the connecting network between community hospitals and tertiary care hospital. The main mission and results were supported the administrators to plan and control cost of the project. In the first year (2009)[1], there was increased rate of patient referred via real time telemedicine system that measure blood pressure, oxygen saturation, pulse and ECG during transfer between 20 community hospitals and tertiary care hospital, but there were problems such as treatments for critical patients both before and during transfer, the coverage of usage the system and lack of continuity of care especially between community hospitals and tertiary care hospital. The solving some problem was a 4 months training course for transfer nurses or namely Mobile ICU Nurse Course. Then, the telemedicine consultation system was started in November 2010 and used the Mobile ICU Nurses to operate the real time telemedicine consultation both in ambulance and consultation center at tertiary care hospital or called ICU Hub. Cost accounting methodologies are many methods to link clinical process outcome and administrative data. Activity-based Costing (ABC) has assumption that cost-objects devour activities that turn on consume resources. ABC could be accurate than traditional cost calculation and the process analysis shows non value-added steps and causes of process variation. The advances of ABC for administrators were informed for decide some project, continuous quality improvement, control cost or cost reduction [2].

## Objective

The purpose of this study was to evaluate emergency telemedicine consultation system for a value of cost by Activity Based Costing: ABC.

## Methods

The study applied activity-based costing methodology to evaluate the pilot project. The ABC analysis was calculated by capital cost, material cost, and labor cost. Total cost consisted of direct and indirect cost within

consultation unit. ABC calculation concept was process mapping that the process be divided into different activities. The process of referral and consultation in critical care was categorized into 6 activities; 1) Patient reports from the community hospitals, 2) Basic consultation by mobile ICU nurses, 3) Specialist or emergency physician consultation, 4) Emergency treatments for crisis of critical patients both before and during transfer, 5) Monitoring via real time telemedicine, 6) Patient reception at tertiary hospital. For total direct cost, each direct activity was calculated from capital cost(CC), material cost(MC), labor cost(LC) then plus indirect cost within unit (administration and non medical cost) was allocated by proportion of patient volume in the system [3]. Example of direct cost, labor cost was calculated each income of full time health care professional in hospital minus by proportion of working time in this project. The indirect cost center mean that cost of total support service and back office (non-revenue producing cost center: NRPCC) was 20% of total direct cost [4]. Then, the direct cost plus indirect cost was full cost activity. The cost driver was a number of critical patients in the period of study (December 2010)

Full cost telemedicine consultation = Total direct cost + Indirect cost

## Results

This study included 501 critical patients undergoing refer and consultation system. The process of referral and consultation in critical care were categorized into 6 activities; Patient reports from the community hospital (100%), Basic consultation by mobile ICU nurse 394 case (78.64%), Specialist or emergency physician consultation 108 case (21.56%), Emergency treatments for crisis of critical patients both before and during transfer 74 case (68.52%), Monitoring via real time telemedicine (78.26 %), Patient reception at tertiary hospital (100%). The capital cost, consisted of telemedicine devices and location for consultations was 3396.76 euros, material cost was 705.45 euros, labor cost was 2204.16 euros and indirect management cost approximate 20% of total direct cost was 1277.97 euros (approximate 20% of total cost). The Full cost was 7567.64 euros and the cost per case consultation was 15.11 euros.

## Discussion

This project was a pilot study conducted by the Ubonratchathani Administration Referral Committees that consisted of administrators of community hospitals and tertiary care hospital. Activities-based Costing (ABC) was used to connecting the gap between administrators focusing on cost and medical personnel focusing on quality and effectiveness. Based on the results of this study the committee could decide to drop or ongoing the

real time telemedicine referral consultation. Furthermore, the point of total cost could control by reduce some part of indirect cost such as control labor cost. For developing country, the quality of care especially accessibility to specialist from many areas was effective and ABC could be a power tool in the heath care system.

## Conclusion

The emergency telemedicine consultation intervention for critical patients during transfer is effective and not expensive. But in the future studies should be investigated which patient benefits from emergency telemedicine consultations. Besides, the quality of critical care during transfer was benchmarked to standard of care and the pitfall was detected and the solving effected to patient outcome.

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# eHealth Consulting Life Cycle: A Reference Model with Practical Relevance Taking Into Account Service Quality and Cost

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***Abstract:*** **The present study results in a consulting approach that is combined with eHealth to stabilize the health system. With its help implementation models can be developed and implemented.**

## Motivation

The citizen's orientation applies to a strategic aim of the European Union to stabilize the health system in Europe according to the decision No 1350/2007/EC of the European Parliament and the Council of 23 October 2007 establishing a second program of Community action in the field of health (2008-13). The current efforts aim to information and communication technology (ICT).

## Statement [1]

The citizen's orientation in the European health system with the objectives of cost reduction and quality improvement to the strategic control and implementation of a modern health system is treated inadequately, because so far the interface Citizens - Healthcare (Ci-HC) is arranged inadequately to take targeted influence on it. The reasons are system-control problems by combining growing health care needs with increasing financing problems.

With regard to the citizen's orientation the health system might not be able to master the organization and control problems itself. Thus the central research question is: How the interface Ci-HC can be optimized and managed by ICT consulting in the health system?

## Sequences of model development [2]

*Sequence 1: Implementation dilemma in health system*

In the first step the health system has to be described with a system analysis to create the precondition for the optimization of the interface Citizen-Health care (Ci-HC).

Thereafter, the organizational and control problems relating to citizen´s orientation have to be identified on the one hand for the services recipients (citizens) and on the other hand for the services renderers (health care); for example by knowledge from the introduction of the electronic health card.

*Sequence 2: Strategic management-system-control to the citizen's orientation*

After the identification - in sequence 1 - possible improvements of current management approaches to control and implement a modern health system have to be brought out. For an integrated system approach the relationship between the quality based on products/services and processes on the one hand and the costs in relation to spending and GDP (gross domestic product) on the other hand have to be determined.

*Sequence 3: Citizen's orientation (Customer value management) at interface Ci-HC*

Using sequence 2 as basis - a view about the connection between citizens and health care can be worked out to characterize the interface Ci-HC. Afterwards the IT based and, on the other hand, the not IT based communication has to be considered as a basis for the optimization of the interface Ci-HC.

*Sequence 4: ICT organization and -control potential at the interface Ci-HC*

From the consideration - in sequence 3 - the ICT organization and control potential has to be explained. Here is to be deduced from the examination of the management approaches in the health system and from the ICT organization and control potential in the health system what ICT consulting can do to optimize the interface Ci-HC. Besides the linkages have to be explained from the interfaces management in the health system on the one hand and, on the other hand, from the consulting processes.

General framework [3]

The difference between system and environment is one of the main points in the Luhmann´s system theory. Environment is everything that does not belong to the respective system. The border to the environment is determined by the operations of the system. For every system all other systems belong to the environment.

The environment ensures that the system is not completely abolishing itself. For this reason it is necessary to deal with the environment, which is presented in this study by ICT consulting. The environment (ICT consulting) differentiates itself from the system due to lack of statutory regulation or by the fact that ICT consulting is not standards, certifications or directives subjected by law.

The organizational and control problems show that the health system focuses not only on its core business, namely on the health service performances, but also on areas without existing expertise.

On areas without expertise external assistance such as consulting can be used. This approach, which can be explained with the help of Luhmann's systems theory, is necessary, that the health system focuses essentially on its core business.

Results [4]

Outcome summary from sequence 1 (Integration phase in the Figure 1): **Integration** is not primarily a technical question, but requires efforts at all levels of operational organization. This has to be considered by ICT consulting and to be guaranteed in the solution implementation.

Stable implementation results simplify the citizen´s oriented organization control in the health system.

Outcome summary from sequence 2 (Shaping phase in the Figure 1): If organizations are understood as self-referential systems in ICT consulting, they will respond to targeted intervention trials very different, and result in narrow limits of a targeted controllability; the **shaping** of general frameworks and of indirect (context) control become the focus of attention.

Citizen´s oriented-organization-control promotes the flexibility of the smooth IT communication.

Outcome summary from sequence 3 (Selection phase in the Figure 1): ICT consulting aims with the selection of connection possibilities at the guarantee of a smooth communication, because **selection** is constructed by communication and protects the production of "sense".

The flexibility of the smooth IT communication increases the health service quality and reduces costs through standards.

Outcome summary from sequence 4 (Adaptation phase in the Figure 1): For the citizen's orientation it means for the ICT consulting the service reception areas in the health care not to consider separately, but to treat permanently always in the whole context to guarantee the **adaptation**, as well as the adjustment of the cognitive structures to the environment. The health services contain mainly the prevention, therapy and nursing which is a matter to control interfaces in the course of the ICT consulting.

Standardized interfaces of the services areas stabilize the implementation of the health services.

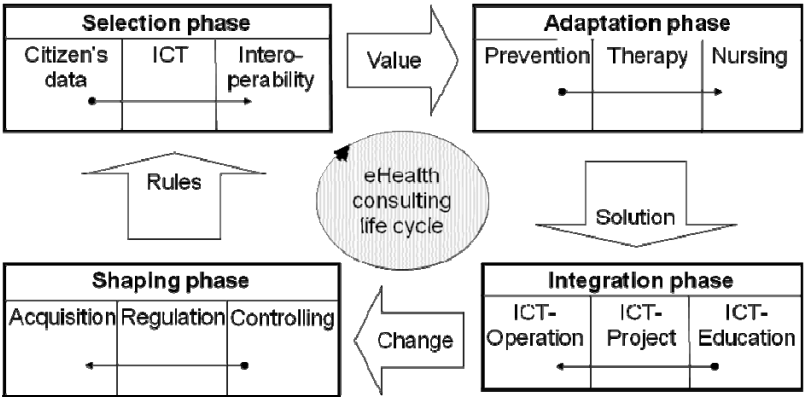


Figure 1: Reference model for ICT consulting in health system [4]

ICT consulting can be brought in connection with the health system and therefore offers a way to lead the health system on its core business (health service performances).

In this regard the following circular causal chain "eHealth consulting life cycle" specified in Figure 1 can be considered as a reference model for consulting processes: Shaping - Selection - Adaptation - Integration.

## Conclusions

The "eHealth consulting life cycle" is a solution model with practical relevance to the strategic control and implementation of a modern health system taking into account service quality and cost.

The present study results in a consulting approach that is combined with eHealth to stabilize the health system. With its help implementation models can be developed and implemented.

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# Formulation of a Model to Develop Telehealth Actions Allowing Comparison between Countries: The Situation in Latin America

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***Abstract:*** **The incorporation of telehealth resources as part of the public policies of several Latin American countries is on the way. For the integrated process of development of activities in this field, within the project called "Regional Protocols to Public Policy on Telehealth Project", financed by BID, and composed of nine countries member, one opted for a process of formulating telehealth action from the elaboration of a roadmap. The first step was the preparation a set of variables that would allow a comparison of the degree of development of telehealth activities between the countries. The purpose of the present paper is to describe the activities formulated to bring forth a comparative model for the development of telehealth actions in Latin America. The following activities were develop: identification of telehealth focal point; development and implementation of a guide for mapping the telehealth situation; specialized technical groups for specific components were set up for analyzing the diagnostics; drawing up of variables for each component and workshops to validate the model proposed.**

**The focal point for telehealth policy in the Ministry of Health of each country was identified and a diagnostic of the situation of the telehealth initiatives. Technical groups were established for developing proposals for comparative variables. These proposals are validated during meetings involving people from the academia and health care professionals. The model formulated includes: standards and**

**technological infrastructure; implementation strategy; project management; research network structuring; telehealth training and innovation policies. Each dimension has its variables, making it possible an overview of the situation of development of the telehealth in each country.**

## Introduction

The incorporation of telehealth resources as part of public policies of several Latin American countries is on the way: some countries already have their national projects consolidated, like Brazil, Mexico and Colombia [1,2], while others are still planning their first steps [3]. Experience exchanging initiatives in this area have contributed to this development.

At a more global context, the study done by WHO in 2009 [4], regarding the process of developing telemedicine actions in the world categorized telehealth action development as established, pilot, informal and no stage provided in tele-radiology, tele-pathology, tele-dermatology and tele-psychiatry. The result shows that provision of telemedicine is far less evolved in upper-middle, lower-middle and low-income countries than in high-income countries. The WHO recommends building long term strategic plans for developing telemedicine because at the moment, only 20% of the countries in the world have defined telehealth national policies.

From this global context, the 9 Latin American countries (Mexico, Brazil, Colombia, Ecuador, El Salvador, Uruguay, Chile, Argentina, Peru) are organizing themselves in order to establish common instruments that would allow them to have a follow up process of telehealth action development in their countries, taking into account the reality in Latin America.

These actions are being developed within a project called “Regional Protocols to Public Policy on Telehealth Project”, financed by the IDB. The choice made is a process of formulating telehealth action having as a reference a set of established guidelines that could reflect telehealth development process of the different countries of the region. The purpose of the present paper is to describe the activities formulated to bring forth a comparative evolving model for the development of telehealth actions in Latin America.

## Methods

Initially, the Ministry of Health of each country appointed the representative for telehealth in the country. Later, a diagnosis of the telehealth situation in the country was done from a questionnaire prepared by a group of specialists. The questionnaire included several dimensions of the development process of telehealth actions at a national level. Then six

technical groups involving academic institutions and Health Ministries were created. The groups were structured around the following topics: standards and technological infrastructure; implementation strategy; project management; research network structuring; telehealth training and innovation policies. These groups work periodically during 4 months, via videoconferences.

Each country appointed at least six specialists for each technical group. The technical groups analyzed the diagnosis and formulated proposals of variables related to their topic. A workshop was organized with specialists that validated the model proposed.

## Results and discussion

The countries involved have telehealth coordination and appointed specialists who participated continuously in the six technical groups created involving academia and services. A diagnosis of the telehealth situation in the nine countries involved in the project was carried out. The technical groups analyzed the diagnosis and then the variables that allow the following classification per component were prepared: non existing, incipient; intermediate, advanced and exemplary. The variables were structured taking into account an evolving development concept of telehealth actions, in order to enable countries to easily identify the required steps for the development of telehealth area in each component. It also allows the countries to better see the situation regarding telehealth actions in comparison with other Latin American countries.

In the Standard component, the following aspects were observed: a national policy of standards for telehealth; participation in international standard producing entities and a national institution able to produce standards in telhealth. Regarding the management of telehealth projects, the following areas were considered: national telhealth project; regulation policies by professional boards; remuneration policies for telehealth procedures and evaluation policies of telehealth projects.

On the implementation strategy component, the following aspects were covered: levels of healthcare systems with implemented telehealth projects, specialties involved, a telehealth national agency, telehealth national boards or associations. With regard to structuring telehealth university networks, the following areas were considered: network structuring, research groups with virtual sessions and healthcare institutions that use webconferencing resources.

For the aspects of telehealth training policy, the following dimensions were included: telehealth subjects in undergraduate and post-graduate courses; human resources training on telehealth topics in the public service;

Master's and PhD degrees in telehealth; distance learning courses using basic and advanced resources for healthcare professionals: 3D modeling and simulation. For the innovation component, the following aspects were studied: articulated policies between the Ministries of Science and Technology and Health involving telehealth and state financing resources available for research on telehealth.

All the variables proposed are being validated in workshops with representatives from all countries and PAHO, IDB and CEPAL. Later, data will be collected to build the diagnosis of Latin American countries. Countries with structured national projects, with experience on the area, such as Brazil, Mexico and Colombia are able to contribute to the variable elaboration process in a significant way. However, the option made to include all the countries will enable to have a real process of marking the development of telehealth actions in Latin America. Thus, the diagnosis will need to consider already incipient aspects, in order to see the development process of telehealth policies in the context of each country. At the same time, the process made possible to build a critical mass of accumulation on the several dimensions that telehealth has. This is necessary for the development of the area [5]. The model presented has been proposed as a contribution for the structuring of telehealth actions in Latin America, enabling the countries to easily see their situation and which are the steps that need to be taken to continuously develop telehealth actions.

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# Home Automation and ICT Solutions Applied to Furniture to Facilitate Use and Assist People with Reduced Autonomy

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***Abstract:*** **The increasing importance of aging at home opens new perspectives to technicians who are able to propose and implement adapted technical solutions which compensate the handicaps and delay the loss of autonomy. In this frame, three "smart" furniture projects using ICT and home automation are under consideration.**

## Introduction

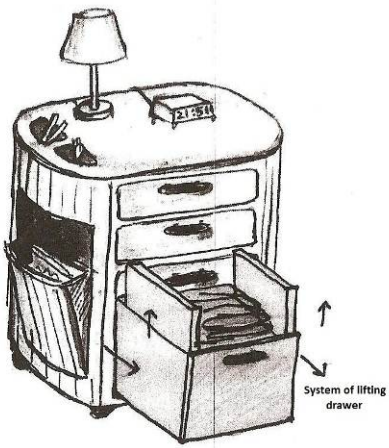
In a regional background, the Limousin's Chamber of Craft Trades has created the Innovation Pole for health, autonomy and trades (CNISAM). The CNISAM is an Innovation Pole (a label granted by the French government). It aims to be a resource centre capable of identifying solutions adapted to the needs of small enterprises, and of coaching them in their development process through technologies and innovation. The CNISAM helps the craftsmen to integrate sanitary, social and statutory environmental aspects in their professional practices, especially in the design of housing environment and installation of home automation equipments. One of its roles is also to work on the design of adaptable and intelligent assistive furniture through the use of ICT and home automation technologies.

In this frame, three furniture projects are under consideration: a "smart" bedside table, a bed for child under three years suitable for parents with disabilities, and a closet/dressing increased with home automation functionalities. Both physical disabilities and their potential evolutions are considered. This furniture is meant to be prototypes which will inspire designers and carpenters in making furniture for people with disabilities. In addition, this furniture is designed for the public market and must not be based on the furniture that can be found in professional health institutes.

## The Bedside Table

As an example, the first project deals with the design of a bedside table (Fig. 1) which purpose is to make life easier for disabled people during the night. It is easy to get disoriented when waking in the dark and often difficult to find or reach the switch on the bedside lamp for people who suffer from physical or cognitive impairment, which may cause risk of falls. Compared to a conventional bedside table, the prototype will integrate a backlight that will illuminate the night table at the touch of the user to help him locate things on the table (water bottle, glasses...) during the night. It will serve as night light and thus enable the frail person to locate and be able to move around the room without trying to find the main light switch. The prototype will also be able to communicate with different equipments (roller shutters, heating, lighting, light paths...). The home automation and communication interface will be installed on a flexible arm that will be available for the bedridden people. The objective is to improve availability of equipments and ease of use. A color code will be used to differentiate the drawers and help people suffering from cognitive disorders or vision problems. The bottom drawer is accessible for wheelchair users through a system of enhanced raised drawer. An integrated automated pillbox will guide the user in taking his medications and treatments.

Fig. 1: Intelligent bedside table



## The Secure Bed

As shown in Fig. 2, the bed is not designed for children who present a disease or disability. Its role is to facilitate the use for parents with disabilities. The height of the bars of a conventional bed is an obstacle when lying or standing of the child for people in wheelchairs or who are struggling to get upright. This prototype must allow parents to be able to fully address the survey, of lying and supervision of their child during the sleep of the child. In particular, this bed will be elevated to facilitate access to an adult using a wheelchair.

A first prototype project was envisaged for which major defects were identified (Fig. 2) among which the bars of the front of the bed arranged horizontally which could serve as a ladder to the child, and the too important height of the mattress.

In its advanced version, the bed will be equipped with one or more sensors that inform the child's presence in his bed and position (standing or lying). For greater safety of the child, the bed will also be equipped with a lockable opening allowing easier entry of the child, while denying the latter the possibility of opening access to its bed. A system will raise and lower the mattress so that the child is at floor level during his sleep phase thereby reducing the risk of falling while allowing access for a wheelchair.

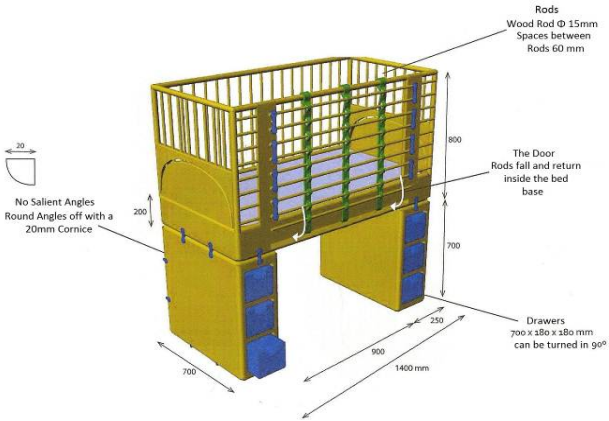



Fig. 2: Project of secure bed

## The smart dressing

As for the two previous prototypes, the dressing will also include a feature for all types of disabilities and their evolutions (Fig. 3). It will be

equipped with similar systems to the bedside table: enhanced drawers system with easy opening, different color codes …

Prehension distances for a person in a wheelchair are integrated as a priority. The prototype will be equipped with an interface that allows selection of different types of clothing of the user. For example, when selecting the shirts, system will automatically leave up all the shirts placed on hangers at an adequate height for people in a wheelchair.

All features added to the traditional furniture are thought referring to official norms and standards. Sustainable development and eco-design aspects are also taken into account with energy management and regulation.

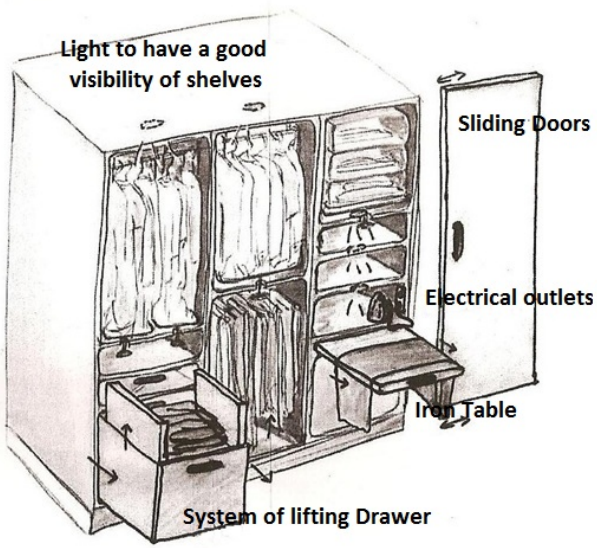



Fig. 3: Project of smart dressing

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# Operational Costs in a Large Scale Telehealth Service

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***Abstract:*** **Cost effectiveness evidence is a relevant barrier to a more intensive use of telehealth and one of the causes of this lack of information is because only a few projects reach large-scale utilization. The Telehealth Center at University Hospital of Federal University of Minas Gerais (THC/UFMG) – Brazil provides teleconsultation and telecardiology services for 608 villages since 2006 reaching in December/2010 the level of about 24,000 teleactivities/month. Consequently to disseminate information on the cost of operating a system of such scale can be useful in assessing the potential of telehealth. A comparison of operational cost in 2009 and 2010 has shown that telehealth, due to its high fixed cost, requires large utilization. Cost follow up should be a routine practice, not only when the project reaches large-scale level, but also since the beginning. It has been proved to be a fundamental factor of success to transform telehealth projects in routine practices.**

## Introduction

A relevant factor acting as a barrier for a more intensive use of telehealth is the weak evidence of cost effectiveness relation, sustainability and financial impact [1,2,3]. Decision makers in health care require information on costs and benefits to evaluate telemedicine applications, particularly when high cost technology is used and in developing countries where the resources are limited. In this aspect, cost analysis is an important factor to contribute for a successfully implementation of this technology. One of the reasons for this lack of information is because most of the projects worked as pilots, finishing by the end of the financial support and before reaching a routine service level. The Telehealth Center at University Hospital of Federal University of Minas Gerais (THC/UFMG) – Brazil provides teleconsultation and telecardiology services since 2006, presently for 608 municipalities, reaching in December/2010 the level of about 24,000

teleactivities/month. To disseminate information regarding operational cost of such scale system can be useful for assessing the potential of telehealth.

In 2009 two important modifications were introduced in the service:

- 328 new municipalities were incorporated from August/2009 to July/2010
- Until June/2009 most teleconsultations were answered directly by specialists. Thereafter, teleconsultation is directed to a generalist physician and, if necessary, goes to a specialist. This modification increased the use of the system.

The objective of this work is to disseminate cost values of a large-scale system and to evaluate the impact of organizational structure. Although cost information gathering started in 2007, the costs to be presented are relative 2009 and 2010.

## Methodology

Although funded by public funds, since the beginning the administration of the system acts as a private enterprise and a methodology to collect information regarding costs was developed. All expenses are collected and categorized according to usual accounting systems and them divided in fixed and variable costs. The most important fixed cost is personal (administrative, technical, coordination staff and shift doctors involved in teleconsultation). The clinical staff involved in telecardiology and part of teleconsultation is paid by productivity, being these costs the majority of variable cost. Indirect fixed costs were distributed according to the level of each type of activity. These costs were then divided according to the type of activity (telecardiology and teleconsultation) and the unitary cost of each activity was calculated dividing these values by the number of activity.

## Results

Figure 1 shows the annual operational costs of the telehealth system at the THC/UFMG, expressed in US$ at an exchange rate of 1 US$= 1,66 R$ (Brazilian currency). Table I shows the activity levels of the system in 2009 and 2010.

Table I – Number of teleconsultations and telecardiology attendances.

| | 2009 | | 2010 | |
|---|---|---|---|---|
| Telecardiology | 159.715 | 97,2% | 197.367 | 94,9% |
| Teleconsultation | 4.534 | 2,8% | 10.611 | 5,1% |
| Total | 164.249 | 100,0% | 207.978 | 100,0% |

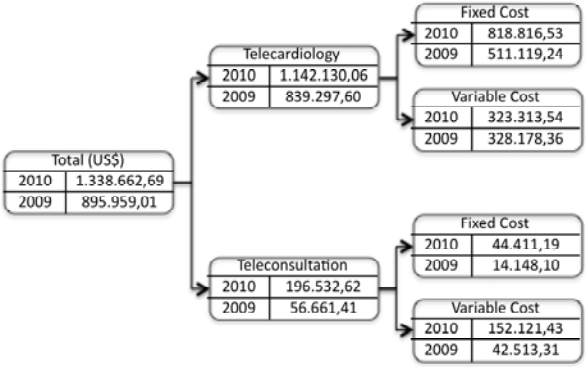


Figure 1 – Annual operational costs comparison (US$) 2009/2010 at the Telehealth Center at University Hospital of Federal University of Minas Gerais.

Dividing the figures shown on Figure 1 by the number of activities according Table I result in the unitary activity cost as it can be seen on Figure II. As it can be seen from Figure II, the most significant cost variation from 2009 to 2010 was on teleconsultation with an increase of 48,3%.

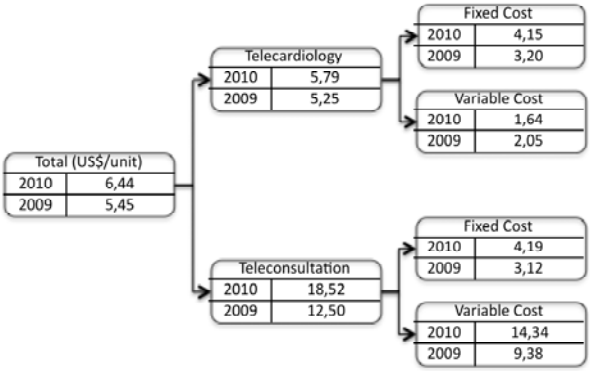


Figure 2 – Annual average unitary costs (US$/unit) at the Telehealth Center at University Hospital of Federal University of Minas Gerais for telecardiology and teleconsultation.

## Discussion

The literature has shown a series of advantages resulting from the use of telehealth. However, the economic argument for using the telehealth is not

so evident. Although most of economic analysis in telehealth is highly dependent on the situation, making difficult an assessment based on a specific case, the results presented here can be helpful for initial evaluations.

First of all, both types of activities have a high fixed cost. That means to become economically feasible the telehealth service has to rapidly reach a high level of activities in order to reduce its unitary costs. To rapidly become a large-scale system it is necessary to start offering a high demand service. That was the case in Minas Gerais where cardiovascular diseases are the main cause of deaths, justifying the initial choice of telecardiology service.

Although telecardiology has reached a high level of utilization, teleconsultation is underused. Considering that each municipality makes around 400 referrals/month [4] the second option through the teleconsultation service could have a higher utilization. A study developed by Alkmim [5] about barriers to the use of teleconsultation at the THC/UFMG showed that high answering time was one of them. The reason for high answering time was due to the fact that teleconsultation was directed to specialists, chosen by the user, before triage. Low number of teleconsultation per day and high number of specialists meant just a few questions for each one, discouraging them to incorporate the process in their routine and increasing the answering time (average of 3 days). The introduction of the gatekeeper, who answers more than 80% of the inquires, reduced the answering time to less than 4 hours. This modification increased the demand from 100 to 1,200 teleconsultations/month. However to implement this modification it was necessary to increase the clinical staff.

Another reason for cost increasing in 2010 is the implementation of new villages. Although connected to the system and able to use it, there is a time delay until the level of utilization increases. And during this period, resources are consumed without been used.

## Conclusion

Cost follow up and analysis have been done at the THC/UFMG since the beginning. This practice has been proved to be very helpful to convince government administrators to pursue on telehealth, transforming an initial research project in a routine health service.

Based on this experience, it is possible to conclude that cost follow up should be a routine practice, not only when the project reaches large-scale level, but also since the beginning. The association of operational and economical indicators is a fundamental factor of success to transform telehealth in routine practice in the future.

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# Success Factors for Telehealth Service Implementation

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***Abstract:*** **Telehealth Center at University Hospital of Federal University of Minas Gerais – Brazil, provides teleconsultation for primary care at 608 villages in the State of Minas Gerais. From August 2009 to July 2010, the service was implemented in 328 new villages in two phases: implementation of teleconsultation service, which used two methodologies (workshops and visits) and telecardiology implementation using health seminars as methodology. Equipments were delivered in second phase. The objective of this paper is to describe these methodologies and to evaluate their effect on the use of the teleconsultations. Descriptive analysis, binomial, chi-square and Mc Nemar tests were applied for analysis. Results showed that visits to the villages are more effective than workshops to improve use of teleconsultation and villages that had sent doctors and nurses have more chance to become a service user. Finally, success factors for teleconsultation implementation are (i) a local visit (ii) to encourage doctors and nurses participation (iii) to deliver equipments specifically to be used for telehealth and (iv) to promote personal contact between users and clinical staff.**

## Introduction

Telehealth Center of University Hospital of Federal University of Minas Gerais provides teleassistance services to primary care for remote villages in the state of Minas Gerais since 2006. It coordinates the Telehealth Network of Minas Gerais, a partnership of six public universities and the State Health Department [1]. The service includes teleconsultation off line available for remote primary care health professionals, analysis of electrocardiogram and teleconsultation on line in cardiology [2]. Presently it is implemented in 608 villages, most of them with less than 15,000 inhabitants and low HDI. To use the telecardiology system, each village receives one computer/printer and one digital electrocardiograph.

Teleconsultations can be accessed through any computer with internet. The demand for telehealth services is increasing gradually [3]: by the end 2010, it was 1,200/month teleconsultations and 23,000/month electrocardiograms.

In 2009, the State Health Department decided to expand the system to 328 new villages. Up to that time implementation method was individual visits. In order to reach such challenge in a short period of time (from August/2009 to July/2010) with a satisfactory utilization of the teleconsultation system and lower costs, three different implementation methodologies were tested: telehealth workshops, visits to each village and health seminars [1].

The objective of this paper is to describe these methodologies and to evaluate their effect on the use of the teleconsultation system.

## Methodology

The implementation process was developed in two phases. (i) From August 2009 to March 2010: implementation of teleconsultation system (without equipments delivery), using two methodologies, telehealth workshops and visits. Telehealth workshops: developed with objectives of training, awareness and motivation on telehealth, with focus on teleconsultation, its benefits and difficulties. Readiness concepts were applied [4,5]. Visit to village: with same objectives and methodology and done in 45 villages individually. (ii) From April to July 2010: implementation of telecardiology in all villages (with equipment delivery) using health seminars. Besides training on telecardiology system, these seminars were also used to promote personal contact between clinical staff and users through clinical staff lectures on most users' demanded themes in teleconsultations and to reinforce training and awareness on teleconsultation. The two phase process was used because since teleconsultation is available from any computer it was not necessary to wait for equipment bid purchasing.

To evaluate the effectiveness of the two methodologies used at the first phase, the villages were divided in two groups according the teleconsultation use in March/2010: villages that had used the system at least once in that month were classified as "Users" and otherwise as "Non-Users". A descriptive analysis involving number of villages and professionals in each type of event and group classification was done. To validate the results of this analysis a Binomial test was applied. Chi-Square test was used to verify the influence of doctors and nurses participation in the events on teleconsultation use.

The effectiveness of health seminars on teleconsultation use was measured in September/2010 when a reclassification of the villages was

done. Another descriptive analysis was done, involving the number of professional participants and the reclassification of the villages as users or non-users. To evaluate the effect of the health seminars, McNemar test for correlated samples was used. The objective was to verify classification changes after the seminars. Chi-Square test was again used to evaluate the influence of doctors and nurse participation.

## Results

First Phase: 16 telehealth workshops were done involving 245 villages and 1,333 professionals and 45 villages were visited training 1,308 professionals. From a total of 2,641 professionals trained, 7.69% were doctors and 18.44% nurses. The classification as "User" or "Non-User" of teleconsultation system by March/2010 can be seen at Table I. Visited villages had larger number of users. Binomial test confirmed descriptive analysis with p-value < 0.001.

Table I – Classification of participating villages after First Phase regarding use of teleconsultation in March/2010

| Village Classification | Telehealth Workshops | | Visits | |
|---|---|---|---|---|
| | n | % | n | % |
| User | 44 | 17.96 | 18 | 40.00 |
| Non User | 201 | 82.04 | 27 | 60.00 |
| Total | 245 | 100.00 | 45 | 100.00 |

Results from descriptive analysis and Chi-Square test show an association between doctors and nurses participation and the use of teleconsultation. OR calculation shows that the chance of a village that had sent doctor for training to become a user is 2.21 ($CI_{95\%}$ = [1.23; 3.95]) higher than the village that did not send. Regarding nurse participation the chances are 4.31 ($CI_{95\%}$ = [1.29; 14.43]). Tables II and III show these results.

Second Phase: 6 Health Seminars were done with participation of 277 villages and 1,040 professionals (21.73% doctors and 34.62% nurses). In September/2010, the classification User and Non-User was done. The descriptive analysis showed an increase of Users, as can be seen on Table IV.

Table II – Descriptive analysis and Chi-Square test of influence of doctor participation on First Phase regarding use of teleconsultation

| Village Classification | Doctor participation | | Without doctor participation | |
|---|---|---|---|---|
| | n | % | n | % |
| User | 40 | 27.97 | 22 | 14.97 |
| Non User | 103 | 72.03 | 125 | 85.03 |
| Total | 143 | 100.00 | 147 | 100.00 |

| | |
|---|---|
| p-value of chi-square test | 0.006 |
| OR | 2.21 |

Table III – Descriptive analysis and Chi-Square test of influence of nurse participation on First Phase regarding use of teleconsultation

| Village Classification | Nurse participation | | Without nurse participation | |
|---|---|---|---|---|
| | n | % | n | % |
| User | 59 | 23.98 | 3 | 6.82 |
| Non User | 187 | 76.02 | 41 | 93.18 |
| Total | 246 | 100.00 | 44 | 100.00 |
| p-value of chi-square test | 0.011 | | | |
| OR | 4.31 | | | |

Table IV – Classification comparison of participating villages regarding use of teleconsultation in March/2010 and September/2010

| Village Classification | March/2010 | | September/2010 | |
|---|---|---|---|---|
| | n | % | n | % |
| User | 56 | 20.22 | 113 | 40.79 |
| Non User | 221 | 79.78 | 164 | 59.21 |
| Total | 277 | 100.00 | 277 | 100.00 |

Mc Nemar test showed that the increase of Users was significant (p-value < 0.001). Chi-Square test was used to analyze the effect of doctor and nurse participation. The results did not show evidences of association (doctors p-value=0.1293 and OR:1.46 $CI_{95\%}$=[0.89; 2.40]; nurses p-value=0.8124 and OR:0.92 $CI_{95\%}$ = [0.47; 1.82]).

## Conclusion

A comparison between two methodologies for telehealth service implementation, workshops and visits used in the First Phase, showed that visits are twice more effective regarding the use of teleconsultation. Doctor and nurse participation also increases the chances of utilization of the system.

Health seminars, used in the Second Phase, were important to increase the number of teleconsultation users. However, there is not evidence that doctor and nurse participation in that phase had influence on the number of villages using teleconsultation. Personal contact between users and clinical staff at these seminars seems to be an important factor to increase the number of users as well the implicit compromise of using the equipment delivered.

Finally it can be assumed that important factors to a successful teleconsultation implementation are (i) a local visit to understand users' reality and demands (ii) to encourage doctors and nurses participation, for example, incorporating scientific clinical subjects (iii) to deliver equipments specifically to be used for telehealth and (iv) to promote personal contact between users and clinical staff.


## Acknowledgment

To the State Health Department for supporting the use of telehealth as a tool to assist public health system in Minas Gerais.


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# Technical Impact of eHealth: A Business Case Ensues

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***Abstract:*** **The business case under scan is one of the many projects undertaken by Centre for Development of Advanced Computing to overcome the barriers in the delivery of Health care. The objective was to electronically link Specialist Eye care centre in the District Dahod (in the state of Gujarat) with the District Banswara (in the state of Rajasthan) along with a mobile Van that can travel in the most unreachable areas in the nearby villages. The result on the usage of the network was overwhelming and the responses from the stakeholders were encouraging towards the technology as well as the telecommunication network. The tele-ophthalmology application implemented under the project ameliorated the barriers of distance and expert availability for the local village dwellers in the far-flung regions. The impact analysis of the established tele-ophthalmic network on the beneficiaries and practitioners is the major outcome of this project and makes the core finding of this business case. Facilitation of communication network has the maximum affect on the lives of the locale habitant established under the project. Though, the skimpy presence of Internet Service Providers in the region with the requisite telecommunication infrastructure of static IP address and dedicated connectivity of minimum bandwidth (384kbps) was a major vault, we, however, overcame it by incorporating ISDN connectivity for the static sites in Dahod and Banswara. This tried and tested network of three ISDN lines proved to be a boon for the end users and facilitated electronic transfer of medical records of the patients as well as video conferencing sessions between doctor and patient without much hassle. However, the crunched bandwidth availability on wireless networks limited the mobile van connectivity to a shared connection through USB interfaced Data cards (with 256 kbps shared bandwidth) with dynamic IP address, thereby, only data transfer is possible and no sessions of Video conferencing is permissible. Even though the wireless connection was decent, it sometimes goes off in interior regions causing**

**offline collection of data that is send later on when the connectivity resumes! The case envisions the impact of the technology on the users by providing data analysis based on the real figures of patients visited the centre as well as the mobile van. This shall strengthen the possibility of replicating telemedicine technology implementation in similar scenario in India as well as abroad, by trusting it as a good practice.**

## Introduction

The Ministry of Health and Family Welfare targeted 700,000 and 300,000 cataract surgeries in the state of Gujarat and Rajasthan respectively [1]. This clearly speculates the present condition of eye care facility in this part of India majorly dominated by tribal clan. The only way out to eradicate this dismal condition is to provide expert eye care at the patient's door step and then watchful monitoring the post operative patients.

Centre for Development of Advanced Computing Mohali centre in Punjab [2] has joined hands with Drishti Netralaya in Dahod Gujarat[3] to set up Teleophthalmology centers at grass root level to achieve the above stated solution. Figure 1 depicts the centres connected under the project.


Figure 1

Connecting the centres was a challenge as the present condition of bandwidth reliability and speed is quite poor in India. There is a huge trade off between Quality of Service and Cost of Service. We managed to establish the connectivity between the two fixed centres namely Drashti Netralaya Dahod and Health centre Banswara through ISDN Connectivity and the mobile van through Data Card. The same is depicted below in figure 2.

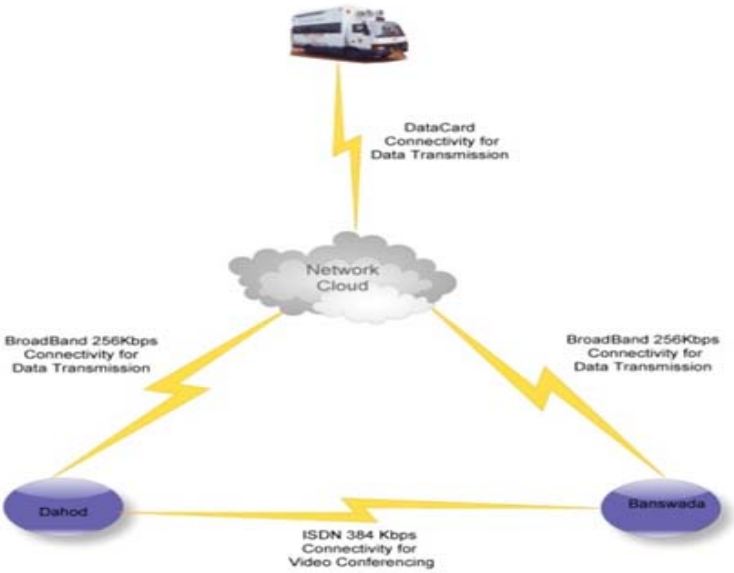
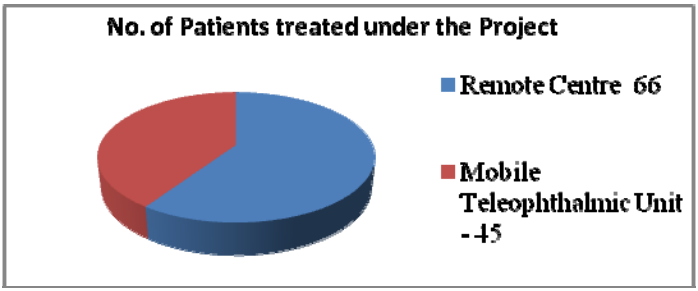
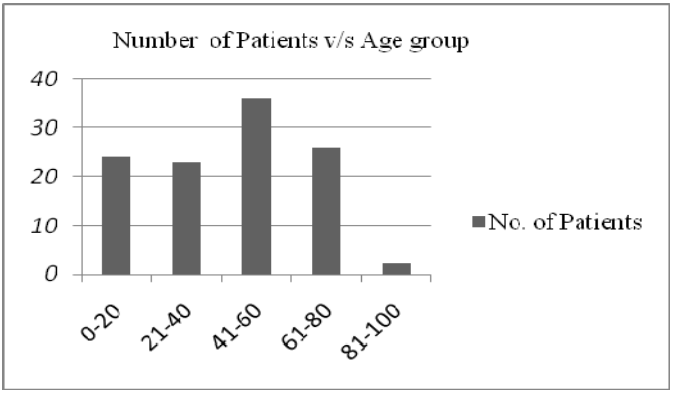



Figure 2

The project received overwhelming response in its very first year of deployment. Not only patients from Banswara ophthalmic unit were benefitted but also people from nearby expanses were attracted to this noble initiative to curb curable eye disorders, non treatment of those leads to blindness.

The tables below describe the analysis of patients cured under the project.



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# The Role of Telepsychiatry in the Rural Settings of SE Cyclades: Providing Cost-Effective Services with a De-Stigmatizing Approach

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***Abstract:*** **Greece is a country with many islands and islets which are not easily accessible due to distance, weather conditions, lack of scientific staff etc. Due to these conditions, mental health care provision to the people of those areas has been limited to General practitioners and medical doctors with no specialization at all. Telepsychiatry gave the opportunity to offer mental health care services to residents in areas as the above ones. SE Cyclades consist of 13 islands with a population of 40.000 that greatly increase during the summer. For the whole geographical area there was no mental health professional neither in a public hospital nor in private practice. Since 2003 the Mobile Mental health Unit (MMHU) of SE Cyclades has offered its services through telepsychiatry to 4.000 patients. In addition, telepsychiatry is integrated into daily practice in order to offer: 24hour emergency support, multidisciplinary treatment, educational and administrative support. Telepsychiatry has also been of great value for the reduction of involuntary hospitalizations to psychiatric institutes and to destigmatization policies. During the years 2005-2009 the MMHU received 84 referrals from the attorney of Naxos in order to report if there was a reason for involuntary hospitalization. All the diagnostic and therapeutic procedures were conducted through telepsychiatry and for the 48% of the cases, treatment to the community instead of hospitalization was offered. Records and statistical data of the patients that were served during the operation of telepsychiatry will be presented as well as the way that telepsychiatry was integrated into the daily routine practice to offer cost-effective services with a de-stigmatizing approach.**

## Introduction

KLIMAKA is a nongovernmental organization active in the field of mental health and social exclusion. KLIMAKA's activities regarding community mental health services include the Mobile Mental Health Unit of

SE Cyclades (M.M.H.U.SE.C.) that was established in 2003 in order to offer mental health services to 13 remote islands where neither psychiatrist nor psychologist existed before. SE Cyclades consist of 13 islands with a population of 40.000 that greatly increase during summer. The main challenges were the increased stigma that was associated with mental illness and the fact that it was difficult to engage psychiatrists to travel periodically and through difficult weather conditions. In response to the above needs telepsychiatry was integrated into the routine practice of the unit. 5 telepsychiatry units were established in 5 islands (Naxos, Santorini, Amorgos, Ios, Sikinos) to offer psychiatric services. In order to facilitate the use of telepsychiatry and enrich the services provided in terms of mental health promotion, each unit occupies a psychologist and/or an administrative assistant.

In order to ensure the quality of the communication between the remote psychiatrist, psychologist, social worker and the patient the means of telepsychiatry include: teleconference equipment, an ISDN telephone connection running at 128kb and shared electronic medical files.

## Services offered via telepsychiatry

The M.M.H.U.SE.C. occupies full time 4 administrative assistants in Naxos, Sikinos, Amorgos and Ios, 4 psychiatrists in Athens, 3 clinical psychologists based in Naxos, Santorini and Athens, 4 social workers in Athens and one ICT technician. It accepts referrals from the police, coast guard, general hospital, community health centres, schools, attorney, self-referrals etc. The services offered include: evaluation of patients and diagnosis, treatment, psychotherapeutic approaches, medication prescription, psychoeducation activities, forensic medical reports, 24hr emergency support, educational activities, staff supervision etc. Since 2003, 4.000 persons were the beneficiaries of the above mentioned services. Fig. 1 reflects the increasing acceptability of telepsychiatry as a means of offering mental health services.

## What has been happening before telepsychiatry?

Given the fact that the years before 2003 there was no mental health services available for the residents of SE Cyclades if somebody needed any

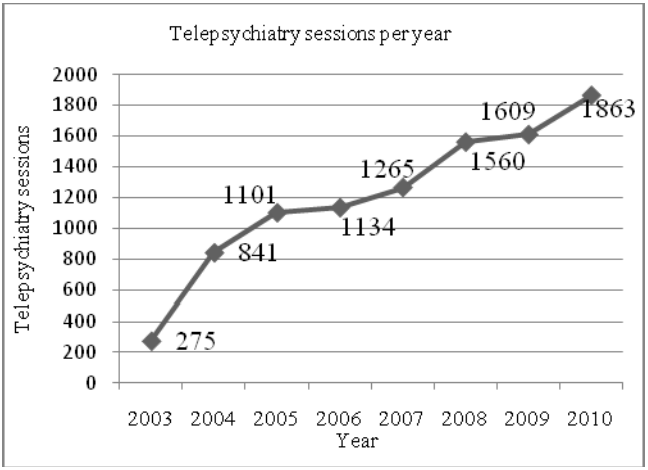

Figure 1

psychological or psychiatric consultation she/he had to visit Athens or the public hospital of Syros. If the weather conditions were acceptable this involved a 4 to14 hours boat trip depending on the island of departure. In case of emergencies, such as acute psychotic episodes or suicide attempts, the patient was transferred to the police station, very often in handcuffs, awaiting an available ship departure. Then he/she was escorted by a police officer and a general doctor to a psychiatric hospital in Athens in order to be involuntarily hospitalized. Obviously, this process entailed high costs, questionable therapeutic effects and intense stigma for patients and their families.

## Cooperation of the Mobile Mental Health Unit of SE Cyclades with the Attorney of Naxos

During the years 2005-2009 the psychiatric service of the M.M.H.U.SE.C. received 133 referrals from the attorney of Naxos.49 referrals concerned the conduction of forensic medical report to be used in court. In 84 cases the psychiatric service was ordered to report if the criteria for involuntary hospitalization were met. All the evaluations and treatments mentioned were carried out via telepsychiatry. In these 84 cases the 72% (60) of the patients were diagnosed with a psychotic disorder, 14% (12) with alcohol abuse and 4% (3) with bipolar disorder. In 40 out of 84 cases the psychiatric service reported that the criteria for involuntary hospitalization were not met and that treatment in community was feasible.

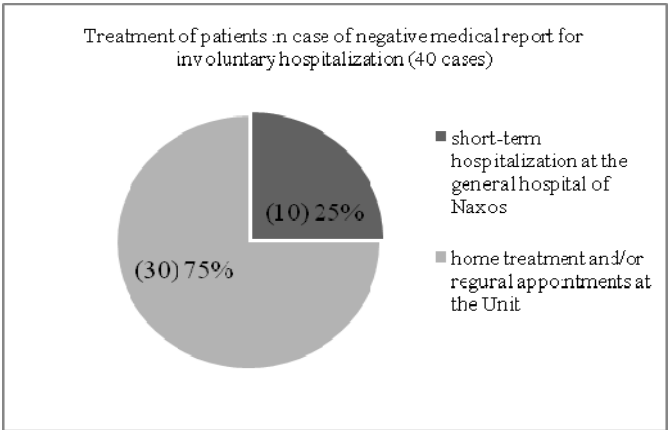


Figure 2

Fig. 2 shows the treatments that were implemented for the cases that involuntary hospitalization to a psychiatric hospital of Athens was avoided.

## Conclusion

Given the geography of Greece, telepsychiatry has a lot to offer for the realization of quality community mental health services. In the case of the Mobile Mental Health Unit of SE Cyclades telepsychiatry was proven to be an effective means of providing regular therapeutic activities but the most important emergency support. The ability to offer 24hour interventions in case of emergency led to the avoidance of involuntary hospitalization for a significant number of patients. Instead, treatment in community, cost-effectiveness and decreased stigma were achieved.

…Ms Garoni Dorothy has been working as psychologist at the Greek NGO KLIMAKA since 2007. KLIMAKA works in the field of mental health and social exclusion. Ms Garoni is responsible for the coordination of research activities of the Mobile Mental Health Unit of SE Cyclades and coordinator of the Department of psychosocial support to prisoners and prison staff. One of her main interests include the applications of telematics to offer mental health services to remote areas and to closed systems such as prisons.

# Distance Consultations and Chronic Disease Management

# A New Challenge for Sanoia.com: Orphan Diseases

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*Abstract:* **The European Organization for Rare Diseases (EURORDIS) has listed yet up to 7,000 distinct rare diseases affecting more than 5% of the European population. Many patients suffering these rare diseases have first experienced a lack of information about both the disease itself and about where to obtain help from qualified professionals or online resources. Nowadays, on the contrary, concerns about security, privacy and ubiquitous access have emerged and represent now true limitations for on-line use of personal data. To address this situation, AIMSU and La Conception Hospital Internal Medicine department have decided to collaborate and provide a dedicated SANOIA.COM access to patients with a rare disease: Immune Thrombocytopenic Purpura (ITP). This system should allow patients to have a permanent access to their important medical data and to specific online resources, but also to self-report about symptoms, medical analysis or environmental factors. Ultimately, data-mining could offer a non-biased approach to discover unanticipated correlations and help redefine the definition of these rare diseases from patients' point of view.**

## Introduction

Orphan diseases, also referred as rare diseases, affect a small percentage of the population (less than 50 for 100 000). However, the European Organization for Rare Diseases (EURORDIS) has listed yet up to 7,000 distinct rare diseases affecting more than 5% of the European population [1]. These patients have first experienced a lack of information about both the disease itself and about where to obtain help from qualified professionals. To address this situation, several actions have been conducted like the implementation in 1997 of the online information server Orphanet [2], and recently, the development of online communities for rare diseases by EURORDIS [1]. Aiming to develop new ways to use the Web 2.0

resources in order to improve the daily lives of ITP patients, we hypothesized that SANOIA might be very useful by many aspects for patients living with this very rare disease. Indeed, SANOIA has demonstrated at the MED-E-TEL 2010 edition its relevance based on patient driven medical information, anonymity and ubiquitously accessible through a unique and secured number [3], and would allow them to directly and concretely participate to it via self-reporting about symptoms, medical analysis but also the influence of environmental factors (food, toxics, ...).

## The ITP experimentation: aims and evaluations

We aim to know how the use of a version of SANOIA dedicated to ITP impact the health related quality of life (HRQuol) of patients with ITP. Sixty consecutive ITP patients will be enrolled from the department of Internal Medicine (Universitary Hospital la Conception, Marseille, France). Demographic and medical data of these patients will be recorded at inclusion. The study received local Institutional Review Board approval and each patient will provide written informed consent before enroling. Patients will have to meet the following inclusion criteria: primary autoimmune thrombocytopenia according to American society guidelines; age between 18 and 65 years; permanent web access. Exclusion criteria include neuropsychiatric severe conditions and/or language problems. These patients will be randomized in 3 different groups: a control group (patients without SANOIA interface), and two other groups of patients having SANOIA, respectively with or without medico-technic hotline (phone and email). HRQuol will be assessed using the ITP-PAQ, that consists of 44 questions organized into 10 scales measuring Physical Health (Symptoms, Bother, Fatigue and Activity Scales), Emotional Health (Fear and Psychological Health Scales), Work, Social Activity, Women's Reproductive Health (which includes menstrual symptoms and fertility) and Overall QoL [4]. These 44 questions are designed to quantify feelings, such as fear of bleeding or hospitalization, bother due to ITP symptoms and limitations on physical, social or work function due to ITP symptoms or treatment side effects. Items are scored on Likert-type Scales of various sizes. ITP-PAQ scores will be evaluated for all patients at baseline, month 1, month 3 and month 6. Change in ITP-PAQ scores from baseline to month 6 is the primary endpoint. Additional considerations about the "real life" usefulness of SANOIA during medical or paramedical consultations will also be assessed, as well as the access via SANOIA to specific resources available for patients and their caregivers (ie, link to the emergency therapeutic protocol for ITP, open self-reporting).

We imagine the generation of a large and evolving database including symptoms, medical events and treatments, intercurrents events, environmental parameters self-reported by patients diagnosed with one or more of the 7000 orphan diseases. The self-reporting will be possible because of the wide implementation of an informatic interface (web and/or mobile access) all across Europe countries (diffused with the help of associations of patients, medical community and general medias), and will be performed by voluntary patients, already diagnosed for one of these diseases. Outputs from this first-round analysis should be shared with patients, medical community but also epidemiologic or environmental disciplines to determine parameters that are relevant enough to be implemented in the ongoing self-reporting (Fig. 1)

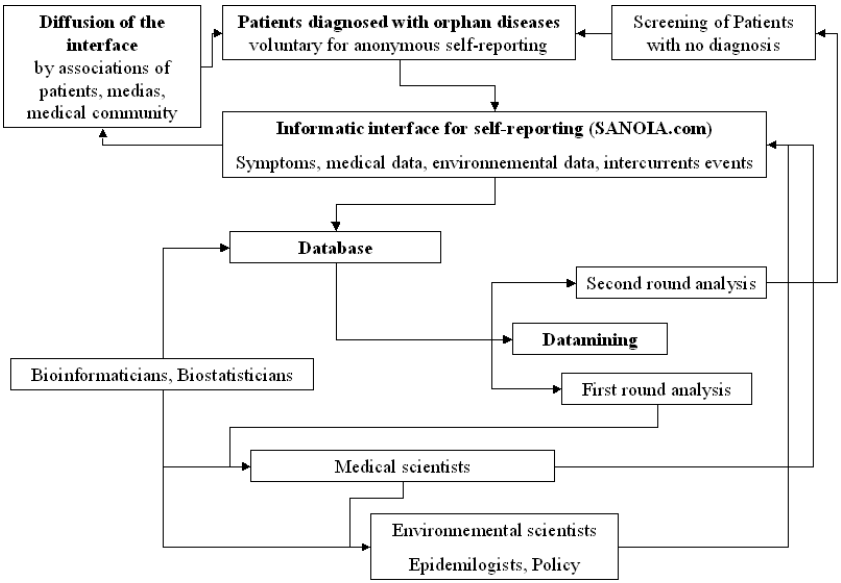


Figure 1: Patients' data driven research.

## Conclusion

Data-mining could offer a non-biased (non-hypothesis driven) approach to discover unanticipated correlations and help redefine the definition (or "signature") of these rare diseases from patients point of view. If the ITP experimentation proves successful, we aim to diffuse this interface to many

other orphan diseases. As orphan drugs meet even more needs in pharmacovigilance than more common medications [5], we could design modules to help to patient to directly report to the European agencies and/or to be alerted immediately about new side-effects of their ongoing or past medications. Finally, because they are naive from standard medical knowledge, "expert" of their own disease with often a strong motivation to improve its knowledge, empowerment of patients with orphan diseases might provide a unique new source of large scale scientific data.


## Acknowledgment

Laurent Chiche thanks Dominique Donnet-Kamel (INSERM, Mission Associations), Viviane Willlis-Mazzichi (European Commission, Scientific Culture and Gender Issues), and Afonso Ferreira (CNRS, INS2I, Institute for Computer Sciences) for their valuable advice and encouragement. Sponsor: Orange Healthcare (co-development of a mobile access version).


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# Affordable Location Based Services (LBS) to assist Alzheimer's Disease Patients

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***Abstract:*** **The paper presents the research activity and outcomes of a project aimed at the design and testing of Location Based Services and anti escape solutions for Alzheimer Disease patients and their caregivers.**

## Introduction

Patients with dementia and Alzheimer's Disease (AD) at the early stage of the illness may be subject to episodes of confusion and space-time disorientation. This often happens in unpredictable ways, with consequences that sometimes can be very serious. With the progress of the disease, the escape and wandering can become symptomatic and recurrent events. Currently, the problem lies completely on the families, which without other solutions, often get to drastic measures, reducing patient's freedom. When this is not possible, they live in a state of continuous stress whenever their relative moves away.

Location Based Services (LBS) can probably represent a useful help.

Several technologies, mostly used in contexts such as car navigation, personal tracking, fleet management and social networking, can provide - with the appropriate customizations – a support in preventing the escape and locating the patients suffering of AD. In particular, services based on personal trackers and/or applications for smart-phones can improve the personal safety of patients and, at the same time, meet the caregivers' needs, both in everyday life and possible emergency situations. This paper describes a research aimed to design, prototype and test affordable services to prevent the escape and locate AD patients.

## Methodology

The research has been carried out according with the User Centered Approach principles: users have been involved in the design process, since the early stages. The first phase of the design process was the problem setting and the users' requirements collection. Interviews and meetings with geriatricians, patients and caregivers brought us to define some basic service requirements. Due to the degenerative nature of the illness, the solutions must provide: flexibility and modularity, intuitive affordances and easiness of use, reliability, battery autonomy, portability, affordability and respect of privacy issues.

Tests with real users have been carried out at different stages of the project, providing constant feedback to the service development.

## Prototyping & User tests

The basic components of LBS are: a localizer device for the patient (mobile phone/personal tracker), a device for the caregiver (connected to the Internet) and a Service Center software application. The LBS can be self-managed or mediated by a Service Center or provided with a mixed approach.

The main functions that LBS can deploy are: location on-demand, continuous tracking and geo-fencing (secure/comfort zone). A scouting about on-the-shelf technologies and services has been conducted in order to identify the hardware components. Trackers, simplified mobile phones, low cost smart-phones and location applications have been selected and tested in laboratory. Particular attention has been paid to battery autonomy (at least 48 hours in standby), GPS (Global Positioning System) sensitivity, reliability and cost (we fixed a threshold of 200€ as maximum cost for the devices).

At the end of the tests, two smart phones (Nokia E52 and Nokia 5230) and two free of charge applications for smart-phone (Google Latitude, addressed to social network users; Phone Locator, used to localize a missed/stolen phone) have been selected. With these components the first version of the service model has been tested in a short field trial, involving two elderly people and their caregivers. The outcomes of the trial provided detailed specifications to develop a new software application, better addressing users' needs. The application "*Sono Qui*" ("*Here I Am*"), based on the Qt Library for Symbian, developed for the patient's device (Fig.1a), enables location on-demand, tracking and geo-fencing: the application automatically starts when the phone is switched on and it works in background.

To locate the patient, the caregiver has to send a SMS from his own mobile phone (no application is required) to the patient's mobile phone. Here, the SMS from an authorized phone activates the "*Sono Qui*" application that performs a fix (by means of Assisted-GPS or cell-id method); it can carry out reverse geo-coding to provide the corresponding address, and finally replies via SMS to the caregiver.

The message contains the hyperlink to a Map Server, the address (if available), the fix accuracy in meters, the patient's mobile battery level and the fix timing.

Moreover, "*Sono Qui*" enables the continuous tracking (activated via SMS as well) useful in case of the patient's loss, for the rescue operations. *"Sono Qui"* could be adopted by the patients at the early phase of the disease, when they still use the mobile phone. Since the application does not require any active action by the patients, it keeps be useful also with a disease evolution. Patients must only carry the smart-phone with them, as a personal tracker.


*a* *b* *c* *d*

Figure 1 a) Smart phone with Sono Qui application, b) Smart phone with simplified touch interface, c) key holder tracker, d) low cost anti-escape solution.

In order to facilitate patients at the early stage of AD, we developed a prototype of a simplified phone interface for touch screen device (Fig.1b). It has main contact pictures larger than usual and includes a soft SOS panic button.

Finally, for those patients suffering from a dramatic autonomy reduction, a very low cost anti-escape solution for home environment has been prototyped. It is based on an intelligent low power consumption threshold strip to be placed near the exit door, a modified slipper and a wireless sound alarm (Fig.1d). This solution allows one to detect the exit of the person wearing the slipper. It is easy to install and the cost of all materials is under 30 €!

Usability and acceptance of the evaluated and developed solutions (shown in Fig.1) have been tested with end-users, in a geriatric day hospital

context, involving a sample of 109 end users. The technology confidence and the stress level of caregivers have been assessed by means of a dedicated questionnaire [1] and the Caregiver Burden Inventory (CBI). The patients have been classified by the Mini Mental State Examination (MMSE).

The user tests involved 57 patients, with a mean age of 79, a MMSE range between 25 (mild) and 4 (severe); the distribution of dementia was: 33 (58%) mild, 19 (33%) moderate, 5 (9%) severe. Most of them (82%) have a mobile phone, 47% use it sometimes in a week's time. 51% of patients have had one or more loss episodes.

The 52 interviewed caregivers (74% females) have a mean age of 57: 51% are consensus adopter of technology [2], they commonly use the mobile phone and PC/internet for doing the basic tasks (SMS, email, browsing); 31% are early/innovator adopters of new technology; 18% are cautious adopter. The CBI shows a range between 0/96 (no stress) and 79/96 (high stress level), and average of 25.

Outcomes show that mobile phones are more familiar and acceptable than personal trackers (54% prefer mobile phones; 18% prefer the personal tracker). Caregivers as well prefer the mobile phone, since it offers the possibility to call relatives, if needed, and since 51% fear that their patients "will not accept to carry the object with them". The usability of the tested mobile phone is discrete: 30% of patients are able to correctly answer to a phone call. The interaction with the phone is extremely improved by the simplified touch interface we developed (51% of tasks successfully ended).

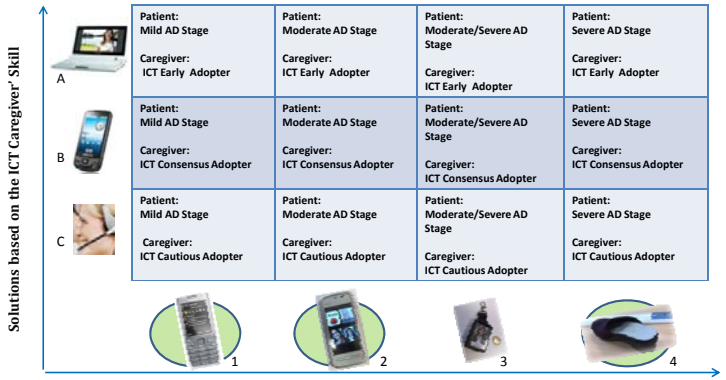
## Conclusions

LBS should be based on usable and acceptable devices (the simplified touch-screen interface has been very much appreciated by patients and caregivers) and the service model should meet various needs: self-managed solutions will be easier to be adopted in a near future; nevertheless nowadays, in our view, it should be better to support an emergency location service also with a seven days available Call Center in order to increase service accessibility.

Patients' abilities and caregivers' needs change during the disease; for that reason, patient's disease stage and caregiver's technological skills should require different solutions, as shown in the two-dimension matrix (Fig.2), summarizing solutions and service models we evaluated, developed and tested within our research.

As a conclusion of the project, a field trial will be conducted from March to June 2011, to test the solutions in everyday life situations with final users that have voluntarily joined the initiative. The experience will get further

developments needs and a technological transfer of more effective solutions.




**Caregiver uses:**

**A) smart-phone and Internet** → *Self managed service (Internet access)*

**B) the mobile phone to call, send and receive SMS** → *Self managed service (eventually supported by a Call Centre)*

**C) the mobile phone to call** → *Service supported by a Call Centre*

**Patient uses**

1. **mobile phone to call and receive and goes out alone** → *mobile phone + "Sono qui"*
2. **mobile phone only to receive and goes out alone** → *mobile phone + "Sono qui" + simplified touch GUI*

Figure 2: two-dimension matrix of Solutions

## Acknowledgment

This work has been funded by the Regione Piemonte Innovation and Research Department, and it is part of the Personal Health Services Project under the CLab Salute activity.

We would thank prof. G. Malnati of Politecnico di Torino and his collaborators A. Nassisi and G. Caputo for the precious support in the development of the Simplified Address Book Interface and the Intelligent Threshold.

Special thanks go also to the very motivated nursing staff of the Geriatrics Department of San Giovanni Battista Hospital of Turin for their enthusiasm.

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# Applications of Tactile Interfaces to Home Automation for People in Loss of Autonomy: Training for Memory Gestures

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***Abstract:*** **Tactile technologies are continuously evolving and now equip many devices. Depending on the level of autonomy and the ability of the person, the adequate interface can generate an effect of continuity between the user and his environment, an effect of harmony between his body and the interface. A study improving tactile interfaces by taking into account the memory of gestures is reported under a semiotic approach.**

## Introduction and context

Many applications of tactile technologies are emerging for people in loss of autonomy. Surveys show that few older people use touch interfaces (between 6 and 15% for people over 70 years against 83% for those under 35). The causes are lack of skills, lack of interest, fear of not being able to use it, health problems, or the cost of equipment. However, another French survey [1] shows that, if the mobile phone is the tactile object the most commonly owned today, the most wanted tactile devices are equipments for disabled people (71%), followed by classical comfort home automation equipments. In this frame, tactile technology can be used more intuitively by elders and disabled people, because they are more intuitive.

To improve tactile interfaces, it is important to take into account the memory of gestures, especially for people with reduced autonomy because the gesture used to interact with the interface is not always obvious. This implies that the functional signs (icons, buttons) and gestural modes of interaction (gestures required for a particular action) are fully embedded in their memories of daily practices. Because each handicap situation is unique, custom and updatable interfaces based on physical and mental skills of each user must be designed. To help disabled people to take possession of the interface and to reactivate their memory of gestures, several parameters must be taken into account: the continuous aspect of the gesture

(to increase the sense of proximity to the object), a maximum contextual speed response and a minimum wait in the resulting action, the accuracy of the system response to the gesture, the adequate feedback of the interface. Tactile feedback information is detected by the surface layer of the skin and can thus be generated as vibrations, textures or temperatures. Depending on the level of autonomy and the ability of the person, the adequate interface can generate an effect of continuity between the user and his environment, an effect of harmony between his body and the interface. The interface is then experienced as an extension of the body of the user.

## The capacity of technology appropriation by the person

The problem facing a touch interface remains a generational problem temporary, since future generations will more easily master interfaces. It is the same for people with reduced autonomy. Fig. 1 shows the results of a study on 24 people (2 groups of 12, 17 women and 7 men) aged between 70 and 95 years (average age 86) suffering physical dependency or cognitive "light". Each group had to provide a particular type of interface, mouse or touch. The touch interface will prove to be more simple, because more intuitive and more fun.

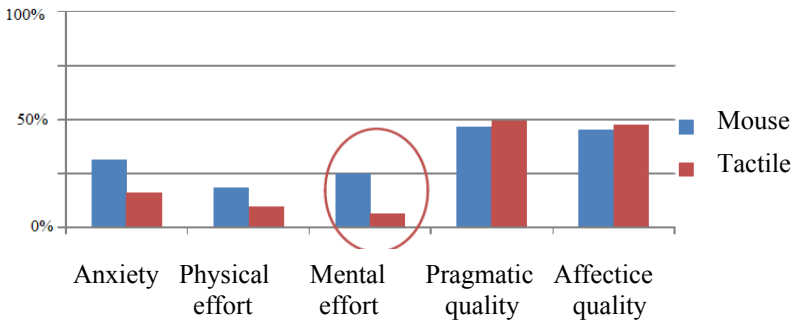


Fig. 1: The parameters of appropriation of tactile technologies [1]

## The memory of gesture: the semiotic approach

To improve tactile interfaces, it is important to take into account the memory of gestures. Especially for people with reduced autonomy because the gesture used to interact with the touch interface is not always obvious to manage in the daily life. They do not want to focus their attention on learning of a system of controls, but they need to feel reassured by the

device. This implies that the functional signs (icons, buttons) and gestural modes of interaction (gesture required for a particular action) are fully embedded in their memories for the daily practices.

Each disability situation is unique, thus we suggest to design custom interfaces and scalable, based on physical and mental skills of each user. In order to provide insurance to dependents and reactivate their memory of acts; several parameters should be taken into account:

*The appearance of continuous movement*

To increase the sense of proximity regarding the object, For example, the combination of gesture movement when pressing a button to lower the roller blind is not obvious. On the contrary, to make a gesture representing the roller blind that goes down is more relevant to the person. It is important that the user has a sense of continuity in the interaction and the interface is seen as a direct extension of the body.

*The appearance of the shorter possible time for the outcome*

For example when the user makes the gesture of lowering the roller blind on the icon, it means that the real action on the object takes place simultaneously.

*The accuracy of the system response to the gesture*

When the action of the user is interpreted as appropriative or false by the user, it gives an effect of non-mastery of the subject.

*Returns / feedbacks*

As part of a human-computer interaction, feedback, whether visual, auditory, or tactile are essential. We consider the tactile feedback as information perceived by the surface layer of our skin, in opposition to the force feedback that includes movements perceptible by the muscles, tendons and joints.

Our skin is composed of thermosensors (hot and cold) and mechanosensors. These sensors allow us to react to different sensations / stimuli (the sensation of weight, shape and volume, rigidity and elasticity, slip, and temperature). The tactile feedback can thus take the form of vibrations, but also textures, or temperatures.

## Comments

Depending on the degree of loss of autonomy and competence of the person, we can, taking into account relevant criteria, generate an effect of continuity between the user and his environment, an effect of harmony between his body and the objects. The interface is then experienced as an extension of the body of the user. Thus, in the case of a blind person, the

use of sensory sounds seems perfectly appropriate, in addition to the use of continuous gestures. For a person suffering from a debilitating disease of the hands and arms, it will obviously favor a voice interface, but take into account the noise characteristics of the contact with the object, the precision of speech recognition, features figurative functional signs.

## Conclusion

Technology can be a problem because of the generation of performance and complexity of use. The designers of tactile interfaces do not necessarily think people losing their autonomy in developing their products. They use unintuitive features and it is for the person to adapt to technology. That is why the study on memory gesture taking into account the various losses of autonomy is important. They allow understanding the interest of making things simple for the appropriation of interfaces by the person.

It is no longer the person to adapt to the interface but the interface to suit the individual.

## References

[1] www.marsouin.org

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# Compare Psychiatric Consultation Face-To-Face and Telepsychiatry

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## Introduction

Telemedicine is one means of providing expert medical treatment to patients distant from a source of care. Pilot studies in telepsychiatry have been conducted since the 1950s. In response to new developments and interest in the area of telepsychiatry, literature on this topic has greatly increased over the past ten years (many articles the MEDLINE, PsycINFO, and Telemedicine Information Exchange (TIE) databases included literature on telepsychiatry applications). Specific forms of treatments and assessments delivered via telepsychiatry have been reported, such as cognitive-behavioral therapy (CBT) delivered via telepsychiatry. Neuropsychological assessments also have been conducted via telepsychiatry, although with mixed results. The use of telepsychiatry with geriatric patients is growing and projects with focus on prison populations and veteran populations. Videoconferencing has been examined as an educational and consultative tool for mental health treatment providers and other health care providers. Recent studies highlighted positive and negative aspects of the use of telepsychiatry for clinical assessments. To use this new technology in psychiatry, it must be demonstrated that psychiatric diagnosis and treatment conducted remotely via telecommunication is as reliable and effective as diagnosis and treatment conducted in person. Telepsychiatry is appropriate for a variety of forensic uses, including patient assessment for involuntary commitment and for conducting commitment hearings. Critical factors specific to forensics services are examined, as are those specific to telepsychiatry, including transmission mode, privacy and confidentiality, expense, quality of care, face-to-face versus video transmission, user satisfaction, and liability concerns in the use of telepsychiatry (1-4). Main question is telepsychiatric treatment same (or similar) with to in-peron treatment? Researchers have established that telepsychiatry can provide a reliable diagnosis of common psychiatric disorders and accurate assessments of cognitive, depressive, anxiety, and psychotic symptoms. A patient satisfaction scale was developed to evaluate patient satisfaction with

the in-person versus the remote interview. Telepsychiatry is an increasingly common method of providing psychiatric care, but randomized trials of telepsychiatric treatment compared to in-person treatment have not been done (5-13).

## Methods

The aim of this study is to compare telepsychiatric services wit Face-to-Face Psychiatry. Participants were sampled from referrals to the psychiatric consultation clinic. In this process, we start by prespecifying value of the difference that could be found between face-to-face care and telepsychiatry and still conclude that the two interventions are equivalent.

We explored how 220 participants are satisfied with psychiatric consultation face-to-face care and telepsychiatry. All participants were provided with written and verbal information about the nature of the study and consented to take part. The satisfaction scale was administered twice to each subject. Sample size was determined with Criteria: Inclusion Criteria and Exclusion Criteria. In the research are included total of 220 patients. **Equipment.** The interactive videoconference equipment consisted of a multimedia Dell laptop with additional a Sony screen 40 inch. The connection was made by using internet lines with a bandwidth over 1 Mbps. (Bps- the number of binary digits transmitted per second in a data communication system) **Instrument.** With Client Satisfaction Questionnaire **(CSQ-8)** we observe satisfaction with the clinical service provided to the two groups using a standard questionnaire. Clients get answer for all of the questions by CSQ-8: 1.How would you rate the quality of service you received? 2. Did you get the kind of service you wanted? 3. To what extent has our program met your needs? 4. If a friend were in need of similar help, would you recommend our program to him or her? 5. How satisfied are you with the amount of help you have received? 6. Have the services you received helped you to deal more effectively with your problems? 7. In an overall, general sense, how satisfied are you with the service you have received? 8. If you were to seek help again, would you come back to our program?

**Criteria.** Because of the broad inclusion criteria, we did not limit psychiatric care protocols to a carefully defined, diagnosis-specific, therapeutic intervention. Furthermore, data on services provided suggests that similar care was actually provided to both groups. Inclusion Criteria: Males or females 18 to 60 years of age, from the ex-Yugoslavia region, in good general health; Psychiatric clinical diagnosis; Capable of understanding and willing to provide signed and dated written voluntary informed consent; The ability and willingness to follow all study

procedures, attend all scheduled visits, and successfully complete the study. Exclusion Criteria: Any clinically relevant finding at their baseline physical examination or medical history without ability for follows all study procedures. We minimized exclusion criteria to ensure the inclusion of a broad range of patients, similar to the usual referrals from primary care physicians to psychiatrists.

Table 1 Demographic characteristics of 220 patients referred for psychiatric consultation, by method of consultation.

| | Face to face(N=120) | | Telepsychiatry(N=100) | |
|---|---|---|---|---|
| **Age (years)** | **N** | **%** | **N** | **%** |
| 18–24 | 12 | 10 | 22 | 22 |
| 25–34 | 20 | 16.6 | 32 | 32 |
| 35–44 | 29 | 24.2 | 16 | 16 |
| 45–54 | 35 | 29.2 | 16 | 16 |
| 55–65 | 24 | 20 | 14 | 14 |
| *total* | *120* | *100* | *100* | *100* |
| | | | | |
| **Sex** | | | | |
| Male | 112 | 93.3 | 76 | 76 |
| Female | 8 | 6.7 | 24 | 24 |
| *total* | *120* | *100* | *100* | *100* |
| | | | | |
| **Marital status** | | | | |
| Single | 31 | 25.8 | 67 | 67 |
| Married | 65 | 54.2 | 19 | 19 |
| Separated or divorced | 24 | 20 | 14 | 14 |
| *total* | *120* | *100* | *100* | *100* |

## Results

The study was conducted between 2008 and 2010. Table 1 shows the baseline demographic characteristics and Clinical characteristics of the two groups.

Table 2. Shows clinical characteristics of 220 patients referred for psychiatric consultation, by method of consultation.

| | Face to face(N=120) | | Telepsychiatry(N=100) | |
|---|---|---|---|---|
| **diagnosis** | N | % | N | % |
| Posttraumatic stress disorder | 65 | 54.2 | 69 | 69 |
| Depression | 36 | 30 | 14 | 14 |
| Alcohol or drug abuse or dependence | 6 | 5 | 5 | 5 |
| Personality disorder | 0 | 0 | 4 | 4 |
| Phobic disorder | 2 | 1.7 | 2 | 2 |

| | | | | |
|---|---|---|---|---|
| Obsessive compulsive disorder | 1 | 0.8 | 1 | 1 |
| Other anxiety disorder | 0 | 0 | 5 | 5 |
| Bipolar disorder | 2 | 1.7 | 2 | 2 |
| Psychosis | 7 | 5.8 | 1 | 1 |
| Other disorders | 1 | 0.8 | 2 | 2 |
| total | 120 | 100 | 100 | 100 |
| | | | | |
| **Satisfaction with psychiatric web based consultation** | | | | |
| Full Satisfaction | 117 | 97.5 | 98 | 98 |
| Partial Satisfaction | 2 | 1.7 | 2 | 2 |
| No Satisfaction | 1 | 0.8 | 0 | 0 |
| | | | | |
| Index of the Client Satisfaction Questionnaire-CSQ-8 (M±SD) | 21.7±3.5 | | 22.2±2.8 | |

We used SPSS-16 statistical program. We found very similare results for satisfaction with psychiatric consultation (Full Satisfaction 97.5% in Face to face responders and 98% in telepsychiatric group. Index of the Client Satisfaction Questionnaire **21.7**±3.5 in groups Face to face and 22.2±2.8 in telepsychiatric group).

## Discussion

Using equivalence methods, we demonstrated that psychiatric consultation and short-term follow-up provided by telepsychiatry can produce clinical outcomes that are equivalent to those achieved when patients are assessed and followed in-person. We do not detect a statistically significant difference in telepsychiatric services and face to face psychiatric care. Our result are similar with other research [3,5,7] also suggested that telepsychiatry, used under certain conditions, can reduce cost to service users. The relative cost of telepsychiatry and Face to face (in-person) care is influenced by several factors, such as the distance travelled, volume of patients, and the type of technology. The clinical service provided via telepsychiatry was less expensive than when it was provided in person. This finding coupled with the equivalent clinical outcomes suggests that telepsychiatry can be a cost-effective method for delivering psychiatric services.

We observe satisfaction with the satisfaction with the clinical service provided to the two groups using a standard questionnaire, the CSQ-8. The results demonstrated similar levels of satisfaction in both face-to-face and telepsychiatry groups. This result suggests that clinicians who gain expertise in telepsychiatry will be able to use the medium to diagnose patients effectively. It also suggests that the utility of telepsychiatry may be

applicable to large groups of patients who are underserved by mental health specialists, particularly psychiatrists.

## Conclusions

Satisfaction rates did not differ significantly between the two types of evaluation. The results demonstrated very similar levels of satisfaction in both face-to-face and telepsychiatry groups. Our findings indicate that psychiatric consultation and short-term follow up provided by telepsychiatric services can produce clinical outcomes that are equivalent with patients "face to face". These findings do not necessarily mean that other types of mental health services, for example, various types of psychotherapy, are as effective when provided by telepsychiatry. The results indicate that the remote interviews were generally acceptable to patients.

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# Effective Telemedicine Consultation on the Treatment of Hypertension

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***Abstract:*** **This paper describes how an innovative Finnish ambulatory blood pressure monitoring service is organized and implemented, and illustrates the various benefits of the monitoring method and service model compared to the traditional procedure.**

## Introduction

In ambulatory blood pressure monitoring (ABPM) a patient's blood pressure is measured automatically with a portable device every 30 minutes for a period of 24 hours, resulting in a comprehensive representation of the actual blood pressure level. The ambulatory measurements take place during a normal day in the patient's life, leading to a more realistic account of the patient's blood pressure profile compared to traditional clinical measurements[1].

There are numerous benefits to ambulatory measurements[2], some of which are listed here: With the help of ABPM white coat phenomenon and reverse white coat phenomenon can be detected. The first is the elevating effect of a measurement performed by a health care professional. The second causes the blood pressure to appear lower than usual in a clinical setting. With the help of ambulatory measurements the effects of drug treatment over 24 hours can be evaluated. Test results[3] show that conventional blood pressure measurements in elderly people often produce considerably higher results compared to ambulatory measurements, which can lead to overmedication and ultimately hypotension. Also, with ABPM nocturnal hypertension and variation between daytime and nighttime blood pressure levels can be assessed.

In Finland, municipalities are required by law to organize and finance healthcare for their inhabitants. Primary healthcare is provided by health centers employing mainly general practitioners and nurses. When a general practitioner suspects that a patient needs specialized care, he or she is

usually referred to a secondary care sector hospital. Unfortunately the waiting times for referrals in the secondary care and the distances between municipalities and hospitals can be very long.

The remote analysis service operator equips a healthcare facility with as many monitoring devices as they need without requiring any investments. A nurse sets the patient up with a monitoring device and sends the patient home. On the following day, the patient returns with the device. The nurse then uses a private internet portal to upload the anonymous data to a remote server over a secure connection. The data is checked for accuracy by technicians and then put forward for specialist (cardiologist or internist) analysis. The specialist writes a report complete with treatment recommendations, which is then returned for download at the internet portal.

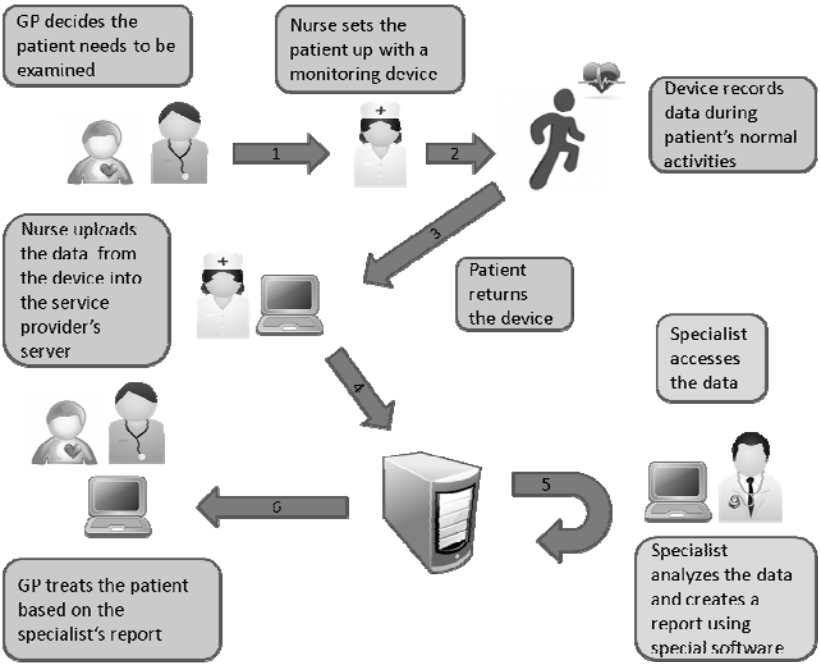


Figure 1. The remote analysis operating model

Charges are based on the number of delivered reports, with a minimum of ten reports per year during a four-year contract period. The innovative service model provides specialist reports to primary care centers, thus making it possible to refer only the patients who actually need secondary

care treatment. Furthermore, with this model the specialists can put their expertise to a much wider use than normally.

In addition to ABPM the system includes sleep apnea monitoring and Holter ECG monitoring services. The service model is in use in over 150 locations all over Finland. In 2010 10347 consultation reports were delivered, of which 1346 were ABPM reports.

## Objectives

This preliminary research project was carried out in order to examine the concrete benefits of the ambulatory blood pressure monitoring method and specialist consultation reports, and to determine the advantages of a telemedicine consultation service. It will be followed by a more extensive project done in collaboration with Laurea University of Applied Sciences. In the follow-up project patients who were treated with the help of specialist remote consultation reports will be observed and the results will be compared with those of a control group of traditionally treated patients. The economic benefits will also be taken into account. The follow-up paper is to be published in 2012.

## Methodology

A quantitative descriptive study was selected as the research method. During March and April of 2010 RA Ltd delivered 247 ABPM reports to Finnish healthcare units. Those were selected as the sample batch for statistical analysis and examined individually. The selection of the sample was based on two requirements: Firstly, the sample had to be large enough to provide a truthful representation of the phenomenon under investigation. Secondly, it had to be recent enough to reflect the current situation of blood pressure management in Finland.

## Results

Of the 247 monitoring, 157 (63.6 %) were performed on females and 90 (36.4 %) on males. The median age was 56 years for females and 53 years for males, the youngest patient being a 16-year-old male and the oldest a 91-year-old female.

The average delivery time of the reports was 69.4 hours (2.9 days) starting from the moment the registration was uploaded into the service operator's server. The delivery time includes weekends and bank holidays.

The analysis showed that two thirds (66.4 %) of the reports included a recommendation to start, stop or adjust medication in some way. These include for example a recommendation to reduce medication of one patient because of white-coat phenomenon and to add a calcium channel blocker to

the existing medication of another patient. Signs of white coat phenomenon were found in 26.7 % of the cases (31.2 % of females and 18.9 % of males). Reverse white coat phenomenon was diagnosed in four cases. Abnormal diurnal variation was diagnosed in 30.3 % of the cases. This figure includes small, large and reverse diurnal variations.

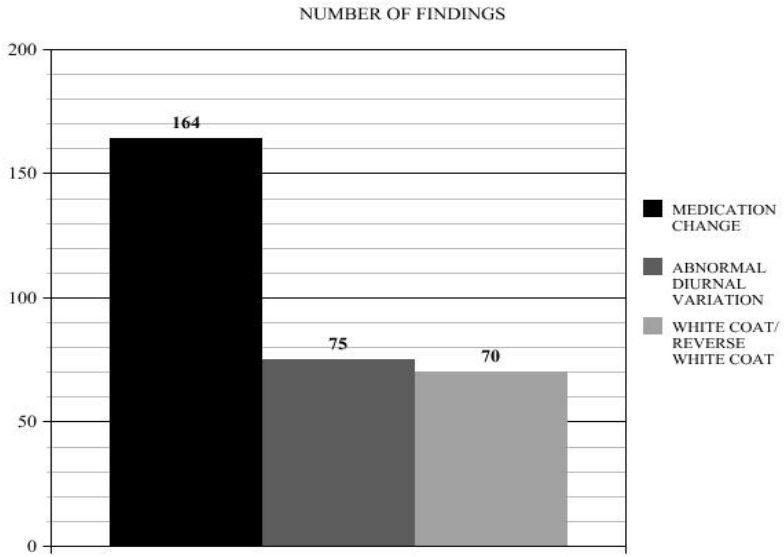


Figure 1. Results

## Conclusion

This report has put forth tangible evidence indicating that the service model of Remote Analysis Ltd is a very useful and efficient way of examining blood pressure. Based on the high incidence of significant findings in the sample it is very apparent that there is a lot of room to improve the quality of care currently provided to hypertension patients. The results suggest that the information in the ABPM reports, along with the specialist's recommendations, helps the general practitioners to treat their patients better.

It is also clear that the model reduces queues to secondary care by allowing patients to be screened very rapidly before referring them. The model also helps to control the costs of specialized care and enhances the accessibility of healthcare. In light of this information is reasonable to conclude that the model should be made a standard tool in healthcare systems globally.

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# IM28, a Complex Molecular Inhibition of HIV Replication and Cardiovascular Risk Reduction

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***Abstract:*** **IM28, an analog of dehydroepiandrosterone (DHEA), inhibits the reverse transcriptase activity, restricts the envelop proteins mediating cell-cell fusion (gp120/gp41) between infected and healthy cells (Mavoungou et al., 2005) and suppress 3TC/AZT resistant clinical isolate HIV-1 (Diallo et al., 2000) *in vitro*. Herein, we tested *in vivo* safety and efficacy of IM28 on volunteers HIV positive patients from Gabon, randomly organized as followed: IM28 alone (15 patients + 30 healthy individuals), IM28+HAART (150 patients), HAART alone (13 patients) and DHEA+HAART (23 patients). All patients were evaluated three times: M0 (pre-treatment with IM28), M1 (after six months of treatment with IM28) and M2 (after 12 months of treatment with IM28).**

## Data

No noticeable side effects were observed for IM28 as evaluated by measuring hepatic, cardiac, renal functions and body weight progression. Compared to HAART therapy, combinations DHEA+HAART, IM28+HAART or IM28, quickly rescued patients from anxiety, restored their appetite and normalized their body weight. However, only patients receiving IM28 alone or in combination with HAART showed normalization of body temperatures and increase in the levels of CD4 lymphocytes ($p<0.01$) and haemoglobin ($p<0.001$), as well as significant reductions of platelets, antigenemia p24 ($p<0.001$) and viral load ($p<0.01$). Moreover, only cardiovascular, obese and hypertensive disease-induced HAART therapy patients under IM28 showed restoration of body levels in lipids, glucose and normalization of blood pressure.

These data unequivocally suggest therapeutic proprieties to IM28 for HIV-1 and cardiovascular-induced HAART therapy. These open new promising insights for IM28

Table 1. Evaluation of IM28 Toxicity. Values are Mean ± SEM of 10 HIV patients under IM28 alone. Statistical analysis was done using a student t test.

| Parameters | Baseline | IM28 | P < |
|---|---|---|---|
| UREA (2.5-7.5 mmol) | 3.73 ± 0.12 | 4.07 ± 0.25 | NS |
| Creatinine 56-120 µmol/L | 77.50 ± 2.50 | 105.20 ± 6.04 | 0.001 |
| GOT (<37 UI/L) | 12.10 ± 0.60 | 15.90 ± 1.11 | 0.01 |
| TGP (<40 UI/L | 10.50 ± 0.98 | 11.70 ± 1.03 | NS |
| Cholesterol (3.6-7 mmol/l) | 4.15 ± 0.98 | 4.09 ± 0.12 | NS |
| Lymphocytes ($mm^3$) | 2202 ± 100.40 | 2377 ± 156.69 | NS |
| Body weight (Kg) | 59.70 ± 1.45 | 61.10 ± 1.36 | NS |
| Haemoglobin (g/dl) | 12.88 ± 0.18 | 12.87 ± 0.16 | NS |
| Glucose (4.6-6.1 mmol/l) | 3.50 ± 0.09 | 4.70 ± 0.14 | 0.001 |

Table 2. Effects of IM28 on Body weight, Hemoglobin & Lymphocytes levels. Values are Mean ± SEM of 150 HIV positives patients under HAART + IM28. Statistical analysis was done using a student t test.

| Parameters | Baseline (HAART only) at Mo | HAART + IM28 at M2 | P < |
|---|---|---|---|
| Lymphocytes ($mm^3$) | 2103 ± 160 | 2460 ± 40 | 0.05 |
| Body weight (Kg) | 59.37 ± 2.075 | 60.05 ± 4.49 | NS |
| Haemoglobin (g/dl) | 13.50 ± 0.40 | 14.75 ± 0.44 | 0.05 |

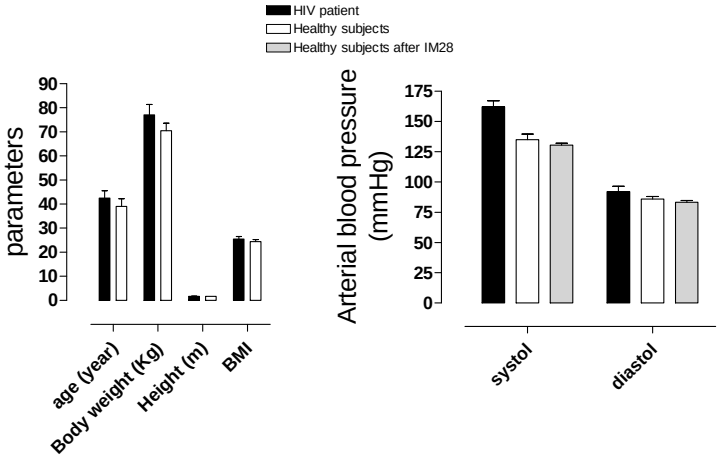


Figure 1. The left panel represent the Age, Body weight, Height and Body max index (BMI) of HIV positive (■) and healthy (□) subjects at M0. The right Panel presents cardiovascular values of HIV positive treated with HAART and healthy subject treated with IM28 (■) at M2. As seen, IM28 did not affect cardiovascular values in healthy subjects. Values are Mean ± SEM of 10 HIV positives patients and 30 healthy volunteers.

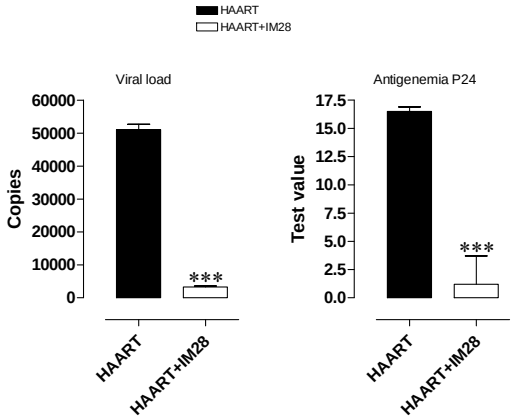


Figure 2. *In vivo* antigenemia P24 and viral load following IM28 supplementation. The left panel represents viral load values and the right panel is the antigenemia P24 of 150 HIV positive (■) patients under HAART and supplemented with IM28 (□) one year later. As observed, IM28 supplementation decreased very significantly viral reservoir in patients yet receiving HAART. Values are Mean ± SEM of 150 HIV positives patients. ***, p<0.001

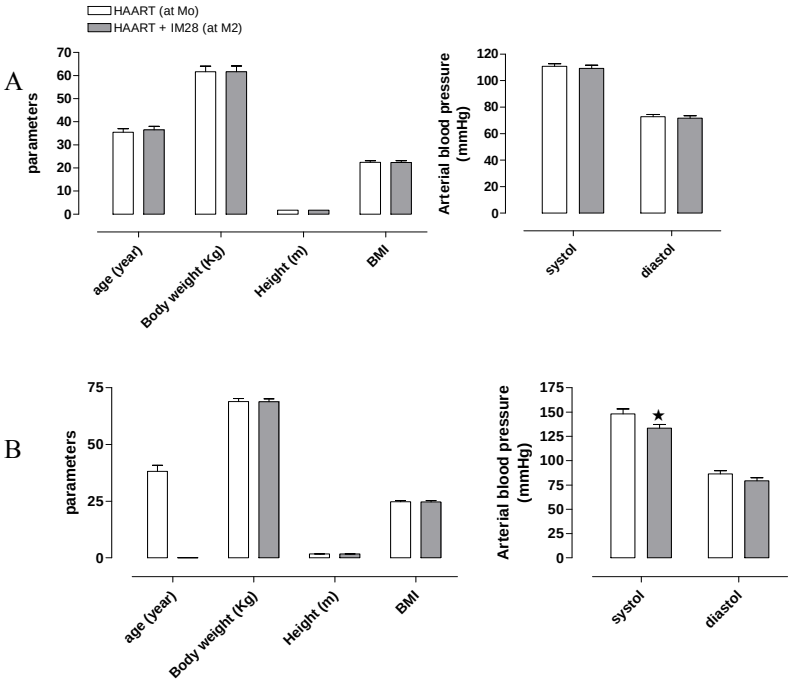

Figure 3. Effects of IM28 on the arterial pressure in HIV positive patients developing hypertension under HAART treatment. Age, Body weight and arterial pressure in normotensive patients (A), and patients developing hypertension under HAART treatment at M0 (under HAART only, □) and at M2 (HAART + IM28, ■). IM28 clearly regulated the arterial pressure of hypertensive HIV positive patients

Table 3. Percentage of opportunistic diseases and their evaluation from M0 to M2

| Pathologies | DHEA + HAART | | IM28 + HAART | |
|---|---|---|---|---|
| % | Base line | M2 | Base line | M2 |
| Tuberculosis | 11.71 | 9.68 | 7.8 | 2.2 |
| Malaria | 80.02 | 79.72 | 76.70 | 3.5 |
| Skin rash | 27.03 | 22.58 | 20.44 | 7.80 |
| Digestive rash | 98.20 | 94.62 | 92.20 | 20.09 |
| Urinary rash | 15.32 | 15.02 | 15.32 | 3.30 |
| facial paralysis | - | - | 0.03 | 0.01 |
| Language and memory troubles | - | - | 0.10 | 0.00 |
| Stroke | - | - | 0.06 | 0.02 |
| Anxiety | - | - | 0.80 | 0.10 |

As noticed, IM28 clearly reduced the percentage of opportunist disease.

## Conclusion

Our experience needs for partners for a global fight against HIV and resulting metabolic diseases

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# National Organ Information System (NOIS) of Turkey

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***Abstract:*** **In the scope of centralization of regional organ waiting list in our country, it was decided to prepare a web based software application by our Ministry capabilities in December, 2006. Following the decision, the analyses and designing studies for National Organ Information System Software was made by Department of ICT, MoH. By this software, the data of regional transplantation centers are centralized. Thus, multiple entries to the system are prevented and the most suitable recipient is detected in several seconds throughout the country. The recipient detecting processes are actualized by a fast and efficient system that also improved the allocation equity.**

## Introduction

As the needs for cadaver organs increases, the importance of accelerating and observing organ allocation process in the most eligible and efficient way raises gradually. Particularly, in the critical period of organ amputation from cadaver and transplantation to patient, finding the most appropriate matching in equitable, fast and effective way is one of the most significant challenges in the success of transplantation.

Before the central computerized waiting list implementation, decision making was done on paper at regional centers where many criteria would not be considered. Patients in need for organ transplantation have to register to multiple centers across the country in order to increase their chances. Otherwise, their chances were limited by the centers which they have registered. In the absence of online access to other transplantation centers database, the access of patient database simultaneously wasn't possible to make an equitable allocation in a limited time. As a result, these vital organs couldn't be able to use effectively.

In December 2006 it was decided to establish Central Organ Waiting List with web based application. Following the decision, Information Technology Department of MoH made analyses and designs for nine Regional Coordination Centers -RCC- under "Organ Coordination Center". In the result of these studies, in February 2007, the software including the

kidney allocation module began to be tested; failures occurred in a test process were fixed and the software was updated by considering feedbacks from users.

## Objectives

A primary goal in organ transplantation system is to provide a necessary coordination between the studies carrying out by Curative Services General Directorate & Department of Information Technology of MoH and organizations & institutions and transplantation services throughout the country. The aim is to provide transplantation to the most suitable patients in a fast and fair way with due regard medical ethic and scientific rules. Patients, clinicians and IT applications and the Ministry of Health shall be grouped as four main categories for the system objectives targeted as below;

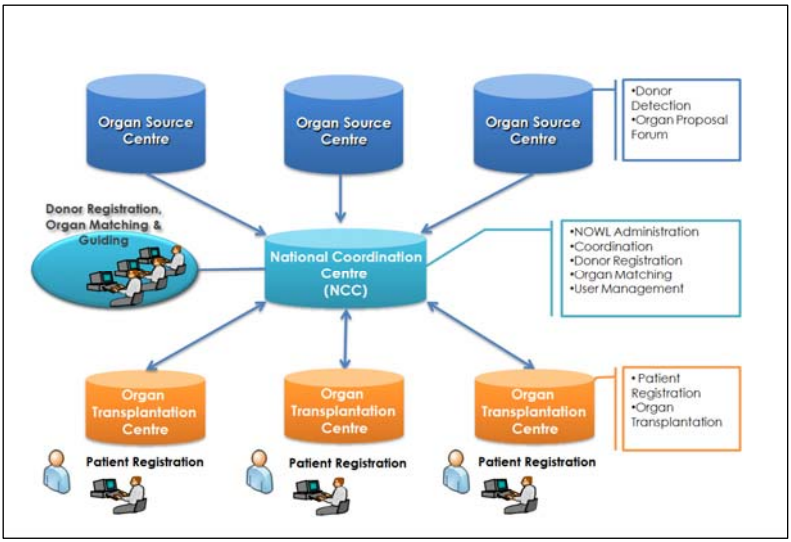
1. Patients
   - The system provides a single registration to the central waiting list.
   - Providing transparency in organ allocation and increasing equitability.
2. Clinicians
   - Availability high quality of patient profile.
   - Standardization of minimum tests needs to be done for organ typing across the country.
   - Standardization of evaluation criteria and providing centralized allocation across the country.
3. IT application
   - Integrating of current Organ Transplantation Centers to the interoperable system.
   - Integrating new centers to the current system easily.
   - Immediate applicability of future changes in the central system.
   - Complex evaluations as needed shall be done by the system to be established.
   - Web based application which has a common functionality across the country.
   - Uninterrupted service 24 hours to seven days.
   - Transferring of data from the current system warehouse to be a guide for the future decisions and processes, automatically.
4. The Ministry of Health
   - Providing equitable, fast, reliable, successful service to patients within the scope of the system applying the procedures in a minimum level.
   - Monitoring allocation and evaluation process.
   - Providing system management from one center.

- Standardization of patient follow-up and tissue typing labs in transplantation and also providing 100% correct, evaluable and fast-access data.
- Making required legislative amendments to the system regarding to legal basis.

## Methodology

Building administrative structure was the first step taken during system establishment. Then, scientific cluster was organized to prepare criteria for the waiting list. The first module of the NOIS was chosen as kidney allocation. In the context of global practices, tissue typing separation parameters and kidney matching criteria are re- listed in respect of our country by a scientific cluster from the Ministry [1-2-3-4].

Figure 1 Structure of NOIS System




In the early years of kidney transplantation, the prevailing opinion in the transplantation community was that HLA matching was the prime importance, and the most allocation schemes were heavily weighted toward close matching. With the passage of time and the introduction of better immunosuppression, other factors are being considered and given greater importance [1]. The matching is done by the patient's blood type firstly and then the tissue type. Scoring is a result of formulation whose parameters are the matching degree among patients, the region of their accommodation,

age group, waiting time and undergoing dialysis period. Also, the number of patients from the same hospitals is another parameter. It gives a chance to transplant the same organ to other patients in need to receive and it minimizes the probability of organ losses. By this programme, preventing organ loss is targeted considering cold ischemia time while sending organs to long distances, thus providing to use cadaver organ in the same place where it is obtained from has a higher priority. Consequently, more advantageous allocation is carried out in this system by considering children patients with high immune sensitivity, long waiting patients and emergency cases.

## Technology Description

User interfaces are designed by Microsoft.NET, C # 2.0 frameworks. All of the controls are handled by JavaScript. As a database; Oracle 10g is used and PL_SQL database language is used as embedded. The access security of system is controlled by primarily CISCO firewall. In addition, all of the users IPs are introduced and the accessing by unidentified IPs is blocked-off. In addition, IIS (Internet Information Server) on the application servers, to be against of web attacks and database hacking, is used as SSL

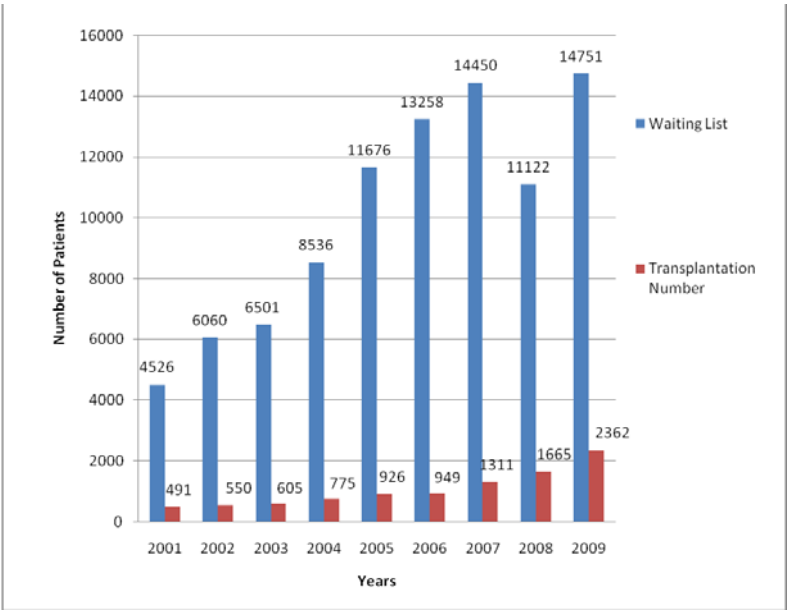



Figure 2 Number of patients in waiting list for Kidney & Transplantation Performed according to years

certificated. Application is operating as a load balance on two web application and two database servers which are on the service as standby and also database back-up is taken constantly.

## Results

During 1990-2007 years, matching process for organ to be transplanted to patient was performed manually on the paper, which was mainly limited within related regional centre. Therefore, matching process time could not be determined exactly. After the system application; matching process takes only a few seconds.

The number of patient waiting list for kidney transplantation in Turkey between 2001 to 2009 years is given in Figure 5. The waiting list numbers are 11.676 patients in 2005, 13.258 patients in 2006 and 14.450 patients in 2007. After NOIS software application the exact number of patients is obtained as 11.122 in 2008 by deleting the multiple entries. The actual number of patients in the waiting list is 17.456 by June 1, 2010. Not only medicine and medical technologies developments but also the increased number of transplantation centers caused rising of transplantation rates significantly between the years of 2000 and 2006. The numbers of kidney transplantations are 926 in 2005, 949 in 2006 and 1.311 in 2007, 1.665 in 2008, 2.362 in 2009.

## Conclusions

By National Organ Information System Software, the database of regional transplantation centers is centralized. After having carried out this programme, it is not necessary for patients to register multiple transplantation centers with their patient files in different cities across the country.

The Patient data entry is done to this system by using national identification number from Central Demographical Administration System. Thus, multiple entries to the system are prevented and exact number of patients is determined precisely throughout the country. Donor and patients waiting for transplantation are taken under control as a result of using this system. In this implementation, not only the tissue matching algorithms, but also the other parameters such as region of their accommodation, age group, waiting time, undergoing dialysis period, the number of other patients who have nearly the same matching degree from the same hospital, are the other factors affecting allocation process. As a result, a system minimizes organ loss as well as providing equitable allocation system.

National Organ Information System prepared and developed by cooperation between Department of Information Technology and General

Directorate of Care Facilities of our Ministry carried into practice in May, 2008. Kidney allocation module under this software is currently on the service and also the liver allocation module is added to system and is being tested. In the near future next allocation modules will be as follows:

- Heart Valve
- Cornea
- Heart
- Bone
- Bone Marrow
- Lung
- Pancreas
- Small Intestine
- Skin

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# On The Use of the Automobile Code of Colors in the Housing Environment Context for Persons in Loss of Autonomy

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***Abstract:*** **The appropriation process of the environmental space parameters by elders can be done through the use of color codes that are meaningful to the persons in loss of autonomy. This approach is based upon the natural interpretation of communicating signs and signals by the brain that helps to answer more quickly to critical situation at different degrees. We illustrate with the transposition of the color codes used in the automobile domain to the housing.**

## Introduction

The persons in loss of autonomy have several sociological and psychological blockings in using the technologies aimed to reduce their dependence. Very often, these blockings are associated with cognitive or visual troubles increasing the non appropriation of the technological assistance. Thus, it is important to offer neither non intrusive nor non stigmatizing solutions. It becomes necessary to propose schemes to allow these people to appropriate more easily the home automation and information technology equipments installed in their housing environment. One interesting and more global solution is linked to the communication with the environment and the appropriation processes through the use of color codes that are meaningful to the persons in loss of autonomy. This approach is based upon the natural interpretation of communicating signs and signals by the brain that helps to answer more quickly to critical situation at different degrees.

Several research projects in association of the University of Limoges [1] are developed using this principle. In this article, we first justify the importance of a color code through the example of the color codes used in the automobile domain [2].

An analysis of the automobile environment management is done to show the possible transposition of the assistance and security in the automobile

domain to the housing environment. This can be used to design more adequate communicating objects through an adapted human-machine interface.

## Color codes as intuitive indicators

*The Green/Orange/Red code in the automobile context*

In our approach, we consider that the potential users of the assistive technologies have all already driven a modern car and therefore understand and know the operation mode and principles underpinning. The objective is to transpose the assistance and security policies used in the car context to the housing environment.

To limit the risk of driving accidents, manufacturers have thought particularly effective signage system by developing many visual and audio codes. Since the beginning of the automobile, colors and interpretations related to certain markings are naturally accepted as logically linked to an innate interpretation of the brain. With the development of sensors for monitoring parameters of conduct and security increasingly diverse, the validation of these color codes were effective, in particular, the codes based on the colors green, orange and red.

This color code indicates the driver to follow the rules for safe driving. The dashboard of the car perfectly integrates a set of logos based on these three colors. The brief appearance of a logo using one of these colors activates an immediate reaction of the person.

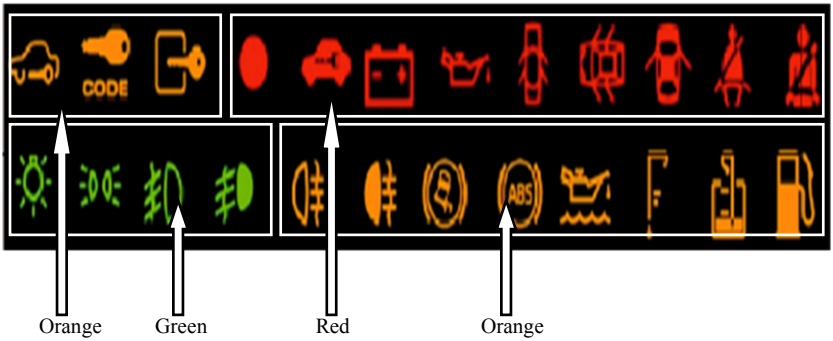
Red means an immediate danger. He was chosen on the one hand for its symbolism (blood, death) and on the other hand because it is quickly visible and identifiable: it is the color that attracts more and faster the attention and look.

Green is indicative and tolerant. Green was not the original color of the traffic light; white, symbol of laissez-passer, had preceded it. But its visibility being poor, it was rapidly replaced by the green, opposite and complementary color to red from a chromatic point of view, which also makes it highly visible and easily identifiable.

Moreover it is a median color, so peaceful, often associated with health, so that green is rarely aggressive.

The orange color replaces the original yellow finally judged visually too aggressive. It is situated between the red and green on the color wheel. It is a very bright color that evokes the heat. It is a color that brings a dynamic and immediate response. It stimulates the brain and requires increased attention. It is often used in road safety (traffic lights, traffic officers' clothes, signs ...).

Fig. 1 illustrates the color code used for an automobile dashboard.




Green: Indicative indicator
Orange: Practical indicator
Red: Important indicator

Fig. 1: The automobile dashboard colors

*Color code and space perception*

The color code now overcomes the frame of the automobile and becomes a way of perceiving the environment in the daily life. It indicates a way of perceiving space. It is thus interesting to study the transposition of this code and related logos to reduce the loss of autonomy in the housing context.

Indeed, some people have trouble apprehending the space and understanding it. Nevertheless, they know the symbolism of colors and can take advantage of color properties to be within their immediate environment in particular for those with visual or cognitive impairment.

People with Alzheimer's disease get lost very easily; they cannot find their way and are not always aware of the danger. They perceive space incorrectly. But thanks to the meaning of well-chosen colors, they can orient themselves and understand where they can go and where they should not go. In particular, they do not go to dark areas.

Similarly, for the persons with visual loss, color is an additional indication in the smooth process of environmental perception. Placing the red color on daily objects will prevent these persons from danger. The orange color will alarm from a potential danger, and the green color will indicate that everything is fine.

Associate the color to perception of space is therefore a good idea since it helps guide and reassure vulnerable people about their immediate space environment. If the threshold of a door is painted in orange, the person will know intuitively that he must be prudent. Objects (i.e. kitchen items) or red household appliances will be understood as at risk. Floors or pathways

painted in green will indicate the way to go safely. Thus a person who tends to forget how to get in the bathroom or who is simply disoriented (especially at night) may thanks to a colored pathway recover its independence at day and at night.

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# Reproducibility of Structural Light Assessment 3D Posture Telediagnostics: Preliminary Reliability Study

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***Abstract:*** **The study was designed to determine reliability of back evaluation performed utilizing the 3 dimensional telediagnostic measurement system. The measurement module is based on structured light method. Measurement data is archived and securely accessible for remote investigator over the Internet. Presented, originally developed system combines postural telediagnostic screening and monitoring. The study was designed to determine reliability with 4 investigators using back evaluations performed and analyzed remotely using telediagnostic system. Investigators assessed anatomical back landmarks of the seventeen back three dimensional clouds of dots. The technique for 3D image acquisition of back shape is based on temporal phase shifting and Gray codes. Acquired "images" were transferred to Telediagnostic Center for clinical evaluation. Spine parameters and deformation indexes like Posterior Trunk Symmetry Index (POTSI), Deformity in the Axial Plane Index (DAPI), kyphosis and lordosis angle were measured. Interrater Correlation Coefficient for the POTSI, DAPI, kyphosis and lordosis angles has values 0,9178; 0,9432, 0,9055 and 0,934 respectively. The reliability revealed very good results for intertester reliability. The technique is well suited for analysis of the back in standing position. The safety and procedure of presented examination method was highly accepted by examined persons.**

## Introduction

The study was designed to determine reliability of back evaluation performed utilizing the 3 dimensional telediagnostic measurement system. Rasterstereography and structured light methods are used for noninvasive follow-up of patients with trunk deformities [1-5]. These methods allow obtaining 3-dimensional back shape analysis, without radiation exposure, to supplement radiologic and clinical examinations in orthopedic diagnostics, screening and biomechanics [1-5].

Marker based approach is utilized most frequently. The patient can be examined automatically in a various positions. However mostly the standing, habitual position is most frequently used.

The aim of the study was to determine the reliability of 3-dimensional back surface analysis and reconstruction telediagnostic markerless system, of the spine in test subjects [3].

## Material and Methods

Preliminary analysis was performed on selected cases from database of patient's cohort. Measurement data is archived and securely accessible for remote investigator over the Internet. Presented, originally developed system combines postural telediagnostic screening and monitoring. The study was designed to determine reliability with 4 investigators (2 physiotherapists and 2 orthopaedic surgeons) using back evaluations performed and analyzed remotely using telediagnostic system. Investigators assessed anatomical landmarks of the seventeen back three dimensional clouds of dots, namely accordion, lower angle of scapula, waist, posterior superior iliac spine, and others. The technique for 3D image acquisition of back shape is based on temporal phase shifting and Gray codes. Acquired "images" were transferred to Telediagnostic Center for clinical evaluation. Investigators assessed anatomical landmarks of the seventeen back three dimensional clouds of dots, namely acromion, lower angle of scapula, waist, posterior superior iliac spine, and others. Spine parameters and deformation indexes like Posterior Trunk Symmetry Index (POTSI), Deformity in the Axial Plane Index (DAPI), kyphosis and lordosis angle were measured. Intraclass Correlation Coefficient was calculated utilizing trial edition of MedCalc software (Version 11.3.0.0; http://www.medcalc.be). The study was performed on seventeen subjects who undersigned informed consent forms were assessed utilizing 3D Orthoscreen system. Data of the one subject with missing data from one rater. Clouds of dots of sixteen subjects were finally analyzed. The study group consisted of 9 females and 7 males. Subjects were in average age 39 y.a. (range 9 - 69). The exams were performed at the Recreational Center in West Pomerania located at the sea

coast (distance 463 km) and transferred via ftp server. Data were ret rived in Clinical facility in Warsaw from the server directly on line utilizing combined application for acquisition and analysis of 3 dimensional clouds of dots of the back shapes of the patients.

## Results:

Interrater Correlation Coefficient for the POTSI, DAPI, kyphosis and lordosis angles has average values 0,9178; 0,9432, 0,9055 and 0,934 respectively.

Tab. I. Intraclass Correlation Coefficient for selected postural assessment measures: [a]The degree of absolute agreement among measurements. [b]Estimates the reliability of averages of kratings.

Table I

| Measurements | Measures | Intraclass correlation [a] | 95% Confidence Interval |
|---|---|---|---|
| POTSI | Average [b] | 0,9178 | 0,8257 to 0,9678 |
| DAPI | Average [b] | 0,9432 | 0,8795 to 0,9778 |
| Kyphosis | Average [b] | 0,9055 | 0,7995 to 0,9630 |
| Lordosis | Average [b] | 0,934 | 0,8599 to 0,9742 |

Questionnaires were used to assess whether the diagnostic procedure is accepted and safe. All patients confirmed its safety and acceptance.

## Discussion

Only a few stationary systems have provided data on its reliability. Hackenberg et al. [4] found that raster stereography provides an objective assessment of back surface rotation in standing posture avoiding the risk of errors due to forward bending and may be an alternative to traditional examination techniques. Mohokum et al. [5] determined reliability with 3 investigators using of raster stereography 3-dimensional back surface analysis and reconstruction of the spine in healthy test subjects. The intertester-reliability for the kyphotic angle spine parameter was 0.979 (95% CI). The study presented here concern the reliability of the unique, remotely operating system for 3 dimensional spine assessment.

## Conclusions

The postural assessments can be performed on remote the reliability revealed very good results for intertester reliability. The technique is well suited for analysis of the back in standing position. The safety and procedure of presented examination method was highly accepted by

examined persons. The reliability revealed very good results for intertester reliability. The structural light 3D remote postural assessment allows the analysis of the back in standing position. There are only a few methods available for noninvasive follow-up of patients with spinal deformities but the presented one is unique suitable for telediagnostic and screening.

## Acknowledgment

The project is supported by grant number NR13-0020-04/2008 from the Ministry of Science and Higher Education.

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# Supervision System of an Experimental Apartment for Evaluating Risk and Improving Safety of Persons in Loss of Autonomy

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***Abstract:*** **An experimental apartment consisting of a bedroom, a bathroom and a kitchen was equipped with communicating devices and remote controls. The aim is to validate the possibility of returning home a patient who have stayed at the medical centre and have motor and cognitive disabilities. Supervision software enables the complete management of all alarms and commands. Doctors and therapists are able to follow the daily activities in the apartment to assess the ability of residents to return home. The system also targets the requirements of housing adjustment aimed at dependent persons returning at home.**

## Introduction

The Functional Rehabilitation and Reeducation Centre (CRRF) in Noth in the department of Creuse in France is seeking permanent home automation solutions that help patients to safely have more autonomy in everyday life.

In this experimentation, a number of equipments have been installed to assist the person in rehabilitation in the apartment. A Konnex EIB/KNX bus [1] is used to interface all the sensors and actuators.

In the bedroom, an environment controller allows to control objects often inaccessible to the patient because of his disability. Ambient and reading light, shutters, heating, nurse call and television are actuated by conventional switches which have been increased and relayed by the controller. Different functions of the bed can be remotely controlled such as the legs folding, the inclination of the headrest and the height of the bed. A contrast of the switches has been adapted for better visibility. Easily understandable pictograms have been added for an intuitive use. The bedroom door is managed through push up buttons that can be switched with the elbow for a person in a wheelchair.

In the bathroom, occupancy sensors have been installed to adjust lighting for better use of health facilities. Counting of water associated with flood detection prevents and detects potential overflow of sanitary and bath.

In the kitchen, the height of work plans and mobile furniture is adjustable by hand or knee to facilitate access for people with motor disabilities, with safety contacts in case of obstacles.

### Rooms securing and management of cognitive disability

Scenarios have been defined with ergo therapists to prevent the patient against electrical, gas and water dangers in the apartment. These scenarios are managed by a controller that determines the type and degree of danger: the high level (gas, iron, fire risk) and the low level for events that do not require immediate action (oven, electric hob, gas hob, coffee maker and microwave oven).

### Supervision software & system

The supervision software used is TopKapi from Areal [2]. It enables the complete management of all alarms and commands transiting through the communication bus via a MODBUS TCP interface [3].

Supervision of the model apartment consists in storing in a database historical events that occurs in the apartment, in monitoring the activities of the resident, in remotely controlling some equipment to secure the rooms, and to forward the various alarms on the monitor server or any workstation connected. Thus, doctors and therapists are able to follow the daily activities in the apartment and check the history to assess the ability of residents to return home. The system also offers the ability to target the requirements of habitat adjustment aimed at dependents returning to their homes.

The introduction of supervision was conducted in two steps. The first step involved:

- The development of an ergonomic human-machine interface (HMI),
- The drawing on the supervision software of the kitchen and bedroom as well as associated elements,
- The information regarding the resident activities relevant,
- The determination of relevant data to collect and plots to carry out.

The associated secure database will include basic information on residents, namely the medical information, dates and duration of their stay in the center, the activities to be monitored. It should enable the storage and retrieval of data. The events to follow and the graphic representation of the monitoring for these events are not yet defined by doctors and therapists.

They would cover activities in the apartment and especially about using the oven, the hob, the iron and equipment in the bathroom.

The second step (June 2011) will cover the programming and testing of the supervision process. It will consist in setting the EIB parameters and the supervision links to the equipments and sensors.

In the kitchen, supervised elements are the power of the oven, hotplates, coffee maker, iron, movement and position of the iron, gas detection, detection of flood, counting the hot and cold water and various audio and visual alarms in the room. Fig. 1 shows a first draft of the strategy of supervision of the kitchen.

In the bathroom, monitored parameters are the use of the equipments in terms of time spent in the bathroom and the way toilets are used.

In the bedroom, supervised equipment are reading light, ambient light, blinds, heating, door entry and nurse call. Fig. 2 shows a first draft of the supervision strategy for the bedroom.

Supervision system will be a tool for tracing and monitoring of the patient by occupational therapists. Through this tool, they will assess the ability of the patient to govern themselves and to quantify the return home adequacy.

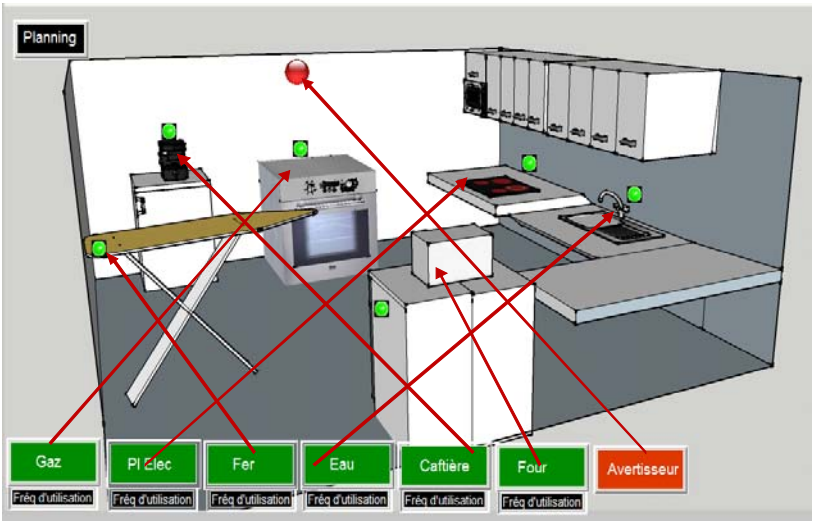


Fig. 1: Visualization of the supervision strategy performed with the software Topkapi

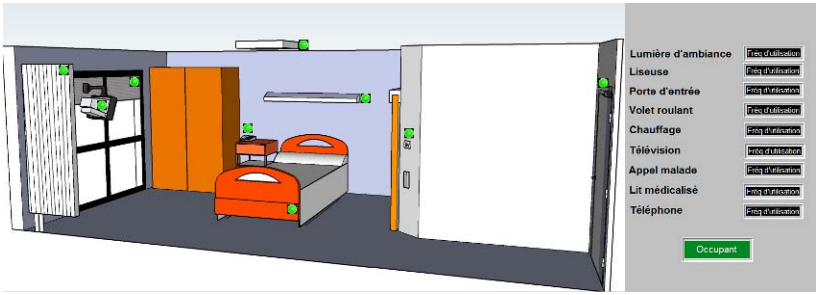


Fig. 2: Visualization of the supervision strategy for the bedroom

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# Telemedicine for Critical Patients during Transfer in Ubonratchathani, Thailand

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***Abstract:*** **Objective: To solve the problem of care in critical patients during transfer from community hospital to tertiary care hospital by telemedicine.**
**Methods: Implementation of telemedicine in the referral system of Ubonratchathani province, all critical patients have were monitored BP, oxygen saturation, pulse and EKG during transfer in mobile ICU ambulances from 20 community hospital to tertiary care hospital since October 2009. The real time telemetry has been shown in ICU hub at the destination so specialists can advise and treat via this system immediately.**
**Results: In the first 6 months, all 3,358 critical patients were transferred and detected critical and abnormal signs. The top three problems were low oxygen saturation, hypotension and abnormal pulsation respectively. All patients were evaluated the quality of care when arrived at the emergency department in 5 aspects: airway management, breathing assistance, bleeding control, intravenous fluid and immobilization. By the regular referral conferences, we had to emphasize the hot issue "airway management" to improve the knowledge and skill of attending personnel.**
**Conclusion: The real time telemedicine can show the important monitoring and guide to manage during transfer in the critical patients who are looked after from the remote center by specialists. This system has been established in Thailand and the first application was occurred in Ubonratchathani for support the referral system in the rural area.**

## Introduction

Ubonratchathani is a large province in the northeastern region of Thailand, located at the southeast part of this region. It is a border of Laos and Cambodia as the Emerald triangle. There are 20 community hospitals and only one tertiary hospital "Sappasittiprasong hospital" where look after 1.8 million populations in 161,000 square kilometers [1]. The health care system is managed by provincial public health office under ministry of public health. Some districts are apart from the tertiary hospital more than one hundred kilometers. The top three causes of death in Thailand in 2009 were cancer 88.3/100,000, trauma 55.6/100,000 and heart disease 29/100,000 respectively [2]. The outcomes of the last two groups were depended on how to detect and manage in the exact time and correct treatments as rapid as possible. The patients were sent to the hospital by 2 systems, the first one was emergency service system (EMS) which transferred from any place to the hospital and the second one was Referral System which transferred between the hospitals nevertheless both systems merge together in their functions[3]. We had concerned about the risks during transfer due to the long distance which took time by the road and lack of sufficient specialists. So the way to solve these problems was the application of telemedicine in order to give the evaluation and prompt treatment the critical conditions on the ambulance. These actions could make the confidence for medical and paramedical personnel who face the dynamic change of patients and can decrease the morbidity and mortality rate.

## Methods

The project was applied with the collaboration of provincial public health office and "Sappasittiprasong hospital" the tertiary care hospital in Ubonratchathani province emphasized how to manage the critical care especially for the critical patients during transfer. The 3 major principles to achieve the purpose were: 1) Upgrade the ambulance to be mobile ICU by investment for transport ventilator, defibrillator, intra-venous infusion pump and monitoring equipments. 2) Communication of the important detection such as vital signs, oxygen saturation and EKG between the running ambulance and central station in tertiary hospital via CDMA Thailand [4]. The real time monitoring and treatment are going on between the referral personnel and the remote specialists. 3) Increase potentiality in critical care of medical and paramedical personnel by training both intensive course and in the job training. They were modified for actual situations which were requested from the regular referral conference.

These actions have been launched out into the referral system especially for critical cases since October 2009. The telemedicine has been

implemented between mobile ICU ambulance from all community hospitals and Sappasittiprasong hospital.

## Results

In the first 6 months, there were 3,358 critical patients (non trauma 2,787 cases and trauma 571 cases) who were evaluated and consulted to the specialists during transfer. The ICU hub followed the dynamic change of vital and important signs of the patients who were referred from the different hospital average about 18-19 cases/day or 560 cases/month. The ratio between non traumatic emergency and traumatic cases was 4:1. The top three abnormal problems which were detected and corrected were low oxygen saturation, hypotension and abnormal pulsation respectively. However the abnormal digital telemetry may relate each together. The quality of critical care was evaluated in the 5 aspects including airway management, breathing assistance, bleeding control, intravenous fluid therapy and immobilization when the patients arrived at the Emergency Department. By the activities of the referral conference, we found the chance for improvement of care to emphasize “airway management” and planned to set the intensive course for the attending referral nurse to improve the knowledge and skill.

## Conclusion

In the real situation, the critical patients in the rural area may take risk from deteriorated progression of disease during transfer. The referral system in Ubonratchathani has been improved the way to communicate between the ambulance and the tertiary hospital by implementation of telemedicine and support with mobile ICU ambulance which has well trained personnel. This system will expand to cover other rural parts in Thailand.

## Acknowledgment

The authors thank Dr. Somchai Chaeupetcharasophon for support in this valuable health service care resulted eventually in our patients.

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# The Malaysian Ministry of Health Teleconsultation Experience

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Teleconsultation project was initiated in June 2009 and ended in December 2010. The specific problem was the unavailability of the respective disciplines services to the target clients/patients at the underserved parts of the country from centres of excellence. This lack of services was contributing to increased morbidity and mortality among these patients. Patient care could not be delivered to the point of contact. Patient transfers could not be reduced. Specialist visits had to be increased to the facilities. This had further strained the available scare resources.

The other specific problem was the unavailability of second opinion for specific clinical diagnosis and updating of clinical management protocols among practitioners. All the various levels in the delivery of healthcare were actively involved. The local issues were identified by Focus Group Discussions (FGDs) where various tools were used to understand the strength, weaknesses other options and perceived threats.

Work procedures, Standard operating procedures of the facilities were studied in depth. Staffing and certain human resources issues at the facilities example rapid turnover of certain caregivers. The critical success factors were broadly divided into:

1. Software enhancements and the Functional Specification Requirements (FRS);
2. Hardware upgrades;
3. Human factors (importance of training, work processes and protocols that support TC;
4. Organizational changes, process flows, patient management and the human factor;
5. Training, transfer of technology to the end users;
6. Continuous Change Management (CM) at the healthcare facilities.

Business process improvements and policy changes were made to accommodate the current ongoing TC project. MOH policies had to be relooked at and revised in tandem with the existing laws that were directly related to healthcare in general. Important prerequisites identified, in brief,

an assessment of the pilot project and a comparison of sites with lagging adoption revealed that there were some important prerequisites:

- Site appropriateness ;
- Current referral pattern;
- Case volume of suitable cases;
- TC protocols Protocols & Process Flows;
- TC Enablers that match

Currently we have 60 Teleconsultation sites, with 45 sites being the sending sites and 15 reading sites for the four clinical disciplines. The equipment at the various sites will be outlined during the presentation. Our initial outcomes have been:

1. The simplest measurements were the volume of the cases that were generated.
2. Fulfilling the Key Clinical Performance Indicators of the respective disciplines.
3. Reduced transport of the patients to centres of excellence.
4. Reduced frequency of specialist visits to the healthcare facilities.
5. Better clinical outcomes.
6. More interaction between the healthcare facilities and centres of excellence.

Strategies for the future (Internet Strategic Plan Yr. 2011-2015):

- To link up 900 Health facilities (Hospitals, Institutions & Clinics)
- Rollout and Integration
- Upgrading of the Infrastructure
- Increasing the connectivity (Speed)
- Upgrading the software
- Device upgrading

## Further readings

Contract document for the TC Project.; Proceedings of the TC Project meetings; Telehealth Blueprint MOH Malaysia; Multimedia Development Corporation (MDec); MOH, Malaysia Yearly Reports; WorldCare Health Malaysia Sdn. Bhd.

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# The Potential Socio-Economic Impact of Using Telehealth Technologies for Diagnosis and Management of Autism Spectrum Disorders (ASDs): A Case Study Progress Report

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***Abstract:*** **We review the literature on the socio-economic benefits of the use of telehealth technologies in ASD related health care with a focus on access to services and care management. We specifically estimate unmet ASD service demand and access to care in the Central Savannah River Area (CSRA) of Georgia and South Carolina, USA. Our findings indicate the potential benefit of using telehealth technology based systems for diagnosis and management of ASDs with resulting potential socio-economic benefit.**

## Background, Framework and Literature Review

An increasing ASD prevalence [1] demands economic evaluations of alternate service delivery models in the USA in general, and specifically in the Central Savannah River Area (CSRA) of Georgia (GA) and South Carolina (SC). ASD prevalence in GA and SC is documented in Table 1[2]. High societal costs of care in ASDs have been discussed in the literature [3].

Full economic evaluation requires analysis (identification, measurement, valuation, and comparison) of both costs and outcomes (consequences, impacts, and benefits) of alternative health care resources [4]. Existing studies of telehealth technology applications in ASD disproportionately assess feasibility and cost rather than consequences, including both economic and social impacts [5] is an important issue given that service

delivery using telehealth technologies is both impacted by, and in turn, impacts socio-economic factors.

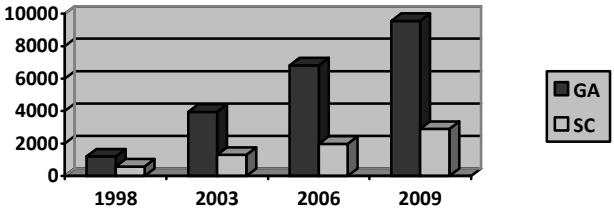


Figure 1. Numbers of Patients with Autism Age 6-21 for GA and SC

Published literature review reveals a long list of socio-economic consequences of the use of various telehealth technologies (ranging from telephone-based applications to interactive computer network systems) in ASD-related activities [5-8]. These include: (a) access, (b) education, (c) support, (d) social isolation, (e) acceptability/satisfaction, (f) quality of care (faster accurate diagnosis and treatment selection; increased medication adherence), (g) employment and risk of job loss, (h) quality of life (employment; travel; leisure; classroom; waiting and consultation time), (i) health outcomes, (j) health service utilization, (k) hospitalizations and emergency room visits, (l) employment time/productivity, (m) length of consultations, (n) knowledge transfer, (o) travel and home visits, and (p) clinic visits and referrals. A systematic review of studies targeting socio-economic indicators in ASD related fields, (pediatrics, mental health, and rural/remote health services) shows that use of telehealth technologies offers significant benefits to patients and families, health-care providers, and the health-care system as a whole [5]. A heterogeneous range of telehealth technology facilitated delivery methodologies (i.e., synchronous, or real-time delivery, versus asynchronous, or store-and-forward delivery) provide major socio-economic benefits: increased health services access, medical effectiveness, cost-effectiveness, decreased health services utilization, increased earnings, enhanced educational opportunities, improved health outcomes, better quality of care, better quality of life, and enhanced social support [6,8]. In fact, increasing access has been a major rationale for introducing telehealth technology facilitated services delivery in many health care fields, along with decreasing costs and improving efficiency [8]. The significant shortage of child psychiatrists and qualified Applied Behavioral Analysis practitioners in the USA, the state of Georgia, and in particular the CSRA is an important reason why telehealth

technology-facilitated interventions could significantly benefit the ASD population.

## The Potential Impact of Telehealth Technology Facilitated Services Delivery for Improved Access in ASD

Among the several identified socio-economic consequences of telehealth technology interventions in ASD-related fields, we focus on access to service and care as a "prerequisite" condition for the other benefits to occur.

Medical College of Georgia Health System (MCGHS) is located in the CSRA, a Georgia-South Carolina border region. For children with ASDs, MCGHS offers a behavior modification and social skills program. ASD patients undergo initial assessment by an MCGHS psychiatrist before internal referral to the program. Directed by a psychiatrist who specializes in ASDs, the program offers outpatient and inpatient psychiatric assessment, group therapy focused on behavior modification and socialization skills, and medical management.

Early identification is extremely important for ASD patients. The shortage of providers to care for children with ASDs at MCGHS is evidenced by the possibility of waits of up to 4 months for an appointment for initial evaluation. Once a child has been diagnosed with an ASD, symptoms and developmental progress should be monitored. Currently, once all available resources and services are in place, and using the in-person delivery model, patients with ASDs may need to be seen at intervals of only 6 months. If they have more behavioral problems or need medication, follow-up visits should be more frequent.

In order to assess how telehealth technology-facilitated delivery could improve access to services for the ASD population served by MCGHS, we conducted a case study of patients diagnosed with ASD and receiving services at MCGHS between 2009 and 2010. Our approach was two fold. First we estimated ASD service demand and the percentage of it MCGHS meets. Based on zip code information, we identified GA and SC counties served by MCGHS, found their population of children under 19 years of age, and based on published ASD prevalence rates, and MCGHS Electronic Medical Records (EMR) data estimated: (a) ASD service demand, (b) the percentage of this demand met by MCGHS, and (c) the difference between (a) and (b) - the unmet demand. Second, we provided an assessment of access to care for existing MCGHS patients. We calculated the average frequency of medical visits per patient using zip (postal) code to identify urban versus rural utilization. Primary data were extracted from the EMR. We captured the number of patients and visits by the patient's zip code, based on the presence of the two ICD-9 codes listed as a primary diagnosis:

299.00 (Autistic Disorder) and 299.80 (Asperger's Disorder, PDD NOS). In addition, we used Census [9] and OASIS [10] population data. To define urban-rural zones we used Rural-Urban Commuting Area Codes [11].

Table 2. Unmet ASD Service Demand in Augusta, Georgia

| Region | Pop. 0-4 years | Pop. 0-19 years | MCGHS EMR patients | Estimated demand 0-4 years | Estimated demand 0-19 years | Unmet demand 0-19 years (%) |
|---|---|---|---|---|---|---|
| GA | 34,193 | 132,027 | 500 | 349 | 1,347 | 847 (63%) |
| SC | 36,436 | 706,813 | 92 | 331 | 6,426 | 6,334 (99%) |
| Aiken | 9985 | 36,352 | 80 | 91 | 330 | 250 (76%) |

Reference [1] estimates that on average, 1 in 110 children in the USA have ASD; GA's rate is higher (1 in 98). We used these prevalence rates, EMR data, and population data [9, 10] to estimate the unmet demand for ASD services in 14 GA counties that receive services from MCGHS (Table 2). SC data represent estimates for patients from the six closest of the ten counties served by MCGHS. Aiken County had the vast majority of SC patients; its demand was calculated separately.

To estimate the unmet demand for ASD management and treatment, we used data for the population under 19 years of age. Given the median age in months of the earliest diagnosis of an ASD in GA [1] of 53 months (range 2-101 months), and in SC of 54 months (range 13-103 months), to identify demand in terms of screening and diagnosis, we found population figures by county for ages 0-4. The 92 patients from SC do not include 13 patients from Richland, Sumter, Kershaw and Berkeley counties because of their distance from Augusta, GA compared to Columbia, SC. Unmet demand was estimated by multiplying ASD prevalence rate by population and subtracting the number of patients identified as being served by MCGHS using its EMR. Our findings suggest that 63% of CSRA ASD patients that could be serviced by MCGHS are not receiving services, while services provided in SC are insignificant when compared to estimated demand.

Table 3. MCG Health System Patient Distribution by Zone

| Zone | GA Visits | GA Pati-ents | GA PPV | SC Visits | SC Pati-ents | SC PPV | Total PPV |
|---|---|---|---|---|---|---|---|
| Urban | 1100 | 391 | 2.81 | 221 | 92 | 2.40 | 2.61 |
| Large Rural | 37 | 23 | 1.61 | 12 | 6 | 2.00 | 1.80 |
| Small Rural | 158 | 67 | 2.36 | 7 | 3 | 2.33 | 2.35 |
| Isolated | 34 | 19 | 1.79 | 4 | 2 | 2.00 | 1.89 |
| Unknown | NA | NA | NA | 3 | 2 | 1.50 | 1.50 |
| Total | 1329 | 500 | 2.66 | 247 | 105 | 2.35 | 2.50 |

Our calculations of care services utilization by existing MCGHS patients are summarized in Table 3. We found the average number of per person visits (PPV) by zone, as defined by Rural-Urban Commuting Area Codes [11] to differ significantly when urban zones were compared to large rural and isolated rural zones, especially for GA. The difference was not as great in the case of small rural areas. The PPV for GA dropped from 2.9 to 2.2 and for SC from 2.9 to 1.9 if patient's distance from MCGHS exceeded 50 miles. These findings indicate the need for an additional method of service delivery – potentially telehealth technology facilitated access - to increase the PPV for patients from large rural and isolated zones, as well as from areas at a distance beyond 50 miles.

Telehealth technology facilitated services delivery in the CSRA has the potential to increase access above the current minimum of one visit per patient per year, a rate which is unsatisfactory based on current needs. Our preliminary findings highlight the current need for establishing telehealth technology-based initiatives to enable establishing foundations for wider telehealth technology based programs that could address not only the unmet ASD service demand, but also provide greater access to services and care for patients already receiving ASD services. These programs would have the potential to positively impact patient and family quality of life as well as to bring socio-economic benefits to the recipients and the region.

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# eHealth Applications in Psychiatry, Occupational Therapy and Rehabilitation

# Help4Mood – Distributed System to Support Treatment of Patients with Major Depression

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***Abstract:*** **Help4Mood is a project inside 7th European Framework Programme for developing a computational distributed system to support remotely the treatment of patients with major depression at home. One of the main goals of this system is to use the paradigm of a Virtual Agent to support the first symptoms of clinician alert of a patient, to interact with him an to prevent some causes of relapse. The system processes inputs from different devices (to monitor sleeping, speech and motor activity) in a decision support system, and the virtual agent interacts with the patient before clinical support from hospital is needed. This paper also presents the first ideas towards the further development of this virtual agent to support the treatment of major depression.**

## Introduction

Help4mood [1] proposes to significantly advance the state-of-the-art in computerized support for people with Major Depression by monitoring mood, thoughts, physical activity and voice characteristics, prompting adherence and promoting behaviors in response to monitored inputs. These advances will be delivered through a Virtual Agent (VA), which can interact with the patient through a combination of enriched prompts, dialogue, body movements and facial expressions. Monitoring will combine existing (movement sensor, psychological ratings) and novel (voice analysis) technologies, as inputs to pattern recognition based decision support system for treatment management. The main aim of the Help4Mood system is to provide an approach for supporting the control, communication and treatment management of patients with major depression. This approach will be a distributed system with the three main components (the Personal Monitoring System, the Virtual Agent component and the Decision Support System for Treatment Planning) deployed at patient's site.

## HELP4MOOD Project and 7th European Framework Program (FP7)

Help4Mood is an initiative funded by the 7th Framework Programme on 2009, in the call FP7-ICT-2009-4.5.1 for Personal Health Systems [2]. Help4Mood is a collaborative initiative of several European institutions, based in United Kingdom, Spain, Romania and Italy.

This project is funded by the objective addressed by FP7-ICT for Mental Health, specifically for ICT based solutions for persons suffering from stress, depression or bipolar disorders, where interdisciplinary research will address the parallel development of technological solutions, as well as new management or treatment models based on closed-loop approaches. Help4Mood emphasizes the use of multi-parametric monitoring systems, which monitor various metrics related to behavior and to bodily functions (e.g. activity, sleep, physiological and biochemical parameters). The proposed system will aim at (i) objective and quantitative assessment of symptoms, patient condition, effectiveness of therapy and use of medication; (ii) decision support for treatment planning; and (iii) provision of warnings and motivating feedback. In the case of depression, the system will also aim at prediction of depressive or manic episodes. The solutions will combine portable or implantable devices, with appropriate platforms and services. They will promote the interaction between patients and doctors and facilitate self-treatment and cognitive behavioural therapy where necessary.

## The Virtual Agent Component

The Virtual Agent will be the component of the Help4Mood system that will interact directly with the patient at specific phases of the treatment. This interaction will take place mainly through a combination of basic dialogues and a set of body movements and facial expressions designed to maintain the attention of the patient and help him/her to effectively manage important stages of his/her treatment. The research work carried out in the development of the system offers a unique opportunity to explore different perspectives in the development of the VA including the design of the graphical appearance in the agent, the study of adaptive dialogue management, and the generation of a coherent behavior in the agent while interacting with the patient. An alternative touch screen graphical interface, but also containing the VA, can be considered for patients who are hard of hearing, who lack sufficient privacy to speak to the VA, and who prefer visual interactions.

All these features need to be suitable designed for a non-typical user group which is nevertheless a significant and sensitive part of the general

population of users. Therefore, the main aim of the VA is to support Cognitive Behavioral Therapies (CBT) and self-help through:

- Enhanced reminder prompts: Reminder prompts can cover life style advice, medication, and self-directed CBT interventions. Self-directed CBT interventions can range from listening to relaxation exercises provided by the VA to completing worksheets suggested by the clinician. Whenever the VA delivers a reminder or a prompt, the user can record comments on compliance or non-compliance, if desired. The prompts will be designed to be motivational and non-confrontational.
- Spoken diary: Patients will be encouraged to reflect on their day or the past couple of days using structured prompts adapted from CBT. Patients can record their thoughts for later review by themselves or, exceptionally, by a clinician.
- Computer-based interviews: Computer-based interviews are highly structured system-initiative dialogues where users can enter information about their day, complete standardized assessments recorded daily and keep a spoken diary for recording general mood and views. These may include monitoring (administered daily or more often) and review (at longer intervals, such as weekly) interviews. Monitoring assessments may include the Clinical Global Impression (CGI), simple visual analogue scales for mood and anxiety [12] and items from Automated Thoughts Questionnaire. Review assessments may include longer measures such as the PHQ-9 [14] and Beck Depression Inventory.

All the characteristics embodied in the VA will be developed in close consultation with the three main stakeholder groups, patients, caregivers, and clinicians. The stakeholder groups will also be involved in the design of four key aspects of the visual appearance of the VA: realism vs. iconicity; face; body and costume design; and visual style [4].

Previous EC-founded research projects, such as the Engaging Media for Mental Health Applications (EMMA) project have shown the potential of using virtual reality environments containing "emotionally charged" scenarios in the treatment of mental health problems [3]. Building on recent research [10], our system will create behaviorally coherent and thus more believable characters with emotional characteristics and personality. Moreover and due to the importance of empathy in providing CBT [5], the design and development of a cognitive-emotional architecture that leads to an emphatic behavior in the agent is currently analyzed to be implemented in the VA [7]. Although there are currently some similar works that have already implemented emotional architectures that generate empathic attitudes in virtual characters for different purposes [8], [9], we will explore

the development of a cognitive-emotional model based on the conceptualization of therapeutic empathy [11].

Empathic attitude in the VA can be achieved by implementing different personality traits in the agent, putting emphasis (but not only) in the modeling of those personality types in which empathic traits are facilitated (such as the agreeableness personality from the OCEAN model). Using different personality traits, empathic actions in the VA can be for example activated/deactivated according to the particular characteristics of the modeled personality. Even thought that our VA does not intend to have the role of a therapist, but more related to a helper/guide, an empathic attitude in the VA would contribute with a better engagement of the patient with the agent supporting a better and effective self-management of his/her treatment.

Since the use of VAs in mental health must be guided by the "do no harm" clinical maxim, a very important consideration in the development of the VA is the prevention of harmful behaviors. Moreover, the VA needs to be clinically evaluated in terms of safety and efficacy that contributes in the further translation of this technology into clinical practice. The achievement of these objectives for the VA (and also for the other components in the system) is not a minor issue and needs the deep involvement of the clinicians, patients and eHealth policies and health informatics evaluation experts throughout the complete life-cycle of the project. We are adopting a user-centered design methodology [6] during the development of the system. This type of methodology emphasizes the active engagement of end-users (and other relevant stakeholders) with the aim of maximizing the conceptual fit, functional utility and usability of the product. Currently successful medical informatics applications have been reported following this methodology [13].

## Expected Impact

Help4Mood has been conceived as a research and technological effort providing new tools to support patients with Major Depression and their care providers and impact directly to their disease evolution and recovery. Such expected impact will be shown by the achievement of the following points:

- Involving patients in their own care promoting the actively participation throughout their treatment process. The Help4Mood virtual agent delivers motivational prompts and assure medication adherence. These initiatives may help reduce risk of patient relapse or treatment failure, and thus reduce their hospitalization.

- Remote assessment of health status provided by Help4Mood's Personal Monitoring System will retrieve data to effectively identify the daily behavior patterns in the patient supporting a better assessment of their health status.
- Data obtained from the patient site can be used by the Help4Mood Decision Support System for personalized treatment planning, enabling, better and more timely disease management for each patient.
- Identifying and supporting patients with delayed recovery, our model has the potential to target additional monitoring and treatment to patients most in need and will lead to an earlier return to normal health and social and economic activity in these individuals.
- Effectiveness trials would evaluate Help4Mood in routine care settings. Health economic data will be collected at all stages of trials and include both direct healthcare costs (including drug prescription, face to face mental health treatment and hospital costs) and indirect costs (time off work, sickness related benefits, impact on careers). As a result will support new business models creation and evaluation specially devoted to promote health providers innovation.
- All Help4Mood components will adhere to current standards of interoperability. In particular, the network of sensors to be developed will use a standard networking protocol such as the IEEE802.11, HL7 messaging and IEEE11073. Moreover an important outcome of Help4Mood is the development of ontology to define the concepts used in the clinical domain of Major Depression.

## Acknowledgments

The authors thank Help4Mood consortium for their contributions to this project and European Commission for their interest on it and funding of this research project.

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# Hypertext: Young Adult Implementation of Social Media to Communicate, Preserve and Project Self

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***Abstract:*** **This study explored the practices, preferences, and motivations of 18-26 year olds (n = 81) in relation to their use of social media in relationships and self-presentation. The advent of widespread social media allows for a more tailored form of selective self-presentation. This study explored the extent to which the possibilities afforded by social media appeals to individuals, the extent to which they utilize them (or not), and why.**

**Notable results included a disparity between methods that males and females use in self-disclosure, and a stronger male interest in text based communication, with relative female neutrality. Research uncovered a strong trend of preference for the use of text based communication in distant relationships, but face-to-face interaction in intimate relationships. The more time participants spent using the internet correlated with a greater concern with dishonesty online and a greater posting of false information. Participants who displayed misleading information online had a higher likelihood of pursuing romantic relationships online as well as being sexually affected by information displayed through social media. Those who posted misleading information were also the most concerned with how others viewed them (appearance) both online and offline.**

## Introduction

No longer constrained within the conventional limitations of time, space, and physical reality, computer mediation and cell phone SMS (short message service-also known as "texting") provide new possibilities for manipulation of self-presentation through delayed feedback, limited nonverbal information, the ability to edit text prior to sending, and difficulty in locating an individual geographically (which may prompt more unedited disclosure. [2]) Major motivational factors for online usage are often affordability, accessibility and anonymity, [3] while others studies suggest that instant messaging is easier than face-to-face interaction for individuals of disagreeable personalities or low self-esteem. [4] Some have found that

internet proficient technologies create new social possibilities, free of physical interaction for self conscious individuals, and that "with visual anonymity, shy individuals are able to self-disclose more information once a topic has been started. [5]"

Not only does the internet provide an outlet for some individuals to express more of their true selves, it can also act as a veil behind which users can mask their true selves. Some research demonstrates that individuals maintain fairly consistent identities within cyberworld domains and social network sites as well as through screen name or user name (login) choice that shapes their online persona. [6]

Online visual and textual disclosure serve higher motives than simple egocentric deception, as evidenced by the promotion of social integration, friendship satisfaction and reliable alliance as witnessed in blogging, [8] the self-reported group identification and personal memory functions of Facebook users' profile pictures [9] and the healthy empowerment of users through awareness and control to regulate [10]. In other words, online disclosure is not always about falsifying an idealized image, but can serve numerous constructive social purposes as well such as building a professional image to project one's qualifications for job hire, showcasing relevant experiences and giving a textual "picture" of one's hobbies which may serve as more holistic curriculum vitae for potential employers. On the other hand, critics raise social concerns over cyberpspace because of "profound questions about new forms of alienation, between persons, between humanity and the transcendental realm, between individuals and their own bodies." [11]

Theorists have also demonstrated that hyperpersonal interactions invite users to "fill in blanks" about unseen others with unsubstantiated idealized information [12] and that a disinhibition effect ensues so that individuals reveal information more readily when outside of face-to-face contexts because there is less perceived risk involved, [13] especially to males. Along this same line, males tend to perceive fewer privacy risks than females. Males did not feel disturbed by receiving unsolicited e-mail, whereas females feared the misuse of personal information and felt vulnerable upon receiving unwanted e-mail. [14] After an examination of such trends, studies and theories, the authors of this study sought to explore the textual and non-textual online communication choices of the latest generation of emerging adults ages 18-26 in terms of practices, gender, and honesty and level of exposure in selective self-presentation.

## Methods

An online survey was distributed through Facebook via the web based platform Survey Monkey, targeting individuals between the ages of 18 and 26 (appendix 1).

Of the eighty-one participants, thirty-two identified as male, forty-five identified as female, and one identified as "other."

### *Display of False Information*

Those who never posted any misleading information about themselves online were the least concerned with maintaining an image online, as they also posted the least amount of information about themselves on social networks (table 3). However, the same sample showed a moderate amount of concern for maintenance of their image in "off-line" arenas.

Table 3. Means, Standard Deviations and Chi Square results for Posting of Misleading Info

| Posting of Misleading Info | Posted misleading info | | | Did not post misleading info | | | Mean | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | N[a] | *SD* | Mean | N[a] | *SD* | Dif. | $x^2$ | *p* |
| Most appealing Aspect of Internet | 1.50 | 24 | 0.83 | 1.25 | 40 | 0.71 | 0.250 | 1.280 | .227 |
| Sexual Effect of Online Info | 1.81 | 26 | 0.94 | 2.52 | 46 | 0.84 | -3.328 | -0.714 | .005 |
| Concern over Online Image | 2.68 | 25 | 0.90 | 1.67 | 46 | 0.76 | 1.01 | 4.984 | .000 |

Participants who posted misleading information online, 65.4% experienced a sexual effect (romantic interest) that influenced their attraction to others based on information posted. Of participants who never posted misleading personal information online, 26.1% were sexually affected. This proved to be statistically significant ($x^2$ (2)= .005, p < .05). This significance may indicate a preference for fantasy and "fill in the blank" thinking theorized about in literature, especially given that these participants named anonymity one of the factors that they like about this type of communication.

An item that explored the frequency at which participants posted misleading information about themselves online indicated that 35.6% of participants displayed misleading information online about themselves (*n* = 73). Participants who posted misleading information online had a higher likelihood of pursuing romantic relationships online (19.2%) compared to those who never posted information online (8.5%). Participants who displayed misleading information online (20.8%) chose "anonymity" as the

most appealing aspect of the internet as opposed to those who never posted misleading information (7.5%), which did not result in statistical significance ($x^2$ (3)=.227, p > .05).

However, of participants who posted misleading information online, 65.4% experienced a sexual effect (romantic interest) that influenced their attraction to others based on information posted. Of participants who never posted misleading personal information online, 26.1% were sexually affected. This proved to be statistically significant ($x^2$ (2)= .005, p < .05). This significance may indicate a preference for fantasy and "fill in the blank" thinking theorized about in literature, especially given that these participants named anonymity one of the factors that they like about this type of communication.

Table 1. Means, Standard Deviations and Chi Square Results for Disparity between the Sexes

| Gender | Male | | | Female | | | Mean | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | N[a] | *SD* | Mean | N[a] | *SD* | Dif. | $x^2$ | *p* |
| General Communication | 2.52 | 29 | 1.122 | 2.93 | 44 | 1.108 | -.415 | -1.56 | .432 |
| Disclosure of Personal Info | 3.38 | 29 | 0.862 | 3.82 | 44 | 0.620 | -.439 | -2.53 | 0.008 |
| Sexual effect of Posted info | 1.66 | 29 | 0.613 | 1.79 | 43 | 0.558 | -0.135 | -0.97 | 0.481 |
| Factors of Sexual Attraction | 2.86 | 29 | 1.51 | 2.89 | 44 | 1.30 | -0.24 | 0.73 | 0.245 |

Interestingly, of the participants who posted misleading information, 4.0% were "not all concerned' with maintaining an online image while 47.8% of participants who never posted misleading information were "not at all concerned". This was also statistically significant ($x^2$ (3)= .000, p < .05). Users may choose to view themselves more positively in online situations, where their physical and personal flaws of reality cannot affect the way in which other online users may view them. In this instance, individuals may choose to live within a fixed and even stylized image of themselves (fantasy), in which their identity within cyberspace is persistently maintained and consistently defended in "real life".

*Male Preference for Text Based Communication*

Male participants preferred to "generally" communicate in-person only 39.7% of the time and females preferred it 60.3% of the time. A chi-square goodness of fit test was calculated comparing gender and preferred mode of

general communication (table 1). No significant difference was found, ($x^2$ (3) = .432, $p > .05$). However, when the disclosure of personal information

Table 2. Means, Standard Deviations and Chi Square results for Frequency of Internet Usage

| Frequency of Usage | Low Frequency Users | | | High Frequency Users | | | Mean | |
|---|---|---|---|---|---|---|---|---|
| | Mean | N[a] | *SD* | Mean | N[a] | *SD* | Dif. | $x^2$ |
| Romantic Pursuit | 3.38 | 50 | 1.12 | 2.52 | 23 | 1.28 | 0.858 | 2.907 |
| Online Concerns | 1.79 | 48 | 0.97 | 2.10 | 21 | 1.04 | -0.304 | -1.171 |
| Amount of Personal Information Posted | 2.26 | 50 | 0.75 | 2.35 | 23 | 0.71 | -0.087 | -0.471 |
| Posting of Misleading Information | 1.38 | 50 | 0.60 | 1.48 | 23 | 0.59 | -0.098 | -0.651 |
| Factors of Sexual Attraction | 3.02 | 50 | 1.30 | 2.57 | 23 | 1.52 | .018 | 1.321 |

was explored, 90.9% of females did so in-person as opposed to only 58.6% of males, indicating a statistically significant difference, ($x^2$ (3) = .008, $p < .05$). Males may prefer to disclose in the online/text realm rather than face to face, as they may feel less exposed to rejection and feel safer to disclose in online settings. This would allow males to distance themselves from unexpected responses online; as such responses would be unavoidable and more awkward in face-to-face settings. The more intimate a situation was rated, the greater the disparity between male and female responses, with females preferring less physical space during communication and males preferring more distance.

*Increased Time Online, More Romantic Pursuit Online*

There were marked differences between participants who spent less than an hour to two hours daily socially interacting online (low frequency usage) and the groups who spent two to four hours or over four hours (high frequency usage). High frequency users chose textual methods for romantic pursuit 52.1% of the time (table 2), versus less than 22% of low frequency users. A chi-square goodness of fit test was calculated comparing sex and communicative methods of romantic pursuit. The results were statistically significant with ($x^2$ (3) = .015, $p < .05$). Low frequency users pursued romantic relationships in person 74% of the time while only 34.8% of high frequency users pursued relationships face to face. The more time subjects spent using the internet, the more likely they were to prefer romantic

interaction via text and thus demonstrated less need for social and physical interaction.

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# Implementation of Virtual Reality Program "Emotion 1.0" to the Study of Theory of Mind in Children in Primary Education

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## Introduction

This study is based on the following research: Static facial expressions (1); Eliciting emotional subjective emotional experiences through facial expressions (2); Understanding emotional situations (3). The following are the objectives of our study: 1. To propose a method to investigate human perception of emotional facial expressions of different kinds; 2. To analyze the differences in perception of emotional facial expressions static and dynamic; 3. To analyze the effect of the situations eliciting emotional content neutral, positive and negative emotion recognition related to facial expressions; 4. To determine the diagnostic ability of negative socialization behaviorsthat stand out agressive behaviors, oppositional defiant disorder and dissocial

## Instrument Features

The instrument e-motion 1.0 used for the development of this study consists of the following groups:

1. Introduction (4 items): This section refers, on the one hand, to the environment and, secondly, shows exercises for visual fixation and visual field analysis; 2. Baseline (21 items): First, static facial expressions appear, then, are dynamic facial expressions from a neutral expression, and finally, we propose random combinations dynamic facial expressions of 6 basic emotions; 3. Static scenes and facial expressions (8 items): It presentes scenes about the feeling of the observer and the feeling of the actor in relation to each proposal scene; 4. Static facial expressions in dynamic scenarios (12 items). Scenes are presented and also wonders about the sense of observer and actor; 5. Dynamic facial expressions in dynamic scenarios (4 items): it keeps asking about the feeling of the observer and the actor on the scene; 6. Choice of scenarios with static facial expression dynamic scenarios (9 items): It keeps asking about the feelings that arise each of the scenarios; 7. Final scenarios (2 items): It terminates the application with

questions about these two scenarios. In all scenarios, the chosen answer is recorded by the child and reaction time.

On the other hand, we also used the FEEL test (Facial Expressed Emotion Labeling). This computer based test assesses subject´s ability to recognize facially expressed emotions (3).

## Validation

This study is framed in Overall Study. Therefore, the validation of the instrument mainly includes two phases: Phase 1: To validate static and dynamic scenes in a non-virtual. On the one hand, we collect data from a control sample comprising 700 children and these children are aged 8 to 11, and enrolled in the third to sixth levels of primary education. And on the other hand, we have an experimental group comprising 100 children with oppositional defiant disorder; Phase 2: To validate static and dynamic scenes in a virtual environment. On the one hand, we collect data from a control sample of 100 children with hyperactivity syndrome. And, on the other hand, a group of 100 children with oppositional defiant disorder.

## The sample

The sample consisted of 300 cases:

- It is a multistage cluster design.
- This is a representative sample of primary education.
- It´s based on a census survey of students in Vizcaya (Basque Country).
- There were 6 clusters formed by 100 students each.
- Once you set the sample size (n = 600), proceeded to the random selection of clusters.
- The preliminary sample of 300 cases.

The criteria for inclusion in the sample are: Compulsory Schooling; Studying third to sixth in Primary Education; To be familiar with the computing environment; To have the informed consent of parents. And the exclusion criteria is: Diagnosis of pathology according to DSM-IV criteria, conducted by school psychologists. Ultimately, 61% were boys and 39% girls.

## Inquiry procedure

These are the main steps in the research process:

- Ten assessors previously trained in the application of the tool; subsequently, individual applications were made in rooms where students had class;
- Likewise, it was reported the goal of computerized tests (e-Motion 1.0 and FEEL);

- Tests were performed in order and time frame. In the case of e-Motion 1.0 was 20 minutes, and for the FEEL was 15 minutes.

## Method

The method used for this study was based on the following three types of validity:

a) Content validity: The instrument was submitted to four judges with research experience in the study of emotional facial expressions;

b) Internal validity: Correlations were obtained through inter-item chi-square for nominal scales assessing groups perceived emotions in oneself and in the other. Also, Spearman correlations were obtained between continuous variables based on reaction times; and,

c) Concurrent validity: On the one hand, made the comparison of scores using Pearson correlations between: subscales of the e-Motion 1.0 and the total score scale FEEL dimensional computed (alpha = 0.77) (5), University of Ulm (Germany) based on research of Matsumoto and Ekman (6). On the other hand, made the comparison of scores using Pearson correlations between: subscales of the e-Motion 1.0 and the total scale score IECA (7).

## Results

We highlight several issues about the early results of this preliminary study:

• The correlation between the scale e-Motion 1.0. and scale FEEL:

• Total score of the first three subscales of the e-Motion 1.0. Feel with total score ($r = 0.238$, $p = 0.000$).

• Score of the subscale dynamic scenes proceeded by neutral scene ($r = 0.50$, $p = 0.000$).

• Correlations between e-Motion 1.0. ACE inhibitors and scale (7) (Spanish version) were small (Pearson $r = 0.10$).

## Conclusions

The application of virtual reality for children may be helpful: As proceedings in the early stages of learning social skills, especially in those groups where the physical and / or mental prevents its insertion in the context of socialization. In those groups in which the person is giving negative socialization behaviors that stand out aggressive behaviors, oppositional defiant disorder and dissocial. The virtual environments provide a promising new approach for training in communication skills related to the Theory of Mind (7), (8), (9): The ability to attribute mental states to others and himself.

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We are a research team from Deusto University, in Spain. Our research is related to the application of the technologies on the assessment and intervention in people with Neuromuscular and neurodevelopmental Disorders and their families.

The experiments in which we are currently working can be categorized in the following areas:

- Online interventions with children affected by neuromuscular disorders and their families.
- Development of a Virtual software to assess emotional facial expression and empathy processes in children: eMotion1.
- Assessment of facial recognition skill in different collectives: healthy children and adults, people with myasthenia gravis, multiple sclerosis, Steinert Dystrophy.
- Development of a Virtual software to assess social skills: eMotion2.
- Validation of emotional facial recognition´ softwares.

# Key Aspects, Efficacy and Best Practices for Online Suicide Intervention Training

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## Introduction

Suicide intervention is a challenging task. Despite the development of a variety of initiatives and approaches across the world, there are still limited evidence-based, effective and sustainable methods for preventing suicidal behaviors. Previous reviews have indicated that some approaches yield promising results, although methodological shortcomings (including small sample size, follow-up periods of short duration, and recruitment biases) require caution in interpreting their results.

### *History and Development of On Line Suicide Intervention*

The development of information technology and opening of new communication channels have created new opportunities in suicide intervention, research and clinical practice. Telecommunication technologies have been used to provide support to individuals in crisis, to supplement psychotherapy and to increase treatment compliance and motivation among individuals with a history of suicidal behavior. They have also been utilized for screening and assessment of suicide risk, and to provide education and training to mental health professionals and the general public.

Despite a rapid increase in suicide intervention initiatives and programs based on telecommunication technologies, there have been few research projects to evaluate their effectiveness. The guiding principles of anonymity of callers and confidentiality of services do not allow for randomized controlled follow-up studies and create ethical and legal problems related to data collection. Online crisis intervention services face identical difficulties in data collection and analysis. Although correlational studies show an impact of crisis intervention centres on suicide rates, they do not allow for drawing cause-and-effect conclusions. Anecdotal reports and qualitative data indicating high levels of callers' satisfaction with services and high numbers of people using services are not sufficient to prove their impact on the actual prevalence of fatal and non-fatal suicidal behavior.

Suicide intervention is too important to be left to traditional, slow-evolving, monolithic, institutionalized classroom models of education and training. Absent an aggressive research and technology-transfer agenda to evaluate the merits of e-learning technologies in the intervention of suicide, lives may be unnecessarily lost.

*QPR*

QPR stands for Question, Persuade, and Refer -- 3 simple steps that anyone can learn to help save a life from suicide. Just as people trained in CPR and the Heimlich maneuver help save thousands of lives each year, people trained in QPR learn how to recognize the warning signs of a suicide crisis and how to question, persuade, and refer someone to help.

*The QPR Institute*

The QPR Institute is a multidisciplinary training organization whose primary goal is to provide suicide intervention educational services and materials to professionals and the general public. It was founded in July of 1999 by President and CEO, Paul Quinnett, PhD in three-year joint effort with Spokane Mental Health Center in Spokane, Washington. Its mission is to save lives and reduce suicidal behaviors by providing innovative, practical and proven suicide intervention training. As a leading provider of suicide intervention training in the United States, the QPR Institute and its online educational partners, Eastern Washington University and Essential Learning Inc., now provide competency-based knowledge and skills training for most major helping professions via the internet.

*Key Aspects of Suicide Intervention*

While expert opinion may differ as to what helper competencies are required to assist suicidal persons achieve the most beneficial outcomes, little controversy exists about the lack of qualified manpower to help the thousands of people who choose to access help only through text messaging or email. Moreover, even among licensed professionals there is a serious lack of systematic training in how to a) detect suicide risk, b) assess immediate risk for suicidal behaviors and c) provide helpful crisis mitigation services to suicidal persons.

Many training organizations and agencies provide excellent instruction in crisis response, handling of telephone calls, and resource and referral practices for telephonic and face-to-face service delivery. However, and to our knowledge, no organization offers an established, well-tested, researched approach to how such interventions might be best conducted entirely over the internet. As leader in this field, however, the National Board of Certified Counselors has published ethical guidelines for counselors wishing to provide

services over the internet and empirical support for online interventions and assistance is growing.

As an educational organization, the primary mission of the QPR Institute has been to provide technology transfer of evidence-based knowledge into useful skills and helpful interventions for those wishing to assist suicidal persons. To this end, the Institute has developed comprehensive training programs to address the training deficits among clinical providers as outlined in the National Strategy for Suicide Intervention, and to provide various levels of suicide intervention training to match the level of duty or willingness of any community member who may be able to recognize, refer or otherwise assist a suicidal member of his or her community, including communities that exist only on the internet.

With a focus on suicide intervention and patient safety, these training programs have been researched and tested in hundreds of sites over the past 13 years and are currently in use in hundreds of service provider organizations and psychiatric hospitals. The public health QPR gatekeeper training program for citizens has been taught to more than one million people by more than 4,500 Certified Instructors in multiple countries and online. It is from these well researched educational programs that the following online training has been derived.

*QPR OnLine Suicide Intervention Training Goals*

1. To develop a virtual core competencies training program for volunteers and professionals working online with suicidal people using measurable training outputs.
2. To enhance access for suicidal people to well-trained suicide intervention specialists available online, especially for those living in remote areas or who request or require text-only communications.
3. To provide competency-based training and certification to a global workforce whose online availability to at risk persons is accessible, affordable, and adequate to deliver effective risk mitigation services to millions of suicidal people surfing the web for emotional support, empathic understanding, and reasons to live.

*Anecdotal Evidence of Suicide Interventions (3 cases)*

The following situations have been chosen to highlight the success of suicide interventions from a first person perspective and to provide material for exploratory discussions. None of these people were ever on Michelle's caseload further demonstrating the opportunity for people to become aware of and intervene in suicidal behaviors in everyday life. The course and nature of the interventions will be elaborated upon during the presentation.

*Case 1 – In person intervention within a mental health clinic setting*

Upon returning to her office in upstate New York, Michelle noticed a small spot on the bathroom floor. Turning on the light, she saw that it was blood. One of her co-workers was in his office with the door closed. She interrupted and informed the counselor about the blood. Upon returning to his office, the counselor found that his client had slit his wrists in the bathroom in the middle of a session, and returned to the session wearing a heavy parka.

*Case 2 – In person intervention in a hotel setting*

While vacationing in San Diego, California, Michelle was engaged in a poolside conversation among a small group of hotel residents. Each person introduced themselves and named his/her occupation. The casual conversation continued for a while and the group broke up. As Michelle was leaving the pool, one of the women approached her and stated that she was glad to meet a mental health clinician because she was going to kill herself.

*Case 3 – On Line Suicide Intervention*

Michelle was writing an on line advice column in 1997 when her first suicide threat occurred. The e-mail was discovered several hours after it was sent. Upon reading it, Michelle responded and managed to engage the woman in an e-mail exchange. In between e-mails, Michelle contacted her local police department to request assistance. The town sent an officer, who stayed with Michelle for an hour, then returned to the station to follow up with the woman's ISP and other police departments in 2 other states.

Paul Quinnett, Ph.D., Founder and CEO, QPR Institute, A clinical psychologist and trainer for more than 35 years, Dr. Quinnett developed and managed a suicide prevention hotline, an emergency services department, and a dozen mental health service delivery programs. He has authored seven books, many professional articles and book chapters. He was Director of Training for the Spokane Mental Health APA-approved psychology internship program for more than 20 years and has served on board of the American Association of Suicidology. He was a founding board member of two national suicide prevention organizations: The Kristin Brooks Hope Center (1-800-SUICIDE), and The Suicide Prevention Action Network.

Michelle Franklyn Davis, M.Ed., M.S., OnLine Instructor, QPR Institute, has worked in the mental health fields since 1969. Her professional roles have included mental health clinician, community advocate and teacher. She has been involved in the development of many social service programs including Dial Help, 1969, The National Center for Runaway and Youth Services, 1974, Town of Hilton Youth Services, 1976, Brighton Treatment Center, 1996, and OnLine Mental Health Action Committee, 2007. Michelle is a pioneer in on line clinical training, having run successful training sessions completely on line in 2008 and 2009.

# Lifestyles and Behaviors: Social Urgency of the Prevention of Health and Sustainability of National Health Systems: The Need for Telemedicine

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## Introduction

The early 2000s, many countries seemed to have exaggerated expectations in the United Nations and World Health Organization both in the considerable increase in the number of the elderly people and the reduction in mortality for acute events, and in the growing spread of obesity diseases among young people due to a lack of information on preventive health behaviors and nutritional education. The demand for healthcare is likely to increase over time: the first phenomenon is due to the increased prevalence of chronic diseases, who have specific developmental characteristics that often are associated with different levels of disability and/or the presence of acute episodes; the second phenomenon which involves increases in spending, unthinkable 20/25 years ago, to treat young people as a result of diseases related to bad obesity and diseases caused by bad deeds (abuse of alcohol and drugs). Today in all EU countries there is awareness about the truthfulness of these predictions that have been transformed into realistic data. Therefore, in the absence of appropriate health policies with the use of ICT and digital technologies, the consequences of these phenomena may soon have disastrous effects on the sustainability of health systems and welfare, also considering the reduction of financial resources available. The EU requires that each country made increasing financial care planning in health assistance, with more extensive use of ICT and telemedicine. The use of e-health system, that the EU supports since the plan *e-Europe 2005* and which has been updated within the plan *i2010-201*3 and Digital Agenda 2020 should be more widespread.

To earn health: it is a possible objective. To live well and in good health there is need: a corrected feeding, a regular physical activity, little alcohol and nothing smoke. A healthy life style and assets is pleasant and allows

preventing many chronic pathologies like the cardiovascular illnesses, the cancer respiratory, the diabetes, but also the excess weight and the obesity which are on the growing increase in the children. We are what we eat but also how we move. The sedentary and not a very active life style are risk factors for pathologies like the cardiopathy coronary, the diabetes and the cancer at the colon. An active life is the best tool to prevent many pathologies; in fact he contributes to lower the values of the arterial pressure and those of *ipercolesterolemia* to prevent cardiovascular illnesses, obesity and excess weight, diabetes, osteoporosis; he contributes, also, to the psychological wealth, reducing anxiety, depression and solitude sense, especially in the elderly ones.

Besides, sport and physical activity contribute to avoid, in young people, set up it he of wrong behavior, what the habit to smoke and alcohol and the use of drugs. It is necessary not only to know what to do to assume healthier life habits, but be also informed about the tools and the offered chances by the environment in which one lives.

In presence of renewed economic, cultural, social and epidemiological conditions entirely, a substantial afterthought of the organizational logics is essential on the protection and promotion of the health, and from the reflection on the approaches to the integration and on the more diffused mechanisms of coordination for the inherent problems the assistance emerges as such tools, primarily risen note in a relief dimension, finds important application limits in the dominion of the management of you address him preventive and organizational.

The principal cause is traceable in the difficulty of communication, implied at the base of the coordination. In a high-intensity environment informative what that of the health the integration has the tendency to depend, in fact, essentially on the availability of variously composed and structured changing information and knowledge of the specific roles, tasks and objectives some involved operating individuals.

In this perspective, the ICT, as technology to support of the processes of communication and decision of individuals that develop assignments among them interdependent, it results to constitute a dimension of analysis of great interest in the dominion in examination.

Wide information and initiatives serve one in the basic schools, in the universities, in the category associations, using the means of the ICT in Health: Call centers, network and telecom services.

*The e-Health system: teleassistance and telemedicine culture*

The telemedicine has to be brought to the attention of the people: it is one of the main requests than the European Committee has turned members to

the states in the COM-2008-689 document concerning the telemedicine on wide stair. A request which, obviously, regards also Italy, where such culture appears scantily spread, even between the health operators. The applications and the knowledge on matters of telecast of data and images are still not very diffusing (ultrasound and teleradiology) for teleconsultation or Tele-diagnosis.

He is necessary so spread this culture to earn health with a wide activity of information, turned to many addressees: operating subjects institutional in the health, doctors, other, to young people, to the citizens, with a popular language, of easy learning, which shows the merits and the benefits of life styles and adequate behavior. There is needed to make initiatives of communication and to give information frequent, adequate and complete about the e-Health system benefits on the advantages:

- The health education through Telecom Nets as big communities can reach themselves with a good quality service and to contained content costs. The information on the hygiene of life, prevention of diseases of major social diffusion, the course of the same, the most appropriate therapy can be distributed over the channels for mass distribution or mobile stations through telemedicine (mobile laboratories) for screening and monitoring campaigns;
- Remote monitoring of telecare and telemedicine (telecardiology, teleradiology, telemonitoring of patients with chronic diseases socially relevant, remote recording all the variations of a physical and clinical involve the need for a change in treatment (blood pressure, temperature, O2 and CO2, weight, spirometry, blood glucose, ECG). With these applications you can reduce the number of improper hospitalizations that increase the cost of the health system and that significant resources to escape most needed;
- Distance learning for health workers, especially between central and remote health facilities, for structures in disadvantaged areas (eg. Eastern Europe or facilities for humanitarian missions).

*Ethical considerations*

The telemedicine realizes medical practices and therefore the ethical rules must have respected:

- "*Primum not nocere*" (*Ippocrate*);
- The maximum and central attention to the patient; what is possible from a technological point of view necessarily is not useful for the patient;
- Safety and reservation of the data.

We believe that the telemedicine is a profit help, but it must not constitute the goal.

The critical points on such service derive from the fact that the Institutions are to a large extent "absent" to program the telemedicine among the health performances; also the medical Organizations, also considering with favour the telemedicine, don't to assume valid initiatives near the competent Institutions to promote its development on vast staircase. A certain level of indifference shines through for the telemedicine, determined by the institutional lacks on its development, even if you find in different Regions various programs and also projects experimental, but of limited operational value. We think that the telemedicine is a good aid, but it is not the final scope. In this proposal we believe that in the third millennium the life styles and behaviors and nutrition education for the prevention of health should be undertaken with more breadth and urgency through the applications: call center systems, hospital networks and services on-line. These are commitments of resources, not only financial, that are as necessary as those required to provide remote medical assistance to patients who cannot be immediately reached by a white coat or be hospitalized.

The Lombardia Region has realized the guidelines (2008) for the prevention of young as this method: *Stengthening Families Program and Life Skills Training (LST).* The method concern a prevention program about the excess use of drugs and is accepted valid to reduce the consume of alcohol, tobacco and drugs. The LST program concerns on the main factors that move at individual consume of drugs and other components and the method learns the abilities to solve in positive mode the situation whit high risk for health.

*LST* is promoted by World Health Organization already many years.

To conclude we need, today, a lot of investments in ICT for the development of e-Health system and also telemedicine that, in Italy, needs more attention by Regions and more interaction, but now to increase the investment in telemedicine is problematic in all Region, although there is a need to develop culture and education at all levels in telemedicine.

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# Monitoring, Treatment and Prediction of Bipolar Disorder Episodes MONARCA

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***Abstract:*** **MONARCA will develop and validate solutions for multi-parametric, long term monitoring of behavioural and physiological information relevant to bipolar disorder. It will combine those solutions with an appropriate platform and a set of services into an innovative system for management, treatment, and self- treatment of the disease. The MONARCA system will be designed to comply with all relevant security, privacy and medical regulations, will pay close attention to interoperability with existing medical information systems, will be integrated into relevant medical workflows, and will be evaluated in a statistically significant manner in clinical trials. The MONARCA system will consists of 5 components: a sensor enabled mobile phone, a wrist worn activity monitor, a novel "sock integrated" physiological (GSR, pulse) sensor, a stationary EEG system for periodic measurements, and a home gateway. It will combine GPS location traces, physical motion information, and recognition of complex activities (nutrition habits, household activity, amount and quality of sleep) into a continuously updated behavioural profile. Physiological information from the "GSR sock", the periodic EEG measurements, voice analysis from mobile phone conversations, and motion analysis will provide an assessment of emotional state and mood. Combining this information with patients' medical records and established psychiatric knowledge quantitative assessment of patients' condition (expressed in Psychiatric Rating Scales like BRAM or HAMD) and prediction of depressive and manic episodes will be implemented.**

## Introduction

Bipolar disorder, also known as Manic-Depressive illness, is the sixth leading cause of disability in the world according to World Health Organization. Statistics show that people affected by bipolar disorder lose on average 13.1 years of their productive life as a consequence of the illness. Moreover, Unipolar major depression is considered the leading

cause of disability worldwide with 43 years lost in terms of productivity. Therefore, there is a clear need to manage and reduce negative impact that these diseases have on social and economic spheres.

Bipolar disorder is diagnosed in around 1% of the EU population, 2.6% of the USA and at least one alternate manic-depressive episode occurs in around 10% of the world population during their life time (National Institute of Mental Health's data).

For these reasons, the European Commission decided to finance research efforts targeted at supporting therapy and self-management of people suffering from bipolar disorder.

An example of this is the recently funded EU project: MONARCA (MONitoring, treAtment and pRediCtion of bipolAr disorder episodes) coordinated by CREATE-NET Research Center with the collaboration of several international partners (EC Funding of near 4 Million Euro). MONARCA is thoroughly investigating aspects of bipolar disorder by adopting a holistic approach to assessment, treatment and self-management of the disease. The project focuses on objective assessment and prediction of bipolar disorder episodes and aims to further advance the discovery of new markers for this disease.

The project utilises state of the art methodologies for treating Bipolar Disorder based on pharmacological, psychotherapeutic methods and clinical scales (e.g. BRAMS, HAMD, self assessments); developing and validating a multi-parametric, closed-loop approach to improve the treatment, management, and self-treatment of bipolar disorder disease.

MONARCA is an innovative system, which consists of five main components (a sensor-enabled mobile phone, a wrist-worn activity monitor, a novel - sock integrated - physiological sensor (GSR, pulse), a stationary EEG system for periodic measurements and a home gateway. MONARCA will combine GPS location traces, physical motion information, and recognition of complex activities (eating habits, household activity, amount and quality of sleep) into a continuously updated behavioural profile that will be provided to doctors in a meaningful way to support the treatment. The information based on sensing technologies will be used as an objective basis for discovering trends and predicting episodes of bipolar disorder.

The monitoring systems of MONARCA are as follows:

1. A smart phone equipped with GPS and an acceleration sensor. The accelerometer can provide information on the overall level of activity and contribute to stress level analysis (through motion pattern analysis). Location tracking from GPS (and base station info) is an important clue to daily activity patterns and social contacts. Further information about

social contacts can be derived from phone records. Voice analysis during phone calls can be used as an indication of stress.

2. A wrist worn accelerometer/microphone combination for fined grained activity analysis. The accelerometer will give information on arm motion. Combined with ambient sound and location info it can be used to infer a broad range of behaviours such as nutrition, homemaking as well as different leisure and sports activities. Furthermore, the wrist worn accelerometer will be a valuable source of information on sleep quality.

3. A ‘smart sock’ that will provide GSR (galvanic skin response) and pulse signals as an indication of stress. The choice of a sock as platform is due to the fact that reliable GSR signals can only be collected at the palms (which is not practical) or at the feet. Blood vessels in the lower leg can be used to derive a pulse signal using infrared pulse oximetry or capacitive methods.

4. A stationary, easy to use EEG device from which additional information relevant to state assessment and episode prediction will be extracted.

5. An easy to use interaction interface for the patient that will allow him/her to input additional information (e.g. periodical additional questionnaire) and easily get in touch with the therapist when needed.

In this manner, the patient's medical record will correspond more accurately with the patient’s condition and medical staff can elaborate their diagnosis based not only on self-reported experiences by the patient, but also on objectively measured information, sourced from the physical and physiological sensors.

MONARCA system includes a closed-loop approach between patients and medical staff realised through purpose-built interfaces. On one hand, people affected by bipolar disorder will be aided by mechanisms of self-assessment, provision of warnings and risk profiles through persuasive interaction and coaching to support self-treatment. On the other hand, the medical staff will have access to interfaces for interpreting patient data, therapy assessment, medication planning and scheduling visits tools, developed by the project.

In order to become a useful tool for the patients and doctors, MONARCA’s research effort is based on close collaboration with two hospitals, partners of the project, namely Psychiatric Center Rigshospitalet (Denmark) and Psychiatric State Hospital of Tirol (Austria) allowing the patients and the doctors to be involved from the early stages.

In this way, patients and therapists can interact with researchers and provide their feedback and requirements about usability and interaction with

the system in order to maximize system adoption and give patients an active role in the decision-making and self-management of their disease.

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# The Influence of Preoperative Physiotherapy on the Willingness to Participate Internet Based Remote Home Rehabilitation among Patients Suffering Coxarthrosis

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***Abstract:*** **Osteoarthritis (OA) is in the forefront of the most disabling musculoskeletal disease, claimed as civilization-related disease by WHO. The effectiveness of pre-operative physiotherapy against OA is anticipated. The development of modern information technologies enable to arise new kind of physiotherapy –telerehabilitation (TR). The aim of the study was to assess if the participation in pre-operative rehabilitation influenced on willingness to take part in telerehabilitation among patients with OA of the hip. Forty five patients participated to the study. The examination included assessment of physical abilities and various questionnaires concerning the quality of life and the willingness of telerehabilitation participation. Examined patients presented their willingness to take part in telerehabilitation regardless of their previous experiences of participation in physiotherapy, considering that telerehabilitation can support physiotherapy programs carried out at patients home.**

## Introduction

Osteoarthritis (OA) is considered as the most disabling musculoskeletal disorder producing variety of remarkable social, health and economic problems [1-5]. World Health Organization (WHO) considered OA as a civilization-related disease. It is estimated that almost 37% of adults have evidence of OA in radiography. Physiotherapy takes part of fight against OA [1-4]. The effectiveness of pre-operative physiotherapy is anticipated [1,2,5,6]. The main effect of physiotherapy in OA of the hip is to reduce

pain and improve or maintain muscle function and joint motion. An increased prevalence of OA is predicted because of the aging society and a chronic character of the disease. The development of modern information technologies enable to arise new kind of physiotherapy - telerehabilitation. Telerehabilitation enables patients to take part in IT supported physiotherapy and to be remotely mentored by a physiotherapist [7,8]. The aim of the study was to assess whether the participation in pre-operative rehabilitation influence on willingness to take part in telerehabilitation among patients with OA of the hip. Results of any preoperative rehabilitation were evaluated in contrary to no physiotherapy participation prior the surgery.

## Material and Methods

Forty five patients treated at the Chair and Department of Orthopaedics and Traumatology of Locomotor System were recruited to the study from January to May 2010. The average age of patients was 59 years (from 30 to 82; 58 y.a. woman, and 64 y.a. men). Patients were analyzed accordingly to their history of participation to pre-operative physiotherapy. The disability and quality of life assessment was supported by multiple hip disorder oriented, rehabilitation participation prior surgery and telerehabilitation oriented questionnaires (Harris Hip Score (HHS), Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Short Form – 36 (SF–36), Hip disability and Osteoarthritis Outcome Score (HOOS) and VAS. The examination included assessment of joint Range of Motion, muscle strength and lower extremities measurements. All except four patients answered the question about their attitude toward telerehabilitation. Statistical analysis was performed using statistical software Statistica 9.0 (StatSoft) utilizing Mann-Whitney test and the Student's t-test and descriptive statistics.

## Results

Preoperative physiotherapy was found as significant factor reducing pain and improving disability and some aspects of the quality of life ($p<0,05$) among patients with OA of the hip joint. Descriptive statistics and t test results are presented in the Table 1.

Forty four percent of patients showed the interest to participate in telerehabilitation. No significant difference of the attitude toward telerehabilitation was found between groups of patients independently to participation to physiotherapy prior the surgery ($p>0,05$) (Tab.2).

Table 1. Differences between rehabilitation participating versus nonparticipating groups (bold represents significant difference).

| | AVG study group | AVG control group | Test T | p-value |
|---|---|---|---|---|
| HOOS function, daily living | 39,97 | 26,47 | 2,34 | 0,02 |
| SF-36 vitality | 46,48 | 35,56 | 2,34 | 0,02 |
| SF-36 mental health | 60,59 | 46,89 | 2,36 | 0,02 |
| SF-36 social functioning | 48,14 | 31,94 | 2,07 | 0,04 |
| DIFFERENCE : INDIRECT LEG- LENGHT | 2,00 | -0,67 | 2,93 | 0,01 |
| DIFFERENCE: ACTIVE INT. ROTATION ROM | 11,48 | 4,17 | 2,48 | 0,02 |
| DIFFERENCE: PASSIVE INT. ROTATION ROM | 12,22 | 3,61 | 2,83 | 0,01 |

Table 2. Mann-Whitney test value between groups.

| Patients who didn't participated in preoperative rehabilitation | Patient participated in preoperative rehabilitation | Mann-Whitney test (p-value) |
|---|---|---|
| 16 | 25 | 0,72 |

## Discussion

The number of patients with OA is predicted to grow up because of the aging society and a chronicity of the disease [1-4]. It will be encountered more often in orthopaedics and related physiotherapy practice [1,2]. Telerehabilitation enables patients to participate in physiotherapy. During exercising patient can be remote mentored by a physiotherapist via Internet or can use the individual rehabilitation exercises instructional videos added on website by a professional therapist. Many local and international projects are focused on telerehabilitation recently.

## Conclusions

Telerehabilitation can support physiotherapy programs carried out at patients home. Patients present their willingness to take part in telerehabilitation regardless of their previous experiences of participation in physiotherapy. Other factors may influence patient’s attitudes towards telerehabilitation.

## Acknowledgments

This study was partially supported by project CLEAR ((ICT-PSP-224985) Clinical Leading Environment for the Assessment and validation of Rehabilitation Protocols for home care).

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# TheraNet: Occupational Therapy Support through Social Networks

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***Abstract:*** **Occupational therapy is, nowadays, one of the best practices we have against several neurodegenerative diseases as Alzheimer's (AD). It trains the brain as physical exercises do in our body. However, this therapy could be improved in different ways. Our proposal is based in a social network where relatives and caregivers of the sufferers could be connected with each other, achieving the following objectives: sharing experiences, releasing their stress and creating customized exercises for the patients. These exercises could be practiced, later on, in the occupational therapy activity at day centres or in their own homes.**

## Introduction

Nowadays, many of the diseases most frequently suffered by our society are those related with neurodegeneration. These are different ills that cause an excessive dependency to their sufferers. This is the case of several dementias as AD, a disease that is, unfortunately, rapidly being more and more famous due to the large number of affected people (young people as well). What is more, there is not a known cure for this illness yet and it neither can be certainly diagnosed until the autopsy time.

However, what we do know is how to decelerate its effects and how to try to delay its appearance in a very simple way: mental exercise. This idea is based on the same fact which claims that physical exercise will help us to maintain our body in good shape. That's the reason why centres and residences employs occupational therapy as a key event in the daily activities proposed to their patients.

In short, occupational therapy tries to activate our brain using different games, exercises and questions. All of these exercises are usually made in a

generic way for every patient and, only in some specific cases, asking them about their relatives or about more personal knowledge (only if the caregiver knows the patient personally). It is obvious that the amount of this kind of data is very poor when the carer is a worker from the residence instead of a relative. Our previous work tried to solve this problem through a content management system where relatives and caregivers introduced the personal knowledge of the diseased people. After that, at home or in their residences, patients were asked about that knowledge contained in the system: e.g., where did he/she work, what is the name of his/her best friend.

Additionally, the patients themselves are not the only ones affected by this kind of diseases, because people who usually take care of them, those who know them better, notice, day by day, the degeneration of the sufferer, a person they love. They also realize how the communication between them gets more and more difficult every day. Some authors name this problem as the caregiver stress and a few third-party approaches to solve this issue will be listed at the state of the art section of this paper.

After that, we propose our own solution, which tries to solve both of these problems, putting the personalized occupational therapy and the carer relief together.

## State of the art

In the previous section, we introduced the stress and pressure experienced by relatives and caregivers of an AD sufferer. González-Salvador [1] names this problem as the caregiver stress. It's usual to put the interest on the disabled people before their carers, because the former's illness is more obvious than the latter's. Nevertheless, there have been several researchers who have pointed this problem out trying to achieve a solution from different scenarios.

For instance, there are lots of communities (not only digital networks) which bring dependant people's caregivers an opportunity to communicate between them, learning how to take care of the sufferer in the best possible way [2]. More recently, Becker [3] provides this kind of support to the caregiver using a pocket PC. With this application, the patient's carer is able to get remainders or the needed care when facing any event. The application also monitors the daily activities of the patient and uploads them to a webpage in order to be shown for his/her family.

On the other hand, there are other applications which are focused in provide different services directly to the patient in a huge variety of ways. An example of them is the work of Guo [4], which employs an immersive simulation of a three-dimensional kitchen to train patients with brain damage in the task of cooking. Talking about the occupational therapy,

Hofmann [5] developed a cognitive training which employed personal and biographical material directly related with the social and local environment of the patient. After the study, and according to the Bäckmann's criteria, they concluded that eight out of the ten patients fail less times after the training and they made every task in a quicker way and with fewer help. This is just an example of how technology could be used to improve the occupational therapy received by the patients.

Talking about social networks offered to caregivers, there were, actually, some works which stated the benefits that the social contacts could provide. Some of them were written even before computer-based social networks appeared. This is the case of Cohen [6] and Hardy [7], who emphasize the sharing of feelings and the support from others as the most beneficial aspects of group participation. More recently, other authors, like Colvin [8], have applied these ideas to the Internet-based social networks. They concluded that computer mediated communication was seen as an advantageous tool which allows them to communicate in an asynchronous and anonymous way, although limited by the absence of physicality.

## A network to help both patients and caregivers

It is redundant to say that dependant people need someone who takes care of them. It has even been scientifically proved in a huge variety of studies ([9]) that burden of care leads to deterioration ([10], [11]) and the presence of support ties protects against illness ([12]). What it is less known by people (fortunately, not by scientists as said in the previous section) is that caregivers suffer the illness as well, in an indirect way. And no one loves to work when stressed. This leads to the idea that we should focus also on caregivers, not only to help them, but also if we want them to take care of dependant people in a proper way.

Consequently, our proposal expects to be a solution with two targets: to help the patients (improving their occupational therapy activity) and to relieve their caregivers and relatives from their tough duties. This means that the solution will be focus on caregivers, but will has a total influence in the life of dependant people.

More specifically, the idea is to build a computer-based social network where relatives or professional caregivers of the AD sufferers could communicate with others who could listen to them properly. There, they could schedule remainders of the day by day activities, achieve a proper communication between day centers or residences and homes of the patients, post their doubts or advises in a forum or, simply, talk between them about anything they want.

What is more, occupational therapy could be improved from different sources. For instance, relatives of the sufferers could introduce a huge variety of knowledge into the system: favourite songs, cities they have visited when they were young or, simply, family events where the patient took part. Also, they could create their own family tree. This is an activity which relatives will enjoy but, at the same time, could be used at occupational therapy in order to ask (not only with words, but with additional pictures, sounds or videos) the patient about what is the name of his/her nephew, how many grandchildren have she/he got, etc.

As a result, dependant people will receive a better care even from their not professionally trained relatives, who will be better informed and will have better materials straight from the network. Besides, they will be less stressed after talking with people in their same situation. This is also suitable for professional carers, who, additionally, will have large personal information of their patients at their disposal to be used at the occupational therapy activity. Of course, this should be a dynamic platform that is going to grow following the needs of their users, who will improve it day by day.

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# eLearning: Informed Citizens and Distance and Tele-Education of Medical Professional

# Changing Practice Through Multimedia Education – Early Detection of Hip Dislocation in Children

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***Abstract:*** **The clinical screening of infant hips by experienced clinicians has shown to be effective in reducing late presentations of developmental dysplasia of the hip (DDH). An evidence based multimedia education module was developed to increase the basic knowledge, confidence and clinical skills of health professionals involved in screening of the DDH. A two year follow up study was undertaken to assess the long term impact of this education module. Two hundred and three maternal child health nurses in Victoria Australia were recruited into the study. An improvement in four clinical practice areas at three months were observed (all p-value<0.001) and this was maintained in three of the areas at the two year follow up (all p-value<0/001). At the three month and two year follow up, knowledge scores were higher (p-value<0.001) as well as confidence scores (p-value<0.001) compared with pre-module. This study demonstrates that e-learning to deliver continuing education is an effective medium.**

## Introduction

Clinical screening of infants by experienced clinicians has shown to be effective in reducing late presentations of developmental dysplasia of the hip (DDH) [1]. Early detection of DDH is vital, as the delay in diagnosis leads to surgical interventions and poorer outcomes such as osteoarthritis in adulthood. In Victoria, Australia, the prevalence rate in 2005-06 was reported to be 27.5 per 10,000 births, making DDH the 5$^{th}$ most common birth defect in this state [2].

In Australia, the clinical screening of DDH is conducted by a number of health professionals including maternal and child health (MCH) nurses and general practitioners. A needs analysis revealed that there was inconsistency in screening practices. An evidence-based education module was developed to increase the knowledge base, confidence and clinical skills of health

professionals involved in the screening of this condition. Produced on a DVD, the education module utilised a multimedia format by combining 3D animations (Figure 1) with voice-over text and sound effects.

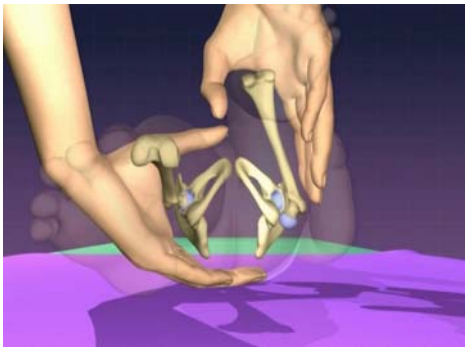

Figure 1: Animation from DDH education module

## Methods

A two year follow up study was undertaken to assess the impact of the education module. The primary outcome was self-reported change in clinical practice. Secondary outcomes were changes in overall knowledge and confidence. Two hundred and three maternal and child health nurses from metropolitan and rural regions in Victoria were recruited in the study. All participants watched the education module in a group environment within their regular team meetings. A knowledge questionnaire was administered before and immediately after the education module was viewed and at two years. Participants completed a clinical practice and confidence questionnaire prior to watching the module, at three months and two years later.

## Results

There was a response rate of 86% at the three month follow up and a 75% response rate at two years.

*Changes in clinical practice*

Improvements in clinical practice were observed at three months and at the two year follow up. Clinical examination techniques were improved, with a reduction in the number of nurses incorrectly examining infants from the side. At pre-module, 34% of nurses were reporting this behaviour compared with 23% of nurses at three months (n=171, p-value=0.003), and

21% of nurses at two-years (n=146, p-value=0.001). Sixty percent of nurses were more likely to push firmly in testing for hip instability at three months compared with 47% of nurses pre-module (n=170, p-value<0.001). This improvement was not sustained at two years, with only 46% of nurses pushing firmly (n=146, p-value=0.78). Nurses demonstrated a better understanding of clinical signs, with fewer nurses incorrectly believing hip creases were the most important physical feature of DDH. Prior to watching the module, 43% of nurses agreed with this statement, compared with 25% at three months (n=172, p-value<0.001), and 19% at two years (n=148, p-value<0.001). Referral practices also improved, with less number of nurses referring infants with clicks in isolation. At pre module, 86% of nurses reported this clinical practice, compared with 47% of nurses at three months (n=171, p-value<0.0001) and 34% nurses at two years (n=147, p<0.001).

*Knowledge gain*

Prior to viewing the module, participants averaged a score of 8.4 out of a possible 18, on the knowledge questionnaire. Years of nursing experience did not correlate with higher scores (r=0.003). Immediately post module, scores improved to 14.6, an improvement of 6.2 questions (95% C.I: 5.8 to 6.5, p<0.001). This improvement was sustained at two years, with an average score of 12.6 correct questions, an improvement of 4.2 questions from pre module (95% C.I: 3.7 to 4.9, p<0.001).

*Change in confidence*

Prior to viewing the DVD, the mean score for self assessed confidence was 19.4 out of a possible score of 30. At the three month follow up, the mean confidence score was 22. The difference in the means between pre DVD and three months was statistically significant (n=165, 95% CI:2.1 to 3.3, p-value<0.001). At the two year follow up, the mean score reduced slightly to 21.3. However, the difference in the means between pre DVD and two years was statistically significant (n=142, 95% CI:1.4 to 2.8, p-value<0.001).

## Discussion

Various traditional teaching methods such as didactic presentations have been utilised to address the continuing education needs of clinicians. However, these methods alone have shown not to change professional practice [3]. E- learning formats are becoming increasingly popular in delivering continuing education to health professionals due to the following benefits: a) an enhanced learning environment which accommodates individual learning styles (visual, auditory, tactile/kinaesthetic); b)

flexibility of delivery (online, CD-ROM, DVD), providing improved access to a wide audience, including clinicians residing in regional areas; and c) opportunities for self-paced autonomous learning on an ongoing basis which can be easily incorporated into individual or group professional development. Our study suggests that multimedia education modules can have a positive influence on clinical practice. These findings are similar to previous studies of technology-mediated learning. For example, Reference [4] conducted a one group pre test-post test design to evaluate knowledge and self reported confidence change across multiple web-based courses for physicians. The results showed that this method of delivery was effective in enhancing knowledge, confidence and self reported practice change outcomes.

## Conclusion

The multimedia education module was associated with improvement in knowledge and confidence over time. More importantly, it showed that it can lead to changes in clinical practice which can be sustained in the long term.

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# Computer and Internet Use among Undergraduate Nursing Students in Ribeirão Preto, Brazil

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## Introduction

The ability in handling computers and Internet has become inherent in nursing professionals to obtain information that support their professional practice, and there is need to develop these skills still during the undergraduate nursing programs [1-2]. This descriptive study aimed at describing the use of computers and Internet among undergraduate nursing students of an undergraduate Nursing Diploma Program in a Public University in the state of Sao Paulo, Brazil, participating in an online module on Endocrine Physiology.

## Methodology

The sample consisted of 44 students who met the following inclusion criteria, namely, being a student of the Nursing Diploma Program, agreeing to participate in the online module on Endocrine Physiology by signing the Free and Informed Consent (FIC) and being enrolled in the Physiology course for the first time. This research project was reviewed and approved by the Research Ethics Committee (CEP) of the University of Sao Paulo at Ribeirao Preto School of Nursing (EERP). A database collection tool was developed based on a similar used by the National Exam for Undergraduate Programs - called '*Provão*' - for the data collection of the nursing program. The researcher gave two envelopes to the project participants, one containing the FIC and the other with the instrument for the data collection, which needed to be answered separately. Later the envelopes were collected without identification, to guarantee the anonymity of the participants.

## Results and Discussion

The results showed that most students were female, n. 41 (93.2%) and between 19 and 23 years old (75%), as presented in Table 1.

Table 1 – Sociodemographic characteristics of students participating to the online module

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

All students used computers and 25 (56.8%) of them did it on a daily basis. As shown in Table 2 twenty-three students (56.1%) used the computer at their own institution and most of them (58.1%) learned how to use it on their own.

Table 2 – Distribution of the computer use by students participating into the module. Ribeirão Preto, 2008

| **Computer use** | **Students** | |
|---|---|---|
| | n. | % |
| **Place where most frequently you use the computer** | | |
| At the institution where I study | 23 | 56,1 |
| At home | 17 | 41,5 |
| At my workplace | 1 | 2,4 |
| Total* | 41 | 100,0 |
| **How did you learn to use the computer?** | | |
| Alone, by trying | 25 | 58,1 |
| In specialized courses | 17 | 39,5 |
| With orientation, at the institution where I study | 1 | 2,3 |
| Total | 44 | 100,0 |

* Considered only participants who answered the question.

For 23 students (59.0%), Internet was the most widely used mean to keep updated. Students had access to the Internet at the teaching institution, 30 (68.2%), at home, 13 (29.5%), or at work, 1 (2.3%), as shown in Table 3.

Table 3 – Distribution of the Internet use by students participating into the module. Ribeirão Preto, 2008.

| Internet use | Students | |
|---|---|---|
| | n. | % |
| **Mean used to obtain updated knowledge** | | |
| Internet | 23 | 59,0 |
| TV | 11 | 28,2 |
| Newspapers | 3 | 7,7 |
| Magazines | 2 | 5,1 |
| Total* | 39 | 100,0 |
| **Place from where most frequently access Internet** | | |
| At the institution where I study | 30 | 68,2 |
| At home | 13 | 29,5 |
| At my workplace | 1 | 2,3 |
| Total* | 44 | 100,0 |

* Considered only participants who answered the question.

When exploring the use of IT resources by undergraduate nursing students our results look similar to these shown by other authors, who evidenced that ~85% of the students uses computers at their own University. Moreover, the institution is the place where they can get Internet access, and ~62.06% of the students use the computers of their own institution for that. These authors also pointed out that the institutional policy is to provide access to the Internet to all undergraduate students. This permits having a differential in the education and training profile of undergraduate students preparing for the labor market, meeting the professional expectations of the 21st Century [3,4]

## Final considerations

The computer and the Internet are present in the daily lives of undergraduate nursing students. Nevertheless, it is necessary to ensure students access to these resources and their use in mediating the teaching-learning process in any subject.

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# “Does Online Counselling Help The Helping Professionals?” Randomized Controlled Trial of Effectiveness of Online and Face To Face Counselling Intervention

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***Abstract:*** **Work in healthcare sector is characterized by high level of work stress internationally. Information technology mediated behavioural and psychology cares are widespread around the world. Through synchronous chat based format, the present trial examined the difference between effectiveness of online and face-to-face counselling both led by cognitive behavioural approach for doctors and nurses who experienced psychological conditions. Online counselling and face-to-face counselling interventions had similar effect in reducing the symptoms of depression and anxiety.**

## Introduction

It is well studied that health care professionals are at great risk of developing psychological conditions which have significant relationship for their wellbeing [1]. The most important factor to deal with this is to acknowledge the problem and to consider the possible intervention strategies. But very little has been done to investigate if any of these are encountered by Mongolian health professionals where certain stressors are prevalent as consequence of former socio-economic regime. Survey result shows that regardless of care level doctors and nurses suffer from over workload, e.g. physicians in primary care level serve over 40 patients a day while specialized doctors in obstetric unit serve 27 patients in inpatient as opposed to 12 in outpatient care [2].

Most of the interventions done on burnout are career counselling mainly through face to face (F2F) format and this practice is typically considered to involve the counsellor and client sharing the same physical space and it is

widely practiced in Mongolia. However this mode of service is more time and money consuming. Clients use videoconferencing, synchronous chat, and asynchronous e-mail with professional psychologists in place of or in addition to F2F counselling.

The purpose of the present trial was to examine the differential effectiveness of online and face to face counselling for doctors and nurses.

## Methods

*Participants*

The study was conducted from March till October 2010. Participants recruited from 9 hospitals in Ulaanbaatar. Based on the screening questionnaire we invited 212 potential candidates to the intervention. Overall 145 eligible participants remained in the randomization. 49 participants were assigned in online counselling group, 48 in face to face counselling and 48 in control group

*Design*

The study was a randomized controlled trial. Participants who fulfilled the inclusion criteria and scored higher on the outcome assessment scale entered the study. Participants were randomly assigned to 1 of 3 conditions: 1) synchronous chat based online counselling; 2) F2F counselling; 3) control group.

*Assessment*

Assessment contains personal burnout, depressive symptoms and anxiety.

Personal burnout is one of main dimensions of Copenhagen Burnout Inventory [5]. Depressive symptoms were measured by the short version of CES-D [6] which contains 10 questions about the 7-day incidence of different types of depressive symptoms. Anxiety was measured by State-Trait Anxiety Inventory (STAI) to evaluate trait and state anxiety separately [7].

*Intervention method*

Intervention content was theoretically based on Cognitive-behavioural therapy (CBT) model. This is one of the extensively researched forms of psychotherapy and is highly effective for conditions such as depression, generalized anxiety disorder, and panic disorders [3]. CBT is considered one of the most applicable therapies to computer-mediated counselling [4]. Participants allocated to online counselling group were offered three to five sessions of CBT through synchronous chat over the course of 4 months. The other group of participants allocated to face to face counselling group was offered the same therapy to be conducted in professional counselling facility

where both therapist and client's presence were required. The goal of the intervention was to reduce symptoms of burnout, depression and anxiety disorders by restructuring and change behaviour by applying 8 different techniques of CBT.

*Statistical analysis*

The analyses presented difference of depression and personal burnout scores between pre and post assessment of the intervention for 3 groups were calculated using ANOVA. Because STAI score was missing for control group at pre assessment, the score difference between online and face to face intervention group was calculated using paired as well as independent t- test. Data analysis was performed with SPSS for Windows.

## Results

At the end of the intervention 11, 10 and 14 participants completed the online, face to face counselling group and control group, respectively. Therefore 35 participants who completed the intervention according to the protocol were included in the final study analyses.

The average length of face-to-face counselling session was 55.75 minutes. In online counselling average length of each session was 87.5 minutes. The difference of online counselling time was 31.75 minutes longer than face-to-face counselling.

Participant's mean age was 39.1 years (SD 7.19) and 85% were women overall. Of all the participants, majority of them were doctors (60%) and were from tertiary care level hospitals. The distribution of depression, personal burnout and anxiety scores at baseline had no significant difference across the 3 groups.

Table 1. Scores on main outcomes at baseline and at post assessment

| Variables | | Total | | Group | | | | | | p-value |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | online | | face to face | | control | | |
| | | mean | SD | mean | SD | mean | SD | mean | SD | |
| Depression | baseline | 11.8 | 4.96 | 11.36 | 5.87 | 12.1 | 4.72 | 11.93 | 4.71 | 0.94 |
| | post | 6.43 | 3.54 | 5.91 | 3.14 | 5.7 | 3.43 | 7.36 | 3.93 | 0.457 |
| Personal burnout | baseline | 55.57 | 15.61 | 54.55 | 14.05 | 61.5 | 10.55 | 52.14 | 19.19 | 0.349 |
| | post | 37.01 | 11.81 | 32.55 | 9.43 | 31.88 | 11.58 | 44.2 | 10.53 | 0.009 |
| State Anxiety | baseline | 31.86 | 9.27 | 30.27 | 8.4 | 33.6 | 10.3 | | | 0.425 |
| | post | 23.06 | 4.95 | 23.27 | 4.47 | 20.9 | 4.79 | 24.43 | 5.2 | 0.228 |
| Trait Anxiety | baseline | 51.38 | 8.74 | 49.73 | 8.58 | 53.2 | 8.99 | | | 0.377 |
| | post | 41.77 | 8.1 | 40.36 | 8.13 | 41.4 | 7.85 | 43.14 | 8.63 | 0.696 |

Table 1 presents the scores of outcome indicators assessed at baseline and at post intervention. We added later the STAI scale of anxiety proneness. All outcome indicator scores were decreased at post assessment among 3 groups. But there was not beneficial significance between the measures of depression and anxiety. But we found significant effect on personal burnout scores in both intervention groups at post intervention measurement.

## Discussion

The present trial examined the difference between effectiveness of online counselling which is synchronous chat and face-to-face counselling led by CBT for doctors and nurses who experienced person related burnout, depression and anxiety in Mongolia. Although the result was not statistically significant, online counselling and face-to-face counselling interventions have positive effect in reducing the symptoms of depression and anxiety. This extends previous findings among patients with mild depression which reduced depression level in 8 weeks using telephone administrated-cognitive behavioural therapy [8]. Another study investigated in this field [9] also used to help self care management, give information, support decision making and problem solving, advance communication and counselling with the intention of reduce negative behavioural symptom among chemotherapy patients.

Even if the goal is the same, modified techniques used in different trials, i.e Huibers et al [10] used 10 techniques divided into 2 stages. In this trial there were 8 techniques used.

Contribution of counselling was related to internet access and computer literacy among doctors and nurses on contribution of online counselling. Only 30 per cent of computers are connected to internet and most of health professionals were not well educated in computer literacy. Mallen [11] suggested that it is not present in face-to-face studies of counselling; a clients or a therapist does not suddenly disappear from counselling room. Disconnection of online session could be disorienting to both clients and therapist.

Finally, our study demonstrates that

- Online counselling and face to face counselling interventions have positive effect in solving common psychological conditions and similar effect on reducing symptoms of depression and anxiety in comparison with control group.

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# HEALTHY SHIP: An Innovative Project for Health Care Improvement and Health Promotion On Board Ships

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***Abstract:*** **This paper presents HEALTHY SHIP, a collaborative project of the Centre for Clinical Research, Telemedicine and Telepharmacy of Camerino University, the International Radio Medical Centre (CIRM) in Rome and the shipping company FINAVAL. The goal of HEALTHY SHIP is to move from a maritime telemedical service available on request for treating diseases or accidents on board ships into an articulated service of global care of seafarers on board ships. The project is based on different actions from health education of seafarers, psychological assessment, risk communication and management, occupational health surveillance, health/medical data collection to be used for occupational medicine purposes and for medical care and stress prevention. The project is ongoing and from its global approach to the different aspects of seafarer's relevant health care improvement and health promotion on board ships are expected.**

## Introduction

Provision of high quality medical care to sailing seafarers is still a challenge to medicine and probably has not improved parallel to the increase in quality of medical assistance of people living ashore. With the exception of passenger/cruise ships that carry a doctor, the majority of ships normally do not carry a medical doctor or paramedic personnel adequately trained. In this situation, the best possibilities for treating diseases or accidents on board are: (i) To provide medical advice via telecommunications systems; (ii) To guarantee adequate training of personnel with the responsibility of health care on board; (iii) To have an

adequate supply of drugs and essential medical equipment (ship's pharmacy called also ship's medicine chest).

The possibility of obtaining medical advice from remote doctors became possible with the development of radio-telegraphy in 1897 by Guglielmo Marconi, the subsequent introduction of radio equipment on ships and constitution of coastal radio stations. For approximately the entire 20$^{th}$ century, medical assistance to seafarers on board ships consisted in the so called *radiomedical advice*. This term indicates a request via radio communications for medical help by the officer responsible for health care on board to a centre providing medical advice to ships. A problem encountered with requests of radio medical advice is that in general it was required in emergencies only or in cases not otherwise solved using medical knowledge of ship's captains or officers. Communicational problems with the medical centre, underestimation of the gravity of the case to treat and the wrong concept of considering medical advice by radio as a synonymous of *evacuation* were probably the reasons of the relatively limited number of radio medical consultations compared with the number of sailing seafarers and with the occurrence of pathologies on board [1].

The progress of telecommunication technology and the development of telemedicine has offered new and exciting opportunities for improving medical care of remote patients such as sailing seafarers [2,3]. There are however, several practical difficulties and cultural barriers for a large diffusion of telemedicine as a standard operational procedure in medical assistance on board ships primarily in case they have no medical facilities on board.

Here we present a project aimed at improving health care of sailing seafarers by associating with appropriate ICT systems several initiatives which in general proceed independently.

## The HEALTHY SHIP Project

The project Health Protection and Safety on Board Ships (acronym: HEALTHY SHIP), is an initiative developed in Italy for improving standards of medical assistance of seafarers on board ships using telemedicine according to MSC/Circular 960 [4]. Circular MSC 960 (Medical Assistance at Sea) is a document issued by International Maritime Organization on 20 June 2000 and identifies and summarizes the elements of a global system of medical assistance at sea.

HEALTHY SHIP is an innovative project for health care improvement and health promotion on board ships established in collaboration by the Centre for Clinical Research, Telemedicine and Telepharmacy of Camerino University (UNICAM), the International Radio Medical Centre (CIRM) in

Rome and the shipping company FINAVAL. UNICAM is an old and prestigious Italian University established since 1336. A modern Telemedicine and Telepharmacy Centre operates at Camerino University. It delivers telemedicine and telepharmacy services and organizes educational activities in the field. CIRM is the Italian TMAS. It was established in 1935 and represents one of the centres with the largest experience in the world of medical assistance to remote sailing seafarers. FINAVAL is a shipping company operating for over 20 years in the seaborne transport of crude oil and petroleum products, having established strong national and international partnerships.

HEALTHY SHIP is a project for providing global health protection of seafarers on board ships. The project includes phases listed below.

*Health education.* It is based on information campaigns on the major health risks for seafarers and on their prevention. Each campaign is preceded by a questionnaire on the awareness by the crews of the topics to be covered. The first campaign was focused on personal hygiene and infectious diseases prevention. Incoming topics will be: Food hygiene; Stress management; Prevention of sexually transmitted diseases.

*Psychological assessment of on board employment and duty assignment.* It includes setting of employer's profile by psycho-aptitude tests and training for equipe-work in the maritime environment using specific testing and high quality psychological counselling.

*Risk communication and risk management.* It is an action of sharing information to promote understanding about risk reduction and informed decision-making. Travelers must be actively involved in behavior decisions. They should receive relevant information about risks, possible consequences and how to minimize exposure during travel with "realistic" information. Risk management strategy includes appropriate recommendations and prevention strategies provided to the traveler.

*Occupational surveillance.* It is the basis for analyzing and controlling worker's characteristics and the influence of what he is doing on its health. Health/medical data are collected into the same electronic system handled by UNICAM Telemedicine Center and CIRM/TMAS. The first institution takes the responsibility of coordinating health surveillance activity. These data put into a WEB-based health database of each seafarer will be available as a personal medical record of the seafarer in case of accidents or diseases on board. CIRM/TMAS doctors can have access to these data in case of requests of telemedical advice. This will guarantee the delivery of high levels assistance based on the previous medical history of the seafarer.

*High quality medical assistance.* Delivery of high quality medical assistance requires a given technological background. For making easier

and less expensive occupational surveillance on board, ships involved in this project will be equipped of basic telemedical devices for assessing blood pressure, pulse rate, electrocardiogram, blood oxygen levels (oxymetry) and basic hematochemistry tests. Information collected by these devices can be used for providing medical assistance in case of medical problems on board.

*Stress prevention and management.* This action will include: (i)Assessment of "perception of stress" in the specific sea-work set; (ii) Training in stress management of the staff; (iii) Improvement of communication between different groups of employers in order to promote cohesion of the "ship community" (even by using on board opportune visual signals with guide-lines to manage interpersonal conflicts);(iv) Preventing of burn-out.

## Conclusions

It is expected that coordination of sparse initiatives in favour of seafarer's health protection as planned in the HEALTHY SHIP project can improve and enlarge the approach of health protection in favour of seafarers and can ensure high-quality treatment of patients on board ships in case of diseases or injuries.

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# Information and Communication Technologies in Nursing Education: An Action Research Project

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## Introduction

The union between informatics, information and health sciences has played an important role in professional development and education, enhancing learning through the use of teaching strategies that permit autonomous study and research. In nursing education, training and competency development are necessary, in safe and controlled environments, which minimize anxiety, preserve patients and students and facilitate clinical reasoning and relations, granting the opportunity for scientific foundations. Information and communication technologies (ICT), at a relatively low cost, offer the advantage of students' active involvement; facilitate knowledge transfer and approximate people.

## Aims

Making available contents to support nursing teaching in a Virtual Learning Environment (VLE); assessing students' degree of satisfaction and the VLE's influence in knowledge transfer and nursing competency development.

## Method

Ongoing multicenter project between researchers from *Escola Superior de Enfermagem de Coimbra* (ESENFC) and the University of São Paulo at Ribeirão Preto College of Nursing (EERP-USP), after approval from both institutions' Institutional Review Board. This project comprises two phases: 1) development and preparation of pedagogical material for use in a Virtual Learning Environment and videoconferencing, 2) Assessment of these strategies. This research describes phase 1 (construction and establishment

of contents in the VLE Moodle and preparation of videoconferences). To accomplish this phase, the contents were elaborated and established in Moodle in Brazil. This platform was chosen due to its international aspect, up-to-dateness and easy use at the Brazilian college. Then, the platform was semantically and culturally adapted to Portuguese from Portugal and subject to face and content validation by Brazilian and Portuguese experts. Researchers from both countries jointly prepared the videoconferencing sessions

## Preliminary results

At the Brazilian college, faculty members use the VLE Moodle for course management, as part of a social network that involves students, faculty, employees and former faculty. All users from the Brazilian college, when registered in the social network, automatically get access to the VLE. The Portuguese students and experts' access was restricted to the contents offered and the team that administers the platform in Brazil individually and manually registered them to enter the platform. To construct and establish the contents, images and literate published in both countries were used. After the adaptation, the content was presented in two versions (Portuguese from Portugal and Portuguese from Brazil). Brazilian and Portuguese experts positively assessed the environment, and agreement corresponded to 88%. The estimated duration of the videoconferencing sessions was 45 minutes, including interaction among students, presentation of theoretical contents and discussion with a specialist. To allow researchers from both countries to participate, the activities were divided between researchers from Brazil and from Portugal. During the next months, participants will access theoretical contents in the VLE. Then, two videoconferencing sessions will be held, the first transmitted from Brazil to Portugal, involving students and trainers from both countries; the second will be transmitted from Portugal to Brazil, but for half of the Brazilian group. Thus, groups from Brazil and Portugal will have access to traditional as well as technology-mediated teaching/learning methods. At the end of these phases, the students will answer socio-demographic characterization, usability and satisfaction questionnaires. Knowledge and competencies will also be assessed. Until date, the use of videoconferencing showed to be effective and motivating in activity preparation and interaction between Brazilian and Portuguese researchers.

## Conclusion and future applications

Until date, it is concluded that nursing teaching and research strategies involving information technologies can be used among distant research,

cultural and socially approach people and offer motivating contributions in nursing research development. The use of a common language, in this case Portuguese, entails the potential for use in other Portuguese-speaking language, as an economic way of taking updated scientific information to countries with limited economic resources.

## Additional Reading


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# OPLAN PHONEPAL: An Intervention in Increasing the Level of Knowledge and Self-Confidence in Postpartum and Newborn Care

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*Abstract:* **Objective: To assess the effectiveness of OPLAN PHONEPAL in increasing the level of knowledge and level of self confidence of postpartum primiparas in rendering postpartum and newborn care.**
**Method: The study used a Classical experimental design which included 26 postpartum primiparas who delivered in Dr. Jose Fabella Memorial Hospital selected through purposive sampling. Through the OPLAN PHONEPAL program, the researchers provided health teachings on postpartum and newborn care by conducting mobile phone calls daily for 10 days. Before and after the intervention, the subjects answered a Postpartum Knowledge Assessment Exam and Self-Confidence Checklist.**
**Results: The findings of the study showed that (1)there is no significant difference on the level of knowledge on postpartum and newborn care of the experimental and control group prior to the use of OPLAN PHONEPAL;(2)there is no significant difference on the level of self-confidence of the experimental and control group prior to the use of OPLAN PHONEPAL;(3)there is a significant difference on the level of knowledge on postpartum and newborn care of the experimental and control group after the use of OPLAN:PHONEPAL;(4)there is no significant difference on the level of self-confidence of the experimental and control group after the use of OPLAN PHONEPAL;(5)there is a significant difference in the level of knowledge and self-confidence of the experimental group before and after the use of OPLAN PHONEPAL program**
**Conclusion: OPLAN PHONEPAL was proven to be effective in increasing the level of knowledge and level of self-confidence in postpartum and newborn care.**

## Introduction

In the Philippines, 160 out of 100, 000 postpartal women die or suffer from complications following childbirth (UNICEF, 2009). Therefore, knowledge should be provided and emphasized through discharge teachings to assist the mother in ensuring her physical and her newborn's health. However, a shortened hospital stay may be a barrier to effective health education because there is a significant cognitive deficit in the first 24 hours after delivery [1]. Due to that trend at present, there comes a need for further instruction and guidance which could be provided beyond the borders of the hospital. Through an emerging technology called telenursing, postpartal care can be more accessible to the public.

## Method

A Classical experimental design was used in the study. The subjects were 26 postpartum primiparas who delivered in Dr. Jose Fabella Memorial Hospital selected through non-probability random sampling. The eligibility criteria included: (1) female adults, 18-34 years old; (2) primiparous women who are within the first 2 weeks of postpartal period; (3) with normal spontaneous delivery; (4) with no pre-existing conditions or complications; (5) had a prenatal check-up; (6) with a full term newborn (37-40 weeks) who has normal health status; (7) owns a mobile phone; (8) able to read, write and understand Filipino.

The researchers devised two instruments for the study which were given as pretest and post test to both the experimental and control group. The Knowledge Assessment Exam had two parts which consist of the Demographic Profile of the respondents and the 22-item test on postpartum physiologic changes and their corresponding management as well as newborn care. The second tool was the Self-confidence checklist which is a 25-item 6-point Likert scale which measured their level of self-confidence in rendering postpartum and newborn care. Before given discharge teachings, the subjects took the pre-test of the two instruments in the hospital. The experimental group was oriented to the mechanics of the OPLAN: PHONEPAL Program which was originally developed by the researchers. After discharge, health teachings were made through mobile phone calls to the experimental group about maternal physiologic changes and home management as well as newborn care. They were called daily for 10 days from October 1 to October 10, 2010. Ten to fifteen minutes were allotted for each call. Each day, there was a specific area to focus on with its corresponding nursing interventions. The program was limited to teaching, counseling and referral. After the 10-day period, the experimental and control group were asked to come back to Dr. Jose Fabella Hospital to have a post-test using the same instruments.

## Results

Table 1
Demographic Profile of the Respondents ( n = 26)

| Characteristics | EG | CG |
|---|---|---|
| Mean Age (years old) | 22.46 | 22.92 |
| Educational Attainment | | |
| Elementary Level | 0% | 7.69% |
| High-school Level | 61.54% | 84.62% |
| College Level | 38.46% | 7.69% |
| Socio-economic Status | | |
| Below Php 500/day | 61.54% | 100% |
| Php 500-1000 /day | 23.08% | 0% |
| Above Php 1000/day | 15.38% | 0% |
| Mean Number of Prenatal Check-up | 5.77 | 6.54 |

Table 2: Mean and Independent T-test Results of the Experimental and Control Group

| | EG (mean) | CG (mean) | T-Computed | T-Critical | Decision |
|---|---|---|---|---|---|
| Level of Knowledge | | | | | |
| Before | 13 (A) | 11.92 (A) | 0.96 | 2.064 | NS |
| After | 19.23 (AA | 13.62 (A) | 8.94 | 2.064 | S |
| Level of Self-Confidence | 102.38 (A) | 113.15 (AA) | -1.08 | 2.064 | NS |
| Before | 139.62 (AA) | 130.23 (AA) | 1.73 | 2.064 | NS |
| After | | | | | |

Note: S= Significant; NS = Not Significant; A = Average; AA = Above Average

Table 3
Paired T-test Results of the Experimental Group Before and After the study

| | Mean | T - Computed | T-Critical |
|---|---|---|---|
| Level of Knowledge | 6.23 | 6.71 | 1.78 |
| Level of Self-Confidence | 37.23 | 4.89 | 1.78 |

Note: S = There is a significant difference

## Discussion

The results revealed that the EG is more knowledgeable on Postpartum Physiologic Changes and Newborn Care prior to the use of OPLAN PHONEPAL due to the fact that 38.46% of the respondents from the EG reached the college level as compared to the CG that only has 7.69% of the respondents who reached the college level. The study of Zhao, et. al (2009),

supported the result of the EG having a higher knowledge score due to better education and better family income[2]. Moreover, the CG showed more confidence in rendering postpartum and newborn care than the EG prior to the use of OPLAN PHONEPAL due to their greater number of prenatal visits. Childbirth education prepared them adequately for the birthing experiences and the postpartum period. It helped to reduce their fear of 'the unknown' through education and support [3]. However, there is no significant difference in the level of knowledge and level of self-confidence of both the EG and CG prior to the use of OPLAN PHONEPAL since they are both primiparas with no experience of motherhood yet.

After the use of OPLAN PHONEPAL, the EG registered a higher knowledge score than CG and the rating improved from average to above average. Hence, there is a significant difference on the Level of Knowledge between the two groups of respondents due to the fact that the EG underwent the OPLAN PHONEPAL program and thus received continuous health education and follow-up which also provided them with greater access to health information that could aid in improving the EG's knowledge about postpartum and newborn care. The study of Dinesen (2008) supports the results of this study wherein patients who were able to use telehealth had more chance to understand their disease and symptoms and ultimately increased their level of knowledge[4]. For the assessment of the level of self-confidence, the EG also showed more confidence in rendering postpartum and newborn care which could also be attributed to the OPLAN PHONEPAL program. Being primiparas, there is a felt need for knowledge and social support during the early postpartum days[5]. Lack of education causes anxiety and therefore impedes their self-confidence in rendering postpartum and newborn care[6]. OPLAN PHONEPAL program answers those concerns through provision of health teachings and social support thus, allowing them to gain knowledge and self confidence in post partum and newborn care. Also, there is a significant increase in the level of knowledge and self-confidence of the EG before and after the study due to the follow-up care given by the OPLAN PHONEPAL program.

## Conclusion

OPLAN PHONEPAL was proven to be an effective tool in increasing the level of knowledge and self-confidence on postpartum and newborn care among postpartum primipara mothers.

## Acknowledgement

The researchers would like to thank the fhe National Telehealth Center for allowing us to use their sources and Dr. Jose Fabella Memorial Hospital

for allowing us to conduct our study in their hospital. We would also like to thank all those who supported us financially in the publication of this thesis.

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# psychoED: Online Alternatives for Caregiver's Support of Handicapped People

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***Abstract:*** **It is presented a web platform for delivering cyber-psychoeducation called psychoED. psychoED is an own development of INTRAS Foundation that is aimed to deliver cybertherapy: i.e., providing psychological support in the Internet environment. psychoED includes a cybertherapy room where it is possible to maintain both individual and group video conferencing, a chat, the possibility of using presentations, a library which provides for Psychoeducation documents, expert forums and forums for mutual support. All the information exchange takes place through distance electronic communication, either by mail, chat, video-conferences or being it by reading and/or participating in the forums.**

## Introduction

Aging process, diseases, and prolonged and severe illness may increase the dependency; in these situations the families often assume a great number of the cares. This care translates into a high burden for the caregiver as well as a great loss of free time, while requires a range of knowledge to take on the responsibility. Faced with these difficulties Psychoeducation has been shown to be an intervention that improves the quality of life of the caregiver and the cared [1].

But the process of Psychoeducation is not simply or easy. Many families have problem to assist; not have time to spend in a traditional treatment of psychoeducation; What is more, many families have fears or are reluctant to go to a health center to avoid the stigmatization [2]. All this is even more complex in the rural population where resources are limited and the

possibility of stigma is greater [3]; something similar happens with rare diseases that lack a sufficient number of professional and specialized centers.

Recently, new technologies of the information and communication, particularly the Internet, are being positioned as an ideal means to develop distance and cost-effective interventions, even the researchers are proving that distance interventions would be equivalent to some traditional face to face therapies [4].

In this context Fundación INTRAS and the Service of Psychiatry of Zamora developed a web platform called psychoED, designed to deliver cybertherapy. psychoED is an alternative to overcome the difficulties of access experienced by the caregivers to interventions of proven effectiveness like Psychoeducation. In the same direction, psychoED probably is an alternative for delivering many types of psychological interventions that could be developed in the environment of Internet.

## Characteristics of psychoED

psychoED is a website that contains multimedia resources, characteristics of the 2.0 web and the possibility of multi-video-conference functionality. It contains, among other things, an access to a forum of questions answered by professionals that constitutes a database of questions and answers at the disposal of the web visitors; the resource of a so-called “Ask the Expert”, as it is intended to result in cognitive and educational guidance, a key component of traditional psychological treatments, but this time transferred to a cybertherapy.

Another resource is “The Library”, where the visitors may review multimedia files specially designed to meet their concerns (summaries of articles, books, videos, presentations, etc). The Library fulfills a self-help role and Psychoeducation.

Other forum integrated is the self-help forum for users that aims to develop mutual support as in a self-help group. This forum can be visited by therapists, who may play a role of "moderator" on occasions when it is necessary, for example, when the effect of “*disinhibition online*” is developed in its negative side [5]. In this forum, users may share with other people ways of dealing with similar situations or receive emotional support from those who go through a similar situation.

One of the main resources of psychoED is the “Cybertherapy Room”. This room attempts to reproduce the traditional therapeutic encounters in a space online. On the cybertherapy room, users and therapist can simultaneously see and hear each other, and includes other elements that enhance videoconference: a chat and a place to upload presentations (eg

PowerPoint) and that can be controlled by the therapist (broad, fast forward, rewind). Thus, the chat can be used to emphasize something and presentations can facilitate the understanding of an explanation.

Is important to notice that the "Room of Cybertherapy" can held individual and group meetings. In the group meetings, up to six connections are enabled for the participants and an one for the therapist; in these cases the therapist can mute participants and determine which member of the group want others to listen. This resource facilitates the guidance of a group that communicates through online videoconferencing.

Another resources available in psychoED are the news section, where each therapist can upload news which are approved by the site administrator; a directory of therapists where it is possible to review the credentials of each professional accessing psychoED; and also includes a directory of mental health facilities in the area where psychoEd is applied .

In technical terms, the spirit of psychoED is to be a web of cybertherapy that does not need complicated technical requirements. In this sense, psychoED simply requires a computer and a domestic Internet connection, along with simple accessories (webcam, microphone, headphones or speakers) and free access software. For example, from the perspective of the user, the minimum Internet connection required for an individual video conferencing is 1MB/200Kb, and in the group situation is 1MB/300Kb, whilst the therapist requirements in the group situation is a connection of around 3MB/500Kb.

Another important feature is that it has psychoED incorporates a translator that supports up to 44 different languages, likewise its structural design has been developed integrating a multilingual function, whereas at this moment, the vast majority of the platforms are being developed in English, French and Portuguese.

Finally, PsychoED is highly flexible, its structure can incorportate different contents, so that resources can be use in all kinds of diseases, languages and in other applications. Such other applications are the use of psychoED as a learning environment, where the videoconferencing allows for synchronous work and exposure of content (Like a classroom), forums will serve to dispel doubts and library for storing information

## Current uses of psychoED

At this moment psychoED is being used by the psychiatric services of Zamora and INTRAS Foundation. Studies on psichoEd have been conducted with careers and families of people diagnosed with schizophrenia, as well as in remote care of people with mental health problems living in a rural environment. At the same time, it has been used

in the contact between tutors and users of therapeutic flats of people with severe and prolonged mental illness. It has also been used in the monitoring group as well as distance neuropsychological assessment of people with schizophrenia. Nowadays it is planned to use psychoED as a platform to deliver psychosocial care of people with Alzheimer's and other mental disorders.

## Acknowledgment

psychoED was possible with the support of IMSERSO; consortium bien. e.star (Consolider-C program); and the project RESATER (Program SUDOE IV B). We also appreciate the participation and support of users, families and professionals who are part of the Network of Psychiatry in the Province of Zamora

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# psychoED: Experiences of Cybertherapy for Caregivers

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***Abstract:*** **When a family member gets sick, often some aspects of the care are assumed by their relatives; Psychoeducation have been shown to be an effective intervention to enhance the role of careers, but some barriers exist to develop these kinds of interventions, one of the most important is the problem of its access for the families. New technologies, particularly Internet are being positioned as an ideal environment to develop psychological distance-therapies. In this study it is presented a web platform designed to develop cybertherapies where it is tested a tele-psychoeducation for the cares of people with diagnosis of schizophrenia. It was compared the performance of psychoED with a traditional psychoeducation and a control group. Results indicated a good level of alliance of work; an enhance of the knowledge of careers; and a complementary impact of the psychoED when is faced with results of traditional Psychoeducation.**

## Introduction

Due to different diseases, the families often assume a great number of cares. This translates into a high burden for the caregiver and high sanitary costs. Faced with these difficulties, Psychoeducation has been shown to be an intervention that improves the quality of life of the caregiver and the patient [1]. But, the most important difficulty to develop a psychoeducation is justly the participation of the careers. Recently, new technologies of the information and communication, particularly Internet, are being positioned as an ideal environment to develop distance and cost-effective interventions, and researchers are proving that cybertherapies would be equivalent and

even better than some traditional therapies face to face [2, 3]. There are previous experiences of implementing Psychoeducation in online format with promising results [4].

Zamora is a province of Spain where the 65% of the population lives in rural zones and where there are many problems with transport and terrestrial communication [5]. In these conditions, Fundación INTRAS and Service of Psychiatry of Zamora decided to develop alternatives that would facilitate user access to services, one of which was the platform psychoED. In this paper we present a pilot application of a program called psychoED, experience that was conducted specifically in the psychoeducation of carers of users with a diagnosis of schizophrenia.

## Methodology

The platform psychoED was tested with caregivers of people with schizophrenia; the test was developed in diverse aspects, mainly: expectative in front of the treatment [5] alliance of work [6], results on satisfaction [7], knowledge [8], and general health [9]. It was compared the effects of a traditional psychoeducation (face to face) and an online psychoeducational treatment by psychoED, including also a control group.

It was used a quantitative design, using the model of a clinical trial in an ecological, longitudinal and pre-experimental format. The variable manipulated was the type of treatment to determine their effect on the three conditions: control group (waiting list), psychoeducation traditional and e-psychoeducation program (psychoED). Sampling was by convenience, the option to participate in online therapy was determined by the difficulties in attending to the traditional treatment as well as the technical feasibility of cybertherapy. Measurements were made at the start and end of 11 months of treatment.

The traditional psychoeducation was performed with a group of careers who attended a clinical service in the city of Zamora. The online format used was psychoED, a website that contains multimedia resources, characteristics of the 2.0 web like forums, library, and the possibility of multi-video-conference. psychoED allows access to an intervention of proven efficacy as psychoeducation is, without the need to travel, maintaining continuity of care and strengthening social support. Access to psychoED is as easy as accessing a private website and its technological requirements are as simple as a domestic Internet connection and a multimedia computer with webcam; all the user of psychoED received the psychoeducation at home by Internet. The control group did not receive psychoeducational intervention, only the traditional care.

## Results

The total possible participants were 58 people, but a 55.1% (32) finally refused to participate. The study involved a total of 26 participants; six in psychoED, 11 in the traditional group, and nine in control group. The sample at the end of the study was nine in traditional psychoeducation, six in psychoED, and five in control situation; a total of 20 (76,9%) finalized the study (Death of sampling of 23.1%). There were no statistically significant differences between groups in terms of sex, educational level, socioeconomic status, only the online group was different in terms of age of its members. Before treatment no differences were found between the groups in the measured variables. After 11 months of treatment the main results point to a statistically significant better performance of psychoED in comparison with the control group and a similar result in comparison with the traditional intervention; even, in some cases the effect of psychoED is complementary to traditional treatment outcomes.

Thus, we found no significant differences in expectative in front of the treatment and in the evaluation of the therapeutic alliance between traditional and online group by the participants; no differences in term of satisfaction with the service, except the dimension of accessibility where psycho group differs from the control situation. In the knowledge about the illness the performance of the treatments (Traditional and psychoED) was statistically significant better than the control situation. We found no difference in the general health measurement

## Discussion

The sample death was lower in psychoED, and the users approached to it with similar and positive expectations, both online and traditional treatments. Results indicate no differences in the development of working alliance in the comparison of treatments online and face to face, which suggests that it is possible to develop psychotherapeutic process in a web environment.

Moreover, satisfaction with psychiatric services does not differ statistically between the experimental groups except in the dimension of accessibility, although descriptively satisfaction is higher in the group online. Knowledge about the disease and their cares increases over time, but progress is much higher in the groups receiving Psychoeducation. We do not found impact of the treatments in the general health of the users.

## Conclusions

Preliminary results point to a rationale for the incorporation of the Internet based tools as a media to develop counseling and psychological support. Cybertherapies seems to be a new alternative to develop mental health treatments that facilitate access to and can complement actions developed in the traditional treatments (face to face). Places with access problems or limitations in the number of specialized professionals can benefit from these cyber and distance interventions.

## Acknowledgment

This research was possible with the support of IMSERSO; consortium bien.e.star (Consolider-C program); and the project RESATER (Program Interreg SUDOE IV B). We also appreciate the participation and support of users, families and professionals who are part of the Network of Psychiatry in the Province of Zamora

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# Technology and the Reconstruction of Doctor-Patient Relationship

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***Abstract:*** **The advancements in communication technology increasingly influence access of information in every culture where they are available, empowering individuals where rigid and anonymous institutions used to hold authority. Telemedicine and the Internet as tools of increasing the circulation of information can empower patients by democratizing knowledge, once exclusive to doctors, by forming strong social on-line networks, and by enabling patients to be more involved in decision making about their health and treatment.**

## Introduction

According to Moore's Law, the power of information technology doubles every 18 months [1]. These advancements are increasing the flow of health-related information and knowledge wherever they are available, stimulating globalization, but also the empowerment of individuals. Telemedicine includes a wide range of practices which all share the use of telecommunications in medicine. Its benefits have been recognized in some countries where travel distances are great and infrastructure poor, but they have also been acknowledged by the European Union [2]. Nevertheless, some uncertainty is inherent to the very name of this practice, its applications, benefits and drawbacks, as well as legal and ethical aspects. This paper will examine how telemedicine may influence society by reorganizing power structures. Following an outline of the concept of power and its controlling and destructive, yet often invisible sources, located in institutional practices such as health-centers and clinics [3], I will argue that telemedicine may substantially change power relations on the scale of doctor-patient relationship.

## Power relations in the technologically enhanced society

Bourdieu examined symbolic power that is "hidden" in activities that do not appear to be linked with control and domination, but have exactly that effect [4]. In his view, the individuals and their interrelationships are generated by human agents who create, reproduce, and change a number of

“taxonomies” that actually make the world for the people who live in it. Power is established, enforced, and maintained through all the visible and almost invisible actions of individuals who perpetually negotiate their social position in terms of dominance and subordination in relation to others. According to Bourdieu, individuals may change their status, and thereby their level of power. This is related to recent technological developments, especially the Internet, as a number of contemporary writers dealing with economy, politics, and social changes, describe the impact of the Internet on the new generations and therefore on culture [6].

## Technology and the Potential Power of the Patients

One of the most important questions in the use of telemedicine is how these new, technology-enhanced services will change the conventional health consultation and the relationship between doctors and patients. As knowledge and education are intricately related to empowerment, the changing knowledge base becomes very important. Public education of patients via the Internet is significant for the stimulation of their empowerment [7]. The so-called tele-information through websites offering information on issues of diet, exercise and hygiene, and specific diseases and conditions help the patients gain knowledge about medical advances, their choices and rights. On the other hand, the data acquired may be incomprehensive or incomplete such that the physicians need to explain the discrepancies, which reshapes their role and makes them a sort of a “filter”.

The effect of the redistribution of power is thus significant for the physicians, too, as it reduces their autonomy and thereby their authority, while the patients, additionally empowered by the increasingly available health-related information, are encouraged by the system to acquire higher status in their interaction with their physician. The view that therapeutic relationship is basically unequal was explored by [8] who argued that this inequality “essentially concerns the respective situation of the patient and his or her doctor vis-à-vis medical knowledge”. Technology could bring the two parties involved in therapeutically relationship closer to one another in terms of status as well as activity. Thus, [2] states that telemedicine is important in empowering “health consumers” who wish to be better informed about their medical conditions and to be “involved actively in decisions related to their own health, rather than simply accepting the considerable discrepancy (‘asymmetry’) in knowledge between themselves and health professionals”.

Reference [9] emphasizes the importance of trust in the doctor-patient relationship when communicating with the help of information and communication technologies (ICT). According to this research, the use of

technology both strengthened the relationship between doctors and their patients and enhanced patient involvement and participation in the consultation. This is because ICT stimulates informal language use and encourages people to contact their doctor earlier then that would have done otherwise, resulting in a higher awareness of their health through their gaining more knowledge and reflecting on their condition [9]. Similarly, [10] argue that greater access to medical information on the Internet has a profound impact on the doctor-patient relationship and maintain that "[t]he Internet is an opportunity, rather than a challenge to medical authority [as it can] facilitate genuine consultation, and promote partnership with patients and empower people to deal with chronic, complex and life threatening illness". Pilot studies show, for example, that the rate of depression and sensitivity to pain can decrease among patients with breast cancer who join an on-line support group as well as that accessing information and support on-line groups affect positively men's experiences of prostate cancer and the quality of life of renal patients [10].

But telemedicine will only prosper if organizations as well as individuals both agree to use it. In order for telemedicine projects to be successfully implemented, the community needs to comply with them; otherwise, the projects can be disrupted the technology discredited by those that were suppose to use it. My own fieldwork in a Slovenian rural town, for example, showed that even the elderly patients have a very positive attitude towards the use of technology in their interaction with doctors and specialists. Once telemedicine is explained as user-friendly, they quickly understand how it could help them save time and money. Similarly, telepsychiatry, offered in two Canary Islands, was very successful and well accepted by the patients; on the other hand, many psychiatrists, health related professionals and administrators rejected it as they were unfamiliar with ICT and because they would have to adapt their existing therapeutic framework. Thus, "regardless of telemedicine efficacy, availability and patient desires, if psychiatrists are dissatisfied with telepsychiatry or do not believe in it, they will probably not offer it to their patients" [11].

## Conclusion

Telemedicine as one of the uses of the modern telecommunications changes the basic and most sensitive relationship in healing, namely that between the doctors and their patients. Bourdieu's theory of implicit institutions, establishing and maintaining hierarchical power-based structures, shows how individual's status may be reshaped. Telemedicine may provoke reorganization of power in doctor-patient relationship. Through the introduction of technology in medical consultations, indirectly

through access to health-related information and support groups on-line or directly in the form of teleconsultations, this relationship is becoming a partnership in which both parties are on the same level of authority regarding the decision-making in the treatment process. It is very likely that the patients will adapt to new ways of communicating with their doctors, despite some initial difficulties. The doctors' accepting new approaches is just as important for the application of telemedicine to succeed.

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# Telehealth Nursing: Knowledge Generation and Practice Application

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***Abstract*: The application of eHealth is changing healthcare delivery worldwide for providers and recipients of care. This paper describes the scope and impact of telehealth nursing by drawing on the characteristics of the ICN Telenursing Network membership and the topics and methods of nursing research.**

Innovations in telehealth, with actual and potential risks and benefits for healthcare policy, management, and practice, are bringing delivery strategies and patient outcomes that were unimaginable a short time ago. Nurses are engaged globally in a wide range of activities that use telehealth technologies best targeted for the recipients, whether individuals, groups or communities. Telehealth nursing leverages information and communication technology (ICT) to extend the capability of nurses with the aims of improving access and quality, and managing costs. While the use of technology changes the care delivery medium, and may necessitate new competencies, the nursing process and scope of practice are not significantly different in telenursing [1].

The International Council of Nurses (ICN) initiated a Telenursing Network in 2009, and any nurse in the world is welcome to join via the interactive website. The Network supports ICN's mission of advancing nursing and health worldwide. The Network aims to seek, educate, support, and collaborate with nurses and nurse supporters worldwide, and to promote nursing involvement in the development and use of telehealth technologies. The Network serves as a global resource and global information exchange for nurses. As of January 2011, the 140 members of the Network represented 46 countries. A picture of telehealth nursing, in the greater context of eHealth and multidisciplinary health care systems, can be drawn from this group and given context from nursing research. This picture is important for several reasons.

First, nurses are using, and involved in developing, telehealth strategies in nearly every specialty of clinical care. Nurses use telehealth technologies to

extend their capabilities in specialties of clinical care including, but not limited to, emergency care, chronic disease and illness (eg, diabetes, hypertension, pain management, oncology, and cardiology), palliative or end of life care, mental health, public and community health, health promotion and wound care.

Second, nurses are reaching clients in rural and remote areas, underserved areas, hospitals, clinics, and homes. As remote sensors, reminder tools, and web-based communication features are being placed in homes [2], nurses are adding the management and results of these capabilities to their home care protocols and findings. One critically important use of telehealth technologies for such outreach is education, both for people with health care needs [3, 4] and for care providers [5]. As more education of both of these groups is delivered using ICT, research and programme evaluation are needed to assess the quality of the content and process of sending education out, as well as the perceived value and the mastery of the material on the part of the recipient. Health promotion, disease prevention, and disease management education are necessary in every part of the world since personal and environmental risk factors, as well as chronic illnesses, are universal threats to health today. Nurses are also helping to bridge the rural-urban divide that could otherwise keep people in need of health care away from clinical centers and specialists necessary for their health condition [6].

Third, nurses are fully engaged in the development and application of standards, legal and ethical analyses, regulations, and quality improvement processes that guide and direct eHealth and the rapidly expanding innovations and applications of ICT [7-8]. Nurses are working with regulatory bodies and professional organizations to ensure that the risks of telehealth are considered and minimized, and that the benefits of telehealth for recipients are not constricted by policies and laws delineating the scope of nursing practice. The issue of legal opinions and regulatory requirements is of great concern to all who are enthusiastic for eHealth success. Establishing the point of care from a legal perspective (eg, provider site, recipient site, technology site) and assuring a complete and interoperable record for each care recipient are just two of many challenges facing the eHealth community.

Finally, nurse researchers are contributing to the body of knowledge for eHealth, telehealth and telemedicine, through nursing and interdisciplinary research and dissemination. Recent nursing research reports looking at patient or client outcomes include, for example, randomized controlled trials comparing automated telephone intervention with controls in people with type 2 diabetes [9] and comparing videophone or telephone interventions, or usual care, among patients with heart failure [10]; a quasi-

experimental study of telephonic interventions and quality of life in women with breast cancer [11]; a descriptive repeated measures study comparing symptom management intervention with usual care among adults with coronary artery surgery [12]; and a qualitative study assessing the feasibility and acceptability of telehealth monitoring and support for insulin initiation and adjustment in diabetics [13]. Nursing research also focuses on telehealth nurses themselves, for example, assessing their experiences working with computerized decision support [14], their use of knowledge management in telemedicine [15], nurses' perceptions of caring while providing primary care using telehealth technology [16], and ensuring treatment fidelity in a patient-centered coping and communication support intervention for aging patients and their caregivers [17].

Telehealth nursing practice and research are essential parts of the continued success of eHealth worldwide. Nurses will innovate and exploit telehealth technologies and strategies to increase nursing capabilities and knowledge, and to improve the quality of healthcare and care outcomes in all populations served. It should be noted that telehealth nurses or telenurses are not a new specialty for nursing. Telehealth nurses practice in their area of expertise, collaborating to the fullest extent possible with other medical and health disciplines, and also with technology developers and vendors. Telenursing competencies published by ICN [1] reflect this commitment to enhancing the nurse's chosen specialty with information and communication technology. In addition to adhering to the standards of practice and professional performance in her/his specialty, the nurse meets the telenursing competencies in the areas of professional, ethical and legal practice; care provision and management; and professional development.

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# TV-based Services in an Ambulatory Care Nursing Scenario

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***Abstract*: In Germany there are approximately 2.25 million persons who require care. The number of people requiring care is expected to rise to 2.94 million by 2020 and to 4.7 million by 2050. Unfortunately, the number of qualified staff is falling behind the demand for outpatient care. Therefore, the search for new solutions in supporting and relieving working conditions is becoming more important. In the VitaBIT project an ICT platform for supporting ambulatory care nursing was created. The VitaBIT platform is composed of four different software clients based on mobile, web and TV technologies. The TV-based application which runs on a set-top box (STB) offers several services besides TV-related features such as a medicine reminder, a vital signs diary, a meal order service and games.**

## Introduction

The increasing number of people in need of care present challenges to the healthcare sector, in the present, and even more in the future. To meet the challenges of growth, process optimization in the area of outpatient care is required, but in the cooperation with other healthcare sectors as well. Also newer concepts like telenursing, telemedicine and telerehabilitation should be considered by service and health insurance providers and integrated in their processes.

In the area of outpatient care especially, there is a lack of computerization and digitalization that is needed for faster exchange of information. To face these challenges, the VitaBIT platform [1] was developed.

## The VitaBIT Platform

The VitaBIT platform is composed of four different software clients. The first one is a web application at the administrative workplace located in the central unit of the nursing service station. Administration of patient's data, planning of routes and services for ambulatory nurses are carried out in the central unit. Therefore, the central unit needs to know continuously where

the nurses are located, what treatments they are applying and how the patients are feeling. The second client is the mobile application. It is used on site by ambulatory nurses when working with their patients. From the device, they receive all relevant information about the patients and their schedule. It offers an interface for locally installed native applications, e.g. wireless vital signs monitoring and injury photos management system. The integration of a digital pen and wireless vital sensors allows the caregivers to collect patients' data digitally. Injury images can be taken with the mobile device's integrated camera. The third possibility for accessing the common database is used by the general practitioner (GP). The fourth client is a TV-based application which runs on a set-top box (STB) in patients' homes and offers entertainment, telenursing and telemedical services. Many older people are reluctant to use personal computers but would be prepared to use interactive television to obtain information. Television is extensively used by older persons throughout the day as a major source of leisure time activity and as compensation for reduced social interactions [2].

TV-based services for elderly people

The meal service application (Fig. 1) provides a simple interface for elderly people with which it is possible to order meals for the current week. Once a user orders the meals, the information is stored in the VitaBIT platform. An assistant at the administrative workplace of the nursing service plans the routes for delivering the meals to all the patients with the help of a VitaBIT feature, which generates geo-optimized routes. The person that is in charge of delivering the meals receives all the information about the route on the mobile phone. In addition the patient can check with the STB-application who and when the meal will be delivered.

Figure 1: Meal Ordering

The medicine reminder service (Fig. 2) is based on a wireless pill dispenser which is filled with tablets by the nurses.


Figure 2: Medicine Reminder

The pill dispenser automatically dispenses medication at pre-set times, providing an audible and visible alert to the user. If the user fails to access the medication, a confirmation message reminding him to take the medication will be displayed on the TV. The patient can confirm that he took the medication by accepting the confirmation message using the remote control. The confirmation will be registered in the record of the patient in the VitaBIT platform. In this way the GP or nurse can have diary access to the medication of the patient. If the patient ignores the reminders, a sms with an alert text will be sent to the mobile phone of the competent nurse.

The vital signs diary service (Fig. 3) provides an interface where the patient can store manually or automatically via a bluetooth enabled device the vital signs values. Collecting vital signs will be supported by personalized symptomatic questions. It is beneficial to ask symptomatic questions, because it can help patients gain a greater understanding of their symptoms, and thereby contribute in improving the patient's awareness of their own condition, and make them react on any changes that might occur. The collected data is also stored in the patient record in the VitaBIT platform, so that the nurses and practitioner can access the data and give feedback to the patient.

Also other TV-based services like home control, news and games where implemented, but these are not in the scope of this paper.


Figure 3: Vital Signs Diary

## Discussion and Conclusions

As a consequence of demographic development, ambulatory nursing services are facing a big challenge. The VitaBIT Platform ensures the communication and the secure information exchange between all stakeholders in the ambulatory care scenario.

A first system evaluation was carried out with the VitaBIT prototypes except for the TV-based services, in order to assure the best benefit in a typical nursing workday. The systems evaluation consisted of four different phases: functional test in the FZI Living Lab AAL, pretest, expert review and field test with an ambulatory nursing service [3]. The next step will be the evaluation of the TV-based services in assisted living residences. This can give important evidences, how users accept the system after a longer period of learning and how they interact with the system.

## Acknowledgment

Research carried out in the VitaBIT project is funded by the Federal Ministry of Economics and Technology (BMWi) in Germany.

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# Urgency and Emergency: An Analysis of an eLearning Course

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***Abstract:*** **The Telehealth Center (NUTEL) of the Federal University of Minas Gerais School of Medicine in Brazil has developed several telehealth activities with the objective of spreading healthcare knowledge and producing digital educational contents. We have been using 3D modeling, educational videos and animation effects. This paper aims to describe the analysis of an emergency care eLearning course that has been developed for health professionals from the public health system in the city of Belo Horizonte, Minas Gerais State, Brazil. The selected modules of the course were: basic life support, advanced life support, cardiopulmonary failure, shock, respiratory distress and failure, cardiac rhythms disturbs, metabolic and electrolyte imbalance, accidents with poisonous animals, poisoning and trauma. The digital tutorials contained 3D model images, animation effects and videos. We designed a brief, user-friendly, questionnaire that assessed at the end the eLearning course appreciation. Ten distance courses were analyzed. One hundred and ninety eight professionals took these courses, 60% of them being medical doctors and 40% nurses. The percentage of participants that considered the distance course good or poor were 72% and 18%, respectively for the general quality , 91.8 and 8.2 % for the video quality, 91.7 and 8.3% for the use of images and animations. The system was considered user friendly by 91.7% of the users. The course was well evaluated and the system was rated good and easy to use. This emergency course shows to improve the knowledge and contributed to the continuous education of health professionals in the city of Belo Horizonte.**

## Introduction

Information and communication technologies (ICTs) have great potential to address some of the challenges faced by both developed and developing

countries in providing accessible, cost-effective, high-quality healthcare services [1].

Health professionals have a commitment to continuous studying and lifelong learning. As a result, healthcare professionals employ many methods to keep abreast of new information and to meet their continuing educational needs [2].

Distance Education (EAD) dissemination on several industrialized and on some developing countries implied a strategy for quick and updating professionalization, satisfying a need of the labor market and helping the worker to access professional training [3].

The Telehealth Center (NUTEL) of the Federal University of Minas Gerais, School of Medicine in Brazil has been using e-learning with the objective of spreading healthcare knowledge. We have been using 3D modeling, educational videos and animation effects.

The Belo Horizonte City Department of Health (SMSABH) wants to provide the quality of assistance in urgency and emergency cases. In addition, it structured the educational training of the professionals by using innovative distance learning resources.

Cardiac arrest occurs in a wide variety of settings, from the unanticipated event in the out-of-hospital setting to anticipated arrests in the intensive care unit. Outcomes from cardiac arrest depend on many factors including the training of health professionals [4].

This paper aims to describe the analysis of an emergency care eLearning course that is been developed for health professionals from the public health system in the city of Belo Horizonte, Minas Gerais State, Brazil.

## Methodology

This is a qualitative study based on a descriptive analysis of a semi-structured questionnaire-based survey involving the participants of a distance emergency course.Lessons were developed by professors and health professionals with expertise in this area. The selected content of the course was: basic life support, advanced life support, cardiopulmonary failure, shock, respiratory distress and failure, cardiac rhythm disturbs, metabolic and electrolyte imbalance, accidents with poisonous animals, poisoning and trauma. The digital tutorials contained 3D model images, animation effects and videos.

The Moodle platform was used as Learning Management system for this course. At the end of each lesson the students' gain of knowledge was assessed by answering questions related to the covered topics.

We designed a brief, user-friendly, questionnaire that assessed this eLearning course appreciation. The answers of the participants to 10 distance learning courses were analyzed.

Figures 1 and 2 are example of 3D model images that have been used for emergency care in the distance learning modules.

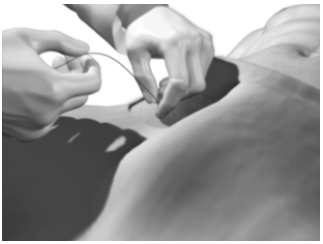

Figure 1 – Femoral access

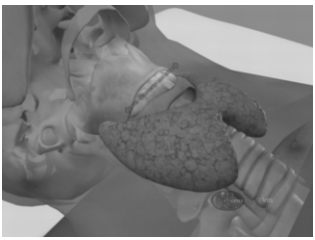

Figure 2 - Cricothyrotomy

## Results

One hundred and ninety eight professionals took the course, 60% of them being medical doctors and 40% nurses.

The percentage of participants that considered the distance course good or poor were, respectively: 72 and 18% evaluating the general quality, 91.8 and 8.2% the video quality, 91.7 and 8.3% the use of images and animations. The system was considered user friendly by 91.7% of the users.

In general, the course was well evaluated and the system was rated good and easy to use. Course participants have welcomed the presentation and content of the course. The vast majority of them would recommend the course to others. A small number considered that the amount of educational videos produced should be increased.

## Discussions and Conclusion

Nowadays, the incorporation of ICTs by health professionals has been regarded as positive.

Simple, user-friendly interfaces and systems that people with little or no technical expertise and limited English-language knowledge can operate are important means to overcome barriers and to implement and enable a swift dissemination of telemedicine applications in healthcare within developing countries. This principle is valid for technical solutions as well [1].

In this course, we show that participants evaluated positively the accessibility and usability of the emergency eLearning modules, based on

clinical case scenario, within defined learning objectives, using critical concepts and considerations in policy documents, summaries and revision questions. We have been using 3D model and animations videos to improve the learning process and to attract the interest of students. The pparticipants' evaluation of the course has been shown to be positive and they would like to see a greater number of educational videos included in the modules. We believe that such learning tools encourage students to learn.

The process of incorporating telehealth resources in SMSABH reflected the objective of providing an assistance model to strengthen the quality of care [5]. Students considered that the course should be made available to other colleagues.

Based on this study we have concluded that this emergency course improves the knowledge and contributed to the continuous education of health professionals in the city of Belo Horizonte in Minas Gerais State, Brazil. In general, this course has been well evaluated by the participating doctors and nurses. This course has been generating new educational possibilities and approaches in emergency medicine.

## Acknowledgment

Special thanks to the many authors and reviewers who contributed with their time and ideas to this distance learning emergency course.

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# Volenti Non Fit Injuria 'To One Who Volunteers, No Harm is Done': Informed Consent for Telemedicine

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***Abstract:*** **Regulators view telemedicine as something new and feel that it must be regulated in order to protect patients. In South Africa it has been proposed that written informed consent be required for all aspects of a telemedicine consultation. Four hundred doctors and nurses completed a questionnaire investigating their current practice regarding informed consent in routine non-telemedicine consultations and when using a telephone, telefax, email or short text messaging service. Written informed consent is seldom obtained and consent is either implicit or verbal. The need to regulate telemedicine by the imposition of written informed consent is questioned.**

## Introduction

Telemedicine poses a dilemma for regulators who the one hand desire to protect the patient and on the other the health care practitioner. They intuitively perceive telemedicine to be something new, unproven, inherently riskier, therefore needing regulation. A simple form of protection under these circumstances is the requirement to obtain written informed consent.

The Health Professions Council of South Africa's (HPCSA) recent, but as yet unpublished, booklet on the General Ethical Guidelines for Good Practice in Telemedicine defines telemedicine as "*The exchange of information amongst Healthcare professionals at a distance for the purpose of facilitating, improving and enhancing clinical, educational and scientific healthcare and research, particularly to the under serviced areas in the Republic of South Africa*."[1] This definition covers a wider range of activities than is probably intended, as it omits to mention the mode of information exchange, information and communication technologies (ICT).

The proposed guidelines require the practitioner to obtain written informed consent based on full and frank disclosure of all the material facts and that expressed consent as in a routine clinical encounter is not

sufficient. This would include for example obtaining consent to transmit and store patient information, take a history by videoconference, use a telediagnostic instrument for examination, and consult with another practitioner electronically. The procedure to be followed when one practitioner consults another or gives treatment instructions by telephone, fax, or e-mail is not explicitly covered and as these actions constitute the practice of telemedicine it must be assumed that the intention is that these too will require written, signed informed consent to be obtained.

The aim of this study was to ascertain the knowledge, practice and attitude of doctors and nurses towards informed consent in clinical practice and to determine if and when written consent is routinely obtained for a face to face clinical encounter.

## Methods

This study is part of a larger study on the knowledge, attitude and practice (KAP) of doctors and nurses in South Africa, looking at ICT use, privacy, confidentiality, data security and issues of informed consent, In accordance with recommended guidelines for KAP studies the sample size was set at 400. Convenience sampling of doctors and nurses was undertaken at academic meetings, formal post graduate educational sessions and at various hospitals in urban and rural areas. Participation was voluntary and ethical approval was obtained from the Bioethics Research Ethics Committee of the University of KwaZulu-Natal.

A self administered questionnaire consisting of questions regarding their practice of taking consent was administered to doctors and nurses in both public and private practice. The initial part of the questionnaire consisted of demographics such as qualification, gender, area of practice and year of medical graduation. The second part comprised questions about telephone, cellular phone, fax and email use. Respondents were also asked about their awareness of legal ethical guidelines regarding the use of the telephone in clinical practice. The final two sections of the questionnaire consisted of questions pertaining to everyday clinical practice and informed consent and computer use at home, clinical practice and hospitals. Respondents were also asked if and what their telemedicine ethical concerns were and whether they had in fact practised telemedicine and if so in what form.

## Results

One hundred and ninety-three doctors and 207 nurses completed the questionnaire. While 68% of doctors and 87 % of nurses obtained consent before examining a patient, only 4% of doctors and 13% of nurses gained written consent.

For clinical investigations like blood tests and x-rays, only 13% of doctors and 35% of nurses obtained written informed consent. A potential confounder amongst the nurses is that written informed consent is taken for HIV testing but not for other routine blood investigations.

Referral is an integral part of many telemedicine activities and currently 18% doctors and 28% nurses obtained written consent from the patient to refer them to someone else for a medical opinion. The telephone was used by 67% of doctors to obtain a second opinion about a patient and by 56% of nurses. Forty-five percent of doctors and 29% of nurses receive sms text messages from patients.

Only 20% of doctors and 16% of nurses use email as a means of communication when sending patient information. Of the 38 doctors who transmit patient data by email, 10 get verbal consent and 6 written consent to do so.

## Discussion

The use of information and communication technology in medicine is not new. The use of the telephone for clinical consultation was reported in the Lancet in 1879, [2] Eindthoven transmitted electrocardiograms by telephone in 1905 [3] and use of an electric stethoscope linked to a telephone was reported in 1910 [2]. The argument for the need to regulate telemedicine because it is new is not necessarily valid.

Should a patient be required to provide written informed consent to participate in any aspect of a telemedicine encounter, including a telephone call or email? For telemedicine to thrive it needs to be integrated into everyday practice and be seen as an alternate form of face to face consultation. The guidelines for written informed consent for telemedicine should be the same as for a face to face consultation. International Guidelines currently present differing views regarding written informed consent. Some insist that it is necessary, as telemedicine is not yet a routine service while others state that implied consent is sufficient, as the ethical standards in a telemedicine consult should be the same as for a face to face medical encounter.

A survey on the current status of consent for telemedicine conducted in Canada in June 2005 illustrates the diversity of opinions regarding the need for expressed consent, with most Provinces and Territories moving towards verbal rather than written consent for telemedicine exchanges. The expert consensus was that telehealth, especially video-consultation, had moved away from the experimental phase and that an implied model of consent for videoconsultations was acceptable and in keeping with a routine face to face encounter [4]. There is a distinction between verbal and implied consent and

in South Africa, the HPCSA guidelines suggest caution when interpreting patient compliance as consent.

In South African law informed consent has been regarded as falling under the defence of *volenti non fit injuria*. By using this approach the courts favour autonomy and a self determination approach to consent as opposed to a paternalistic one. The South African Bill of Rights enshrines theprinciple of autonomy and freedom to make decisions for oneself. The National Health Act of 2003 is clear regarding informed consent, stating in section 7(1) that a health service may not be provided to a user without the user's informed consent, with provisions made if this is not possible.

This study has shown that a very small percentage of health care professionals, 4% of doctors and 13% nurses in this sample obtain written informed consent for any aspect of routine clinical encounters. It also showed the majority of respondents do take verbal consent from patients.

The HPCSA guidelines that determine clinical practice state that patients can indicate their consent either verbally or in writing. It therefore seems logical that telemedicine guidelines adopt the same pragmatic approach.

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# Electronic Health Records

# A Demonstration of the Impact of the Use of SNOMED CT® Enabled Systems in Telehealth to Update the EHR

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***Abstract:*** **This comparative demonstration looks at the use of SNOMED CT (SCT) terminology-enabled systems in telehealth services to determine its impact on factors such as timely updating of the patient's electronic health record (EHR). A comparison is made between two scenarios, one where data are captured by currently available telehealth services and plug-in devices and another using those services and devices which have SCT-enabled systems. International Open Source standards, which support SCT and are required to enable the communication between plug-in devices and the EHR, are addressed.**

## Introduction

As there are currently no standard definitions for the terms telehealth, telemedicine, or telecare, for purposes of this paper, telemedicine and telehealth will be considered synonymous and used interchangeably, in accordance with the definitions used by the World Health Organization [1].

After reviewing published work and results of randomized controlled trials in telehealth services for over a decade, it appears that the value of capturing data in that setting is often underestimated, at least in some defined telemedicine scenarios [2-5]. These data are not just limited to written and speech recorded data, but also include interpreted images and video clips. Data from videos in a telemedicine setting could be regarded as a multimedia-enabled reporting method of clinical findings. The capture of these data, as well as those from clinical reports and the interpretation of findings, could be enabled through the use of an encoded terminology such as SNOMED CT (Systematized Nomenclature of Medicine–Clinical Terms) to update the patient's electronic health record (EHR) in a timely way [6].

## Standards

In order to avoid double entry of data and the ambiguities of full-text clinical reporting, a standardized terminology should be used, such as

SNOMED CT (SCT). SCT can be used as clinical content which meets the standards of different information and communication models. These models enable communication of data between telehealth plug-in devices and the EHR.

Several international Open Source standards exist for Information Models which support SCT, including [Health Level 7 - Terminfo project (HL7 version 3)], [HL7 RIM (Reference Information Model)], [HL7 HMD (Hierarchical Message Description)], [Clinical Document Architecture (CDA)], and [openEHR Templates] or [EN13606 Archetype] and [Logical Record Architecture (LRA)].

HL7 RIM and HL7 HMD are required to represent SCT data in an Information Model in order to share with those data based on HL7 V 3 Standard. HL7 HMD transforms the SCT messages into a structured format to allow conversion into a template-based EHR system. Examples of template-based systems include CDA, openEHR and EN13606. The LRA model provides a different format of a template-based EHR system, but provides a complete record system for connected health and social care. Additionally, the LRA system is able to detect users with different security levels as well as the origin of messages, and also provides access to data warehouses. For EN13606 structured data format, Continua Healthcare Alliance provides an End-to-End solution with interoperable interfaces, which is included in its recent Design Guidelines of 2010 [7].

## Demonstration

The purpose of the demonstration is to illustrate how the appropriate implementation of SCT could support the capture of formatted data to enable seamless communication of those data to the EHR, in order to update patient information without major changes to existing systems.

Teleconferencing services currently used in certain telemedicine scenarios, such as the classic psychiatric interview, provide data recordings of the encounter between patient and provider in video and audio format. Expert analysis of the recorded interview is required to identify characteristic mannerisms and behaviors that are observed in the patient that must be interpreted in order to lead the clinician to conclusions about the diagnosis of a disorder or anomaly. These findings must be recorded separately as written clinical findings for each patient record, then must be converted to a text file and finally encoded into SCT using a text encoder (such as Medsight) [8]. These various conversions are required before key symptoms, clinical findings, and recommended procedures can be communicated to the EHR.

Two scenarios are demonstrated, one using only conventional telemedicine patient interview techniques and auxiliary biometric plug-in devices as they currently exist and the other using SCT-enabled devices to capture and communicate patient data. Plug-in devices are widely used in current telehealth services for capturing vital data from point-of-care (POC) devices. These devices, such as biochemical, ECG, and other patient surveillance systems, include those that can be applied and operated by the patient, by trained healthcare staff (e.g. nursing, paramedics, social care), or are operated only by medically qualified and appropriately trained clinicians. Currently, these devices provide only terminal 'snapshot' readings of patient status rather than recording and storing the data in the EHR.

The demonstration highlights how improvements could be made to both subjective data from patient interviews and objective data from POC devices by appropriately implementing SCT terminology.

By enabling these POC devices with SCT, formatted data would be produced which could be recorded and communicated through a standardized Information Model directly to the EHR, in a multimedia format. The data would update the patient record and be available for direct comparison to SCT-embedded data already in the EHR, without further manipulation or translation.

## Discussion

A current issue with the use of SNOMED CT is the appropriate implementation of this terminology using all the advantages of the system. One advantage is that SCT is independent from a specific Information Model (e.g. HL7 v3 HMD, EN13606, openEHR and LRA) while each of these models identifies SCT expressions content as a preferred system.

Another advantage is that in connected SCT-enabled POC devices, such as for biochemical analysis or vital signs recording, there are a limited number of known clinical procedures that are carried out, so a discrete subset of clinical terms could easily be encoded into the device (usually by bar code readers or electronic chips). In ECG devices, automatic analysis of the recording can deliver preliminary clinical findings which are also in easily encoded format. Therefore, SCT expressions, specific for each device, can be prepared in the device where only the measuring data or the clinical finding needs to be automatically entered. This will allow direct comparison with similar data already in the EHR.

Pre coordinated clinical terms already exist in SCT concepts to represent telehealth encounters. These are defined by standard 'lead' expressions such as 'surveillance: remote electronic,' 'remote verbal consultation,' and

'remote verbal assessment.' These expressions would provide a basis for a SCT post coordinated expression in which any telehealth assessments could be embedded including the telepsychiatric conference as equivalent to the classic psychiatric interview, POC, and vital sign device surveillance assessments.

## Conclusion

Examples of data capture demonstrated in this telemedicine setting shows that the EHR could be significantly enhanced by including currently available devices, standards, record architectures, and SCT. A rich multimedia patient record could be developed easily without interpretation and reformatting of data and with minimal changes to existing systems. Using these standards and applying them appropriately can ensure connectivity of future devices, regardless the operational platforms and design on which they will be built.

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

Janis Huston has over 35 years experience in Health Information Management (HIM), both in academia as a Professor of HIM in the USA as well as direct involvement in healthcare delivery in both the USA and UK. For the past decade, she has worked in the UK with the National Health Service in various areas of development of the electronic health record (EHR) including documentation standards, clinical terminology, clinical coding, national clinical datasets, data quality, information governance, and workforce development. She has completed projects at the Royal College of Physicians, UCLH Trust, The Royal Marsden Hospital Trust, and the National Programme for IT in London. Dr Huston has also been involved in telemedicine and telecare since serving as a Telemedicine Evaluation Research Associate at the University of Kentucky in the mid-1990s. She became a member of the Telemedicine and eHealth section of the Royal Society of Medicine in 1998 and Fellow in 2008. Dr Huston has authored numerous publications on a variety of topics concerning documentation of patient care including security and medicolegal issues in the EHR and telemedical records, HIM training requirements, and recently co-authored an online course in SNOMED CT for the Ohio Health Information Management Association. She has served as an invited external peer reviewer for the British Medical Journal since 2008.

# EHR2Roche Project towards a Pharma Research Infrastructure

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***Abstract:*** **Pharma-related research is very expensive and data intensive. Often data already entered in an IT system needs to be re-typed and checked. Increasingly data is available in Hospital Information Systems. The ability to extract data from these systems and use in the research environment will decrease cost and data entry errors.**
**Due to these benefits Roche and partners started the EHR2Roche project. In phase 1 a proof-of-concept was performed. The Pilot phase is in preparation. The PoC was successful and proved that using the CEN/ISO 13606 standard hospital data could be normalised to 13606 format, transformed to the CDISC ODM format and sent to an EDC system. The PoC was executed within a short time frame (10 weeks) and in budget.**

## Introduction

*Business Problem*

Clinical studies with real patients are extremely important for the Pharma Industry. Legal, ethical and regulatory requirements drive this process. Many times Investigators re-enter data from existing sources, creating matching and typing errors that need a resource intensive (time and personnel, money) series of steps to re-enter and check data. Increasingly data needed for the Pharma studies are available in information systems that healthcare providers use in their clinical practices.

It is expected that reuse of this data and information will increase the data quality and subsequently free up resources needed to do clinical research.

*Technical Solution*

The CEN/ISO 13606 EHRcom [1] standard for Electronic Health Records communication (EHRcom) and supportive artefacts, tools and other software are used for reuse in pharma studies in this project to retrieve and normalise data from existing sources that the healthcare provider is already using.

The Medidata Rave® EDC/CDMS system from Medidata Solutions [2] is used in this project to test reuse of pharma study specific data via the ERS platform in the CDISC ODM format [3]. Much of the technology used up until now for exchange of data between databases has been shown to be inflexible, difficult to implement and maintain, and therefore less able to support easy reuse.

The new technology provided by the EHRcom standard is not only much more flexible and easy to deploy, but the standard supports legal, ethical and regulatory requirements, because it explicitly deals with the patient mandate (privacy). The EHRcom standard is implemented in ERS CESIL™ (Cross Enterprise Semantic Interoperability Layer) [4] and is used for the process of data extraction, normalization and integration of data expressed in proprietary (database) schemas or existing messages.

The CESIL platform allows an agile way of implementing the exchange between systems because the needed software is generated in a model driven way.

## EHR2Roche Project Description

### *Project Phases and Objectives*

It is the intention of the project to obtain relevant expertise and Key Performance Indicators in creating a state-of-the-art research infrastructure in hospital environments via a process in three phases: (1) Proof of Concept demonstrating the technical feasibility; (2) Pilot obtaining information (cost/savings, ethical, legal, regulatory, organisational and technical) about implementation in a real-life situation using a real study and (3) Scale-up, using the results from the previous steps in a number of hospitals.

### *Proof of Concept*

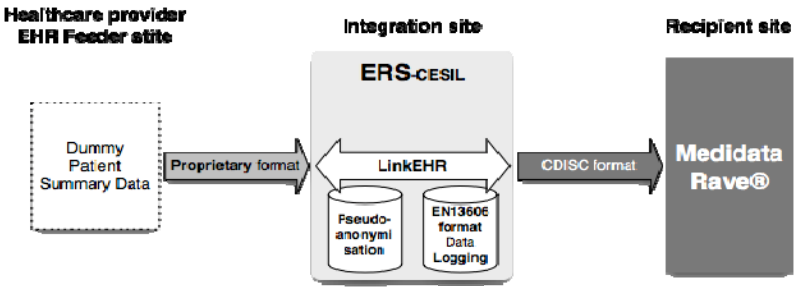
Research questions:

1- Prove interoperability using ERS CESIL™ and Rave

2- Develop (and validate) selection criteria

3- Develop further the business case.

Patient data in a proprietary format was transformed into the standardised CEN/ISO 13606 format, anonymised and stored in a local database. Hereafter the data was transformed into the CDISC ODM format and sent to the Medidata Rave system for further processing.




EH2Roche Proof-of-Concept

The data sent consisted of data types that are used in health care provision. The researchers concluded that in this PoC the exchange proved technically feasible, and exhibited maximal flexibility for both the CEN/ISO 13606 and CDISC ODM formats to define structure in which data is stored/exchanged. All types of (clinical) patient data in any structure could be handled. An initial set of EN13606 archetypes and mappings of those to CDISC ODM was produced that will be published in the public domain via the EN13606 Association.

A document was produced with criteria to select appropriate studies and sites to conduct the Pilot as part of a Toolbox approach for easing scale up.

*Pilot*

In the Pilot the technical solution will be installed in at least two hospital sites. Using an ongoing patient study the pilot, in piggy-back style, will use that study. At the same time the 'old' way of re-typing and double checking will be used in the actual study. For a limited number of patient visits (100-120) the new installed infrastructure will be used.

In this real-life situation with legal, ethical and regulatory requirements integrated with existing business processes we will observe and document usability aspects, organizational and technical problems. In addition this set-up allows us, using Key Performance Indicators, to obtain quantitative measurements (cost involved in study set-up, data governance, time to closure of study, availability of data that can be retrieved automatically, etc). These facts will help us prepare the next step: Scale-up.

*Scale-up*

During the Scale-up using more hospitals, more studies, more extensive financial and other Key Performance Indicators will be obtained. These will be used to help convince the pharma industry, hospitals and their

investigators to invest in new technology that creates an effective and efficient research infrastructure with more patient safety .

## Results of the EHR2Roche Proof-of-Concept

In a period of 10 weeks the PoC was executed within budget. The majority of time was used for the study of the CDSIC ODM Reference Model and configuration of Medidata Rave Web Services.
In less than a week the transformations from the legacy to the CDISC format were finished.
All generally exchanged types of data and their data formats were used: diagnosis, problem list, alerts, lab results, units of measurement, text, coded text, ordinals and binary.
All data in the proprietary system could be transformed into the CDISC format and exported from Medidata Rave for statistical analysis (using SAS).
Once the technical infrastructure is set up, any change in the data needed to extract and transform can be completed in a matter of minutes/hours.

## Conclusions

- The CEN/ISO 13606 EHRcom standard can be used to extract data from legacy systems and transformed into CDISC ODM format, making it available to ODM-compatible an EDC/CDMS system.
- Once the technical infrastructure is in place the production and implementation of the transformation using the tools and software takes minutes to days at most.
- The positive technical feasibility warrants starting the next phase in the EHR2Roche project.

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Peter Buckman - Project Director Medidata Solutions Worldwide - Peter has 14 years of experience in the clinical systems arena. Having trained as a Software Engineer Peter moved into project management and has managed many custom development & 'off the shelf' implementations of systems and processes within biopharmaceutical companies worldwide. These include EDC implementations, E2B safety system integrations as well as many custom tools and processes associated with coding of medical terms.

# Impact of EPR Systems: How Have Seven Years Improved Information Flow in Finnish Health Centers?

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***Abstract:*** **We studied how well health care personnel involved in Anticoagulant (AC) treatment in Finnish Health Centres (HC) are able to obtain information related to the AC treatment thorough Electronic Patient Record (EPR) systems. This study was conducted in the South-Ostrobothnia region of Finland. A structured questionnaire was sent in 2003 to the staff of 15 HCs. The questionnaire dealt with access and availability of EPR information for patients receiving AC treatment. Respondents were asked to rate how often they obtain information concerning AC treatment from various sources. In total 1114 questionnaires were sent and 862 answers were received. A repeat study was conducted in 2010 and 923 responses were obtained (response rate 56%). Paper-based AC treatment cards carried by the patients were an important information source for 75.1% of the respondents in 2003 and 55.2% in 2010. For all new AC treatments, the EPR was a primary information source for 33,7% of respondents in 2003 and 61.1% in 2010. In the case of on-going AC treatment, the EPR system was the primary information source for 43,4% of respondents in 2003 and 72,2% in 2010. In the seven years covered by this study, EPR systems have become more important as information sources for clinical data, but there is still room for improvement.**

## Introduction

Finland has a relatively long history of utilizing Electronic Patient Record (EPR) systems in primary and secondary health care. Despite significant development efforts, physicians are still critical of EPR systems used in Finland [1]. Quick, effortless access to patient data is one of the key requirements in clinical work [2]. We have previously studied how well electronic patient record (EPR) systems meet the needs of general practitioners (GPs) and other health-care professionals [3]. In this project, we focused on how well health care personnel involved in Anticoagulant (AC) treatment in Health Care (HC) centres are able to obtain information related to the AC treatment through EPR systems. Patients receiving AC treatment form a significant patient pool in Finland [4] and often receive treatment in different health care organizations. By focusing on a specific data set for patients receiving AC treatment, we hope to determine what impact the adoption of EPR systems has had on availability and flow of patient related information.

## Method

This study was conducted in the South-Ostrobothnia region of Finland. The total population of the region is 196 000; Primary Health Care is provided by Health Centres. In 2003 there were 16 Health Centres in the region. Due to organisatory changes, in 2010 there were seven centres left, although the total number of care sites in itself was not reduced. In some cases, social care services were transferred in 2010 to the HC organization. Health centres offer a wide range of services e.g. health promotion, prevention of diseases, provision of medical treatment and rehabilitation services. Many health centres have a hospital of their own. In 2010 health centre hospitals in the South-Ostrobothnia region had 1130 beds. Secondary care is provided by Seinäjoki Central Hospital (560 beds) and Ähtäri hospital (28 beds).

A structured questionnaire was sent in 2003 to the staff of 15 Health Centres. These used three different EPR systems. Seinäjoki Central Hospital had started implementation of an EPR system in 2002, but it was not functional in 2003. The questionnaire dealt with access and availability of EPR information for patients receiving AC treatment. A reminder letter was sent some time after the initial questionnaire form. Respondents were asked to rate how often they obtain information concerning AC treatment from various sources, for instance: EPR, patient AC treatment cards, telephone inquiries, relatives, etc. The scale used ranged from one to five (1= very rarely, 2= rarely, 3= sometimes, 4=often, 5= very often).

A repeat questionnaire study was conducted in 2010. Due to mergers of HCs, seven separate HCs remained, with six using the same EPR as Seinäjoki Central Hospital. Responses from personnel that dealt with AC treatment on a weekly basis in 2003 and 2010 were compared and analyzed ($\chi^2$ test).

## Results

In total 1114 questionnaires were sent in 2003, and 862 answers were received (response rate 77.4%). In the repeat questionnaire study of 2010, 1675 questionnaires were sent and 923 responses were obtained (response rate 56%).

The paper-based AC treatment cards carried by the patients were an important information source for 75.1% of the respondents in 2003. The importance of this card was reduced so that 55.2% of respondents dealing with AC patients on a weekly basis indicated that they obtained information from this source often or very often in 2010 ($p<0.000$).

For all new AC treatments, the EPR was a primary information source for 33,7% of respondents in 2003 and 61.1% in 2010 ($p<0.000$). In the case of on-going AK treatment, the EPR system was the primary information source for 43.4% of respondents in 2003, this was increased to 72.2% in the 2010 responses ($p<0.000$).

## Discussion

EPR systems have become more important as information sources. However, they are still not the sole source of information since only 72.2% indicated the EPR to be the primary information source in 2010. There are several possible reasons for this: lack of interconnectivity between EPR systems and organizations, insufficient user training [5,6], and user interface problems. For instance, some types of information have to be manually filled into multiple data fields in the EPR system.

The requirements placed on EPR systems are exhausting, therefore additional types of records will be kept for specific purposes. One such record is the paper based AC treatment card carried by some patients [7], this research indicated that these traditional methods of recording information are still in use.

In the seven years covered by this study, EPR systems have become more important as information sources for clinical data, but there is still room for improvement.

## Acknowledgment

This study was supported by the research fund of South-Ostrobothnia Hospital District.

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# Managing Chronic Conditions through Hosted Medical Records in Kenya

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***Abstract:*** **Complex medical conditions are rising in developing countries at very alarming rates. E.g. projections from the World Health Organization's global burden of disease and risk factors report chronic diseases are responsible for up to 50% of disease burden in selected countries. Diseases hitherto associated with the developed countries like diabetes, cancer and Hypertension are in the increase in developing countries. Management of these medical conditions calls for a new way of delivering health care services in these countries. Long term therapeutic management of these diseases requires availability of medical records to a provider when a patient presents him/herself at a medical facility. Advances in technology present opportunities for informing systematic management of these chronic conditions within constraints of resources that these countries face.**

## Introduction

The global health conditions and associated disease burden in the world has been changing from one dominated by infectious diseases to one characterized by chronic conditions such as hypertension, cancer, diabetes, and chronic respiratory diseases [6, 9]. Whereas these conditions have traditionally been associated with the developed world, the reality is that the developing countries are increasingly faced with these diseases at alarming rates. According to World Health Organization's (WHO) global burden of disease and risk factors report, chronic diseases are responsible for up to 50% of disease burden in selected countries [6]. Moreover, according to [7] 80% of worldwide deaths from chronic conditions occur in low-income and middle-income countries.

With already over stretched budgets of developing countries in addressing primary care needs and infectious diseases, the "new" source of burden calls for a new way of thinking and delivering health care. It is not

only the lack of resources that requires new innovations to deal with these conditions but also the requirements for proper management of such conditions are different from how infectious diseases are managed. One critical aspect is the need for systematic treatment management plans by health care providers. Long term therapeutic management of these diseases requires availability of medical records to a provider when a patient presents him/herself at a medical facility (therapeutic). In this respect, electronic medical records provide opportunities for easy sharing and exchange among service providers. However, the installation of electronic medical records in developing countries is not a priority since there are more pressing needs for *drugs rather than computers*. New way of delivering technology, especially cloud computing, presents opportunities for cost-effective technology support in management of chronic diseases.

Gartner Research defines cloud computing as "a style of computing where massively scalable IT-related capabilities are provided 'as a service' using Internet technologies to multiple external customers." Our take from this for the healthcare industry is that the IT infrastructure used in healthcare needs to be a non intrusive tool that does not come in the way of a provider but rather enables s/he to better deliver the health service. A typical health service providing facility (e.g. public hospital) is faced with challenges of enough medical staff, making it unrealistic to expect full time personnel to manage (on a full time basis) technology related issues at a hospital. Support by technology is expected to cover typical medical records activities of collection, recording, organization, storage, retrieval, transmission, aggregation of epidemiological statistics. Most of these can be "outsourced" to an entity providing software ‘as a service’. Carrying out of other tasks (especially recording and retrieval) need to be made easier by use of modern day tools like mobile phones.

## Our proposed Technology’s Rationale

We believe that the Kenyan health sector is ripe for embracing cloud computing technologies. The sector has in the last five years enjoyed sustained reforms that have among other things defined and developed data capturing tools. The sector has an institutionalized culture of capturing medical information (demographics, vital signs, medication and allergies, immunization status, etc). The challenge is the management and use of the data for decision-making [4, 3]. The next level of the reforms in health management information systems is likely to concern how the Internet will affect both administrative and clinical tasks; how it impacts communication between and among patients, payers, and providers; and how it can be harnessed into integrated delivery systems [8].

We propose a project that will introduce remotely hosted medical records of patients to enable health service providers make references to a patient's medical history for an informed therapy plan. A hosted service is cheaper than individual installation at clinics. Starting with two regions (Nairobi and Machakos), we shall install a server that will aggregate diabetes and hypertension data from the two regions in ca. 20 hospitals. The records will be searchable provided a valid patient-specific code is entered.

## Proposal and addressing Emergent Challenges

Since the time of Hippocrates the need to maintain the confidentiality of medical information has been recognized [2]. A major concern to be addressed involves ensuring integrity of the information practices, especially confidentiality in access and interchange of stored data. In this regard we tap into the privacy of mobile phones whereby access to the system will be tied to a time limited session. To initiate a session, a user will login and upon request to access a medical record of a patient, the system will generate a code sent to the patient's mobile phone number. Access to the code is therefore limited to the patient who must retrieve it from his/her mobile phone.

This is one concern among several that we address as per European privacy association that include Scope(s) of the processing, Information notice and consent, Data security measures (service level agreements), Data subject's rights, Data transfer to third parties(consent clauses), termination / erasure clause [1]. Regional government officials in these regions will only access summaries that will never expose names nor patient identification. Providing views of de-identified patient data in the server for research (and aggregation of epidemiological statistics) purposes makes good sense because the primary will shift to aggregate data analyses of massive numbers of records (e.g. for informing data-driven planning).

In the first 2 months we shall carry out a baseline survey to select participating hospitals and identify the basic parameters for data capture. In the next 3 months version 0 of the system will be operational with basic patient data (bio information, latest vital signs and medical history notes). Updates to these records will be possible via SMS and via authorized email. After a review of the project in the sixth month, we plan to extend it to include hosting of radiology images. Thus acting as a clearing-house of making reference to radiologists' reports (currently patients undergo radiology exposure very often since no records are available).

## Conclusions

We believe that this system will lead to information driven decision making and improve health services delivery in Kenya especially once reproduced / adopted beyond the two regions. A major advantage is the relative low cost of getting started. For less than USD 10,000, the system will reach a catchment area of about six million residents. Targeting the public facilities initially means we shall be covering an area reporting about 30,000 patients' visits per month [5]

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# Personalized System of Instruction – Using PSI to Develop Virtual Content: Nursing Records

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***Abstract:*** **This study presents the use of the Personalized System of Instruction (PSI) in the development of content for Virtual Learning Environments (VLE) concerning nursing records.**

## Introduction

Distance Education (DE) is a suitable strategy used in continuous education that facilitates self-learning with the aid of organized didactic resources. One of these resources is the Personalized System of Instruction (PSI).

PSI is defined by the student's performance, who develops his/her learning through small stages (steps) that are adapted to an individualized process according to the student's performance. The difference of PSI in relation to the traditional method is evidenced in five main characteristics: individualized rhythm, disciplinary content divided into small stages, lectures aimed to motivate students only, emphasis on written content that can be accessed by the student for convenience, and the importance of a monitor/tutor as the immediate feedback provider [1]; [2]; [3].

This study describes the development of virtual content on nursing records for Virtual Learning Environment based on PSI developed according to the 15 steps recommended by Ref. [4].

## Method

The problem of the instruction program was formulated as follows: **How one can take good nursing notes?** Then, the final objectives were specified in behavioral terms and the intermediate components to achieve each final objective were analyzed, defining preliminary requirements for each component. Finally, teaching activities were planned and organized in steps to be followed by the students.

## Results

Based on the description of the problem of the instruction program the following final consequences for taking good nursing notes were identified: legibility, coherence, organization, objectivity, impartiality, honesty and knowledge.

We opted for presenting three of the seven final consequences in this abstract jointly with their intermediate components and preliminary requirements (Table 1).

Table 1. Description of the final consequences, intermediate components and preliminary requirements of the problem of the instruction program. Ribeirão Preto, 2010.

| **Preliminary requirements** | **Intermediate components** | **Consequences/ Final** |
|---|---|---|
| **Neatly describe situations/facts: Arrange priority ideas/facts** | Logical Sequence | Organization |
| **Be fair/impartial when describing a situation/fact** | Be free of one's own opinions and preconceptions | Impartiality |
| **Be truthful in describing a situation/ fact** | Be faithful to reality | Honesty |

The teaching activities were planned based on each intermediate component. Then, these activities were organized into units or steps to be followed by the students (Table 2).

Table 2. Description of teaching activities to be performed by the students. Ribeirão Preto, 2010.

| **Teaching Activities** | **Behavior students have to present** | **Expected consequences for expected behavior expressed by students** |
|---|---|---|
| An explanatory text and a case study in the form of a mock session are presented so students develop nursing notes in an organized/ordered manner to be presented in the VLE environment. | Access the VLE to read content and respond to the proposed exercise based on previous reading | Raise awareness concerning the importance of taking organized notes. |
| An explanatory text and an exercise (simple crossed words) are presented for students to solve the problem and display their results in the VLE | Access the VLE to read content and complete the proposed exercise based on previous reading | Raise awareness concerning the importance of taking impartial notes |

| | | |
|---|---|---|
| An explanatory text and an exercise (simple crossed words) are presented for students to solve the problem and display their results in the VLE | Access the VLE to read content and complete the proposed exercise based on previous reading | Raise awareness concerning the importance of taking honest notes |

## Conclusion

This didactic resource was viable in the development of virtual content directed to nursing professionals. It enabled the development of organized, objective and rich content in relation to the problem of nursing notes. It is expected that this context facilitate the learning process because it was constructed in steps and respects the unique rhythm and time of each student.

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# Using Organizational Security Policy for Ensuring Privacy of Electronic Health Records

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## Introduction

The costs of data breaches examined by a recent study reported that highest costs of data breaches are associated with the pharmaceutical and healthcare sectors [1]. Data breaches in the United States involving third parties accounted for 42% of all cases in 2010. These breaches have substantial financial impact on the organizations mainly due to additional costs of investigations. These statistics are not drastically different from the ones on the other side of Atlantic where NHS reported 40% of data breaches that involved a third party [2].

There exist a number of security measures that big organizations such as healthcare adopt to shun data breaches. Various international standards such as ISO27002 [3] and ISO27799 [4] have facilitated the emergence of some best practices. However, the lack of a comprehensive security methodology to address this issue is taking its toll on the overall security of the medical data notably electronic health records (EHRs).

This paper presents a methodology to ensure the confidentiality of EHRs from a possible data breach from third party. We propose a methodology for ensuring the privacy of EHRs even when some or all parts of the information infrastructure is no more operational either due to routine maintenance work or due to a calamity. The involvement of third party to carry out maintenance or disaster recovery operations exposes the EHR storage system to theft of private information by intentional or accidental means. Our proposed methodology place the critical mass of responsibility on the shoulders of organization's core employees as it is more viable to assign a defining role of ensuring EHR privacy to those stakeholders who constitute the most trusted group of the healthcare ecosystem. Our proposed approach not only reduces the probability of potential data breaches but also satisfies the emerging legal requirement of notifying data breaches [5].

## Potential of EHR Privacy Breaches in Disaster Recovery Operations

Healthcare units such as hospitals have considerably developed the way of taking care of patient by using more complex information systems. These systems are interconnected in order to produce electronic health records (EHRs). These records are very sensitive by nature and require adequate privacy. However, the complexity of the information system composed by a large kind of devices makes this objective very challenging to meet. A number of devices have their local storage and are very different from each other. For example, a hospital information system can be composed of printers, user desktop, and servers but also by specific imagery systems like MRI (Magnetic Resonance Imaging). These equipments can store some private EHRs. For a secure disaster recovery planning of these equipments, physical access of unauthorized people to these storage resources has to be avoided. The preliminary problem therefore is how to maintain the needful confidentiality level in a post disaster situation.

The problem of security management in the occurrence of disaster can be more complex for two reasons. The first one is linked to the relation defined by contract with the company in charge of repairing. The contact must be defined in a coherent way with the inside organizational policy. The second reason is concerning hospital interconnections. Indeed, since a few years, hospitals are more and more interconnected in order to have the most complete view of the patient EHRs. The problem of maintaining privacy of a medical record needs to be considered through the relationships among the various hospital information systems. The contracts between hospitals must be also consistent with each local organizational policy and the internal policies must be consistent.

This paper analyzes the problem of ensuring privacy of EHRs in the specific context of information system interconnections. Our proposed methodology aims to address this problem by using organizational security policies based on ISO 27799.

## Organizational Security Policy for Protecting EHRs

Figure 1 depicts the set of EHRs stakeholders. Their access rights are generally governed on the basis of their respective roles in the e-health ecosystem. However, our focal point is the third party personnel whose involvement in an e-health system should not become its *Achilles' heel*. We meet this objective by defining a detailed methodology for involving third party personnel. It is the detailed interpretation of the section 10.2 of ISO27799 that covers third party service delivery management. Following

are the highlights of our proposed methodology that tangibly transfers the responsibility on the shoulders of direct subjects of the e-health ecosystem:

*Service delivery*

- Principle of least privilege is applied to all third party personnel.
- No access to EHR contents is granted for the service delivery quest.
- No physical access should be granted to those devices that can be accessed without traceable access control.

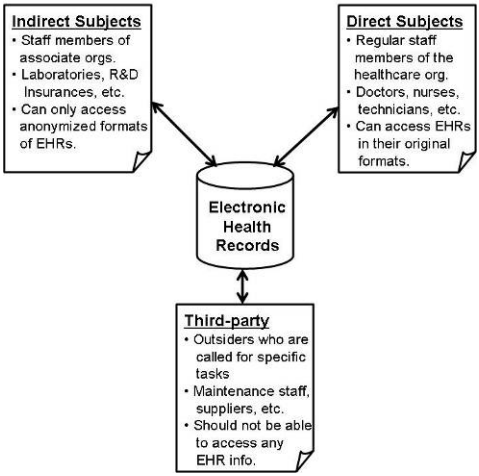


Fig. 1: Stakeholders of a typical EHR

*Monitoring and review of third-party services*

- Explicit monitoring of third party personnel.
- Tracking and logging of actions taken by third party personnel.
- Periodic review and analysis of the monitoring logs by a designated direct subject.

*Managing changes to third-party services*

- Lifespan of third party services should be precisely defined. It includes the events triggering the involvement (starting point) of third party services (e.g. a server breakdown) and the events that terminate (concluding point) the role of third party (e.g. restoration of server)
- A designated direct subject should be informed of any issue related to third party personnel such as revocation of access credentials in the advent of change of employment or even change of role in the third party organization that no more requires access to the EHR physical storage facility.
- Third parties should not be allowed to take away any electronic device that contains any form of storage media unless its contents are *washed out* by some other party who has no conflict of interest with the party entrusted to remove the device.

## Discussions

Use of third parties offers fascinating prospects for a diverse range of organization models. However, security implications remain a bottleneck for their wider adoption [6] [7]. The conventional approach for establishing trust with the third parties is based on some underpinning agreements of legal bindings [8]. However, the globalization of business operations and their loose coupling with a number of third parties require a more formal approach to cope with the risk of security breaches. Our proposed methodology in this paper provides a concrete foundation for the evolution of a methodology to formally bring the third party actors in the security perimeter of a sensitive organization such as healthcare one. Our recommended approach based on ISO 27799 ensures that non-abiding third party actors are automatically blocked from accessing the privacy sensitive health records. The gravity of responsibilities always remains on the shoulders of the organizational staff members. This approach not only helps to reduce the costs associated with the analysis of any security breach but also removes the legal chinks from the armor of organizational security.

## Acknowledgments

The research leading to the results presented in this paper is carried out in the context of an eHealth project of the Walloon Region of Belgium, supported by the FEDER – European Union and the Walloon Region under the terms defined in the Convention n°ECV12020022296F. This work has also received partial funding from European Union's seventh framework programme (FP7 2007-2013) Project RESERVOIR under grant agreement number 215605.

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# Evidence of Telehealth Outcomes

# BELGIUM-HF (Better Efficacy in Lowering Events by General practitioner's Intervention Using Remote Monitoring in Heart Failure): Solid Evidences for a Need of Telemonitoring Vital Signs in HF Patients

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## Background

Although efficient treatments are available for heart failure (HF), delayed diagnosis of clinical aggravation contributes to maintain mortality and hospitalisation rates at excessively high levels. Randomized-control telemonitoring (TM) trials totalizing about 4000 patients compared various clinical outcomes of telemonitored HF patients with those receiving usual care. TM appears to perform equally or better than usual care but has a cost. It should perform better because the prevalence of disabling HF is increasing (2% in developed countries) and because hospitalizations for recurrent HF represent 60% of all HF-related expenses. Therefore TM should be improved. Hence, the added value of TM compared to usual care is threefold: it should generate original informations, should increase speed and accuracy of worsening HF diagnosis and should guide cares that lead to an improved prognosis. BELGIUM-HF was the only trial designed to pursue these 3 goals.

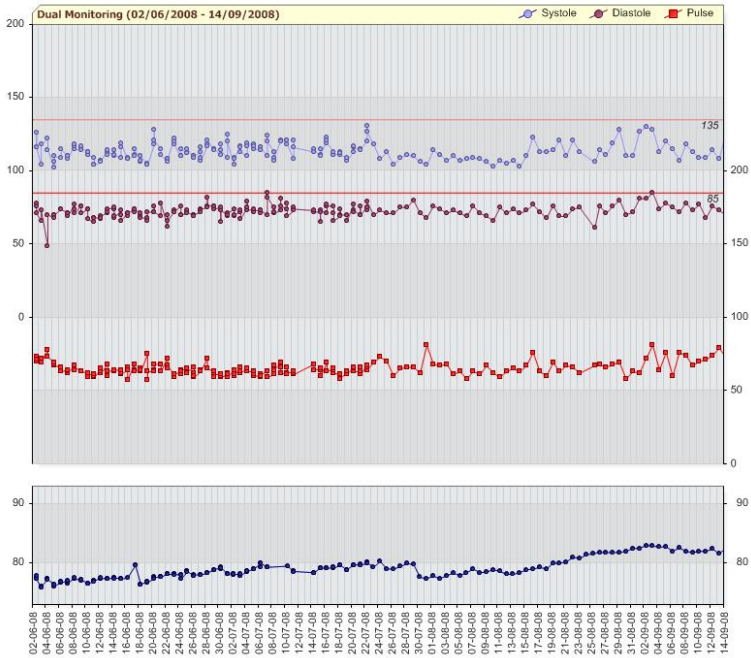
## Methods- Organization

The BELGIUM-HF Registry was designed to identify predictors of clinical outcomes using clinical characteristics and non-invasive home-based TM. Signal-trends based on Weight (W), Blood Pressure (BP), Pulse Rate (PR) and their variations were processed in relevancy with end-point

events (mortality, re-hospitalizations, and urgent visit requiring intervention). Patients were provided with Bluetooth coded scale and manometer. Their intervention was minimized to a single push button action. Morning measurements were automatically transferred to a secured database. Measurements and trends remained blind to all parties during a study period of 6 months. Algorithms of prediction that eventually emerge will be tested for efficacy in a subsequent randomized double-blinded trial (BELGIUM-HF Trial). The TM strategy was also conceived to avoid the need of a centralized TM-educated staff, which has now proved being unsatisfactory if not harmful, but rather to incorporate TM within the usual network of care delivery, involving General Practitioners and Cardiologists for future applications.

## Study survey

The Registry enrolled 172 opportunist patients from 17 sites in Belgium, who fulfilled the inclusion criteria: left ventricular ejection fraction (LVEF)




3-month daily signal in a single patient: Triplicate measurements of arterial systolic (●) and diastolic blood (●) pressures, heart rate (■), and weight (●) were performed until July 2008, showing excellent reproducibility. Notice a weight gain of 4 kg (5.2%) in the last month

≤ 40%, hospitalization for HF in the last 6 months and in need of loop diuretics in the last 2 weeks. Monitoring follow-up will be completed March 31, 2011.

Per-protocol interim analysis of the first 68 patients showed a compliance rate (> 1 month measurements) of 90% and 92% for BP/PR and W recordings, respectively. Median monitoring time was 6 months. The prevalence of cardiac re-hospitalization was 23%, and it was 21% for worsening HF. Need for technical interventions on monitoring was low (8 per 100 patients-month)

## Conclusions

BELGIUM-HF Registry has developed a specific TM-tool to capture fully-automated dynamic changes on daily W, BP and PR measurements, allowing early and accurate diagnostic of HF complications. Early findings fulfil the expectations. In addition, the concept of integrating such a TM strategy within current care networks rather than depending on dedicated centres contributes to wide application while likely cost saving.

# Clinical 'Calibration' of Home Monitoring Devices for Tele-Health: A Component of the HeartCycle Programme

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## Introduction

Technology providing care for patients at home has advanced from simple measurements of blood pressure (BP), heart rate (HR) and weight, to more advanced measurements, such as activity levels, heart rate variability, sleep quality, bio impedance and acoustic cardiography.

One of the fundamental advantages of telehealth is that the patients are active participants in their own care, making informed decisions that enable treatment to be tailored to their own particular needs. This empowerment gives patient a sense of satisfaction, in addition to better and more timely interventions from health services. There is growing evidence that telemonitoring reduces both mortality and recurrent hospital admissions in patients recently discharged from hospital after an episode of worsening heart failure (1). This may reflect improved titration and maintenance of therapy and appropriate, early admission to hospital when required.

However, despite the exponential increase in the use of home telemonitoring devices, the effects of day-to-day variations in diet and activities on their recordings have not been studied. The concept of clinical 'calibration' of home monitoring devices has been evolved as part of the EUFP7 funded HeartCycle Programme.

## Design and Methods

This research programme comprises a series of randomised-controlled studies investigating the effects of common 'challenges' that patients with heart failure might encounter during home monitoring in everyday life. It is funded by the European Union framework Programme-7 HeartCycle programme. The focus is on patients with heart failure but includes patients with uncomplicated hypertension as a control group. The study was approved by the ethics committee. In this article, we report the preliminary

results for one component of this programme. Patients were randomly assigned to take (MT) or to withhold (MW) all their morning medications prior to study and to have a high (HS) or a low (LS) salt diet for 3 days before each study period. Haemodynamic measurements were made using finger probes and volume-clamp technology (Nexfin, Bmeye, Netherlands). In each case, the left arm and fingers were used for measurement.

## Results

Ten men, (median age 70 years) with symptomatic chronic heart failure treated with loop diuretics, ACE inhibitors or angiotensin receptor blockers and beta-blockers have been enrolled so far. Table 1 shows the data for evaluations conducted before and during exercise using Nexfin. HR, BP and cardiac output rose with light exercise, and SVR tended to fall. Cardiac output was higher and SVR tended to be lower when medication was withheld and on HS diet but no consistent pattern of BP was observed.

## Discussion

A number of new technologies are available for remote monitoring of patients vital signs and symptoms (2-4). It is not yet clear which of the measurements that can be made are of practical use. Indeed, changes in medical practice catalysed by new monitoring technologies may change what is monitored (5). An integrated approach to therapy and monitoring technology is an exciting new area of research that is beset by many preconceptions but little evidence. It may revolutionise patient-management and enable truly personalised care.

Surprisingly, no one has ever studied the fluctuations in measurements that are likely to occur from day to day during home monitoring. This is a key issue before deploying new technology for clinical use. Our initial data suggests that patients with chronic heart failure have surprising changes in haemodynamic measurements in response to simple differences in diet or medication intake that they are likely to encounter in daily life.

The ultimate goal of the programme is to develop a strategy of ‘health maintenance’ using remote monitoring which is likely to be much more clinically effective than the current popular strategy of ‘crisis prediction’ which is plagued by the problems of false-positive tests. A ‘health maintenance’ strategy encourages daily adjustment of medications and optimises the use of diuretics. This could be very demanding in terms of nurse and medical support but development of intelligent systems that support patients directly is addressing this problem.

## Conclusions:

Monitoring with Nexfin identified surprising fluctuations in haemodynamics with dietary salt and with timing of chronic medication in patients with heart failure. This will help inform planning of a large outcome study.

| | Pre Exercise (Median) | | | | During Exercise (Median) | | | |
|---|---|---|---|---|---|---|---|---|
| | MT/LS | MW/LS | MT/HS | MW/HS | MT/LS | MW/LS | MT/HS | MW/HS |
| HR/min | 61 | 60 | 63 | 70 | 77 | 79 | 78 | 80 |
| SBP (mmHg) | 107 | 117 | 116 | 116 | 122 | 143 | 132 | 125 |
| DBP (mmHg) | 68 | 70 | 74 | 72 | 76 | 89 | 84 | 78 |
| CO (L/min) | 3.2 | 3.7 | 3.4 | 4.0 | 4.4 | 5.1 | 4.4 | 5.4 |
| SVR (wood units) | 27 | 23 | 24 | 22 | 24 | 27 | 25 | 18 |

Table 1

SBP= Systolic Blood pressure
DBP= Diastolic Blood Pressure
SVR= Systemic Vascular resistance
CO= Cardiac output

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# Market Study of Innovative Services in Health Care: Towards A Better Understanding of Medical Staff Acceptance in Two Case Studies

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Despite Governments, International Organizations, and many companies' growing interest in eHealth Services, the research in this field in developing countries remains relatively scarce. The introduction of Information and Communication Technology (ICT) within healthcare is known as eHealth. The important role of eHealth was officially recognized by the World Health Organization in its Resolution on eHealth approved by the Fifty-eighth World Health Assembly in May 2005. This Resolution stated that "eHealth is the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research." eHealth has the potential to extend medical care efficiently to nearly 40% of the population of developing world, where healthcare is almost non-existent.

This paper aims to present some results of two case studies in Jordan and Azerbaijan dealing with the collection of medical staffs' attitudes and opinions with regard to eHealth acceptance. It was based on a survey developed by the research team within the International University in Geneva. The questionnaire consisted of 50 questions in six sections.

1. The first section has 6 questions asking whether the person has heard about e-Health and if so, from which sources.

2. The second section of the survey has 5 questions and indicates if the person is aware of the benefits of e-Health and whether he or she agrees with them.

3. The third section includes 16 questions about the usage of e-Health, asking the person if he or she would be able to use the telemedicine system, if there is a possibility and interest from their hospital administration to install a Health Management Information System (HMIS).

4. The fourth section addresses the topic of supporting e-Health, not only from the technical side of their hospital, but also concerns the person's personal opinion about whether or not he or she would support the implementation of e-Health at their workplace.

5. The fifth section is regarding the education of e-Health. It has questions that reveal if the person has had some education in e-Health and if he or she thinks it would be useful for their daily working environment.

6. The last section is about the personal data of the respondents.

Due to the limited size of this paper, only partial results of the study are presented.

## Jordan

Jordan was one of the countries in the Arab world which recognized the importance and huge potential value of information technology applications in the healthcare sector. A group of doctors and telecommunication specialists, together with two hospitals in Amman, set up in 1997 a private company called Heartbeat Jordan. Today, the Government of Jordan is giving much needed attention to the improvement of healthcare services in order to benefit from innovative information and telecommunication technologies.

His Majesty King Abdullah II launched the National eHealth Programme "Hakeem" on the 27th of October, 2009 in Prince Hamzah Hospital. This Programme will bring a modern information technology system into Jordan's healthcare sector. Its main goal is to facilitate efficient and improved healthcare to patients through the delivery of high quality, immediate, accurate, and specialized healthcare throughout the country.

In Jordan, 72 questionnaires were distributed and 49 responses were obtained. Let us start with Question 10 and 11 as follows:

*Question 10 (blue).* "*I would use eHealth because I can consult patients from rural and remote areas at a distance.*" We got 41 responses from a total of 49 who supported this statement. It means 84%. There was no one against this statement. The majority of medical staff agreed that eHealth can contribute to better treatment of patients from rural and remote areas.

*Question 11(red).* "*eHealth would provide diagnoses and treatment more accurately through consultation at a distance with other medical staff*." Only 6 from 49 answers agreed with this statement. It means 12%. 88% were neutral. It is important information for the development of a marketing strategy. The majority of medical staff were not sure that consultation at a distance will help them to make more accurate diagnoses. In this case, marketing has to use more evidence- based information to clearly show medical staff where and how the consultation at a distance is helpful and useful.

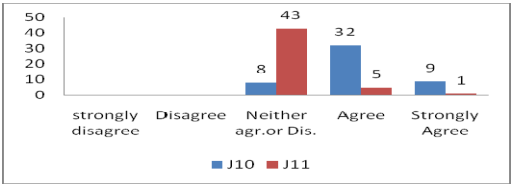


Fig. 1.

*Question 23(blue).* "Doctors and medical staff perceive telemedicine/eHealth as an additional burden since they are overworked and stressed."

*Question 29(red).* "In general, your organization would support the use of eHealth."

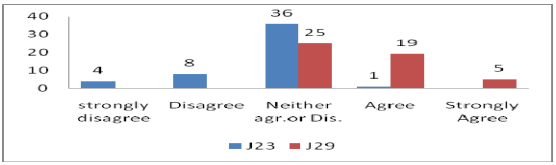


Fig. 2.

There is a common opinion that doctors would not accept eHealth because they are very busy and overloaded. Now, looking at the answers of Question 23, we can see that there is no one who agreed with this statement. The majority are neutral and even 25% disagreed with it. It means that medical staff will accept eHealth if they are convinced that it will be useful for their practice. This study confirmed again that marketing has to include evidence- based information about the beneficial part of eHealth.

*Question 38 (Fig.3, blue). "Introduction to eHealth within my medical education (University/College/Nursing school/Continuous Medical Education (CME), etc.) would make it easier to use eHealth in practice."*

*Question 40 (Fig.3, red). "I would use eHealth in practice if I received training within my medical education (University/College/Nursing school/Continuous Medical Education (CME)), etc."*

It is not surprising to get strong support for education and training. Question 38 got 98%, and Question 40 got 94%. Future success for the introduction and acceptance of eHealth services depends very much on the education and training of medical staff in this field with practical demonstrations.

The Government of Jordan should include courses on eHealth technology in the medical curriculum. Some proposed useful courses are:

- Basic computer skills;
- e-Document flow introduction and development;
- Information and communication technology in health care practice.

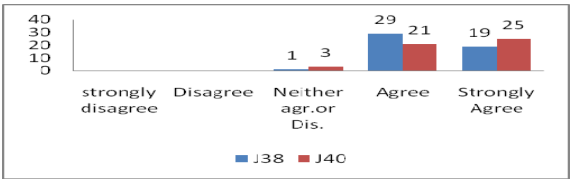


Fig. 3

As to the question, "Where are the main obstacles for the implementation of eHealth services?" The responses were as follows:

- Lack of Government Policy related to eHealth;
- Lack of financial resources for promotion, training and implementation;
- Lack of information on successful eHealth implementations in other countries and particularly, in Jordan.

Azerbaijan

In order to understand how aware or not aware the working personnel in Azerbaijan hospitals about e-Health and its benefits, the same questionnaire was used and 100 responses were obtained. Knowledge gained from the survey may assist policy-makers and healthcare leaders to increase the rate of eHealth adoption.

The majority of the people (95%) said they would find eHealth useful in their job, however, they are afraid that using eHealth could decrease their productivity by serving fewer patients, as they will need additional time for applying eHealth technology and innovative methods. The answers to two questions (23 and 29) are presented below.

*Question 23. "Doctors and medical staff perceive telemedicine as an additional burden since they are overworked and stressed*. 91% agreed with this statement."

*Question 29*. "*In general, your organization would support the use of eHealth*." It is interesting to know that in spite of some difficulties, the majority were in favor of eHealth and even 33% strongly supported eHealth.

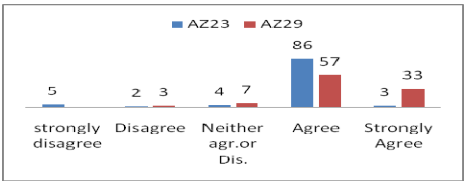


Fig. 4

85% agreed that if they would use eHealth, they would increase their chances of earning more money. They can consult patients from rural and remote areas at a distance. Also the majority agreed (85%) that eHealth would help to provide diagnoses and treatments more accurately through consultation at a distance with other more experienced medical staff.

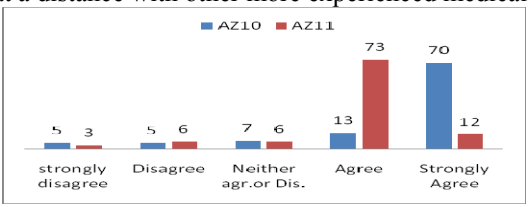


Fig. 5

*Question 10. "I would use eHealth because I can consult patients from rural and remote areas at a distance."*

*Question 11. "eHealth would provide diagnoses and treatments more accurately through consultation at a distance with other medical staff."*

*Question 38. "Introduction to eHealth within my medical education (University/College/Nursing school/Continuos Medical Education (CME), etc,) would make it easier to use eHealth in practice."*

*Question 40. "I would use eHealth in practice if I received training within my medical education.*

*The answers are presented below."*

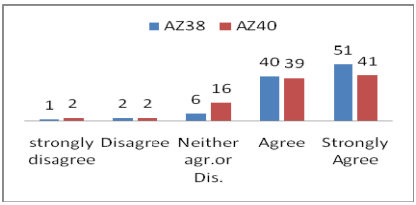


Fig. 6

We obtained nearly the same answer on these two questions. 91 out of 100 people think that the introduction of eHealth within their medical education would make it easier to use eHealth in practice. 80% think they would use eHealth in practice if they received training within their medical education and 79% think they would use eHealth if they received continuous training in eHealth after graduating Medical University/College/and /or Nursing schools.

Based on the result of this survey, several recommendations for the preparation of a marketing strategy for eHealth in Jordan and Azerbaijan are developed as follows:

- Key role of the Government and the Ministry of Health (Questions 35, 36, 37, 47)
- Understanding of eHealth benefits for hospital administration (Questions 25, 37)
- Some medical staff have heard about eHealth, but they do not know many important details (Question 39). Medical staff are largely computer illiterate and they are reluctant to use eHealth solutions as they are perceived to require extra work (Question 23)
- Special attention has to be given to security, privacy, and confidentiality of patient' data (Question 17)
- Training and dissemination of information about best practice will play extremely important role (Questions 38, 39, 40, 41, 50), there is a shortage of medical staff experienced in eHealth
- Importance of eHealth' pilot projects (Questions 28, 51).

Acknowledgement

I would like to thank very much Ms. Noor Rawashdeh (Jordan) and Mr. Tural Maharramow (Azerbaijan) for their assistance in the administration of this survey.

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# mHealth for Diabetes Patients - Proof of Concept based on Keep In Touch (KIT) – Technology

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Management of patient with chronic diseases in general and diabetes mellitus in particular requires a dedicated infrastructure to support patients and doctors to communicate and collaborate intensively, without the need of frequent face to face meetings. "Mobile communication devices, in conjunction with Internet and social media, present opportunities to enhance disease prevention and management by extending health interventions beyond the reach of traditional care—an approach referred to as mHealth" [1].

The present paper describes a proof-of-concept project in the course of which diabetes patients were equipped with a mobile phone based telemedicine system based on the Keep In Touch (KIT) technology. KIT is a concept for intuitive human computer interfacing that uses smart objects and wireless technologies like Near Field Communication (NFC) and Radio Frequency Identification (RFID). KIT enables people to exchange information with health related items of their daily life by simply touching those things with their NFC enabled mobile phones.

The mHealth system used in the project had previously been used and described in heart failure patients [2]. Briefly, patients were equipped with NFC enabled mobile phones with a pre-installed diabetes application and a varying set of medical measurement devices (glucose meter, blood pressure device, weight scales). A dedicated mHealth service platform provided for mobile phone and web-based access for patients and doctors and featured a diabetes specific electronic patient record, communication via email and SMS, data storage and processing, trend curve visualization, as well as support for device management and logistics.

The project is subject to an extensive evaluation program. Among the issues to be assessed are various measures of patient compliance. Since May 2010, a total of 169 patients have been enrolled to the program. Initial

results indicate a persistence (i.e. the percentage of patients staying in the program) of 84% and a concordance (i.e. the percentage of measurements transmitted as compared to the number according to the predefined recording and transmission schedule) of 54% for type 1 and 89% for type 2 diabetes patients indicate that the concept is well accepted by the patients.

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Dr. Schreier is a Distinquished Lecturer at the Graz University of Technology and at the Universities of Applied Sciences FH JOANNEUM in Graz and FH Technikum in Vienna, respectively. His areas of expertise and research interests are in biomedical informatics, telemedicine and eHealth.

# Partnership for the Heart Study - Telemedicine for Chronic Heart Failure

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## Introduction

In January 2008, the world's largest clinical trial on telemedicine, Telemedical Interventional Monitoring in Heart Failure (TIM-HF), was started within the Partnership for the Heart (PfH) project supported by the German Federal Ministry of Economics and Technology. The presentation will describe the study design including technology challenges and solutions as well as the results of the study.

## Design of the PfH Study

TIM-HF was led by the Charité Universitätsmedizin Berlin and aimed at the area of Chronic Heart Failure (CHF). The study included 710 stable, ambulatory patients with CHF (NYHA II / III) with a history of hospitalization for worsening heart failure or therapy with intravenous diuretics in the previous 24 months. Involved project partners are InterComponentWare, Bosch, Aipermon and T-Mobile. Aipermon provided telemonitoring devices at patients' homes as well as substantial data transfer infrastructure for this project. At the PfH study, the intervention group of 354 patients transferred a self-assessment and vital parameters like blood pressure, ECG, or weight to the telemedical centres of the Charité (located in Berlin) and the Robert Bosch Krankenhaus (located in Stuttgart) by a Mobile Medical Assistant (a mobile communication device with special software). The physicians and nurses in the telemedical centres analysed the data and provided medical support 24 hours, 7 days a week according to a structured programme using standard operating procedures. In case of emergency the centres provided an intervention. In such situation the used telemonitoring technology has the unique feature to provide the data transmission of a 3-channel ECG streaming in real-time and to perform oxygen saturation measurements (with an additional device). The general practioners or caring physicians of the patients were informed by the telemedical staff about these interventions, any other events or important

findings because the overall responsibility for the patients' care remained with the local physician.

The control group of 356 patients got usual care, treated by the patient's local physician in accordance with the current standards and guidelines for treatment of patients with CHF. The study design meets international scientific standards (multicenter, randomized, prospective, open, parallel, and controlled).

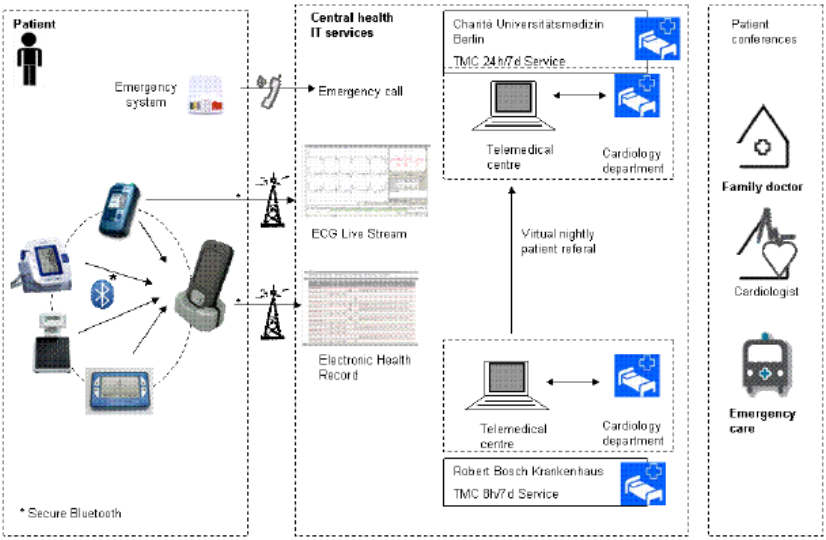


Figure: Telemedical system and service overview

With this telemonitoring technology and the supported treatment of local physicians, patients with CHF are able to live in their familiar surroundings and, in certain limits, gain mobility and travel around.

## Results

The results of the trial suggested that a reduction of mortality by using telemedical interventional management is not improved when the CHF patients are stable and optimally treated. But the results showed that the subgroup of patients with prior hospitalisation, who have a heart capacity LVEF with 25% to 35% and who did not have symptoms of a depression, benefits from this remote telemedical management. The mortality rate and

hospitalisation was reduced significantly (ca. 50%). Furthermore important aspects of quality of life (i.e. depression) and physical function can be improved by remote telemedical management.

Analysis of health economics and further detailed medical analysis are ongoing.

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# Supporting Chronic Obstructive Pulmonary Disease Patients with Telehealth and an National Health Service Call Centre

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## Introduction

Telehealth is the use of information technologies to deliver health services in new and innovative ways. In essence, its the healthcare equivalent of internet banking, call centres, mobile apps, tele-conferencing and on-line communities – areas we are all increasingly using and taking for granted. Telehealth has the same role of improving the services we all need, in often quite profound ways.

Telehealth is an increasingly important health and social care option, intelligent use of which can help patients retain their independence and gain a degree of personal control over the delivery and monitoring of their health and wellbeing. Appropriate selection and implementation of telehealth provides remote access for patient's carers and clinicians enabling many complex chronic conditions to manage in a more 'hands off' and less intrusive fashion than traditional clinic based regimes.

The care of people with complex Chronic Disease puts considerable pressure on health services as it challenges many of the traditional relationships between patients and health care professionals. There is increasing evidence that health outcomes in Chronic Disease depends as much on the patient's behaviour and social and cultural circumstances as they do on the skilled technical interventions of health professionals.

Internationally, a quite staggering number of telehealth trials, pilots and demonstrators have accumulated a complex picture that has increasingly made the case for telehealth solutions such as tele-coaching, tele-monitoring and tele-consultation. The strongest cases, economically, are for long term conditions such as Chronic Heart Disease (CHF), Chronic Obstructive Pulmonary Disease (COPD) and Diabetes and for the support of elders in their homes, labelled telecare.

Hospital inpatient care is the biggest single health care cost, accounting for approximately 60% of the total cost of heart failure in the UK (£375m, 2000) and the cost of COPD exacerbations to the NHS is £550m PA (2004) resulting in 1.2m bed days (1999). Diabetes UK [1] estimates that Diabetes costs the NHS £1m per hour, 10% of the total NHS annual budget.

The Department of Health on its policy guidance of 'Supporting Patients with Long Term conditions' stated that the National Health Service (NHS) should:

- Do more to support people with long term conditions to self care
- Promote well-being and community engagement
- Focus more on prevention and early intervention
- Design services around the patient/service user rather than the needs of patient being forced to fit around the service [2]

and it is seen that Telehealth meets this vision.

## New Telehealth service

In 2008 a Primary Care Trust in the South East of the United Kingdom who commission's care for its local population (342,500) funded a yearlong Telehealth pilot for up to 100 high risk COPD patients in order to evaluate its benefits in the management of patients with COPD within in the community.

The objectives of the pilot were to

1. Improve patients understanding of their condition
2. Improve the way healthcare staff prioritise their workload
3. Create case management capacity
4. Reduce the number of hospital admissions.

The Telehealth pilot used a small home hub [3] in the patients home connected to their own normal telephone line which combined with a range of peripherals measured their vital signs dependent on the patients needs i.e oxygen saturation, blood pressure, weight etc. The home hub has a small screen which asks the patient a range of targeted disease specific nested questions, and requests them to take their relevant vital signs.

The service used a unique model; combining an NHS Call Centre with non- nurse health advisors monitoring the Telehealth data each week day and escalating any problems to the relevant Specialist Community Nurses - Community Matrons (CM's).

The patients data was sent via the patients phone line in encrypted format via an N3 connection to a secure web-sever hosted by the technology provider once a day at 1100hrs.

A robust evaluation framework was put into place to measure the above objectives, which whilst not being a randomised control trial used validated research tools to measure the impact of the Telehealth on the COPD patients, their careers, their CMs, and their healthcare utilisation.

Patient selection

Patients were selected for the service using the following criteria:

*Chronic Disease History:*

- Primary diagnosis of COPD
- 1 or more hospital emergency admission / 1 or more A&E attendances in the last year due to an exacerbation of COPD or other related Chronic Disease
- Unstable condition considered due to anxiety about their condition
- Non-concordant with medication or treatment regime

*Patient (or carer) functioning/ability:*

- Reasonable cognitive understanding to report observations
- Patient or carer has good understanding of English
- Reasonable dexterity ability and is able to use the home hub
- Reasonable dexterity ability to use additional peripherals to perform vital observations (eg. Blood Pressure, pulse, blood glucose,

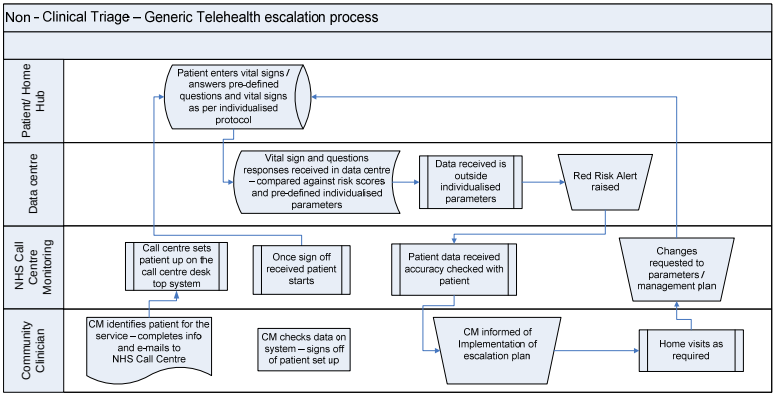


Fig.1.

oxygen saturation weight and temperature)

*Environment:*

- Patient or carer has access to a phone line (essential)

*Exclusions*

- Patient with moderate and severe cognitive impartment

The Model is picture in fig 1

Responsibilities of each party

The Community Matrons were responsible for assessing the patients as per criteria, they continued to support as appropriate and:

- Identified patients who met the criteria for the Telehealth service
- Offered the service to patients who matched the service criteria
- Completed and collated the baseline data per patient
- Gained explicit consent to take part in the service and evaluation
- Gave patients leaflets explaining the Telehealth service
- Completed the assessment and other set up documentation
- Referred patients to the Call Centre via the dedicated safe haven fax line
- Responded to the Call Centre to check the information on the patient record to confirm it was correct before monitoring commenced
- Sent the individual patient vital sign parameters to the Call Centre via safe haven fax
- Responded and signed off verbally to the Call Centre that the clinical parameters had been set up correctly on the system, sending a safe haven fax if any changes were required
- Responded to the Call Centre's request for review of patient data within 12 hrs
- Responded to the request for red flag alert action within 2 hours
- Advised the Call Centre of action taken re: red flag patient i.e GP visit, change in medication etc
- Revised individual data sets on the patient record and alerting the Call Centre once completed
- Completed monthly evaluation data as per the evaluation framework
- Informed the Call Centre when a de-installation was required

Duties and Responsibilities of the Telehealth Supplier

The Telehealth supplier was responsible for:

- Training all staff who were part of the pilot on the use of system
- Supplying the equipment and vital sign peripherals
- Receiving installation instructions via safe haven fax
- Arranging installation appointments with the patients

- Undertaking installations, which used a simple plug and play system
- Responding to any technical issues, either over the phone or by a undertaking a remedial visit to the patients home
- Maintaining the security of the web-based secure clinical database, ensuring it protected the patients confidentiality at all times
- Arranging de- installation as per the Call Centre's instructions, ensuring that these are undertaken in a sensitive and responsive manner in situations such the death of a patient
- Producing weekly patient, nurse and users utilisation and access reports
- Keeping an asset log of the Telehealth equipment on behalf of commissioners
- Cleaning and maintaining the equipment between patients

Duties and Responsibilities Call Centre

The NHS Call Centre was responsible for monitoring and responding to the daily data download, trend analysis of the vital signs/biometrics data:

- If a daily reading was unclear, or there had been no readings received, the call centre would contact the patient directly to identify what the problem was and take the appropriate action
- If a daily reading was outside the 'normal' pre-determined boundaries, the call centre would inform the clinician and recommend a face—to-face intervention
- If a daily reading was clearly within acceptable parameters, no further action will be taken at this stage.

The pilot was CM led; GP's were involved on a patient by patient basis via the CMs.

Patient compliance

Patient compliance for using the Telehealth was 92%. A comparison was made of the patient's healthcare utilisation pre and post pilot.

The patients were also surveyed as to their views about Telehealth and these were as follows.

Patient feedback

- 85% of patients agreed or strongly agreed that the Telehealth service had helped them understand their condition
- 88% of patients agreed or strongly agreed that it had helped them cope with their symptoms

- 81% of patients agreed or strongly agreed that the Telehealth service had helped to reduce their levels of anxiety
- 73% of patients agreed or strongly agreed that the Telehealth service had had a positive impact on their quality of life
- 91% of patients said they were very satisfied or satisfied with the Telehealth service
- 84% of patients would like to continue with the service
- 94% of patients said the Telehealth equipment was either very easy or easy to use.

Other benefits reported were:

- Hospitalisations reduced by 76.12%
- A&E visits reduced by 67.27%
- GP visits reduced by 50%
- 999 calls reduced by 65.12%
- Reduced nurse/case manager visits
- Overall significant reduction in exacerbations
- QOL strongly improved in SE Essex
- Improved self management of condition
- Improved coping with symptoms reported

## Summary

Implementing Telehealth is a major change in the way health services are delivered. This change not only affects the way patients are supported to manage their disease, but in the way in which community based clinicians work and utilise technology in managing their day to day work.

This pilot increased the case for a strong ROI available through reduced use of a number of health services, particular hospital and emergency services.

In summary, this new model works well and increases the number of patients utilising the Telehealth system compared with services that do not use a Call Centre monitoring service.

Patients felt it supported them to manage their condition; it reduced patient and carer anxiety. They report that they would like to continue to have the service.

The number of face to face visits made by the CMs to this group of patients reduced over the pilot period as a consequence of the Telehealth system.

Telehealth is an acceptable way of supporting patients to manage their COPD. It supports CMs in prioritising and managing their case load. It does create case load capacity and reduces the carbon footprint of these services.

Utilisation of this service with the existing service model produces reductions in demand in key areas of the local healthcare economy.

If this service was extended to more patients with COPD there would be significant potential financial savings for the local healthcare economy.

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Angela Single BA Hons started her NHS career as a registered nurse at Barts and Royal London Hospital, England. She trained as a Community Nurse before becoming a Senior Health Service Manager of an Acute Hospital Trust. She completed her BAhons in Healthcare Management in 1996.

She was Managing Director of the first UK's Telehealth Companies, Healthwatch.

Since 2003 she has been Director and Senior Partner of Choose Independence a specialist Telecare and Telehealth Consultancy.

She was the Project Director for the revised 2009 Code of Practice for the UK's Telecare Services Association, is an inaugural member of the International Congress of Nursing's Telenursing Advisory Group and is a member of the Department of Health Telecare Advisory Network. She travels extensively advising on the benefits of telecare and telehealth.

She specialises in strategic re-design of healthcare systems, long term condition management, telehealth and telecare delivery models.

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# Telemedicine in HIV/AIDS Care: A Users' Satisfaction Survey

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***Abstract: T*he Institute of Tropical Medicine (ITM) in Antwerp set up in 2003 a computer aided project to guide physicians, based in developing countries, in the management of difficult HIV/AIDS clinical cases. This teleconsultation system received, between April 2003 and December 2010, 1135 queries from health care workers deployed in more than 40 different countries, mostly resource-constrained. A users' satisfaction survey showed that this system is of value to the users for several reasons: improved patient management, increased knowledge of medical staff, reduced referrals and increased access to medical literature for the health care workers.**

## Introduction

In order to support HIV/AIDS physicians working in resource-limited settings (RLSs), the Institute of Tropical Medicine (ITM) in Antwerp set up in 2003 a web-based second-opinion advice tool (http://telemedicine.itg.be/) for the management of difficult HIV/AIDS clinical cases.

The referrals were organized initially through a list server and afterwards, in response to the need of sharing information between larger groups of colleagues, through a web-based discussion forum [1-3].

## Methods

Between April 2003 and December 2010, the ITM Telemedicine system received 1135 requests of teleconsultations from physicians located in more than 40 resource-constrained countries. Queries varied from use of antiretroviral medications, to the diagnosis and treatment of specific opportunistic infections and/or the general organization of health services for HIV/AIDS treatment and care. All requests were handled by a network of specialists, mainly based in ITM.

In December 2010, eighty Telemedicine members, who had used the system at least once during the previous two years, were contacted via e-mail and asked to fill in a standardized in-house developed questionnaire in order to assess their users' perception of the Telemedicine system.

## Results

The overall response rate to this survey has been 67.5% (54 questionnaires returned out of 80 delivered): 72% surveys (n= 46) came back from "active users" (members posting queries and clinical cases on the Telemedicine discussion forum) and 8 questionnaires from clinicians who did use the system only to browse through the queries and did not actively participate to the online discussion.

Participants' median age was 35.2 years (range 28 to 52), with a ratio male/female 1.07 (n. 28/26), having African (39%), Asian (30%), European (26%) or American nationality (5%).

The main reason to subscribe to the discussion forum was: to learn from others' experience (85%), to submit cases/questions (80%), to be aware of other ways to manage patients (41%) and, only for a small group, to explore the technology used for the teleconsultation system (9%) or for curiosity (5%) [Figure 1].

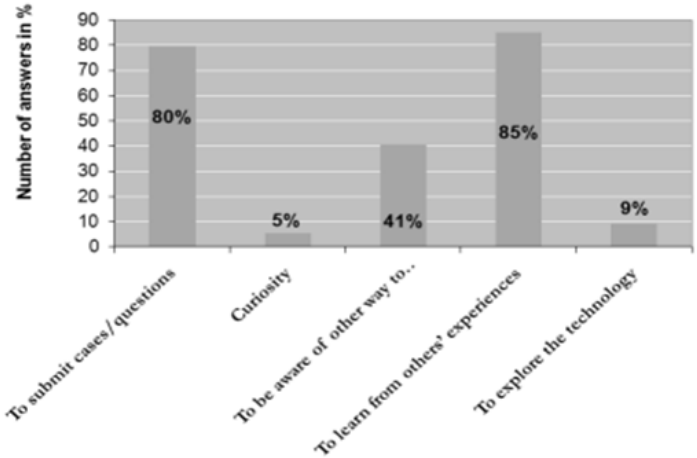


Figure 1. Reasons for subscribing to the Telemedicine discussion forum (http://telemedicine.itg.be)

Users reported that the telemedicine service had influenced the management of the patients in 90% of the cases and they perceived that the advice has been beneficial for several reasons, particularly for the

establishment of the diagnosis (52%) and for the referring clinician's education (65%) and reassurance (31%) [Figure 2].

Between the reasons reported for the decreased usage of the tool, the overstretched working schedule has been the most frequent mentioned (31%), followed by the change of field job or availability of other mentors in the project (30%) and low bandwidth connection (20%).

## Discussion

Internet-based approaches to clinical mentoring can be very effective in certain settings. Telemedicine (using telephone line, e-mail, and internet or teleconference systems) is one possible approach to offer support, mentoring and supervision to physicians working in RLSs [4].

In the recent years a variety of telemedicine networks serving developing countries has emerged, in parallel with the general penetration of ICT: e-mail is increasingly available in developing countries and allows health care workers to query mentors over great distances, including outside their country [5].

We hereby presented the results gathered from a users' satisfaction survey of members belonging to a teleconsultation system operating in LRSs since 2003.

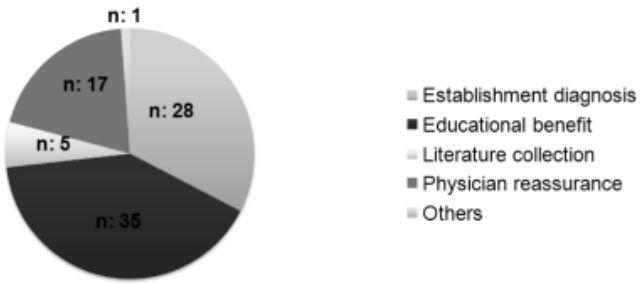


Figure 2. Users' benefit

## Acknowledgment

This project is supported by the Belgian Directory General of Development Cooperation.

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# Global eHealth Strategy - Policy Dialogue on Global eHealth

# Demonstrating the Potential Role of Information and Communications Technologies in Improving Management and Use of Antiretroviral Medicines in Resource Limited Settings

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***Abstract*: Rapid scale up of Antiretroviral Therapy (ART) in Nairobi faces several challenges including inadequate human resources, charged with tedious manual tasks that prevent effective pharmaceutical and patient records management. The pilot project aimed to demonstrate that use of appropriate Information and Communication Technologies (ICTs) can significantly improve ART pharmaceutical and patient management in resource limited and disadvantaged settings. Specifically, it sought to facilitate live data entry, increase accuracy and timeliness of reports, hasten access to patient records, enable patient tracking, facilitate prompt feedback and eliminate time wastage. The intervention was carried out in twelve public health centres in Nairobi Province. A public / private partnership was formed to execute the project, deploying new computer software and broadband wireless connectivity to replace manual ART pharmaceutical management system. An integrated ART patient and pharmaceutical supply management system called Zcore was developed based on the manual Daily Activity Register. Unique software features enable live data entry, quick review of patient medication history, alerts, and identification of defaulters among others. The software is based on open source software platform, eliminating recurrent software licensing fees. ICT equipment was procured and staff trained. Measurable outcomes include increased accuracy and timeliness of reporting, decrease in time spent on maintaining ART records, and elimination of time spent on manual delivery. Non measurable outcomes include ability of site staff to communicate quickly with managers, and ability of the latter to update, monitor and supervise. The project has increased efficiency and strengthened pharmaceutical and patient management practices. Improved communication has enabled quality assurance of processes and timely feedback. The intervention is modular allowing for easy replication.**

## Introduction

HIV/AIDS is one of Kenya's most pressing health concerns affecting all sectors of the population. Recent data show HIV prevalence in Kenya of 7.4%, resulting in 1.4 million Kenyans living with HIV [1]. In 1999 the Government of Kenya declared HIV/AIDS a national disaster and put in place mechanisms aimed at containing the epidemic. A significant strategy is the provision of antiretroviral therapy (ART).

Nairobi is the capital city of Kenya, with a population of about 3.3 million, and which constitutes about 10% of the population of Kenya. Whilst most of the affluent populace in Kenya lives in Nairobi, it is also home to some of the largest informal dwelling places characterized by inadequate infrastructure, poor sanitation and hygiene. The prevalence of communicable diseases in these areas is high thus the disease burden in the city is considerably significant. Health services are provided by the private sector, faith based, community based and the government with the bulk of the population seeking health care from the government institutions. The majority of public health facilities in Nairobi are health centers (81%) or dispensaries (13 %.).

Of the nine provinces in Kenya, Nairobi has the third largest number of HIV infected adults. In 2006/2007 the Ministry of Health instituted the Rapid Results Initiative in order to avail ART as close as possible to the community. Implementation of this initiative led to establishment of ART sites in many of the health centers and dispensaries in Nairobi. However this move was not accompanied by any significant increase in human resource capacity, thus, health centre staff offering

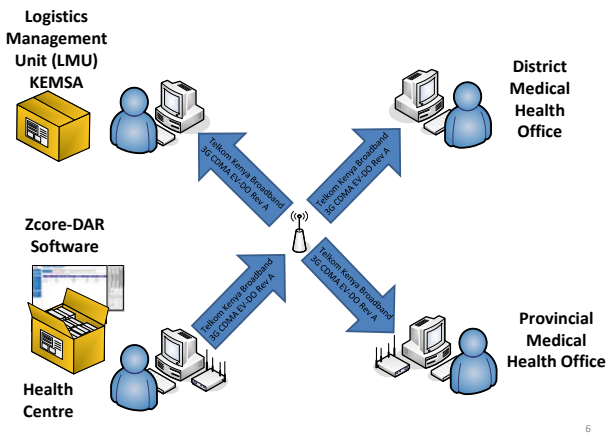


Figure 1: Project goal diagram

ART in these newly established sites had to cope with inadequate staff, high patient loads, and a cumbersome paper based pharmaceutical and patient records system. This was further compounded by the fact that most of the health centers are situated in disadvantaged areas with acute infrastructure, transport and communications challenges.

## Project background

Apart from the significant human resource constraints, other serious challenges included time consuming hand compilation and hand delivery of monthly reports for re-supply of essential drugs, difficulty referring to past patient dispensing records, difficulty in communication with higher levels of pharmacy management, lack of equipment such as computers and telecommunication facilities. All these compromised the efficiency of ART service provision. There was an urgent need for a quick strategy to strengthen the ART management system using the available human resources. Appropriate use of ICTs was identified as a possible and workable strategy that could address most of the prevailing challenges.

In 2007, the Provincial Medical Office (PMO) of Nairobi forwarded a project proposal to Qualcomm, Inc. seeking support to improve the ART pharmaceuticals management through use of appropriate ICTs. The project proposal fell within the scope of Qualcomm's Wireless Reach Initiative which "supports programs and solutions that bring the benefits of 3G connectivity to developing communities globally and provide new ways for people to communicate, learn, access health care and reach global markets". Subsequently, in 2008, Wireless Reach partnered with the Provincial Medical Office (PMO) of Nairobi, the Communications Commission of Kenya, Telkom Kenya, Axesstel, RTI International and Dell to develop a pilot project that creates a more efficient process in the supply management of antiretroviral medicines (ARVs) using wireless technology.

## Project goal and objectives

The goal of the pilot project was to demonstrate that use of appropriate ICTs could address most of the identified challenges and thus improve efficiency of ART service provision.

Specific objectives were to provide staff at ART sites with IT knowledge skills and appropriate ICT equipment, develop software derived from the Government of Kenya (GOK) ART management tools and train staff on its use and to facilitate electronic communication and transmission of reports and requests for resupply of ART medicines to the Kenya Medical Supplies Agency (KEMSA), the Government medical supplies agency.

## Project implementation

Key activities carried out in the project were shared amongst all the partners. Twelve ART sites in public health centers were selected for the pilot project. Each site was equipped with a computer, software and support equipment for wireless connectivity on Telkom Kenya's CDMA EV-DO Rev. A network. The staff in the sites was trained on basic IT skills and use of the software. The software is open source and designed around the manual reporting system for managing ARVs throughout Kenya. The staff enters patient and ARV medicines data live and the reports are automatically generated, ready for transmission. Through the CDMA network, staff transmits the automated reports electronically to KEMSA and receives immediate confirmation of their orders

## Project Outcomes

Table 1: Key indicators

| **Indicator** | **Before** | **After** |
|---|---|---|
| Percentage ART reports submitted before 8th of every month | 50% | 100% |
| Percentage ART reports sent to Provincial Pharmacist | 0% | 100% |
| Percentage of facilities submitting complete and accurate reports | No data | 100% |
| Percentage of facilities completing reports at time of dispensing | 30% | 100% |
| Average time taken to complete data entry per patient | 7.5 min | 2.8 min |
| Average time taken to compile three monthly ART reports | 11.6 hrs | 29 min |
| Percentage of facilities delivering reports by hand | 100% | 0% |
| Average time spent on delivery of reports to KEMSA | 8 hrs | 5 min |

There was an immediate reduction of the manual reporting burden, thus availing more time for health workers to concentrate on patient care. The nature of reporting changed as shown in the figures below.

With the elimination of time previously spent on delivering reports by hand, the clinicians no longer leave patients unattended. Additionally, the automation of the supply management system ensures tracking of supplies, accuracy and timeliness of orders, thus ensuring timely delivery and constant availability of ARVs. Furthermore, the new system now provides mechanisms for the provincial pharmacist to access the reports, which facilitates easier monitoring and supervision of the ARV supply system as well as provision of timely technical support and feedback to the health facility staff.

## Conclusion

The Pilot Project has demonstrated that use of appropriate ICTs can improve efficiency of delivery of ART services in resource limited settings. This is so by saving time previously spent on manual compilation of reports and hand delivery of reports and orders, enabling clinicians to concentrate on clinical work and not paperwork, enabling non-pharmacy-trained staff to perform pharmaceutical tasks and streamlining and speeding up the reporting process. The project also addresses two common challenges that exist when implementing new technology – sustainability and scalability. The software program and communication system developed for the project is open source, locally sustainable and can be extended to manage all pharmaceuticals. Local human resource capacity has been developed and thus the project can be replicated in other provinces in the country.

Figure 2: Before Project

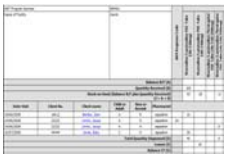

Figure 3: After Project

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# Millennia 2015 ”Women and eHealth”: Empowering Women, Improving Health and Promoting Digital Solidarity to Contribute to MDGs 4 & 5 Achievement by 2015

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## Background

Information and Communication Technologies (ICTs) support the health sector in addressing a vast range of challenges to human life and health. The use of these technologies for health - or eHealth - is about health professionals trained and making better treatment decisions at distance using Telemedicine or mobile phone (mHealth) services, hospitals providing higher quality and safer care to patients, citizens making informed choices about their health, and governments becoming more responsive to health needs. In this context, women’s roles are multiple, from users, mothers, nurses, midwifes, doctors to active builders able to influence the industry and telecom providers to adapt technologies to their needs and local constraints. Millennia2015, "Women actors of development for the global challenges", founded by Mrs Marie-Anne Delahaut, director of research at the Destrée Institute, is the feminine version of the UN Millennium Development Goals (MDGs), and aims at offering a unique opportunity to build a worldwide women's community in which the access and use of ICTs is a key component for their health and contribute to the achievement of the health related MDGs 4 and 5 by 2015.

## Introduction

In 2008, Millennia2015 organized its first International Conference in Liege (Belgium) on Information Transfer, and invited Dr Joan Dzenowagis, scientist in the eHealth unit at the World Health Organization. She gave an inspiring presentation on “Women and eHealth: connected medical knowledge benefiting all”(www.millennia2015.org/2008_Closing_Plenary_2).In consequence, Millennia2015 decided the importance of Information and Technology to connect for health and the first International Working Group,

”Women and eHealth” was launched in July 2010 (www.millennia2015.org/Women_and_eHealth) to conduct a unique research process at the convergence of three areas: Women Empowerment, Health Improvement and Digital Solidarity, coordinated by Dr Véronique Thouvenot, senior eHealth expert and former Scientist at the World Health Organization.

## Goal and objectives

The Millennia2015 “Women and eHealth” International Working group (WeHealth IWG), is a network of 37 members, 27 men and 10 women, from 25 countries, 11 in Africa, 3 in Central America and 2 in Asia. The overall goal is to investigate and raise the best evidence from the local communities of women’s involvement in the use of ICTs for health and their contribution to the achievement of MDGs 4 and 5 by 2015.

The objectives include (a) to support women through ICT with multi-perspectives from basic communications with family to improved health care and Telemedicine, (b) to support women and girls future role in ICT development from simple users into active builders, (c) to enable women and girls to influence the industry and telecom providers to adapt technologies to their needs and local constraints for supporting their health.

## Methods and expected results

The methodology of this research is based on the Millennia2015 foresight exercise and comprises four steps; (a) information collection within women local communities, (b) data analysis along the Millennia2015 variables, (c) development of the first report on “Women and eHealth Global Baseline” and (d) Action Plans to empower women using ICTs for health and contribute to the achievement of MDGs 4 & 5 by 2015.

The analysis of the information collected at local level, will constitute the basis of the first report on “Women and eHealth Global Baseline”, an overview of the global status of women using ICTs for health, documented with interviews, local observations, case studies, selected articles and publications, statistics, country profiles and illustrated in a compendium of photos and videos stored in the Virtual Library. The report will be presented at the second Millennia2015 International Conference , "An Action Plan for Women's Empowerment" organized by the Division for Gender Equality, Office of the Director-General of the UNESCO, and The Destree Institute, at the UNESCO Headquarters, Paris, by end 2011. This first Global Baseline, will contribute to design WeHealth Action Plans 2012-2015, to improve the local and global situation of Women, Health and ICTs and to

build the Millennia2015 Knowledge Base and future Intelligence Platform (www.millennia2015.org/Method).

## Conclusion

The area of women, Health and ICTs together has yet not benefited of any large scale research and investigation. Millennia2015 offers a unique international platform and robust research methodology to pursue a collaborative effort, give a voice and empower silent and isolated women living in local communities and support the achievement of the health related Millennium Development Goals.

Veronique Inès Thouvenot is a recognized e-Health senior expert and head of the Millennia2015 "Women and eHealth" International Working Group, with extensive experience in providing scientific analysis and technical assistance in e-Health, e-Learning , Telemedicine and Gender.
From 2002-2010, she worked with the World Health Organization as a scientist in the eHealth unit and as researcher at the European Center of Humanitarian Health. In this role, she provided technical and scientific content to support evaluation of eHealth processes and frameworks and implementation of e-Health solutions in countries. She has conducted several evaluation missions in developing countries such as Morocco, Jordan, Democratic Republic of Congo, Congo, Madagascar and reported to major donors how to best invest Aid funding for sustainable humanitarian actions. She conducted research on return on investment evaluation in international humanitarian health trainings and anticipating humanitarian crises, published articles and guidelines.

# Tele-Safe Motherhood Pilot Project in Five Villages of Rolpa District, Nepal

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Rolpa district is one of the remote districts of Nepal With a very high maternal mortality rate of 352/100000 live births. 4th antenatal check up is only done in 19% of total pregnancies while Institutional delivery is 5%. Low antenatal and perinatal care is due to remoteness of health facilities. General objective of this project is to reduce maternal mortality by giving pregnant women access to obstetric care using mobile technology. The specific objective of the project is to increase antenatal Care (ANC) uptake, increase deliveries in health facilities and establish a cell phone-based health information system for pregnant women. The target group of the project is pregnant women in five villages in Rolpa district.

# VOICES Project

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The VOICES project VOIce-based Community-cEntric mobile Services for social development is Specific international cooperation actions (SICA) and a proposal of ICT Call 6 FP7-ICT-2009-6.

There is a widespread agreement that ICT services, especially mobile ones, have the potential to play a major role in furthering social and rural development in developing economies such as Africa.. This is opening up lots of new opportunities, but in order to realize the full potential of mobile ICT services, however, important challenges and obstacles must be overcome. This is what the VOICES project sets out to do.

The *Mobile Web for Social Development Roadmap*, recently published as a result of the EU-FP7 Digital World Forum project, makes it abundantly clear that realizing the full potential of mobile ICT and Web services requires addressing two big types of challenges:

1. The leveraging of **content** that is *locally relevant to actors and entrepreneurs* who are of key importance to on-the-ground social and rural development.

2. The removal of a range of **access** barriers that currently hampers *information/knowledge sharing and associated community building* especially in rural areas.

The VOICES objectives are to deliver the following results and advances and show their value particularly in the African context:

• ***Open and Wider Access***: VOICES will improve voice-based access to content and mobile ICT services by building a *toolbox for the development of voice services* that will be made available to local communities and entrepreneurs as Open Source.

VOICES will prove the fitness of its results and its adaptability to the African context by *extensive local pilot and associated community building*: focused ***on health services in Senegal.***

✓ The case for m-health.

The population of Senegal is about 12 million people. The GNP is US$1560 per Hab. The HDI for Senegal is 0.464, which gives the country a rank of 166th out of 182 countries with data (Source: Human development report 2009). Life expectancy at birth was about 57 years in 2005 (source CIA World Factbook). Infectious diseases are the most important cause of death, invalidity and morbidity in Senegal. For example, malaria and tuberculosis are real public health problems. Each year around 600,000 cases of malaria are recorded, of which 5000 are deadly. The tuberculosis prevalence is estimated at 431 cases for 100,000 people. Therefore, epidemiological surveillance is crucially important to control infectious diseases and to fight against poverty. To this end, a national network of laboratories (over 100 in the country) is operational; all the laboratories have efficient connections between them, and data are digitally transmitted. So, detection data at the district level are quickly and efficiently raised at the regional and national level. However, the epidemiological surveillance is not operational in remote areas below the district level, because of the bad communication connections between the field and the laboratories at the district level. Hence, a diseases surveillance system based on the widespread use of mobile phones could have a real impact: with this mobile ICT service concept, any doctor, pharmacist, researcher and specialist in infectious diseases would have access to relevant information in real time to support patients and their families. This provides a solid and sustainable business case for mobile ICT services. Moreover, an additional strength of VOICES in transforming research results into local innovation is the fact that the responsible VOICES partner (Fondation Merieux, with strong involvement of France Telecom-Orange Labs and ESMT Dakar) works directly with the Coordinator of the national network of laboratories, and does so already for several years.

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# Health Informatics

# A Health Systems Engineering Approach to Meet the Demand for Skilled Foetal Ultrasound Services in the Western Cape

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***Abstract:*** **The purpose of this project was to find an optimal combination of technology and business processes to meet the sonography skills shortage in South Africa in a sustainable way. Alternative solutions to educating a nurse or midwife at a rural clinic in sonogram acquisitioning and interpretation were investigated. A certain tele-ultrasound system was found to be the most appropriate. An information and communications technology audit was then done to prove the feasible of using this system for improving sonography skills. Technological, economical, legal and operational feasibility were considered.**

After considering 104 peer-reviewed perspective on telemedicine Sood *et al* [1] came to the conclusion that "telemedicine being a subset of telehealth, uses communications networks for delivery of healthcare services and medical education from one geographical location to another, primarily to address challenges like uneven distribution and shortage of infrastructural and human resources." This paper focuses on the delivery of medical education to address the challenge of the uneven distribution and shortage of human resources.

In its Millennium Development Goals, the United Nations prioritizes the improvement of maternal health in developing countries. The World Health Organization argues that this can be done through improving the accessibility and quality of basic maternal health care, which includes ultrasound services.

The Biomedical Engineering Research Group and the Department of Obstetrics and Gynaecology (OB/GYN) at the University of Stellenbosch in collaboration with the Department of Bioengineering at the University of Washington conducted in 2008 'n tele-ultrasound project [2]. During the project, a web-based asynchronous telemedicine ultrasound system was developed. The system is composed of a portable ultrasound machine, a laptop and a server. It was evaluated in 2008 by a midwife in South Africa and three OB/GYN specialists in the United States.

The workflow for a patient started with the midwife taking the ultrasound image and transferring it unto the laptop. She then (as far as possible) recorded the patient's health record on a website. After making annotations and adding explanatory text to the image, she uploaded the images and requested a consultation with a specialist. A specialist then logged in when he or she had time and responded to the request. This process iterated until all of the midwife's questions in regard with the patient was answered.

In South Africa, many clinics and hospitals have ultrasound machines, but there is a lack of skilled personnel to operate them and to provide safe and meaningful service. The purpose of this paper is to determine the feasibility of using this tele-ultrasound system to address the need for skilled ultrasound sonographers in South Africa.

## Methodology

To achieve the set purpose the following methodology was followed: (1) Alternative solutions to address the sonography skills shortage in South Africa were investigated. (2) Interviews were conducted with practicing sonographers, OB/GYN specialists and health district officials. (3) The current obstetric sonography service system of the Boland/Overberg health district (Western Cape) was documented. (4) The technical and economical requirements for possible solutions to increase the number of available skilled sonographers in South Africa were determined. (5) All of the possible solutions were evaluated in terms of their technological feasibility. (6) All of the possible solutions were evaluated in terms of their economic feasibility. (7) The legal implications of the selected solution were considered. (8) The business processes and change management strategies to facilitate sustained implementation of the system was developed.

## Results and discussion

### *Technological feasibility*

Currently, the ultrasound machines in use in most of the Boland-Overberg (Western Cape) clinics and hospitals are not USB compatible and cannot digitize images. Since these machines were acquired before 1993, they also do not use the DICOM image standard.

The Department of Health's Boland Overberg region is, at the time of this project, acquiring new ultrasound machines for its clinics and hospitals. A timeline for the installation of these machines was however unavailable. It can be assumed though that these new machines will comply with modern industry standards and thus be USB compatible and use the DICOM standard.

Rural clinics in South Africa do not have limited internet connectivity [3]. Most rural clinics rely on mobile connectivity. GPRS signals are available almost throughout South Africa, but 3G connectivity is only available in highly populated urban areas. It was found that it is feasible to use the tele-ultrasound system with GPRS-connectivity as long as it is used in store-and-forward mode.

*Economic feasibility*

When implementing solutions that address health system inadequacies, it is difficult to put a monetary value on the added value of a system. A solution should be sustainable though, however effective it is in solving health system problems. In 2007, there were 10 191 births in the Boland Overberg region [4]. It is in the protocol of the Boland Overberg region to give one free ultrasound for a woman under 24 weeks pregnant. This is however not ideal. Two ultrasounds are preferable for quality health care, one for the end of both the first and second trimester.

Assuming a uniform distribution of service demand throughout the year, the maximum available sessions per sonographer per year was calculated. If the two currently available sonographers work full time, they just cover the demand for the current protocol for sonography services. There is no room for ineffective scheduling or a mal-distribution of patient visits throughout the year. Also, if the ideal protocol of two ultrasounds per pregnant woman is to be realized, more skilled sonographers are required.

*Legal feasibility*

In health care services, this is particularly relevant where patient consent is concerned. The National Health Act stipulates that care for experimental or research purposes may not be provided to a user without the user's informed consent. Patients should thus give consent, preferably written consent, if they are being treated through a system in its testing phases. Written consent should enable a patient to fully understand, appreciate and consent to the harm or risk involved in using the system, especially the risk of misdiagnosis. [5]

The Bill of Rights in South Africa's constitution [6] states that all citizens have a right to privacy. Under these obligations, the National Health Act specifies patients' rights to confidentiality. All information concerning a patient's health status, treatment or stay in a health facility is confidential

When sending data electronically, there is risk regarding security breach. In South Africa, no explicit regulations yet exist to govern security standards [5]. One way of ensuring data security is to encode the data through a security protocol. Another method is to de-personalize data by removing any identifying information such as names and identification

numbers from the records. Finally, user access can be restricted through the use of passwords.

*Operational feasibility*

Whitten *et al*. [7] claim that common barriers resulting in the underutilization of telemedicine include user liability, technical challenges, complex licensure and a lack of reimbursement. However, in their studies, they found that even in cases where these common barriers were accounted for, long-term user acceptance and widespread user adoption were still.

One way to fit new tasks being introduced by technology into work practices, organization and procedures is process reengineering [8]. The process engineering cycle includes identifying the processes that will be affected and reviewing these processes to establish the "as-is" structure. The new processes are then designed, implemented and monitored for evaluation purposes. These steps for process reengineering will be followed to introduce the asynchronous ultrasound system into the daily operations of the rural clinics.

## Conclusion

The purpose of this paper was to determine the feasibility of using this tele-ultrasound system to address the need for skilled ultrasound sonographers in South Africa. After considering the technological, economic, legal and operational implications, it is concluded that it is indeed feasible. A detailed implementation plan was also developed, but cannot presented here, due to restricted space.

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# A Service-Oriented Approach for Implementing Inter-Organizational Healthcare Processes on the Cloud

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***Abstract:*** **This paper is concerned with developing a service-oriented architecture (SOA) based on a cloud computing model with the objectives to automate emergency healthcare processes, to support collaboration and coordination needs among individual process activities and to provide functionality for managing patient information in a platform-independent manner.**

## Introduction

Healthcare organizations are perennially challenged to improve patient care while controlling or reducing costs through technology innovations [1, 2]. During execution of healthcare processes, seamless access to patient information is of paramount importance in order to avoid medical errors and provide best medical care [3,4]. To this end, collaboration, coordination and information sharing among disparate healthcare organizations must be supported.

As SOA provides an architectural style for building applications out of existing components, existing healthcare applications are transformed into web services which may be viewed as implementations of healthcare process activities and orchestrated through the Business Process Execution Language (BPEL). Furthermore, cloud computing represents a paradigm shift which enables IT to focus less on the physical assets it is managing and more on the services it is providing (i.e. services to patients, physicians, healthcare and insurance organizations). Hence, cloud computing can be used for providing services across the continuum of care that require the ability to scale application workloads, share information and ensure that patient information is protected, secured and always available when needed. In addition, a cloud-based SOA will mean changing business cost models, streamlining and automating administrative workflows and clinical healthcare processes, and consolidating IT assets by providing reusable business processes that are accessible on demand. In this context, service-

based applications such as personal health records (PHRs) based on a cloud computing model are in fact provided as a service.

Along these lines, this paper presents a service-based emergency healthcare application based on SOA and the cloud computing paradigm that allows various authorized users to timely access accurate patient information at the point of care when needed. Specifically, the proposed application implements a BPEL process that retrieves patient information from disparate sources (e.g. PHRs, ambulance services), sends it to the appropriate recipients and stores it to virtualized cloud servers.

## Motivating Scenario

Emergency medical services (EMSs) are concerned with the provision of pre-hospital and in-hospital emergency care; their operations typically involve a wide range of interdependent and distributed activities, performed by cooperating individuals (administrative, paramedical, nursing and medical). Conceptually, these activities can be interconnected to form emergency healthcare processes within and between the participating organizations (i.e. ambulance services and hospitals).

Suppose a healthcare delivery situation where a patient is transferred to the emergency department of a hospital. As emergency department visits are unplanned and urgent, there is a need to ensure that pre-hospital emergency case data and past patient data (e.g. allergies, medication history, most recent diagnostic and therapeutic procedures) is automatically made available to emergency department physicians. Thus, care inefficiencies, in the form of redundant testing, care delays and less-effective treatments prescribed are eliminated and quality of care is enhanced.

## System Architecture

Fig. 1 illustrates a high level view of the cloud-based SOA where integrated patient information is accessed via web and cloud services. It is assumed that, at each healthcare organization (hospital or ambulance service) there exists an IT infrastructure consisted of a legacy application and a local security server that implements the local security policy. On Amazon EC2 virtual images there exists: a) a SOA platform that consists of a database server, a BPEL engine that handles the execution of BPEL process and an application server that hosts the web services that implement the BPEL process activities, and b) a global security server that enforces the global security policy. Amazon S3 is used to store and retrieve patient data in the form of XML CDA-based documents. Amazon SQS is used to transfer patient data through messages [5].

The proposed system architecture is intended to provide pre-hospital emergency case data in a standard format and structure to ambulance and emergency department physicians. To this end, a BPEL process has been created. During pre-hospital emergency healthcare delivery, emergency case data is stored in the ambulance service legacy application. Upon ambulance arrival at the emergency department of the intended hospital, a BPEL process is either automatically triggered or executed on demand by authorized users to (a) call web and cloud services that retrieve pre-hospital emergency case data from ambulance service legacy application and, optionally, designated portions of medical data from the patient's PHR, (b) transform this data into a CDA document which is stored in a cloud server and (c) make this document readily available to authorized users of the emergency department.

Within the proposed system architecture, a security architecture was also developed which is enforced by a global security server implemented as an add on to the Amazon security features and based and be compatible to security policies of existing local security servers deployed at each participating healthcare organization [6].

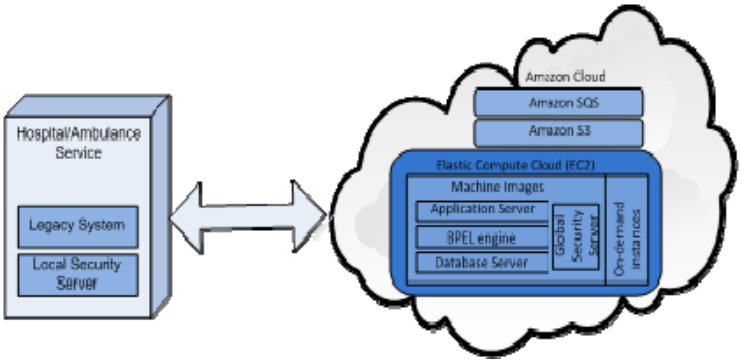


Figure 1. System architecture

The global security server is based on a role-based and context-aware authorization model which was developed with regard to BPEL task execution (implemented as web and cloud services) and associated data accesses. Hence, the global security server is deployed on Amazon EC2 images to provide authorization services with regard to: (a) BPEL process executions, (b) web and cloud services executions, and (c) XML CDA documents access through web and cloud service execution.

An experimental implementation of the above system architecture has been made on the Amazon cloud infrastructure where WSO2 carbon

platform is deployed as a platform as a service (PaaS). The web interface provided by WSO2 Stratos is used for deploying, running and monitoring the BPEL processes and the web/cloud services. BPEL designer on eclipse IDE is used for developing the BPEL processes and the Java 2 Platform Enterprise Edition (J2EE) and the Web Services Tools on eclipse IDE are used to create the web services.

## Conclusions

Recent trends in healthcare delivery require that integrated patient information can be readily accessible by authorized users during the execution of inter-organizational healthcare processes. This can be achieved by using a SOA approach that utilizes web services and BPEL on a cloud computing platform in order to enable scaling up and down the system according to system load. This paper presents such a prototype system on the Amazon cloud to enable availability of integrated patient information collected by disparate and heterogeneous systems involved in an emergency healthcare process while reducing ownership cost.

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# An Algorithm for Automated Detection of Tuberculosis Bacilli Using Color Image Microscopy

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***Abstract:*** **Indian Health Infrastructure and Management are challenged by the fast pace of advances in medical science, increased government intervention and rapid economic growth. While some of the diseases like small pox, polio and cholera are being eradicated from the country, chest-related diseases like tuberculosis, respiratory infections & pneumonia, diarrhea and malaria account for the maximum fatalities. Tuberculosis or TB is a common and often deadly infectious disease caused by various strains of mycobacterium. TB is the third largest killer disease in India. Sputum Acid-Fast Bacillus (AFB) smear continues to be the backbone of TB diagnosis. When the smear is viewed under a microscope, they appear as pink rod shaped structures. Automatic detection of tuberculosis in stained sputum smear would increase the efficiency and reduce costs at the screening phase. The aim of the research is to develop an automated screening tool to detect and diagnose TB. The algorithm uses the hue, saturation and intensity (HSI) color model to identify the Bacilli. Based on an extensive study of the smear images, it was observed that, the HSI color space renders itself much better for analysis compared to RGB (Red, Green and Blue) color space. The size and saturation thresholds are determined by examining many standard smears by using the intensity and saturation histograms. The algorithm is tested with 130 images for accuracy and 100 images for specificity. The accuracy achieved by the algorithm is 90.8% while the specificity is 90%.**

## Introduction

Tuberculosis (TB) is contagious and airborne. The vast majority of TB deaths are in the developing world. 1.7 million people died from TB in 2009, equal to 4700 deaths a day. Considering that Tuberculosis is a dreaded infection prevalent mostly in developing & underdeveloped regions, an automated system for detection of Tuberculosis bacilli in

sputum smear will be very useful. Our objective is to provide a cost effective means by which routine sputum smear test for tuberculosis bacilli detection may be automated. Tuberculosis or TB (abbreviated for tubercle bacilli) is a bacterial infection caused by Mycobacterium tuberculosis that primarily affects the lungs and the central nervous system and can also affect other parts of the body. It is spread through the air when people who have the disease cough, sneeze, or spit.

## Current Methods

Several image analysis techniques have previously been proposed for mycobacterium tuberculosis identification as a tool for tuberculosis diagnosis in sputum microscopy with a fluorescence microscope [1], [2], [5]. Fluorescence microscopy is the standard diagnostic method and requires lower efforts. This method has increased sensitivity, but there is concern that specificity may be lower [3]. This method is not suitable for developing countries due to the high cost of the fluorescence microscope and its maintenance [4]. In the automatic methods used to identify the tuberculosis mycobacterium in fluorescent microscopy, the segmentation of the mycobacterium uses only a threshold operation. In Forero et al. [2] a color segmentation technique was experimentally established based on threshold operation in the Green channel of the RGB image. In Veropoulos et al. [1], [5] the bacilli segmentation was done with a threshold operation in the intensity image. The major task in these methods was the identification process used to determine whether the remaining objects are bacilli. In [6], an automatic method for identifying tuberculosis mycobacterium by sputum microscopy with a conventional light microscope was proposed. The best sensitivity and specificity rate achieved by this method were 76.65% and 12%, respectively.

## Techniques & Methods

The algorithm uses the hue, saturation and intensity (HSI) color model to identify the Bacilli. Based on an extensive study of the smear images, it was observed that, the HSI color space renders itself much better for analysis compared to RGB (Red, Green and Blue) color space. Tubercle bacilli resemble fine red rods standing out against the blue background. They may be slightly curved, granular, and may occur singly, in pairs, or groups. The algorithm detects the Bacilli inside the sputum smear by applying size threshold and checking neighboring pixel clusters which eliminates the possibility of detecting artifacts over Bacilli. The algorithm is evaluated for acid-fast stained thin smears for the detection of the bacilli and uses images of resolution as small as 640 × 480. The slides were obtained from hospitals

in Gadag district. This algorithm is based on the premises that the TB Bacilli appear as deep pink or purple colored rod shaped structures in an acid-fast stained sputum smear. Images from the stained sputum smear are acquired through digital camera from an oil immersion 100x microscopic lens.

The background of the image is not uniformly blue, due to the staining procedure. The background and the bacilli have distinct hue components that could be used for detection. The hue components are studied to arrive at hue thresholds for each of these artifacts. The hue of the bacilli lying between PH1 and PH2 as shown in Figure 1 is near to dark pink. By applying these hue thresholds the background is eliminated. Figure 2 shows the image after hue-histogram windowing.

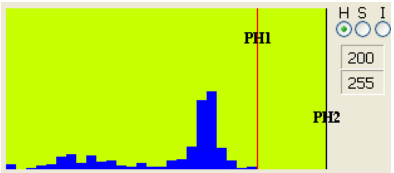


Figure 1: Hue Histogram

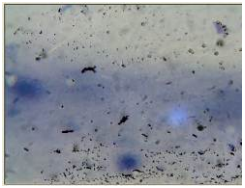

Figure 2: Image after Hue Histogram

The other artifacts found along with bacilli in the sputum smear are removed using saturation components of HSI color space and size threshold. The size and saturation thresholds are determined by examining many standard smears by using the intensity and saturation histograms. The bacilli lie in the intensity range between 0 and PI4 as shown in figure 4. Using these histograms as shown in figure 3 and figure 4, the TB bacilli is differentiated from the other artifacts.


Figure 3: Saturation Histogram

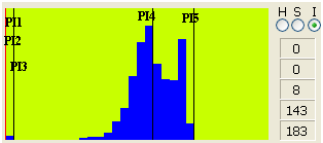


Figure 4: Intensity Histogram

The combined application of both hue and intensity histogram windowing gives the results as shown in the Figure 5 below and the resultant image contains tuberculosis bacilli. The bacilli are perfectly identified as marked in the white box. The above marked ROI's are the TB bacilli.

## Results & Conclusion

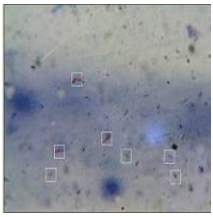
Figure 5: Final Output

The algorithm is tested with 130 TB positive and 100 TB negative images. Out of 130 positive images, 12 were identified as negative, an accuracy of 90.8% and 10 negative images out of 100 are classified as positive giving a specificity of 90% for the algorithm. This is much better than the earlier attempts of automating this process. This automated system reduces fatigue by providing images on the screen and avoiding visual inspection of microscopic images. The system has a high degree of accuracy, specificity and better speed in detecting TB bacilli. The method is simple and inexpensive making it suitable for use in rural / remote areas in the emerging economies.

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# Abdominal Signal Processing: Noise Sensitivity Evaluation of Two Algorithms for Fetal QRS Detection

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***Abstract:*** **Fetal heart rate (fHR) can be derived from fetal ECG (fECG) signals recorded on the maternal abdominal wall. However fetal QRS detection is difficult, not only because of the physiological variability of the QRS complexes, but also because the abdominal recording (ADS) represents a multi-component signal containing several other disturbing signals of high amplitudes besides the low amplitude fECG component. The aim of the present paper is to evaluate the performances of two different methods for QRS detection which are more suitable for real time heart rate monitoring. The algorithms are applied on simulated abdominal recordings using different levels of noise. The method of maternal ECG (mECG) subtraction is performed as a preprocessing step. The performance of the algorithms considered in this study is evaluated through the analysis of three statistical parameters: false positive rate, false negative rate, true positive rate.**

## Introduction

Fetal heart rate (fHR) is an important instrument in fetal monitoring because it supports the medical decisions when evaluating the health state of the fetus. Moreover, fHR variability (fHRV) represents a useful index for evaluating the function of the autonomic nervous system (ANS) [1].

Fetal electrocardiogram (fECG) recorded from the maternal abdominal wall offers the possibility for the analysis of the beat-to-beat fHRV.

However, the signals recorded by contact electrodes placed on the maternal abdomen, are a mixture of electrophysiological signals and noise and therefore requires signal processing to extract the fHR. The various

component types that can be present in the ADS are: the maternal ECG (mECG), electrical activity of the muscles, artifacts due to electrode motion, power line interference, baseline wander, electronic noise (introduced by amplifiers etc). The main source of disturbance is the mECG [2].

There are a relatively large number of papers describing adult QRS detection algorithms which can be classified as methods based on: digital filters [3], amplitude and first derivative [4], first derivative only [5], wavelet transform [6], mathematical morphology and wavelet transform [7], template matching [8], first and second derivative [9].

The algorithms evaluated are selected using complexity and performance as criteria selection [10]. First algorithm is based on first and second derivative and is described in [9], while the second algorithm is based on digital filtering, [3].

## Methods Description

### *A. Algorithm based on first and second derivative*

The steps of the first algorithm, A1, are described in the following equations:

$$y_0(n) = ABS(x(n+1) - x(n-1)) \quad (1), \qquad y_1(n) = {[y_0(n-1) + 2y_0(n) + y_0(n+1)]}/{4} \quad (2)$$

$$y_2(n) = ABS(x(n+2) - 2x(n) + x(n-2)) \quad (3), \qquad y_3(n) = y_1(n) + y_2(n) \quad (4)$$

where $y_0(n)$ represents the rectified first derivative; $y_1(n)$ is the smooth version of $y_0(n)$; $y_2(n)$ is the second rectified derivative and $y_3(n)$ represents the signal used to detect the R peaks. Thus two thresholds are defined:

$$Th1 = 0.8 * \max[y_3]; \qquad Th2 = 0.1 * \max[y_3] \quad (5)$$

A QRS complex is detected as following: i) a point in $y_3(n)$ which exceeds the first threshold is determined; ii) in order to be classified as a QRS candidate, the next six consecutive points must all meet or exceed the secondary threshold:

### *B. Algorithm based on digital filtering*

The second algorithm evaluated in the present paper is proposed in [3].

First, the signal is smoothed with a three point moving average filter:

$$y_0(n) = {[x(n-1) + 2x(n) + x(n+1)]}/{4} \quad (6)$$

Next, the signal is low pass filtered and the output is described in (7):

$$y_1(n) = {1}/{2m+1} \sum_{k=i-m}^{i+m} y_0(k) \quad (7)$$

where $m<n<\text{length}(y_0(n))$.

The squared difference between (6) and (7) is filtered:

$$y_2(n) = (y_0(n) - y_1(n))^2 \left( \sum_{k=i-m}^{i+m} (y_0(k) - y_1(k))^2 \right)^2 \quad (8)$$

The final step consists in determining the auxiliary signal $y_3$:

$$y_3(n) = \begin{matrix} y_2(n) & \left(y_0(n) - y_0(n-m)\right) * \left(y_0(n) - y_0(n+m)\right) > 0 \\ 0 & \left(y_0(n) - y_0(n-m)\right) * \left(y_0(n) - y_0(n+m)\right) < 0 \end{matrix} \quad (9)$$

The array $y_3(n)$ is scanned until the threshold described in (10) is exceeded. Than the exceeding points are classified as QRS.

$$th3 = 0.125 * \max(y_3(n)) \quad (10)$$

However, the algorithm is not able to distinguish between R waves and sharp Q waves, another step being introduced which verifies if the distance in time between two detected QRS complexes is smaller than 200 ms, which represent the minimum period between two R peaks.

## Results and Discussion

The abdominal signals are simulated using the model described in [11]. Thus, 10 channels of abdominal recordings are generated having real spectral parameters, with sampling frequency of 1kHz. As a preprocessing step, the mECG is cancelled using the method in [12].

In order to evaluate the algorithms different data sets are created with different levels of noise. Thus, first the signal to noise ratios (SNR) between the fECG and the mECG and between the fECG and noise are computed with (11);

$$SNR_{fm} = 10\log\left(\frac{\sum fECG^2}{\sum mECG^2}\right), SNR_n = 10\log\left(\frac{\sum fECG^2}{\sum N^2}\right) \quad (11)$$

There are 3 levels for the SNR, -20 dB, -15 dB, -5 dB, and all possible combinations are considered between $SNR_{fm}$ and $SNR_n$.

For each combination of SNR the following parameters are calculated: false positive rate, Fp; false negative rate, Fn; true positive rate, Tp. The results are depicted in Table 1.

Table 1

| S $NR_n$ / $SNR_{fm}$ | -20 dB | | -15 dB | | -5 dB | |
|---|---|---|---|---|---|---|
| | A1 | A2 | A1 | A2 | A1 | A2 |
| -20 dB | 28/349/53 | 20/378/32 | 44/294/92 | 11/315/104 | 45/319/66 | 25/184/221 |
| -15 dB | 39/362/29 | 13/360/57 | 70/299/61 | 16/216/198 | 18/348/64 | 16/267/147 |
| -5 dB | 46/336/48 | 15/368/47 | 76/269/85 | 10/332/88 | 178/206/46 | 12/166/252 |

Each cell of the table contains the Fp, Fn and the Tp values calculated for each possible combination of the SNR. It can be observed that both algorithms show a very poor ability to discriminate between QRS and noise

when the noise level is high. Moreover, the performance seems not to increase significantly when the $SNR_{fm}$ is very low. This can be due to the fact that in this case mECG and fECG have similar amplitudes and this can affect the preprocessing step of cancelling the mECG. The second algorithm, A2 has a better overall performance than the A1 algorithm. Nevertheless, algorithms with adaptive thresholds should have a significant improvement for detecting low power fetal QRS complexes.

## Acknowledgment

The work has been funded by the Sectoral Operational Programme Human Resources Development 2007-2013 of the Romanian Ministry of Labour, Family and Social Protection through the Financial Agreement POSDRU/6/1.5/S/19 and by the grant PNCDI II - IDEI, ID_1723/2009.

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# Contextual Correlation of Stress Parameters in a Petri Net Model

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***Abstract:*** **The paper presents a Petri Net model for the contextual correlation of stress parameters that are relevant for an experimental health monitoring system. The physiological parameters that react to stress and are non-invasively measured have been chosen – heart rate, blood pressure, respiratory rate, body temperature, galvanic skin response. The Petri Net model highlights the possibility to infer various health conditions, aside stress, and the influence of context is also presented through movement identification and other external events.**

## Introduction

Given the high costs on healthcare due to chronic disease and late findings, focus is necessary on prevention of illness [4]. Previous research proves that stress can worsen and/or initiate chronic disease (e.g. hypertension), a variety of syndromes (e.g. metabolic, chronic fatigue), weaken the immune system and cause memory problems [4-8].

While signs of stress are often behavioral, hard to automatically assess and could potentially require journal keeping in order observing them over time, the symptoms (physiological changes) provide an objective measure that can indicate a stressful situation or a disease.

There are several systems monitoring physiological parameters for stress evaluation. The Cocoro Meter measures the level of amylase enzyme in the saliva and provides a feedback on the level of stress. The StressEraser and emWave systems measure heart rate variability and assist the users in observing their momentary state and through breathing techniques change it if needed (e.g. relax). Affective Health is a mobile system that measures heart rate, galvanic skin response and movement and has the purpose to determine the user to self-reflect on bodily reactions and decide herself on the nature of the situation (stressful or not) [1].

These systems don't take into consideration, nor wish to suggest, what the cause of the stress can be and thus also outline the possibility of onset of a

disease. Their proposed techniques can help manage stress, but this paper presents a comprehensive model of the complex environment that can result into un/perceived stress or actual disease. The proposed system measures physiological parameters and suggests if they reflect a reaction to everyday stress or a health condition as fever or arrhythmia.

## Relevant parameters

The experimental implementation of the proposed system consists of a Wi-Fi acquisition system – hardware, firmware and software – that was designed and implemented by the authors. The acquisition tag collects data from a 2-axis accelerometer, 2-axis gyroscope and the 3-electrode ECG sensor board also implemented by the authors (see Fig.1 for an example of obtainable signals). The other measurements – blood pressure, respiratory rate, body temperature and galvanic skin response – are obtained separately.

Elevated heart rate may be the result of various stressors (systemic or neurogenic) or could be caused by e.g. fever. Therefore it is meaningful to correlate it with body temperature (T°) and galvanic skin response (GSR) as well. The estimation of arrhythmia is based on observing R-R intervals (short intervals followed by long intervals) [7].

Physical activity (PA) and the process of identifying it have proved to be helpful for health issues [4] and suggested to be meaningful for a stress monitoring systems as well [2]. Recognizing tremor can help differentiate between a tic manifested because of stress or the onset of a disease and identifying opportunistic physical activities, e.g. walk, run, stand, provides a better understanding of the other measurements (Fig. 1).

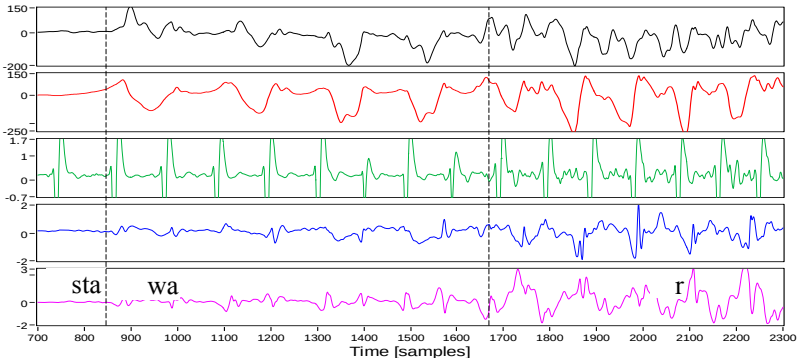

Fig. 1. Example of observable correlations based on movement

Blood pressure rises in context of stress or intense movement, but maintained increase over time could indicate a chronic condition as

hypertension. Respiratory rate (RespR) is also sensitive to the described context [8] and can be used to distinguish stressful situations and illness [7].

Given the physiological inter-dependencies of the parameters, the rule-based engine decides if the situation is normal (e.g. increase in parameters due to intense movement), stressed (e.g. no movement, faster HR, higher GSR and RespR, normal T° and close to normal BP) or suggests illness (e.g. fever, arrhythmia, abnormal tremor).

## Proposed Petri Net model

The Petri Net based model (Fig. 2) shows how perception of events, other external factors and movement can help determine if the physiological parameters result in stress or other health conditions. The Petri Net formalism has been previously used in health related contexts as well [3].

Once the system is started (*P0*) and the sensors are connected and functioning properly (*t0*), the sensor data is sent to the processing modules: *P1* – movement, *P2* – ECG (HR), *P3* – RespR, *P4* – GSR, *P5* – T°, *P6* – BP. Each module stores the sensor data and also sends it forward to the rule-based engine (*t1-t6*). The rule-based engine is extended symbolically by two illustrated sections: (1) the *C1* – *C9* locations that refer to the availability of the needed measurements and *t7* – *t15* transitions that represent the correlations-based rules that provide intermediary results; (2) the *P7* location storing the intermediary results and transition *t16* reasons on them and provides the final decision regarding the state of the person (stress, fever, arrhythmia or abnormal tremor).

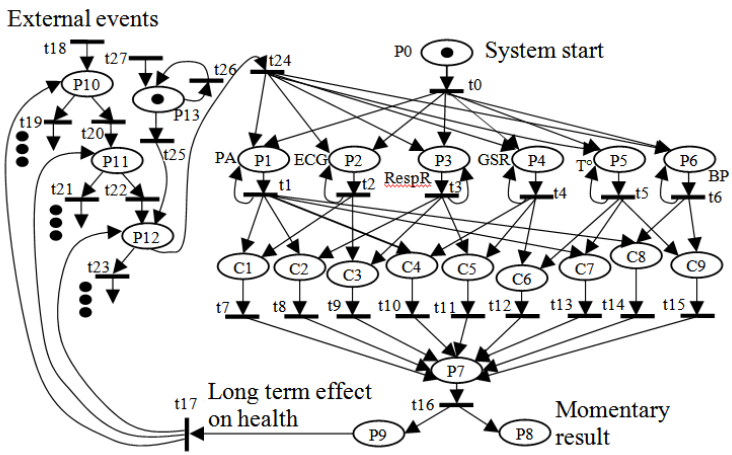


Fig. 2. Petri Net model for the correlation of relevant health indicators

The final result is represented by location *P8* and the cumulative effect of the momentary health situations is indicated by *P9*. *P9* refers to the long term effect, the general obtained health status that affects inner physiological and psychological mechanisms in relations to un/perceived health threats.

The left side of the Petri Net describes the influence of external factors (*t18*) that can represent any ordinary or abnormal events, contexts of everyday life that determine the values of the measurements. *P10* defines the perceived valence of the person's given context (*t19*-positive, *t20*-negative), *P11* refers to the repeatability of the event (*t21*-yes, *t22*-no) and *P12* refers to the adaptability of the person to the event (*t23*-yes, *t24*-no). The cumulative effect of these factors has an influence on the physiological measured parameters. *P13* refers to the existence of other events that may influence the adaptability, e.g. learned stress coping techniques, medication, diet, transitions *t27* being either an MDs intervention or personal decision determining these factors. Given the dichotomy of *P10*, *P11*, *P12*, the Petri Net can be mirrored on its left side.

## Conclusions

The paper presented the Petri Net model of the complex correlations between context and physiological parameters that can help distinguish stress from other health conditions. Parts of the system's hardware – Wi-Fi acquisition tag, 3-electrode ECG sensor board – have been designed and implemented by the authors, as well as the firmware used in prototyping this experimental system.

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# Development and Implementation of an Enterprise Resource Management System (CHRMS) in Ministry of Health of Turkey

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***Abstract:*** **Core Health Resources Management System (CHRMS) developed and used since 2001 is widely used by public health organizations in Turkey; in order to manage human, financial and material resources of the Ministry of Health. The main purpose of this paper is to introduce the system and share experiences gained during the development, implementation and maintenance process.**

## Introduction

The usage of information technologies; ends up with better delivery of government services to citizens, improved interactions with business and industry, citizen empowerment through access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions.

Departing from this rationale, the Turkish Ministry of Health (MoH) started an enterprise and turnkey IT project funded by World Bank, namely Core Health Resources Management System (CHRMS) at September 1st, 1997. The main purpose of the project is to establish an information infrastructure in order to monitor and administer the human, material and financial resources of the public health organizations. By using this infrastructure, the ministry aims to enhance their decision making processes and transform its structure to a more efficient and rational composition.

In this paper, the scope, history and current situation of the project will be introduced. Afterwards the business value of the system for the organization will be implied and future projections about the system will be shared.

## Scope of the System

In order to realize the main objectives pointed out in the Introduction section; the following expectations from the systems were determined.

- Acceleration of data flow between the Headquarters of MoH and Provincial Health Directorates (PHD)
- Specification of the needs of organizations more quickly and efficiently by monitoring current state of the resources.
- Acquisition of the statistical reports which supports the resource planning process timely and accurately.
- Standardization and coordination of the processes in Headquarters and 81 PHDs.
- Preparation of the data infrastructure for Decision Support and Business Intelligence systems.

Like most IT projects; the CHRMS consists of hardware, software and peopleware (training) components and at the beginning phase the software component is divided into three main modules; each responsible for different resource types; namely Human Resources Management System, Material Resources Management System and Financial Resources Management System.

During the maintenance phase; Private Health Organization module was added to CHRMS in order to meet the requirement of monitoring the growing private health sector.

Each main module includes many sub modules which are specialized to perform specific processes and CHRMS also includes a Software Management System which is responsible for supplying user and role based security and definition of common codes used in the system.

## History

The project was firstly planned to be developed by using Client/Server architecture. According to this approach; every PHD will employ a database server and the data produced in the PHDs will be transferred to the central database server at the end of the day. While the data is also produced in Central Ministry of Health (CMOH); this data transfer will be also repeated in the opposite direction. Regarding some difficulties and delays in bi-directional data transfers and the paradigm shift in IT technologies; a critical decision made by the project steering committee at 2001 and the transformation to a Web-based architecture was accepted. By using the advantage of Oracle development tools; the all data entry forms and reports were converted into their Web-based conjugates and the database design

was changed in order to meet new requirements. After completing test and training phases; the system was firstly used in Headquarters in July, 2003. After a pilot study held in 5 PHDs; the usage of system is widened to all PHDs in 2004.

The guaranty and maintenance period of the system; which is still pursued is overlapped with the transformation and reconstruction of the health system in Turkey. As an impact of this fact; in order to meet the new requirements raised from this transformation; a lot of changes were reflected to the system. The most important milestones, affected the vision and scope of the system were listed in Table 1.

Table I

| **Milestone** | **Year** |
|---|---|
| Addition of Contractual Health Personnel Sub Module | 2004 |
| Integration with Basic Health Statistics Module | 2004 |
| Transfer of hospitals belonging to other public authorities | 2005 |
| Usage of the system in public hospitals and county offices | 2005 |
| Adaptation of the Human Resources Management System (HRMS) according to new employment regulation. | 2005 |
| Adaptation of the Human Resources Management System according to be new conscription application | 2005 |
| Adaptation of the Material Resources Management System (MRMS) according to new legislation | 2006 |
| Development of the Personnel Portal used by all employees | 2006 |
| Development of the first Business Intelligence application | 2007 |
| Integration with the Document Information System | 2008 |
| Development of the Private Health Organizations Module | 2008 |
| Integration of MRMS with Hospital Information Systems by using Web services | 2009 |
| Usage of the system by private hospital users | 2009 |
| Integration with Family Practitioners System | 2009 |
| Data sharing with Social Security Organization by using Web services | 2009 |

## Current Situation

As seen in most database systems; the system is still evolving due to new requirements of the ministry, the technological changes and the transformation of the health system in Turkey.

The application is still developed by using Oracle Internet Development Suite tools and it is running on a full Oracle Exadata server. The applications reach this database via 8 application servers. Business Intelligence (BI) Application is running on another Oracle RAC Server and three application servers were used to reach this application. The disaster recovery infrastructure of the ministry established in Konya, (270 km to

Ankara) is also serving to CHRMS and all the applications and data is mirrored in similar servers in order to suffer from extraordinary situations.

The system has totally 35.450 active users, and approximately 4500 users are reaching the system concurrently during work hours.

## Business Value

Currently; CHRMS is serving to all the units of the ministry as the main information backbone for resource planning. Besides it is integrated with other applications of the ministry and the applications of other shareholder organizations by using Web services and other methods. It is also serving as a central repository for commonly used knowledge such as the information about units, material names and codes, personnel titles and hospital types.

In HRMS; the records about the current and past situations of 322.000 current and 125.500 former personnel was saved and processed. The all HR operations such as assignment, promotion, transfer, position and payroll is conducted by the help of HRMS. The most information in HRMS is shared with these staff. Consequently transparency in operations and the trust of the staff to the system is increased.

The material and financial resources of all public hospitals were monitored by using CHRMS. The all acquisition process of organizations is under control and the audit about the procurement results can be made very easily on quality and price basis. Also by using some BI applications; the sharing of medical materials between the hospitals are encouraged and the expenditures are lowered. Only in 2009; nearly 2.000.000 USD was as the result of the usage of this opportunity.

By using the Business Intelligence and Decision Support applications which use the CHRMS database; the information source for all units were unified and the rational base of decisions were strengthened.

## Conclusion and Future Projections

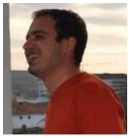
As a conclusion; we can imply that the governmental organizations benefit from the enterprise systems developed specially for them. In addition to the financial advantages that can also be observed in private firms, this kind of systems also plays an important role in increasing the quality of life of the ordinary citizen by speeding up ordinary operations, empowering him against bureaucracy and supplying transparency. These advantages are also valid for the staff working for the government. A lot of paper work is reduced, most operations can be done by using less force and the staff is specialized to its own duty.

In the near future; the most important stage for CHRMS is the integration with the E-Health project; which is also conducted by MoH. The aim of e-health project is to construct the Electronic Health Record for all Turkish citizens. In these records; the all health history of the citizen is stored, including medical examination, diagnosis and interventions.

The most important requirement triggering the integration of CHRMS and E-Health will be the establishment of standard treatment protocols. The usage of human and material resources in the treatment processes can only be inspected by using integration interfaces of these projects. This dimension is important in supplying qualified health service for citizens, but it is also crucial for the payment authorities in order to prevent misuse.

Another challenge for CHRMS will be the integration of the data flow with electronic sign mechanisms. Despite of the fact that the all processes are accomplished by the system; a parallel paper-based (mostly produced by CHRMS) system is preserved in order to meet legal requirements. The electronic sign mechanisms are emerging and a change in the current paradigm of CHRMS is unavoidable.

Lastly, in this section it should be mentioned that the integration with other e-government projects will preserve its importance. Currently, the data sharing is regarded as the primary job on this topic; but the integration of processes between public and private health shareholders will directly affect the quality of health service.



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# ICT Support for Innovation Transfer in the Medical Sector

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***Abstract:*** **Clinics have a high potential for innovations in product, process and service development. However, so far, this innovation potential has been insufficiently transferred into results such as product development for companies. There are many reasons why this Intellectual Property (IP) does not work for better healthcare. Different interests of clinics in the efficient management or the welfare of patients on the one hand, and the economic interest of companies to dominate as a supplier on the other, are the main obstacles of this process. In particular, small and medium-sized enterprises (SMEs) and the development actions initiated by the clinic staff do not have chances to transfer their ideas and knowledge into products. It is necessary to create and provide European wide tools for strengthening the access of SMEs to this innovation potential in the clinics and to open new markets to their products. This innovation transfer can be supported by Information Communication Technologies (ICT), which allow creating and managing the innovative community. SMEs are highly interested in getting the access and in being involved in the transfer. They naturally want to take advantage of this process. It *seems* that creating this kind of tool for initiating the virtual access of SMEs to the clinics innovative potential may become a good practice. There are organized pilot workshops in order to discuss regional particularities.**

## Introduction

Implementation of medical innovation is a process that is currently generated through thematic networks called clusters. Similar relationships are also reflected in the structures of professional social networking portals, whose undisputed leader is now the Facebook. Lately, it has been Poland that opens the ranking of countries where the number of Facebook users grows the fastest. Over the last period of time many thousands of our fellow-countrymen have created profiles for themselves. Just beyond us, there are the Thais, Portuguese, South Africans, Taiwanese, Romanians and

Germans. Facebook has become a synonym of modernity, exclusivity and high status. Therefore, Polish users give up profiles on *Nasza Klasa* to its benefit, and *Nasza Klasa* is beginning to be perceived as out of fashion and provincial, although not so long ago it used to be in the centre of attention. The reason of Facebook's popularity is the fact that it embeds itself in the need of freedom. According to the "social media", it gives its users much greater freedom than other social network services. And hence it embeds itself in the *Internet* community along with the threats that it carries [1].

*The IAD Syndrome (Internet Addiction Disorder)* is a disorder, which relates to 18 up to 29 percent of web users. This phenomenon is widely known and we meet people addicted to the Internet in our everyday life. It is fostered, among other things, by the creation of social network services. In Poland, more then ten million people use these services. It is estimated that the symptoms of addiction may be present even in 1/3 of users. The people most prone to it are the beginner users of social networks. It is observed that they have the withdrawal syndrome, which is manifested by the feeling of discomfort, aggression, sometimes psychosomatic symptoms, such as headaches or muscle contractions. The practitioners observe also a new type of disorder called FAD, i.e. Facebook Addiction Disorder. It is puzzling what kinds of mechanisms cause that users of these portals get addicted. Is there a possibility of redirecting such an inclination into social behaviours, such as creating innovative communities?

Profiles on Facebook are usually created for fun. The users often do not have a need to share their thoughts, and they take most of the comments with a grain of salt. Not so long ago, the most popular portal was MySpace, which attracted teenagers and non-promoted music bands, and Facebook was available only to a selected and rather narrow group of users. The author of Facebook, wanted to help those, who just as him, started studying at Harvard and wanted to find their place in the campus as well as get to know other students. At that time, in order to create a profile, it was necessary to have an academic account and be a student of Harvard or Yale. Then, they decided to open the website for everyone. At present, Facebook gains about one hundred thousand new users a day. The danger of addiction appears only when a user faces elements which have always attracted his attention. Such a factor is often the need of being together as well as the feeling of belonging to an organised community.

BranchOut is Facebook's new functionality, which allows you to transfer easily your contacts to this portal from LinkedIn for example. Practically no one wants to fill in another professional profile in a social network if they have already done it once. The applications idea is smart, at least till the time when LinkedIn decides to block the possibility of importing all the

data. There is a need of systems interoperation, where just by one click of mouse you may have a ready CV on Facebook imported from LinkedIn.

LinkedIn is a social network service offering its users a possibility of creating professional profiles. It seems that by the sensational development of Facebook, social networks go through another mutation. Creation of innovation oriented professional portals is just a matter of time.

## Medical Innovation Processes

Innovation processes in the field of medicine, where the scientific knowledge is created with emphasis on the scientific development and discovering the therapeutic path, are such processes due to which the increase of knowledge is possible and a progress in medical sciences and clinical practice takes place. It is based on conceptual and evolutionary approach to technological changes. Their empirical side often stems from the analysis of a database of scientific publications in the field of medicine over a period of 50 years. Such experience allows to determine common understanding in the disease area. It allows to outline (for the scientific community) the specific trajectory of the general innovation process understanding. It supports the concepts of coordination, where knowledge is a dispersed process, which cuts through and connects complementary areas of knowledge [2].

Medical researches determine various conditions, on which the new knowledge stimulates innovative actions. These are different forms of specialization and the coordinative role of institutions [2, 3, 4]. In this way there is some support provided for the concept that coordination of the dispersed knowledge process, which cuts through and connects complementary areas, is based on the organisation of scientific research, designing legal regulations, development of innovative communities of practice, rendering services (e.g. taking care of a patient) and on creating new market processes [2, 5, 6, 7].

## Innovation Transfer in Medical Sector from Clinics to Commercials

Due to the required level of education of medical staff, Clinics have a high potential of the innovation of products, processes and services development. So far this innovation potential is insufficiently transferred onto results such as: product development, intellectual property (IP) of production processes and better health. There are many reasons why it is happening this way. Among others, the obstacles are related to the fact that clinics are mainly interested in efficient management and welfare of their patients and industrial companies in the economy and economic significance (in places where they dominate as suppliers). These are mainly

the lack of financial means and possibilities for the transfer of knowledge as well as ideas for products that limit small and medium-sized enterprises (SME) in using innovations initiated by employees of the medical sector. Hence, the IntraMED-C2C project starts working out of and supplying the tools which will allow for increasing the access of small and medium enterprises (in the European scale) to the innovation potential in clinics. This process should open new markets of potential customers for innovative products. SME are very much interested in obtaining access to the knowledge generated in the process of innovation transfer. By their flexibility in working out lab types, prototypes and small business solutions in order to improve the everyday work of clinics, they have huge chances to see a success. The tools initiating SME's access to clinics have been so far workshops and meetings, in which medical sector representatives take part. Pilot workshops are organised within the project in line with the needs of the regions carrying out the Project. In order to work out a model concept and an innovation transfer tool, it is planned to take into account a transfer of experience into supraregional, national and international areas.

Creating a social network service dedicated to medical innovations will cover not only bilateral relations of clinics and small and medium enterprises, but also general political conditioning related to limitations in the healthcare sector. It will have an impact on the innovation transfer costs refund system and further financing of providing medical services or sales of healthcare products.

## Summary

The theoretical background and the dynamics of knowledge in the field of medicine give a challenge to the medical sector in the scope of innovation. The empirical analysis in relation with diseases and analyses of networks important in scientific work are significant in creating an innovative community. The main arrangements and summary are related to the fact that the transfer of innovation may be supported by the Information Communication Technologies (ICT), which allow to create and manage an innovative community. SME are very much interested in obtaining access and getting involved in the transfer of innovation. Therefore it seems that creating this type of ICT tools will allow SMEs to have a virtual access to clinics' innovation potential. This may become so called the good practice.

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# IOPIT: A Fast Way for Large DICOM Files Transmission over Internet

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***Abstract:*** **Medical imaging devices render high resolution images and studies containing multiple images within, like CT, MRI and others. The use of PACS is the most suitable option for communication of medical image data over a hospital network. Today a steadily increasing number of applications require image transmission over public networks outside the hospital bounds. In this context, several Web-PACS have been developed for remote visualization of a study from a PACS to a Web-client. For this reason, it becomes critical to save bandwidth and minimize the time for image transmission. Usual approaches employ compression algorithms, but the compression level largely depends on the kind of study and disease. Generally, radiologists focus on a few regions of the whole image so, only these regions are worth to be transmitted at full resolution. On the other hand, the time-to-display (TTD), say, the delay experienced since the study is requested until it is fully displayed on the screen, is associated with discomfort during remote assessing of medical images. Different strategies have been implemented to optimize resources and to minimize the TTD. Communication schemes based on progressive image transmission (PIT) appear as the optimal solution. PIT allows for transmission of compressed image data such client can have a whole reconstruction of the image, since the very beginning. We present here a solution that uses Web Access DICOM Object (WADO) for remote visualization of large DICOM files. The system consists of a server interacting with a PACS and a remote DICOM viewer as a client, based on the Adobe Flash virtual machine. This fact ensures easy and costless dissemination of technology. The transmission algorithm is called interactive optimized PIT (IOPIT) scheme.**

## Introduction

Picture Archiving and Communication Systems (PACS) are widely accepted for communication of medical images within a hospital network [1]. The problem is that specialists are not all the time at the hospital and it is turning common the fact that hospitals need to provide the specialists an access to the PACS, wherever they were located, in order to provide a quick diagnostic in case of an emergency or when a second opinion is needed. This issue requires image transmission over public networks outside the hospital [2]. In this context, Web-PACS has become an attractive option that brings access to medical imaging databases from remote hosts.

However, size of medical images impacts negatively on the teleradiologist experience by increasing the dead times elapsed between study request and its visualization on the remote screen. So, it is of the upmost interest to implement strategies to optimize image transmission [3], especially high resolution images and studies containing multiple images within. Image size is determined by the necessary image resolution being suitable for diagnosis. So, it is critical to save bandwidth and minimize the time required for image transmission. Usual approaches employ compression algorithms. Lossless schemes reduce file size 3 times, lossy techniques reduce file size 100 times or more [4]. In practice, lossy compression levels largely depend on the kind of study and involved disease [5]. Another strategy is Progressive Image transmission (PIT), which allows for displaying the whole image while it is being downloaded from the server.

Generally, radiologists focus on a few image regions after looking at the whole image, so only these regions are worth to be transmitted at full resolution. On the other hand, the time-to-display (TTD), say, the delay experienced since a study is requested until it is fully displayed on the screen, is associated with discomfort during remote medical image assessing. In fact, TTD could be taken as a reliable estimate of the performance of different remote viewers [6]. Several strategies have been tried to optimize resource utilization and minimize the TTD. PIT have been put forward as the optimal solution, it consists of the transmission of compressed image data, allowing for having a whole low resolution image since the very beginning. We use PIT strategy as the base for this work.

## Design

Up to now, web browsers can not display the studies in DICOM format, for this reason most WEB-PACS include a viewer for displaying medical images. Some of these viewers run within the web browser using virtual

machines or specific libraries, others are external applications linked with the browser. These viewing applications should be able to run over different platforms and operative systems, to avoid the use of different applications for different platforms and operating systems.

We designed a Web-PACS featuring a fast DICOM Flash-based viewer which allows for searching/querying studies archived in a Hospital PACS from a remote site using only a Web browser. The system is composed by two applications, a Client and a Server. The former interacts with the user and displays the study; the latter enables the access to the DICOM files stored in a server and the response to requests of the client. Communication between Client and Server is over HTTP and according to the WADO (Web Access DICOM Object) specification of the DICOM standard [7].

Once the teleradiologist requests a study to the Web-PACS, the Client is downloaded from the server. The Client, nothing but a DICOM viewer, provides an image visualization environment. This environment consists of a viewing area (VA) and a few buttons for image handling. Only those parts of the image, which are in the VA, are actually downloaded from the server, at a resolution not higher than the screen resolution. The VA is virtually divided into tiles of fixed size. The Client calculates the number of tiles necessary to cover the VA with some redundancy and determines which parts of the image correspond to each tile. The Client asks to the Server these parts as a list of WADO requests, which are managed by the Web browser and sent to the Server. As can be seen, the image is transmitted on-demand. When teleradiologist interactively selects an area with the zoom tool, the application enlarges the displayed image and then recalculates which tiles must request to the server. Finally when these tiles come up, the application refreshes the image in the visualization area. We call this technique IOPIT (Interactive and optimized PIT).

## Results

The client was developed in *Open Laszlo*, language that compiles the web viewer to run over the *Adobe Flash* virtual machine, it is within this web viewer where the IOPIT strategy has been implemented. The server is a multithread application developed in *J2EE*, using *dcm4che* library [8].

Table I

| **Image type** | **TTD (seconds)** | **TTD (minutes)** |
|---|---|---|
| RAW | 400 | 6:40 |
| PNG | 80 | 1:20 |
| IOPIT | 26 | 0:26 |

We chose TTD for assessing the transmission performance using a 25Mb image and bandwidth of 512 kbps. Results are shown in table 1.

## Conclusions and future works

We built a multiplatform system that can run in any computer with Flash VM installed. The system reduces the TTD in 14 times than RAW images and in 5 times than PNG lossless images, by means of the IOPIT technique to display medical images without compromising the diagnostic, fact which improves the teleradiologist experience when accessing Web-PACS. Since updated Flash player is present in almost every PC, no expert assistance is required to use the system. This fact could reduce training and assistance costs when PACS environments are meant to be spread among radiologists in the framework of Teleradiology programs.

It is a suitable solution to use in rural areas where Internet connections are narrow and in emergency or disasters situation. It is especially important for public health systems of developing countries, where physicians can access to central Web-PACS without any expertise but only using a Web browser with Flash installed.

Future works deals with design of a generic WEB-PACS application that works with any DICOM PACS server and a viewer for mobile devices.

## Acknowledgment

This project was carried out by the UNC Health Technologies Group in collaboration with two companies: Doths Engineering and Tsavo Group.

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# KHRESMOI: Towards A Multi-Lingual Search and Access System for Biomedical Information

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***Abstract:*** **KHRESMOI is a large EU-funded project that aims to build a multi-lingual search and access system for biomedical information and documents, aimed at and adapted to two main user groups: members of the general public and medical professionals. Access to this search system via mobile devices is also planned.**

## Introduction

KHRESMOI is a large EU-funded 4 year project (http://khresmoi.eu) that aims to build a multi-lingual search and access system for biomedical information and documents. This will be achieved by: automated information extraction from biomedical documents, including estimation of the level of trust and target user expertise; linking information extracted from unstructured biomedical texts to structured information in knowledge bases; support for cross-language search, including multi-lingual queries, and returning machine-translated pertinent excerpts; support for image search; and user interfaces to assist in formulating queries and display search results via ergonomic and interactive visualizations. The project is executed by a consortium of 12 academic and industrial partners and has a budget of approximately €10 million. It started in September 2010 and will run for four years. It is planned to make incremental versions of the proposed system available during the project.

Fig. 1 shows an overview of the proposed KHRESMOI system with a focus on input data and target user groups. As input data, KHRESMOI will use data that is available on the web, such as the health websites certified by Health on the Net and open access journals. However, interest in mining restricted information exists – the Cochrane Collaboration has for example

granted KHRESMOI access to its reviews. Use will also be made of existing semantic data, such as the Linked Life Data, and available language resources for the multi-lingual component.


Figure 1. Overview of the proposed KHRESMOI system

## Target User Groups

The system will be designed for and evaluated by two target user groups: (i) Members of the general public and (ii) clinicians and general practitioners. As a group of medical professionals with specific needs, radiologists will also evaluate search in huge multidimensional images, such as MRI, CT and MRI images with a time component, although this aspect will not be treated in this paper.

*Members of the General Public:* 61% of American Adults seek out health advice online. Almost two-thirds of these adults admit that the information found online affected a decision about how to treat an illness or condition [1]. These searches tend to use one of the major search engines [2], leading to information of varying quality. For example, a recent study showed that about 70% of the top websites with information on oral cancers gathered by Google and Yahoo searches had serious deficiencies, such as failing to attribute authorship, cite sources and report conflicts of interest [3]. On the other hand, access to this information has allowed parents to assist in making diagnoses, for example in the case of rare diseases [4]. KHRESMOI aims to allow members of the general public to obtain reliable and understandable medical information by developing automated and semi-automated approaches to classifying information. In addition, machine translation should ease the access to information in their own language.

*Clinicians and General Practitioners:* Physicians often have unmet information needs. These have been reported as occurring for 2 of every 3 patients seen [5], or more recently for 41% of the questions they pursued [6]. Although these medical professionals have many tools available for information search, in the form of PubMed, etc., studies have

revealed that they do not use them to their full capabilities, or are not aware of extended capabilities of these tools, often hidden behind interface links or buttons. Physicians search on average for less than 5 minutes, and seldom search for more than 10 minutes to answer questions [7]. Hence it is important that the pertinent information is found during this time. However, the time taken to answer questions using MEDLINE averages 30 minutes [5], and furthermore, the information found is often scattered over multiple articles, making PubMed searching MEDLINE impractical for intensive clinical use [7]. KHRESMOI aims to make this information easier and quicker to access through, amongst others, interface support for query formulation, extraction and highlighting of pertinent passages from articles found, and summaries of search results.

## Mobile Search

By the end of 2013, 40% of mobile phone service subscribers will be using mobile Internet [8]. Online health-information usage through mobile devices is steadily increasing. A survey conducted among American adults shows that 17% of mobile phone owners have used their phone to look up health or medical information, while 29% of mobile phone owners aged 18–29 have done such searches [9]. Mobile access to medical information is also frequently requested by clinicians who often work away from their offices and who might have to deal with cases happening in varied situations. Such mobile access is also of interest to clinicians who work in rural areas or in areas with poor infrastructure.

KHRESMOI also aims to develop mobile access to medical information. The embedded and integrated technologies of these mobile devices, such as GPS and touch screens, will be taken advantage of as far as possible. Fig. 2 shows an early prototype of access to the medical literature through a mobile device, allowing search by text queries and by image similarity.

## Conclusion

The KHRESMOI project aims to develop innovative approaches to online medical information search for the general public and medical professionals. Methods to access this information from mobile devices will also be developed.


Figure 2. Result set showing text and images on a mobile device

## Acknowledgment

This work has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 257528 (KHRESMOI).

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# MediTrust: Secure Client Systems for Healthcare IT to Protect Sensitive Data of Patients

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***Abstract:*** **Healthcare professionals typically use their computer systems not only for accessing patient health records, but also to connect to medical accounting and billing services as well as other services on the Internet. This raises security and privacy concerns as client platforms may be infected by malware and could manipulate data or leak data to unauthorized parties. The project MediTrust aims to protect medical data of patients from being leaked to unauthorized parties. We propose a security infrastructure that builds privacy protection domains and enforces them up to the end-user platforms. Usability and effectiveness of the security mechanisms will be evaluated in user studies.**

## Introduction

The use of information technology in healthcare enables new and efficient applications like immediate access to and automatic analysis of medical data. E-health systems like electronic health records (EHRs) are believed to decrease costs in healthcare. However, the increasing use of digital medical data and computing systems operating on these data pose new risks with respect to security and privacy. Health professionals, like doctors and nurses, are not trained security experts, but they use standard computing platforms for various tasks, including accessing privacy-sensitive medical data of patients. These platforms may be vulnerable to malicious software, e.g., Trojan horses. In this context, analyses of e-health infrastructures show that the end-user systems are the least secured part [1].

## Project Goals and Application Scenario

The objective of MediTrust is to develop a usable and secure end-user platform that is able to protect sensitive medical data from being accessed or manipulated by unauthorized parties. We define the following goals:

- protecting medical data that are processed on the same computing platform together with other tasks;
- establishing a security infrastructure that securely separates the data of different workflows;
- providing a usable and user-friendly end-user platform that does not impose an overhead in the normal workflow of health professionals.

We consider a scenario where a doctor's practice uses a computer system to process electronic health records of patients that are stored on a centrally managed server (EHR Server). The same computer system is used to send accounting and billing data to a Healthcare Accounting & Billing Server, and the computer is also used to connect to other services, e.g., web sites on the Internet. We propose to construct privacy domains for medical data as a technical measure to support the enforcement of privacy and data protection policies (see Figure 1). The client platforms, e.g., desktop or notebook computers, must be able to partition execution environments for applications into separate domains that are isolated from each other. Data is kept within a privacy domain, and the domain infrastructure ensures that only authorized entities can join this domain [2]. Moreover, data leakage from the domain is prevented by the security architecture and the domain infrastructure. The same system should be able to be used for different workflows that are strictly isolated. Therefore, the focus of MediTrust is on the development of secure client platforms that can be used not only for accessing sensitive health records and associated accounting data securely, but also support standard operating systems and applications which are

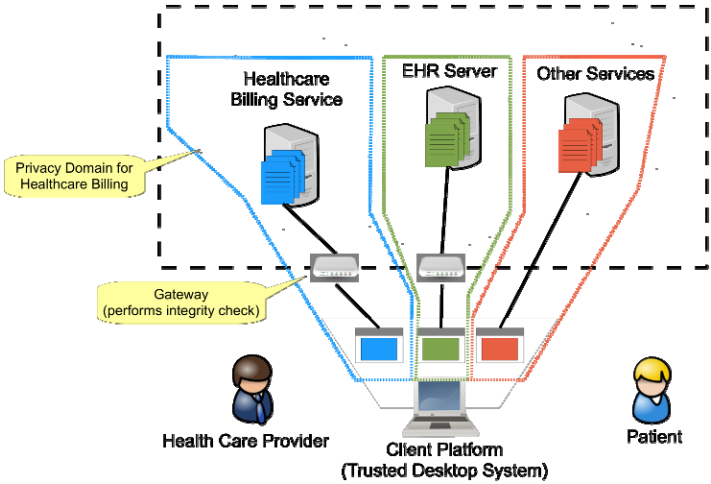


Figure 1. Conceptual view of privacy domains in MediTrust

strictly isolated from the sensitive data and the healthcare client software.

## Technology

The technical solution of MediTrust is based on the TURAYA security platform [3][4]. TURAYA implements a trusted desktop that is based on strong isolation of critical applications and the reliable enforcement of security policies. The underlying security architecture enables a comprehensive and auditable protection of all user data.

TURAYA.TrustedDesktop consists of a security kernel that provides isolated execution environments (which we call compartments) for applications. The security kernel virtualizes the legacy operating system on the client and enables multiple operating systems running concurrently and isolated in different compartments. Communication between compartments is controlled and enforced according to an information flow policy. Therefore, each compartment is associated to a Trusted Virtual Domain (TVD) [3], which spans a closed virtual processing area across multiple platforms. Data leaving a compartment is automatically encrypted and can only be accessed in a compartment that belongs to the same TVD, whether the compartment is on the same machine or on a different physical platform.

The system also ensures that protected information is only processed by trusted components. This is made possible by security kernel technology along with the employment of Trusted Computing technology. The client platform contains a trusted hardware component, the Trusted Platform Module (TPM), which can be used for the verification of the integrity of the software running on the machine.

TURAYA.TrustedDesktop provides the following main security features, which are used to protect medical data from other workflows:

- *Full hard-disk encryption,* sealed to the TPM security chip. The encryption key is never revealed to the operating system of a compartment and, thus, a malicious compartment (e.g., infected by a virus) cannot leak or change sensitive key material.
- *Secure networking.* The TURAYA security kernel enables secure links between compartments according to the TVD policy, and automatically manages dedicated virtual private network (VPN) encryption.
- *Transparent file encryption*. Instead of banning portable storage devices like USB sticks and external hard-disks, TURAYA transparently encrypts data leaving a compartment and restricts the access to other compartments of the same TVD. Thus, it provides offline transport capabilities for exchanged data, e.g., when electronic health records are stored on USB sticks.

- *Secure graphical user interface.* The user interface system supports the different TVDs graphically so that users always know which domain they are currently interacting with. Each compartment has its own virtual screen, which ensures isolation and prevents unintended information flow from one compartment to another without being allowed by the TVD policy. The virtual screens of the compartments are graphically marked with a color and short textual name. Each TVD is assigned a distinct color and name to allow the user to distinguish the different domains. The graphical security information is always under the control of the TURAYA security kernel and shown at the top bar of the screen, which cannot be overwritten by compartments.

## Outlook

We will conduct an intensive field study in real life settings with about 20 users (doctors). We aim to analyze whether the concept of TVDs and corresponding graphical security indicators are properly understood by ordinary users. Moreover, we want to find out whether the system is used correctly (i.e., users do not enter sensitive data into the wrong domain), can be used efficiently (i.e., it does not introduce additional delay in the workflow of the users), and if the screen design approach is sufficient or other security indicators are needed. Potential users of such a system would be over 325,000 physicians in Germany [5], and could be useful in other countries and scenarios as well, e.g., government and enterprises.

## Acknowledgment

This work was partially funded by the German federal state North Rhine-Westphalia and supported by the European Regional Development Fund under the project RUBTrust/MediTrust [6].

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# Semantic Search Engine for Medical Guidelines

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## Introduction

The indexing process in most search engines is mainly based on binding a resource to a series of words, regardless of the meanings of these words. However, this indexing method is not without weaknesses and can result in missing some resources that are relevant to the user, or retrieving false articles because the word used in the query has several different meanings. This happens because these search engines do not take into account the meaning of the words used to build the indexes. For example, searching for articles with the word "cancer" as an input will retrieve articles about "cancer" in the medical domain and also in the field of astrology. For an information system dedicated to the medical domain, the astrological understanding of "cancer" is not relevant. On the contrary it is relevant to be able to use the links between "leucemia" and "cancer", between "leucemia" and "blood". This article describes a Semantic Search Engine for Parkinson Guidelines that takes advantage of these links between concepts – using a technique called "query expansion" - to improve the search experience of the users. After defining the conceptual approach (ontologies and formal concept analysis), the resources involved and the implementation done, the experimentation is quickly described and conclusion and future work described.

## Concepts

The SIMG Search Engine is based on two ontologies - an ontology being defined as a concept hierarchy and a set of relations between the concepts [1]. One of the ontologies is created on the result of formal concept analysis(FCA)[2] which is a mathematical formalism allowing to derive a concept lattice from a formal context K = (G,M,I). FCA has been used for a number of purposes among which knowledge modeling, acquisition, and

processing, lattice and ontology design, information retrieval and data mining. In K, G denotes a set of objects, M a set of attributes, and I a binary relation defined on the Cartesian product G x M. The concept lattice is composed of formal concepts organized into a lattice by a partial ordering, i.e. a subsumption relation comparing concepts. A concept is a pair (A,B) where $A \subseteq G$, $B \subseteq M$, and A is the maximal set of objects sharing the whole set of attributes in B (and vice versa). The concepts in a concept lattice are computed on the basis of a Galois connection defined by two derivation operators denoted by ':

$$' : G \rightarrow M \mid A'=\{m \in M \mid \forall\, g \in A : (g,m) \in I\}$$

$$' : M \rightarrow G \mid B'=\{g \in G \mid \forall\, m \in B : (g,m) \in I\}$$

## Resources & Implementation

The first ontology is built by identifying relevant terms in the considered guidelines, performing the FCA (Formal Concept Analysis) [2], a data mining method, on the result set and finally translating it into OWL-DL (Web Ontology Language – Description Logic) [3] to be able to query it conveniently. The second ontology is created based on the previously identified terms and is structured using the Meta thesaurus and the Semantic Network from UMLS (Unified Medical Language System)[4].

*Building the first ontology:*

| | parkinson | tremor | levodopa | pain | falls | stress | diet therapy | dementia | dopamine | depression | basal ganglia | hypothalamus |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Guideline_1 | x | x | x | | | x | x | x | x | x | | |
| Guideline_2 | x | x | x | x | x | | | x | x | x | x | |
| Guideline_3 | x | x | x | x | x | x | x | x | x | x | | x |
| Guideline_4 | x | x | x | | | x | | x | x | x | | |
| Guideline_5 | x | x | x | x | x | x | | x | x | x | x | x |

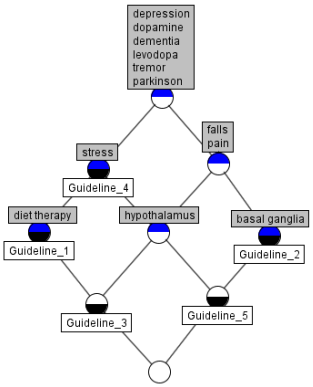


Figure 1. The context of texts-terms and the associated lattice

A formal context K = (G,M,I) (see the – left) is composed of a set G of texts (objects), a set M of terms (attributes), and a relation $I \subseteq G \times M$ where I(g,m) states that the term m appear in the text g. The - right shows the corresponding concept lattice.

The resulting lattice is translated into an ontology (OWL-DL language) following the method described in [Ben08]. This ontology is called "Terms Domain Ontology" (TDO).

*Building the second ontology:*

The second ontology is building from the thesaurus UMLS. For each term extracted from texts, we search the corresponding concept in UMLS. After that, we extract the part of hierarchy in UMLS related to this extracted concept. The resulting hierarchy is translated into an ontology (OWL-DL language). This ontology is called "Information Retrieval Ontology" (IRO).

*Search engine:*

For enriching the users' queries, our methodology proposes to use two ontologies. The search engine uses the first ontology for finding texts that have the terms of the query. If the answer (set of texts) is not relevant for users, then the query is extending by using the information retrieval ontology. The  explains this methodology.

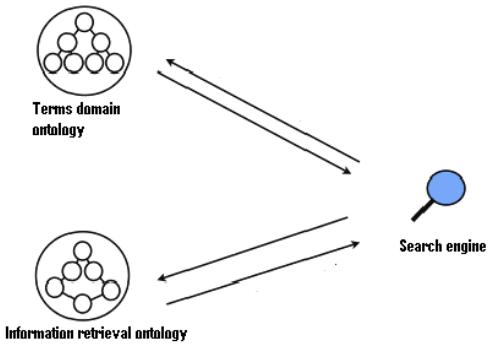


Figure 2. Search engine methodology

## Experimentation

The Semantic Search Engine provides three query expansions, Specialization, Generalization, Relational expansion. These expansion queries are experimented on a corpus of Medical Guidelines for the Parkinson Disease (9 documents, 800 pages total) from which were extracted 250 terms, structured into the TDO and IRO ontologies following the methods described earlier in the article. Figure 3 gives an overview of the three steps offered to create expanded queries and search guidelines.

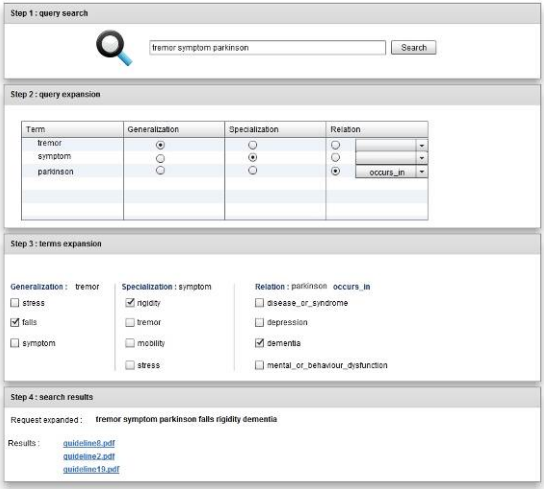

Figure 3. Three steps semantic search using query expansion

## Conclusion and Future Work

In order to create the SIMG semantic search engine we associated several up-to-date concepts and tools: ontologies, FCA, query expansion. The resulting prototype is yet to be evaluated on larger corpora and also to be validated in other domains. For this purpose we identified as relevant the increasing number of Linked Data sources in many domains [6].

## Acknowledgment

The research leading to the results presented in this paper is carried out in the context of an eHealth project of the Walloon Region of Belgium, supported by the FEDER – European Union and the Walloon Region under the terms defined in the Convention n°ECV12020022296F.

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# The Use of Neural Networks to Predict Virological Response in HIV-positive Patients

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***Abstract:*** **In 2008, there were between 30 and 36 million HIV positive patients around the world, two-thirds of whom are in sub-Saharan Africa. HIV infection can be effectively managed with antiretroviral (ARV) drugs but close monitoring of the disease progression is vital. One of the best available surrogate markers for HIV progression is the use of $CD_4$ lymphocyte cell counts. There have been some attempts to measure the progression and other aspects of the HIV disease using machine learning. Most of these techniques however have a major limitation for its use in developing countries as they make use of part of the patient genome as an input into the machine-learning model. Determining the GAG and POL genes is still an expensive and laborious task in environments where there are limited recourses. The aim of this pilot study was to apply a machine-learning technique to investigate if it is possible to forecast $CD_4$ count change by using readily available data. Preliminary results indicate an accuracy of 81% and 85% for classification models. This study shows that it is possible to mathematically forecast a change in $CD_4$ count using machine learning without genome data.**

## Introduction

In 2008, there were between 30 and 36 million HIV positive patients around the world, two-thirds of whom are in sub-Saharan Africa. This number has steadily increased due to the high incidence rate of HIV. HIV/AIDS is the leading cause of death in sub-Saharan Africa and is currently the fastest growing epidemic in South Africa with 5.5 million confirmed cases of HIV/AIDS.

HIV infection can be effectively managed with antiretroviral (ARV) drugs but close monitoring of the disease progression is vital. Laboratory and clinical markers of disease progression are used to monitor HIV infection. One of the best available surrogate markers for HIV progression is the use of $CD_4$ lymphocyte cell counts. $CD_4$ count is recognized as a

standard measure of immunodeficiency in HIV positive patients in developed countries and areas where there is a low rate of HIV infection. Determining a patient's $CD_4$ count is important in $CD_4$–guided treatment of HIV. It thus follows that the ability to forecast $CD_4$ count changes would be valuable to physicians. If one can predict the short-term change of the $CD_4$ count a physician may change treatment in order to take steps to prevent opportunistic infection such as pneumocystis pneumonia and delay the onset of AIDS ($CD_4$ count < 200).

Although the use of $CD_4$ count is part of the standard of care in developing countries, the measurement of $CD_4$ count requires many complex and expensive flow cytometric procedures which burden the minimal resources available. Knowing possible changes to $CD_4$ count may help with resource allocation.

There have been some attempts to measure the progression and other aspects of the HIV disease using machine learning. Studies have been shown the ability of machine learning to predict current drug resistance, future drug resistance, evolution of the HIV in a patient, and predicting future $CD_4$ count [1][2]. Machine learning is an artificial intelligence computer science technique that tries to find a mathematical model that maps between inputs and outputs of a domain problem. There are two stages of using machine learning techniques: creating the mathematical model by learning mappings between given input and output and using the model to predict an output given unseen input.

Most of these techniques however have a major limitation for its use in developing countries as they make use of part of the patient genome as an input into the machine-learning model. Determining the GAG and POL genes is still an expensive and laborious task in environments where there are limited recourses.

The aim of this pilot study was to apply a machine-learning technique to investigate if it is possible to forecast $CD_4$ count change by using readily available data. The objective was to produce a mathematical model that can predict the range of change of an individual HIV-1 positive patient's $CD_4$ count, without any complex tests that will add extra burden to the limited resources of a developing country.

## Method

Separate patient datasets containing treatment information and disease progression were obtained from the Stanford HIV drug resistance database (http://hivdb.stanford.edu/). The datasets from the ACTG 302, ACTG 303, ACTG 306, ACTG 320, ACTG 333, ACTG 364, ACTG 384, GART and HAVANA studies were used. These de-identified datasets are publically

available. Three separate datasets where used for each study. The first dataset consisted of the ARV drugs the patients have been exposed to, the start and stop date of the ART in terms of the number of weeks from the baseline $CD_4$ cell count measurement, genome sequence, patient ID, The second dataset consisted of $CD_4$ cell count, patient ID, and date in terms of the number of weeks from the baseline $CD_4$ cell count measurement. The third consisted of viral load, patient ID, and date in terms of the number of weeks from the baseline $CD_4$ cell count measurement.

The correct viral loads and $CD_4$ cell count were associated with the treatment data by joining the datasets on the unique patient identifier and date. This single pooled dataset consisted of 6149 data elements. A JAVA application was written to determine which patients had two or more associated $CD_4$ cell count and viral loads taken at different times. For each of these patients a difference in $CD_4$ cell count and time was determined. This represents the change in $CD_4$ cell count after a certain number of weeks. This was used to produce a longitudinal type dataset that consisted of 617 data elements. 65 random data elements were removed from this dataset and formed a testing set. Training was done on the remaining data elements of the protease datasets.

A neural network was used to created the first model that takes as input the ARV drugs the patients have been exposed to, viral loads and the number of weeks from the baseline $CD_4$ cell count measurement, and tries to determine if the future change in $CD_4$ count > 25%.

A second classification model was built based on the changes (Δ) in $CD_4$ count. The changes in $CD_4$ count were grouped into four categories as shown in Equation 1.

$$Classification = \left\{ \begin{array}{ll} Output1, & \Delta CD4 < 0 \\ Output2, & 0 \le \Delta CD4 \le 50 \\ Output4 & \Delta CD4 > 100 \end{array} \right\} \quad (1)$$

## Results

Preliminary results indicate an accuracy of 81% for the first classification model. The neural network produced a sensitivity of 72%, specificity of 71%, a positive predictive value of 71% and a negative predicative value of 73%. The second model produced an accuracy of 85%.

## Conclusion

This study shows that it is possible to mathematically forecast a change in $CD_4$ count using machine learning without genome data. The purpose of such a tool is not to predict exactly what the change in $CD_4$ count will be, but to provide a general indication of the change in $CD_4$ count. This information can then be used to better manage scare resources.

This study forms part of a larger study to create a web-based HIV resistance portal. It is envisioned that this portal will be used by clinicians to guide treatment by providing them with information about a specific patient's current resistance profile, future resistance profiles, the effect of changes in treatment and the prediction of the onset of AIDS, opportunistic diseases and mortality. This will guide the clinician in determining the optimal therapy for individual patients.

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# Toward an Adaptive Computer-Interpretable Clinical Guideline for Personalization of Treatments

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***Abstract:*** **Computer-Interpretable Clinical Guidelines (CIGs) are Clinical Guidelines expressed with computer-interpretable languages. This paper presents the iCareflow framework, which proposes to constraint CIGs with external data in order to personalize medical treatment plans.**

## Introduction

Clinical Guidelines (CGs) are recommendations on the appropriate plans for treatment and care of patients with specific diseases and conditions. They are developed based on the best available evidences and are used to make clinical decisions and medical actions more effective. The aims of CGs are to reduce interpractice variations and costs, to develop standardize clinical procedures, to assess healthcare professionals, to educate and training caregivers and to improve the communication between patient and caregivers [1]. The weaknesses of CGs are that they are defined based on: (i) Ideal patients. Patients that have "just the single" disease considered in the CG, and are "statistically relevant", not presenting rare peculiarities/side-effects. (ii) Ideal physicians executing the CG. Physicians, having the basic medical knowledge, properly applying the CGs to specific patients. (iii) Ideal context of execution. All necessary resources are available. In reality, the patients' reactions to treatments are different and some customizations are necessary in order to improve the quality of care. These customizations are either based on the experience of the care providers and on the set of data that care providers have access.

The Information and Communication Technologies (ICT) has been used to improve this scenario by promoting the deployment of CGs and

integrating a subset of information from CGs into the Decision Support Systems (DSS) used by Practices Medical Systems (PMS). According to [2], "*ICT have a tremendous potential to improve the quality of health care, to change the paradigms inherent to medical practice as well as the bases underlying the development and usage of knowledge*". However, the information contained in the CGs is still expressed for human interpretation. Some works propose computer-interpretable languages to express CGs, as shown in [3], in order to build computer-interpretable guidelines (CIGs). But, the methodology to build CIGs are not the same and the quality of the CIGs can change according to authors' methodology.

This paper aims at showing the impact of authors' methodology over the computer interpretation of CIGs and at presenting the outcomes of our works to deal with actions description and multiple constraints integration.

## The iCareflow Framework

The iCareflow framework was proposed for refining CIGs into personalized careflows. It relies on the two most popular trends in eHealth, the *Evidence-Based Medicine* (EBM) and the *Patient-Centered Medicine (*PCM*)*, to obtain a treatment plan adapted to the patient needs.

The main difference between EBM and PCM is that the former searches for standardizing procedures based on observation and generalization. The last focuses on the individual's characteristics and on the potential heterogeneity of patients (or institutions or geographical regions) for customizing care actions. Both approaches are used in a complementary way. For instance, a set of CIGs is selected by a healthcare professional (HP) as the general knowledge used to compose a treatment plan. Then, applying specific knowledge (i.e., information about the health state and preferences of patients, hospital procedures, etc.) the HP adapt the treatment plan to get a personalized one. This process can be supported by IT systems, even though the validation of the resulting treatment plan by the HP is mandatory.

The general idea of this approach is illustrated in Fig. 1, and detailed in [4]. In the left side, a set of actors that participate to the definition and to the customisation of the CIG are represented, and their roles in the process. In the right side, the data sources and the steps needed to customize the CIG are indicated. At this point, the quality of the CIG is supposed to be good and only the customisation process is illustrated. The CIG is supposed to be validated by a standard organization or committee. This CIG is described in a specific language according to a specification approach.

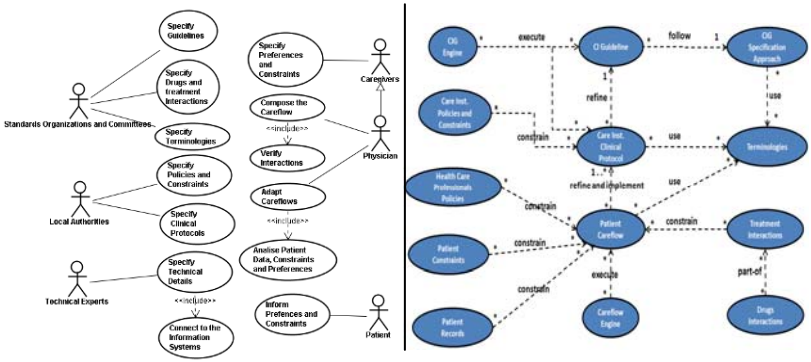


Figure 1: iCareflow framework

The terminology used in the CIG is supposed to be based on standard ones (e.g., ICD10, SNOMED, etc.). Any information that is not directly related to the disease is not included in the CIG. However, this information can be considered during the customization process if they are defined by one of the other actors. For instance, during the period of July to December 2009, all cases of flu were considered as potentially dangerous in Luxembourg and the analysis to identify the H1N1 virus was often requested. This was not included into the CIG describing the treatment of the flu, but it was local information sent by local authorities to concerned physicians. In the iCareflow approach, the constraint (check if the flu virus is the H1N1) can be included in the customization process without modifying the content of the CIG. This is also valid for patients' will (e.g., blood transfusion) or caregivers' preferences.

One of the main challenges of this approach is to harmonize and combine the information coming from different sources. We are working on a description-language independent approach. Thus, several data sources are considered (e.g., CIG editors, local constraints editors, PMS, hospital information systems, etc.). Even if each of them can have different structures and are expressed in natural language, we are formalizing their content using standards like UMLS and HL7/RIM, and Semantic Web technologies. The overall framework is decomposed into two modules: one to transform the input information (care actions) into a format based on HL7/RIM standard; the output of the first module is an ontology used by the second module to constraint the CIG. The rules used to constraint the CIG are expressed in SWRL, and the result of this module is the personalized CIG. The main advantage of this approach is that several CIGs can be

evaluated in parallel during the treatment customization, and external constraints can also been considered.

The current state of this work is the implementation of two supporting tools (called MedAForm and CPS), used to evaluate/validate the modules. A set of CIGs were imported from the Tallis Composer Web Repository (http://www.cossac.org/tallis) and has been used in the evaluation process. The main problems founded are related to the quality of the contents. Some samples of it are presented in table 1.

Table 1

| CIG Name | Action description | Action Name |
|---|---|---|
| Aspirin V1 | If sure of dose ingested patient may be medically discharged (consider psychiatric assessment). If in any doubt confirm with salicylate levels. | Discharge_patient |
| Paracetanol | Start treatment with IV N-acetylcysteine (Parvolex) as directed in the BNF. Take blood for paracetamol levels and baseline INR, LFTs, creatinine and venous bicarbonate (if bicarbonate abnormal, check arterial blood gases). | Treat |

In the same element of the CIG (e.g. actions) we can find, mixed in the same sentence, conditions, explanations or a set of complex procedures. This misuse of the tools can be avoided if a standard description methodology is defined, supporting the correct transcription of the CGs into CIGs.

## Acknowledgment

The present project is supported by the National Research Fund of Luxembourg and co-funded under the Marie Curie Actions of the European Commission (FP7- COFUND)

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# X-Ray Image Based Computer-Assisted Methods for Pulmonary Diseases

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***Abstract*: The aim of this paper is to present some results in the middle of the project DAPSEpro "Medical data acquisition, processing and collection for eHealth solutions". The presented results are oriented to investigation computer-assisted methods based on X-ray images.**

## Introduction

The aim of this paper is to present some results of started as part of DAPSEpro "Medical data acquisition, processing and collection for eHealth solutions" project for X-ray images based computer-assisted methods.

Computer assisted diagnosis is an application of computer programs designed to assist the physician in solving a diagnostic problem [6]. This defines the fundamental limit imposed upon developing methods and techniques: they are oriented to improve physicians' sensor system, to reduce complexity and to improve quality of showed information.

A major problem of methods based on X-ray images is the images' quality used for diagnosis. This applies to all diseases where one of the following changes in image can be observed: changes with a small X-ray density, the appearance of shadows in the image, soft shadows, structural formations with a certain shape (linear, circular or otherwise), etc. Pulmonary diseases are targeted here because in many cases X-ray image is the only way to diagnose in time diseases like peripheral lung cancer, secondary tuberculosis, pulmonary embolism, bronchiectasis, echinococcus of the lung, etc. The low quality of X-ray images is one of the reasons for hypo- or hyper-diagnosis as a result of incorrect deciphering. This problem is even more pronounced using the old type X-ray images (analog images).

The presented in the paper research is oriented to the analyses of some problems and to creation of new techniques and methods for X-ray image processing. The main goal of all research is perception improvement of

processed X-ray images under elimination medical artifact: only after eliminating the possibility of the occurrence of medical artifacts developed techniques and methods can be used for the purposes of computer-assisted diagnostics.

## Quality problems of computer assisted methods for diagnosis based on X-ray images

One of the initial tasks assigned by the hospital staff was the need for digitization and archiving of patients' old X-rays. This involved determining the technology to make it as basic requirements were:

- The ability to obtain 'acceptable' images from all size classical X-rays: old X-rays, wrongly kept at home X-rays, or made a poorly calibrated machine from older generations.
- Very limited financial resources for new equipment.
- Quick and inexpensive image digitalization process: marketing research showed similar services with prices between 2-15 USD depending on the size and quality due

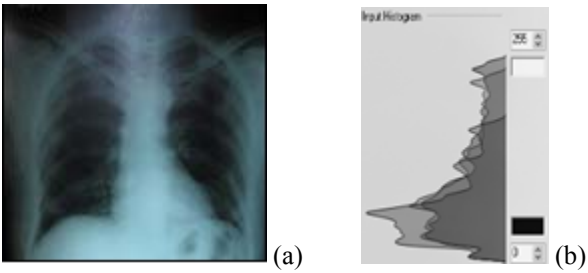

Fig. 1. Coloured X-ray image: (a) digitalized image and (b) its histogram (RGB channels)

Working to solve this task we examined various techniques and devices digitalization old X-ray images. The results of investigation directed our efforts to develop low-cost system based on digital photo cameras [5].

The next stage of our research focused on identifying

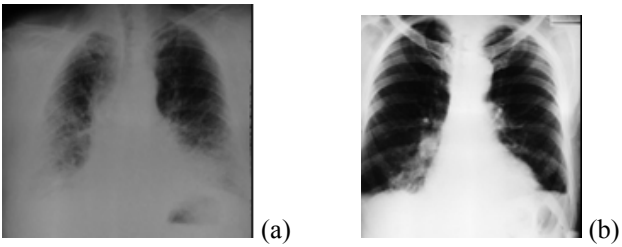

Fig. 2. Badly calibrated X-ray machine: (a) overexposure (b) underexposure

problems in the digitized X-rays. We determined following basic problems' groups:

- The difference between human eyes and digital cameras as a vision device.
- The characteristics of used X-ray machine
- The influence of storage conditions of X-rays on their quality and characteristics.

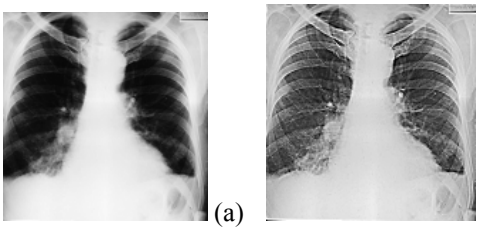


Fig. 3. X-ray image with underexposure: (a) original (b) after correction

The difference between human eyes and digital cameras as a vision device this is due mostly to different color spaces and the specific properties of human vision known as 'visual weight' and 'approximate color consistence' [7]. As a result in many cases when human percept X-rays as grayscale images, digital cameras produce color image (fig. 1). In all these cases a conversion color-to-grayscale is needed. This is risky because methods for this conversion can produce artifacts and some of them can be characterized as medical artifacts [8].

The characteristics of used X-ray machine most often affect the quality of

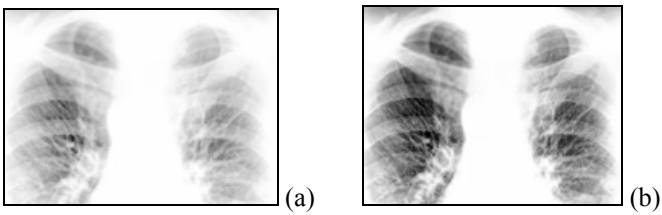


Fig. 4. Fading of X-rays as a result of improper storage: (a) original (b) after correction

the exposure, the contrast and the brightness level. In cases of low quality exposure (underexposure or overexposure) ability to decipher images are limited because images are too white or too black (fig. 2). Problems with low contrast and/or brightness levels are similar: ability of information retrieval decrease and medical artifacts appear on the images.

Improper storage of images leads to the following major issues: fading of images (losing of contrast), coloring X-rays, many kid of injuries.

## Results

Regarding the selection of method for 'color-to-grayscale' conversion of digitalized images we still cannot recommend a single method: some methods are selected for testing and now we are in phase of evaluating result of usage of these methods. Images evaluation based on two criteria: physiological perception and appearance of medical artifacts.

To improve the quality of the digitalized X-rays numerous studies on the

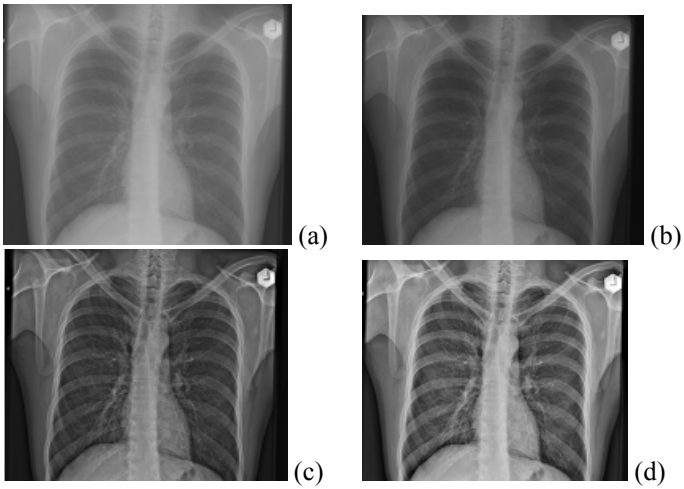


Fig. 5. Improved image quality of scanned X rays: (a) original (b) filtered (c) contrast correction (d) hybrid technique (adaptive algorithms)

filtering methods, methods for contrast enhancement, and combined methods were carried out. Tests were conducted with second-order structures too: the X-ray image of the lung has many transitions between areas of soft tissues and bones, but they have large differences in contrast and brightness in the final image; this generates high frequency components the result of which is artifacts in the image. Some results of these investigations are shown in fig. 3,4,5.

The final direction of our investigation is to develop semi-automatic techniques for improving quality of digitalized X-rays because now all used techniques need full manual control by physician.

## Conclusion

Preparation of the images for this paper resulted to diagnosis confirmation. Additionally was obtained confirmation that personnel with lower qualification can better interpret images. Definitely was confirmed that images with very low quality can be processed and interpreted. These results reduced need for new pictures and reduced dose exposition for the patients [4].

## Acknowledgment

Different parts of this work are funded by Bulgarian NSF under D002/113-2008, DRNF 02/3-2009 and DTK 02/63-2009 projects.

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# International Telemedicine and eHealth Initiatives and Developments

# A Qualitative Study on the Factors Interfering in the Implementation of the Brazilian National Telehealth Project in Minas Gerais

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***Abstract:*** **The Brazilian National Telehealth Program is implemented in 900 municipalities. Currently the main activities in Minas Gerais are as follows: online and offline second opinion followed by fortnight formative webconferencing in medicine, nursing and dentistry. Since we have observed a great discrepancy concerning the frequency with which municipalities use telehealth resources we decided to evaluate the main factors interfering in such process. Fifty municipalities of Minas Gerais were randomly selected to participate in this study. These municipalities underwent a thorough analysis to detect difficulties and benefits to implement and use telehealth resources. In order to reach our goal a semi-structured questionnaire was applied to each family health team coordinator responsible for primary care. The questionnaires were promptly answered by the coordinators who had in general a highly positive overall perception of the project. The positive aspects highlighted were: connection with the university granting healthcare improvement through specialists' support, use of webconferencing as an effective tool to qualify healthcare professionals. The main negative aspect identified in the project was the poor quality of connectivity in a few municipalities. Organizational and connectivity aspects of telehealth as a tool to improve healthcare quality in remote areas appear to be the main obstacle for the success of the project. Based on this study we have concluded that it is possible to increase the frequency of telehealth resources use by changing organizational aspects of healthcare services.**

## Introduction

The strategy of the World Health Organization (WHO) in the 21st century is to make high-quality healthcare available for all [1].

The reorganization of the health system in Brazil, including the focus on primary healthcare, has been recent. The implementation has relied upon professionals who have traditionally had a conventional educational background, with courses structured according to a highly specialized, curative, individual and hospital centered approach. The challenge of incorporating telehealth resources into the Brazilian public system (SUS) is linked to the objective of strengthening the public model already established. It also had the intention of reinforcing the role of primary care in a context where professionals are still not adequately trained, both from the point of view of dealing with clinical issues at this level of care and of promoting health [2].

The National Telehealth Program in Brazil was initially established in nine states, with the purpose of offering essential benefits of healthcare to poor population living away from great urban centers. In order to accomplish this purpose, telehealth requires federal, state and local sectors interaction. In Minas Gerais State, the program has been connecting 100 municipalities. The Program offers videoconferencing, educational teleconsultations (second opinion) and distance courses in medicine, nursing and dentistry [3].

Since we have observed a great discrepancy concerning the frequency with which municipalities use telehealth resources in our state, we decided to evaluate the main factors interfering in such process.

## Methodology

It is a qualitative study and descriptive analysis of a semi-structured questionnaire involving municipalities of Minas Gerais, Brazil, participating in the National Telehealth Program.During 2009, fifty municipalities of Minas Gerais were randomly selected to participate in this study. These municipalities underwent a thorough analysis to detect difficulties and benefits to implement and use telehealth resources. In order to reach our goal, a semi-structured questionnaire was applied to each family health team coordinator responsible for primary care. Data were then submitted to free, open source Qualitative Data Analysis (QDA) software.

## Results

The questionnaires were promptly answered by the coordinators who had in general a highly positive overall perception of the project.

The positive aspects highlighted were: 1) Connection with the university granting healthcare improvement with capability and speed to diagnose a case through specialists' support; 2) Use of webconferencing as an effective

tool to qualify healthcare professionals for their daily tasks; 3) The fast incorporation of technologies.

The main negative aspect of the project identified by the study was the poor quality of connectivity in a few municipalities. Other negative aspects are related to the lack of compatibility of daily schedules with on line teleconsultations. Otherwise, when questions were taken to evaluate personnel, organizational and connectivity aspects of telehealth as a tool to improve health quality in remote areas, it turns out clear that the main obstacle for the success of the project was related to organizational aspects.

## Discussion and Conclusion

The use of telehealth resources in these remote areas introduces a change in the working process. In the past, patients had to travel to large urban centers meaning high costs and unnecessary annoyance for them.

Brazil is a very large country and the cost of transport is high, roads are not good and it is necessary to wait for a long time to obtain a specialist consultation in the public healthcare system.

In telehealth programs, considering the assistance aspects for municipalities, the possibility of health professionals discussing clinical cases with specialists increases the effectiveness and adds quality to primary care [4].

Universities can also benefit from the integration with primary care providers, identifying gaps and improving its teaching/learning activities. Since the education process happens at the healthcare unit, it results in optimizing efforts and rationalizing resources, once professionals do not have to move from their workplace [5].

Such a commitment to improve healthcare delivery, by using information and telecommunication technologies, is also being considered by those with financial means to do so, for example, the participants in various European Commission projects [6].

With regard to the organizational aspect, the study highlights the quality of teleconsultants and the ability and speed to diagnose a case as positive aspects. With regard to the technological component, the study lists the fast incorporation of technologies as a positive aspect, while the problems related to connectivity were regarded as a negative aspect.

Based on this study we have concluded that it is possible to increase the frequency of telehealth resources use by changing organizational aspects of healthcare services. The involvement of State and city Governments is necessary for the consolidation and maintenance of this program. Despite all these obstacles, there is a capacity to produce benefits for the patient

including qualified care, resolution of clinical cases and avoidance of referrals to specialists in most cases.

## Acknowledgment

We would like to thank the technicians at the Telehealth Center of the Medicine School at the Federal University of Minas Gerais, the Ministry of Health of Brazil, other organizations that support this project, and all healthcare professionals participating in the project.

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# A South Africa National Telemedicine Survey

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***Abstract:*** **The first National South African Telemedicine Survey took place in 2010. The aim of the survey was to give an accurate account of the Telemedicine landscape in South Africa. This information would guide further research to provide evidence regarding Telemedicine. The results of the survey were not conclusive; however it did highlight the need for further research. Furthermore, the survey has given a clear indication that there is a huge potential to expand the Telemedicine initiative in South Africa.**

## Introduction

More than 40% of the South African population lives in rural areas [1]. The public health system is utilized by 84% of the 45 million people living in South Africa [2]. Although South Africa is not considered disadvantaged when reviewing the medical practitioner to patient ratio compared to other African countries. The ratio in South Africa is reflected as 27 medical practitioners per 100,000 people and 10 medical specialists per 100,000 people [3].

A review of the literature related to Telemedicine in South Africa indicated that there was 24 articles, of which 20 were retrieved, with 2 being found to be irrelevant (i.e. 'New meningitis threat being contained by web partnerships' and 'Telemedicine in veterinary practice'). The literature review showed that there is a distinctive place for the role of Telemedicine in South Africa, with the relevant pilot schemes being described as having potential for tele-radiology, tele-ophthalmology, tele-pathology, and tele-dermatology applications.

In 1998, the first phase of implementation of Telemedicine began. The implementation was guided by the National Strategy for Telemedicine, the objectives of the strategy focused on: providing high quality and cost effective health care and education; improving recruitment and retention of health professionals; delivering health care at a distance and making specialist health care available and accessible [4]. One of the most common

Telemedicine applications being used in South Africa is tele-dermatology. This application is aimed at the public health sector to alleviate the enormous burden placed on the Dermatologist [5].

This paper documents one of the first steps to gather information about the distribution and status of telemedicine in South Africa.

## Methodology

A list of public health facilities was drafted using sources including the (1) Provincial Registry of Health Facilities, (2) National Department of Health Registry and (3)Nursing Handbook 2009.

The three lists were combined to form a comprehensive list of health facilities in South Africa, which included 2839 health facilities. An ethics application was submitted to the Ethics Committee Medical Research Council and the National Department of Health. Both organizations approved the research. The National Department of Health then sent letters to all provincial departments of health informing them about the research and indicating that the research has been approved. A survey form asking 3 basic questions was sent to 2 839 public health facilities. Letters were posted and return envelopes were provided together with email and fax details to allow health facilities to respond.

## Results and Discussion

The questionnaire response rate was 9.7% (*n=277*). This is a clear indication that a vast amount of research is required to determine the Telemedicine landscape in South Africa. A small percentage, 7.5% (*n=21),* of those that had responded indicated that they have a telemedicine initiative at their health facility. The survey was sent out to health practitioners (e.g. specialists, nurses etc.) as well as systems managers (e.g. operational managers, information officers etc.) in almost equal proportions. The response rate from these groups was also almost equal.

Fig. 1 shows the Telemedicine Application Distribution for South Africa. The distribution of Telemedicine application highlights that the full potential of Telemedicine in South Africa has not been realized.

As 33% of the systems are being used for tele-consultation yet the burden of diseases indicates that the top 5 causes of premature mortality burden is; (1) Human Immunodeficiency Virus (HIV), (2) Homicide/Violence; (3) Tuberculosis; (4) Road Traffic Accidents and (5) Diarrhoeal Diseases [6].

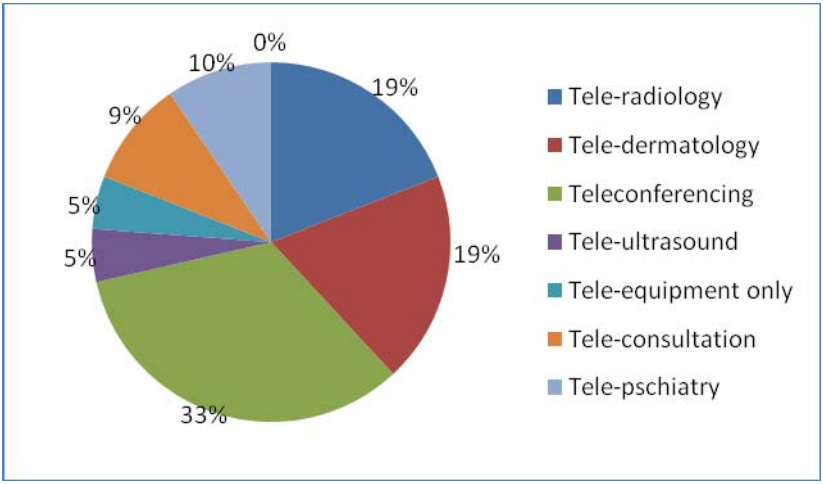


Figure 1: Telemedicine Application Distribution in South Africa

An alternate explanation for distribution of telemedicine applications is that health facilities and key role players lack knowledge about Telemedicine and its potential. The questionnaire clearly defined Telemedicine, so we have ruled out the possibility that Telemedicine was not adequately defined.

Knowledge and documentation exists that there are projects that currently active in South Africa that targets diseases like HIV and TB. These projects include Cell-life, eMUM and Open MRS. Recently in South Africa, there has also been a substantial increase in the use of mobile phones to enable healthcare services and education.

## Conclusion

Due to the disappointing response rate to this survey, it is not possible to draw a clear-cut conclusion from the results. It is therefore recommended that further detailed research takes place to give an accurate account of the Telemedicine landscape. In a follow-up survey certain strategies for increasing response rates to postal questionnaires could be considered [7]. It is also important to note that the questionnaire was only administered in the public health sector of South Africa. A follow-up survey could be extended to the private health sector. This survey has highlighted that there is potential to expand on the existing Telemedicine activities and to introduce new ones. To integrate Telemedicine into the health system it is imperative

that a Telemedicine awareness campaign takes place. A huge capital investment is made not only for the purchase of Telemedicine equipment and infrastructure but also for the development of policy. The disappointing response rate may be indicative of the need to sharpen the focus of this investment on increasing the awareness and knowledge of Telemedicine amongst healthcare workers.


## Acknowledgement

The authors wish to thank the Medical Research Council and Stellenbosch University for their support. The Department of Science and Technology is thanked for their funding contribution.


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# eHealth Economics: The Need For Standardized Metrics and Frameworks

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***Abstract:*** **Policy and decision makers lack economic data on eHealth solutions. A literature review of eHealth economics was undertaken and 2,174 papers and reports identified. Economic evidence of the benefit of eHealth has been poorly studied. There is need to develop analytical frameworks, methodologies, and standardized metrics for the economic assessment of eHealth programmes.**

## Introduction

Healthcare is at a cross-road. The developed world faces rising healthcare costs and an ageing population. The developing world is striving to improve access to and quality of care. Both have limited financial resources albeit of very different scales. eHealth is seen as a possible solution. In the developing world, policy makers not only have far less to spend, they have growing populations, higher disease burden, shortages of healthcare professionals, limited infrastructure and expensive connectivity. The costs of eHealth need to be weighed against the opportunity costs.

Before committing to eHealth solution decision makers should ideally be able to compare the economic and socioeconomic benefits accruing to different eHealth options such as electronic district health information systems, telemedicine, electronic patient records, central patient order entry systems, etc. in order to be able to determine which solution will provide the most benefit within their available resources. This requires evidence based economic data for eHealth solutions which entails the identification, measurement, valuation and comparison of costs and consequences of the options being considered. The process of eHealth assessment is complex and there do not appear to be standardized evaluation techniques. This may be because eHealth encompasses a wide range of applications both clinical and administrative.

The aim of this study was to review the literature on the economics of eHealth, summarize issues relating to eHealth economics and identify frameworks for economic evaluation of eHealth.

## Method

Searches were undertaken of electronic databases, Pubmed, CINAHL, and EconLit using search terms eHealth, telemedicine, telehealth, remote monitoring, remote care and cost, cost benefit analyses or economics. Abstracts were reviewed and papers obtained if relevant. References were scanned for additional sources. Grey literature was searched using Google and Google Scholar.

## Results

2,174 papers and articles from health and economics databases, reports and grey literature were reviewed.

## Discussion

No literature on the comparison of the economic benefits of different eHealth solutions such as telemedicine, electronic district health information systems, electronic medical records, etc. was found. Although there are a large number of documents on economics and eHealth there is a paucity of data on the economics of eHealth and methodologies for economic assessment of eHealth. The lack of well conducted economic assessments of eHealth is documented.[1,2]. It is not uncommon for reviewers of different aspects of eHealth to conclude that "eHealth has not assigned a high priority to measuring or dealing with economic and productivity factors."[1] and "Economic evaluations of telemedicine, however, remain rare, and few of those conducted accounted for the wide range of costs and benefits."[2]

This situation is in part due to the absence of standardized metrics and generic frameworks for evaluating eHealth, with a resultant lack of comparable data. When reported, data tend to be limited, sample sizes small, and evaluation tools poor.

Economic analysis of eHealth is complex and is not merely a simple accounting exercise, as the costs and benefits need to be examined from all perspectives, those of the patient, provider, tax payer, employer, funder or insurer and in some instances society. What may be a benefit to one may be a non-recoverable cost to another.

Over twenty different economic metrics have been used, with cost benefit analysis seen as one of the more appropriate methods of analysis. But this requires non-monetary socio-economic benefits such as quality of life to be converted into monetary values which can be difficult.

The timing of analysis is also important. Analysis should ideally be undertaken during each of the three phases of a programme; planning,

implementation and routine operation. The evaluation methodology should be developed during the planning phase of the project so that the correct data are gathered during each phase. Data from a range of successful eHealth programmes in Europe and the USA have shown that the time to net cumulative benefit can range from 3 to 13 years.[1,3] Early analysis may therefore fail to demonstrate return on investment.

The need for generic frameworks for economic evaluation of eHealth has been stated for over a decade with limited response. eHealth covers a spectrum of activities and the costs and benefits required to evaluate a health information exchange will differ from those of a store and forward telemedicine programme, but the principles should be the same. A context-adaptive approach for a generic model for eHealth economic evaluation was proposed in the eHealth Impact Studies. This is based on cost-benefit analysis and is applicable to a wide range of applications across the eHealth spectrum. The model looks at all relevant costs and benefits to all stakeholders and computes net economic gains, eHealth utilization and productivity through each of the stages of planning, implementation and routine operation. Its use in different settings is yet to be reported.

A 2009 systematic review of economic evaluations of telemedicine, found only 33 papers, in which both costs (resource use) and outcomes (non-resource consequences) were measured. More than half the papers provided limited or unclear cost information but the benefit side of the equation was more consistently reported.[2] Another 2009 systematic review noted that cost analysis was most frequently used, despite the limitation of failing to incorporate the outcomes or economic benefits of the telemedicine program.[4] When costs were reported, cost effectiveness analysis was most commonly used. It is argued that cost benefit analysis is most appropriate for telemedicine but that few such evaluations have been done. It is suggested that this is because the analysis is data intensive and technically sophisticated and there may be reluctance to assign monetary values to health outcomes. There are as yet no established guidelines or systematic procedures on how to undertake cost benefit analysis in telemedicine.

Two systematic reviews on Health Information Technology (HIT) published in 2006, assessed the evidence of benefits and costs of health information systems and the effects of HIT on quality, efficiency and costs of healthcare.[5,6] Many of the 257 papers reviewed were of systems created and evaluated by a few academic and institutional leaders in HIT. As these systems were developed over many years, true development costs were difficult to compute or not provided. Apart from data from the six leading institutions in the USA and the UK, no randomized controlled study

or hypothesis testing study reported cost outcomes of solutions that assessed at least four or more HIT functions. Of 103 hypotheses testing studies only 45 reported cost data, 22 of which reported on systems developed by six leading US institutions or in the UK. The initial costs of the HIT system were reported by six and the costs of implementation by nine. Of note was the range in predicted time to break even which was from 3 to 13 years.[3] A recent review concluded, "In summary, we identified no study or collection of studies – outside of those of a handful of HIT leadership institutions – that would allow a reader to make a determination whether the study's reported benefit was generalizable."

## Conclusions

There is little strong economic data for any eHealth solution. Sound economic analyses of eHealth programmes are uncommon as they are complex and not merely a simple accounting exercise. Frameworks for the economic analysis of the different aspects of eHealth are required together with standardized metrics. Only once this has occurred is it likely that developing nations will be able to make informed decisions on the implementation and choice of eHealth solutions.

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# Ehealth: Legal, Ethical and Governance Challenges – An Overview

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***Abstract:*** **eHealth is moving steadily towards greater deployment and implementation worldwide. Some of its greatest challenges lie in the three fields of law, ethics, and governance. This paper outlines a number of key issues due to be highlighted by contributors to a 2011 book. While the book focuses on the European scene, it is set in the international context.**

## Introduction

eHealth, the use of information and communication technologies (ICT) in providing, managing and enhancing healthcare services is an important area of focus around the world. Internationally, many countries promote and implement eHealth as an integral part of their health strategies [1][2]. In the European Union, eHealth has played an important part in the various actions that have related to eHealth since 2000 [3][4][5]. It continues to have a priority role in the most recent European programmes launched in 2010. In the specific arena of active and healthy ageing, eHealth is at the forefront in at least two flagship initiatives of the EU2020 Initiative, the Digital Agenda for Europe [6] and the Innovation Union (see especially its Annex III) [7]. ICT-enabled healthcare is increasingly considered to enhance the access, quality, efficiency and effectiveness, and safety and security, of services related, for example, to health, medicine, welfare, and care [8].

The use of ICT in healthcare raises a number of challenges related to legal, ethical and governance issues [9][10]. These issues pose both concerns and opportunities to academics, industrialists, legislators, policy-makers, and those responsible for implementing both policy and technologies. However, ultimately, they also challenge the people who use

and consume these services whether they are carers, families, people and patients, or health professionals in a wide range of occupations.

This paper sets out a three-part approach to law, ethics, and governance in relation to eHealth. It highlights a range of perspectives. The issues are reflected in the book on which the paper is based.

## Three eHealth Challenges: law, ethics, and governance

Law as a discipline has a precision that identifies various concepts, differences in context, and norms in relation to eHealth: however, it is often recognised as trailing behind various systemic and organisational developments. It almost constantly plays a game of catch-up with the leaps implicit in technology, particularly those technologies which can be considered as disruptive. Legislation too can take some time to become established and to be successfully applied.

Ethics provides a more familiar foundation from which to explore new concepts and contexts, one that is well understood by many stakeholders in the health arena – especially those which operate in either the clinical/medical field or in the computer sciences.

Governance of good practices, standards, policy and legal implementations, faces a considerable contemporary difficulty. How easy is it to arrive at a common standpoint and perspective on how eHealth should support health systems and services? Such an action is perhaps especially difficult when individual countries have traditionally had a great deal of autonomy in this regard, and when organisations operate using levels of considerable flexibility. Governance – even when a more top down-oriented solution is being developed, as is the case in Europe – is constantly implemented in real-life settings either in umbrella policy or in operational contexts in healthcare and care institutions [11][12].

Several aspects of each of these three challenges to eHealth are explored here in more detail, and are further described in the authors' forthcoming book [10].

### *Law*

The European Commission, in conjunction with the Member States, first stated its desire to see legal clarity in terms of products and services that relate to eHealth in 2004 [5]. There was, and is, no single piece of European legislation which incorporates eHealth. Rather, there is a wide range of both Europe-wide and national sets of legislation which covers its various technologies. Coming to a position of a clear legal understanding on eHealth is by no means, therefore, an easy venture. Translating that understanding into easily understood documentation is even less so.

Understanding the privacy and protection of personal health data continues to be of paramount importance to patients, health professionals, and legislators. This is especially due to the increasing use of electronic health records, and interconnected healthcare technologies, in countries throughout the European Union (including the United Kingdom), as well as the United States. Various other areas or contexts that relate to eHealth such as telemedicine, pharmaceutical sales over the Internet, and the liability of health professionals also bring many legal concerns and challenges [10][13][14].

Each of these legislative contexts may need international, European, national – or even in some cases in certain European countries – regional revision and/or simple clarification and explanation. Such increasing clarity is likely to influence business and commercial confidence in the eHealth sector. Potentially, it could also raise the levels of trust that both health professionals and the public at large experience in terms of their use of equipment and services. As a result, providing and managing eHealth in clinical, organisational, and more commonplace settings should become easier.

*Ethics*

The European Union has placed increasing emphasis on involving the public in regulatory processes with respect to modern technologies. Some theorists hold the view that the tools needed to take into consideration ethical concerns effectively – and to involve European citizens satisfactorily – are not yet fully developed or described [15]. Attempts in this direction are underway in at least one European eHealth-related large-scale pilot (epSOS http://www.epsos.eu/) and its accompanying thematic network (CALLIOPE http://www.calliope-network.eu/). Examining the ethical background that underpins eHealth opens up a wide variety of broad-based considerations. Assessing eHealth use in concrete, applied settings – a pertinent example is telecare, and support for care in the home – raises not only classic, clinical concerns [16], but emphasises the growing importance of issues relating to equity and justice [10][17].

Members of the public are increasingly using the Internet for information on health issues, and sharing information through the social network facilities offered by the web. Issues of information integrity and authority of information are therefore key ethical issues [18]. At least one concrete solution for the enhancement the quality of electronic, health-related information has emerged from the European scene: Health on the Net [10].

*Governance*

European governance of eHealth has taken a number of steps forward

since the mid-2000s. At the start of 2011, an eHealth Governance Initiative has been established, after several years in development. It will become a direct player in the eHealth policy debate, and will report regularly to the appropriate Councils of the European Union. Meanwhile, the European Commission will support the work of the Initiative while it will also continue to fulfil its obligations set out by the Treaty [19] in terms of its right to propose policy and legislative initiatives in the area [10].

At a local or organisational level, information technology (IT) governance ensures that "the organisation's IT supports and enables the achievement of its strategies and objectives" [e.g., 20]. As far as eHealth is concerned, much current work in this field focuses on the secondary and tertiary health sectors. Relatively little data has been available on ICT use in acute healthcare settings outside the United States of America. In 2010, the European Commission commissioned a survey of ICT use in thirty European countries, obtaining feedback from both chief information officers and chief medical officers (the findings that are emerging from this 960 hospital-respondent survey are anticipated to be made public in May 2011 in the context of the eHealth week 2011 in Budapest, Hungary). Several non-American literature surveys are available as well as a set of 2007 European hospital case studies. Alignment between business and IT governance, through eHealth, is perceived as having a positive effect on healthcare performance and effectiveness [10].

However, how would governance operate in a more distributed and less institutionalised setting in which people and patients are themselves involved in even more direct eHealth use? Explorations of the implications of social networking in eHealth are now coming to the fore [10][21].

## Next steps

The authors are in the final stages of editing a book manuscript that will contain contributions on eHealth legal, ethical, and governance challenges. The book is anticipated to be published in autumn 2011.

## Acknowledgments

The book's contributors come from settings as diverse as academe, clinical provision, consultancy, hospital management, industry, law, telecare, and Web service provision. Among the country contexts represented by contributors are Australia, Belgium, Italy, Spain, the United Kingdom, and the United States of America. The book's editors would like to thank a number of authors whose provisional submissions have guided our thinking on the challenges to eHealth: M. Thatcher (Australia), I. Andoulsi, J. Dumortier, G. Verhenneman, P. Wilson (Belgium), H. Ashton,

C.T. Di Iorio, E. Mordini (Italy), E. Beratarbide, M. Rosenmöller (Spain), C. Boyer (Switzerland), M. Fisk, T. Kelsey, K. Wadwa, E. Wicks, D. Wright (United Kingdom), and P. Winkelstein (United States of America).

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# INPRESOL– Integrated System for Prenatal Monitoring

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## Introduction

Integrated system of prenatal care INPRESOL is an electronic system developed for prenatal monitoring (screening) of pregnant women with subsequent automatic analysis of collected data. It helps medical specialists recognise imminent premature delivery in time. It is suitable both for hospitals and outpatient gynaecological clinics.

## Materials and Methods

Our system of correct and timely assessment of pregnancy risk is based on use of continuous external tocography covered by continuous (up to 24 hours) monitoring, recording and subsequent evaluation of pressure fluctuations within uterus with respect to changes of patient's position. Up to 92% correlation between data on uterine activity and imminent premature delivery has been proven statistically.

System INPRES features:

- Continuous monitoring of patients with indicated risk gravidity by the technique of continuous external tocography based on collecting and recording of pressure variations within uterus;
- Creation and maintenance of a central database of all relevant patient and gravidity data;
- Management of complete documentation on the course of gravidity;
- Transfer of collected data into the central database;
- Automatic analysis of collected data (calculation of important parameters);
- Automatic diagnostics (risk assessment of premature delivery based on the analysis).

Principles of INPRES are shown in Fig. 1

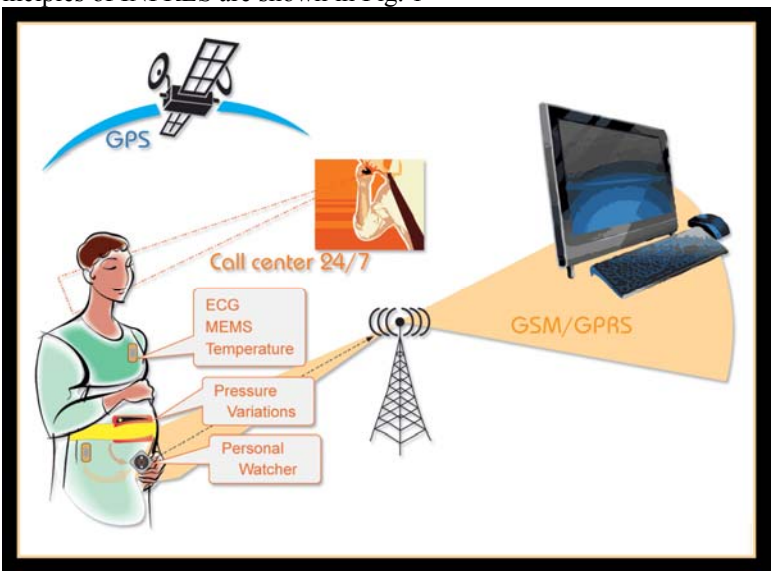


Figure 1: INPRES general diagram.

The system consists of two more or less independent parts: INPRESOL Personal and INPRESOL Central. INPRESOL Personal is designed fo use at home, INPRESOL Central is designed for medical specialist workplace with central computer and application software.

INPRESOL Personal consists of two components: Mobile Sensor Module (MSM) and personal unit (GSM, GPS, RFID, ISM) Personal Watcher (PW).

MSM is the basic module of „holter“ type, which can be placed and worn on woman body, collecting pressure changes resulting from uterine activities and changes of patient's position. It can also record subjective events (the patient presses a „marker“ button). Collected data are stored in the internal flash memory of the MSM. The system is completely safe for the patient. The part in direct contact with the patient is powered from an integrated autonomous source - low voltage battery max. 3.6 Volt DC - and its operation is completely independent on electricity power network 230 Volt AC.

MSM module is equipped also with 3D accelerometer for controlling movement of tested woman.

MSM communicates with PW via special wireless technology TELRAN from company TOUMAZ Technology. PW then send via GSM or RFID all medical data together with GPS position on-line to the central server

(INPRESOL Central). It allows using whole system in terrain without risk of delay in evaluation of data. The complex, “event oriented” GIS server will be used for complex version 3.01. As back- up communication is planned DVB-S2 channel for regions without cellular networks.

Central server manages complete documentation on the course of gravidity, stores the data from modules, evaluates them automatically and presents the results in both textual and graphical form (see Fig. 2).

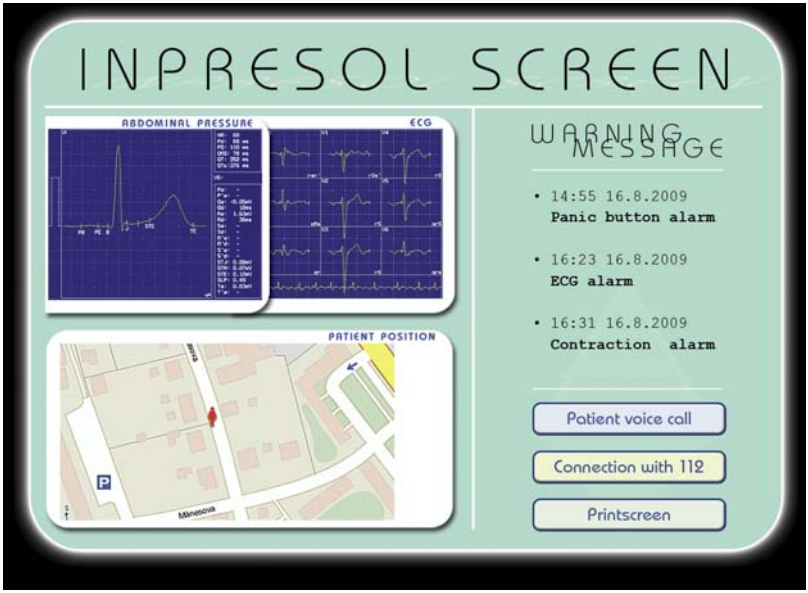


Figure 2: Example of data evaluation screen

## Results

Working model of continuous monitoring of premature delivery risk has been constructed. On the part of the patient (pregnant woman), a non-invasive and unobtrusive body sensor is worn; combination of GPS and GSM/GPRS technologies guarantees continuous central monitoring of possible premature delivery together with exact geographic location of the patient.

## Discussion

For medical and economic reasons, and last but not least with regard to human and moral issues, it is important to utilise all possible means of

positive intervention proactively. This should be the major goal of high-quality prenatal medicine, i.e. prevention of imminent premature termination of pregnancy. Also from the economic point-of-view, even the slightest real decrease of the number ofpremature deliveries from current 4 - 5% to expected 3 - 4% would result in huge immediate cost savings in the health care system.

INPRESOL was awarded by European Space Agency (ESA) with GALILEO Masters Prize 2009.

# ISfTeH Students' Working Group Bringing eHealth for the Academic World

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***Abstract.*** **The International Society for Telemedicine and eHealth (ISfTeH) Students' Working Group is committed to widespread eHealth related activities throughout the academic world. Since 2008, a series of webconferencing sessions have been organized for the student members, allowing a remote and free of charge participation of affiliated students in some official ISfTeH international conferences.**

## Introduction

During the last few years the development and increasing use of new information and communication (ICT) technologies in health sector brought the potential of delivering health care to underserved areas of the globe, and eHealth emerged to establish new frontiers in health care delivery. The ISfTeH is deeply committed to internationally disseminate Telemedicine and eHealth experience and knowledge [1]. In order to widespread the new eHealth concepts and practice, it is very important to promote the involvement of new professionals in a large scale, mainly through educational programs in the developing world [2]. One of the main barriers for the students' participation in international conferences is represented by the high costs of traveling abroad. The ISfTeH Students' Working Group (SWG) is in charge of promoting the active participation of students in e-health related activities, through a free of charge membership category.

## Objectives

The main objective of the ISfTeH SWG is to promote interactivity and dynamic discussion in the field of Telemedicine and eHealth for a new generation of both health sector and IT professionals. Organizing multiseat webconferencing sessions for the student members is part of a global ISfTeH mission.

## Methods

The ISfTeH affiliated students (undergraduate and postgraduate up to MSc degree) can remotely participate in some official ISfTeH conferences - via multiseat webconferencing sessions. Since August 2008, thanks to a partnership established between ISfTeH and the Elluminate® Community Partner Program, up to one hundred participants can remotely attend live webconferencing sessions organized by ISfTeH. The system works well even for those living in areas with limited technological infrastructure (low Internet bandwidth). Each session includes up to 5 remote presentations and the students are allowed to spend up to 10 minutes to present 10 power-point slides. During the session the participant students should remain online, counting with audio and video facilities for live interactivity, including availability to answer questions formulated by the room participants. The ISfTeH offers an award (1000 US dollars) for the best student presentation. A jury composed by three ISfTeH affiliated members - of different nationalities - has the mission of electing the best students presentation. Besides taking part in webconferencing sessions, the ISfTeH student members are also allowed to publish the results of their academic projects and research via the ISfTeH website and periodic newsletter.

## Results

The first ISfTeH Students' Webconferencing Session was held during the 2008 Med-e-Tel Conference in Luxembourg. In that opportunity, five students from 4 countries (Brazil, Germany, Lithuania and India/Sweden) made their live power-point presentations via Skype®. The Power Point files were sent in advance and the chairman managed the slide show guided by a live "Skype®" speech. The second students' session - Med-e-Tel 2009/Luxembourg - was "transmitted" through Elluminate® Virtual Class Webconferencing [Fig.1]. The participant students, from Switzerland/Netherlands, Brazil, Hungary and Poland took advantage of using several interesting e-learning facilities offered by Elluminate®, such as live whiteboard tools, webcam, chat, pooling, etc. In September 2009 - Moscow 13th ISfTeH International Conference - a joint virtual class session was organized by the Telenursing and Students' Working Groups (free of charge ISfTeH membership categories). It included 2 students (from Brazil) and 2 nurses (from USA) presentations made in the Russian Academy of Sciences. The 3rd ISfTeH Students' Session was held in April 2010 - Med-e-Tel/Luxembourg - counting with 3 presentations from South America (Brazil) and 2 from Europe (Poland). Since 2008, an award has been granted for the best students' presentation, elected by an ISfTeH

multinational jury during the academic virtual sessions held at Med-e-Tel in Luxembourg. The winners - R. Cardoso (Brazil, 2008), R. Timm (Brazil, 2009) and A. Kostrubala (Poland, 2010) - use this prize to partly support the international costs (airline tickets and hotel expenses) to take part in the

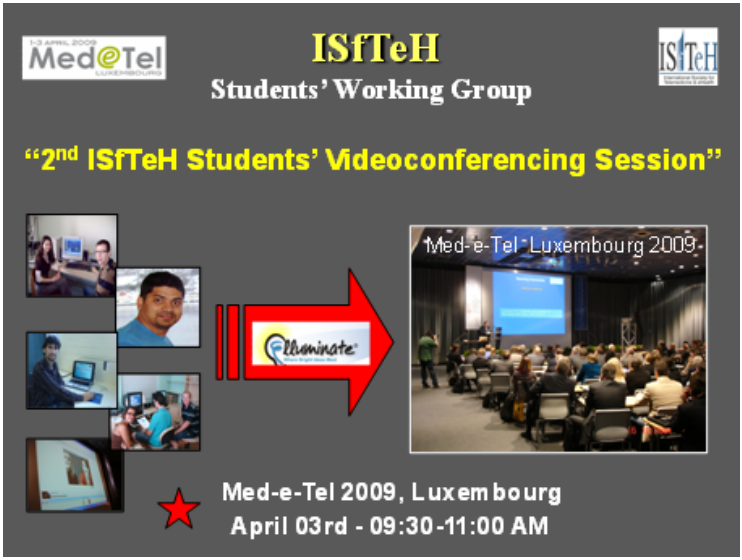


Fig.1 Med-e-Tel 2009: ISfTeH Students' Videoconf. Session

next year's Med-e-Tel conference.

## Discussion

The ISfTeH is a NGO in official relation with WHO [3]. Aiming to achieve its mission, the ISfTeH counts on activities promoted by six Working Groups, one of them is the Students' WG. Telemedicine and e-Health activities organized and broadcasted internationally for the future professionals are key elements for the success and for the sustainability of new eHealth programs. In 2005, through the resolution WHA58.28 of the Fifty-eighth World Health Assembly, an eHealth strategy was defined by WHO, urging Member States to plan for appropriate eHealth services in their countries [4]. Promoting eHealth education toward a new generation of professionals can play a crucial role in this regard. The ISfTeH counts nowadays with around 20 affiliated student members, representing different continents. The very successful experience of previous Students' Webconferencing Sessions, the enthousiastic participation of the local

audience and of the remote participants, as well as the excellent quality of Elluminate® webconferencing facilities, motivated the ISfTeH Students' WG to establish an annual program of virtual room sessions organized toward its affiliated students.

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# mHealth Tool Kit for Low Resource Countries

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**Abstract: Priorities for the 21st century ought to be set based on emerging dominant trends in healthcare, including the shift towards shared or integrated care, in which an individual's healthcare is the responsibility of a team of professionals across all levels of the healthcare system hierarchy. Mobile wireless technologies are increasingly growing in developing countries. There have been several new research and developments in this space which had shown the potential impact of the mHealth. The rapid advancement in the technologies, ease of use and the falling prices of devices, make the mobile technologies an appropriate and adaptable tool to bridge the digital divide. Current mHealth devices are able to continuously monitor an individual's pulse and blood pressure, detect breathing abnormalities associated with bronchial asthma and other chronic respiratory system diseases. Sleep disorders also seem to be one of the main areas in which there is considerable experimentation with mHealth techniques. Expensive telemedicine platform and network media act as barrier in adoption of this technology in health system in low resource environment. Developing countries require low-cost, sustainable telemedicine solutions for the local delivery of primary healthcare at the door step of the each individual. A low-cost portable telemedicine kit called mHealth4U® was designed and developed to address these needs. The kit was developed at the School of Telemedicine & Biomedical Informatics (STBMI), as a part of research strategy on development of low cost tele-health delivery tool, under a research & development grant sanctioned by the Department of Information Technology, Ministry of Communication & IT, Government of India. This telemedicine kit consists of a Laptop, portable wireless broadband internet, software based videoconferencing system, Non-invasive Blood Pressure (NIBP), Spirometer, ECG, SPO2 integrated with Curesoft® Telemedicine software, which is specifically developed & customized for this kit. The**

**practitioner in a remote area can capture patient data in the form of audio, video, and images in an asynchronous /synchronous fashion and forward them over the wireless broad band internet to a doctor for a diagnosis and videoconference could be established for real time consultation. The impact analysis has been successfully carried out using the kit as a 'proof of concept' study in a rural hospital setting in the Indian states of Orissa and Gujarat.**

## Introduction

mHealth is one of the major challenges which has been faced by medical practice as well as healthcare policies. [1] The impact of mHealth is likely to be more far-reaching than other developments such as nano-medicine and genetic therapy as it will create an urgent need to review the way healthcare is financed and blur the boundaries between professional medical help and so-called "do-it-yourself" medicine (i.e. minor treatment or self-medication without consulting a physician, but based on previous medical treatment experience, popular medical literature, or a pharmacist's advice). [2] On current trends, mHealth systems will be more widely offered by mobile telecommunication service providers, and simple, yet important functions may even be offered as built-in features of mobile phones. This, in turn, will imply that technology providers account for a larger than ever share of the total value of medical services. Consequently, systems for the provision of medical care may have to accommodate new expenses, incurred by services from outside of the traditional healthcare system.

## Background

Mobile technology is increasingly been undertaken in the health care sector. Government / corporate organizations use mHealth to collect health-related data on the general population. The use of mHealth is becoming a cost-effective method of identifying and monitoring health issues as well as guiding the formulation of health policies. Programs to support the professional development of people in the health field, using mHealth technology, are becoming readily available. [3] mHealth also provides health professionals with access to patient data as well as access to various information sources, both of which provide valuable assistance in the diagnosis and formulation of treatment. Personnel can use mHealth to access resource materials on health issues. Patients can self-monitor and transmit information to their health care provider; e.g. blood pressure, blood glucose data for diabetes control or a images of a surgical / radiological films. Using mHealth could be particularly important to people living in remote areas or those who are physically impaired.

## Material & Method

mHealth4U® a portable low cost mobile telemedicine kit was conceptualized, designed and prototype developed at the mHealth research laboratory, STBMI in the year 2008. Two versions were worked out, i.e. mHealth4U-B (Backpack) and second mHealth4U-S (Suitcase) having a weight 2-4 kilogram. After testing in bench, a proof of concept study was undertaken in the field to test transmission of vital signs and E.C.G. and software based videoconference using wireless broad band media during a local festival in the month of June 2009 and 2010. An enterprise based wireless telemedicine network with six node was set up connecting specialty hospitals at Bhubaneswar and Cuttack, Orissa, eastern India using wireless broadband network to exchange E.C.G. and carry out videoconference for tele-consultation was done successfully. Subsequently, pilot field deployment was carried out in the State of Gujarat, western India in the month of November 2010. In-service paramedical, laboratory technician & nursing staff were indentified to carry out the pilot project. Basic orientation, demonstration and hands-on-training programme was imparted to give them first hand exposure on the kit and then the kit was installed in four Primary Health Center (PHC) and one Community Health Center (CHC). All five nodes were connected over mobile wireless internet with expert hospital located in the city. The electronic medical record was created using the Curesoft® telemedicine software and the input from integrated medical devices like ECG, NIBP, Spo2 etc were captured through USB 2.0 port into this software which was then exchanged between the nodes and videoconference session followed for tele-consultation after the successful transmission of the data to specialist.

## Result

The outcome of the “proof of concept” was quite satisfactory. [4] We got the acceptance by the end user like doctors, paramedical staff participating at festival site where network congestion was high due to massive gathering of devotees. The pilot deployment was in a different environment than Proof of Concept study. The patient data was exchanged successfully between the expert doctors and remote end and videoconference could be possible even in low bandwidth. The doctors participating in the study suggested some minor changes in the software architecture like incorporating more graphics to represent body parts. Overall performance of the kit was acceptable to them.

## Discussion

In the context of mHealth, three critical sources of risk in clinical practice are identified, namely the medical expertise of healthcare practitioners, the availability of valid supporting information (clinical data, patient records, best practice information, medical literature etc) and the context within which the medical procedure takes place. When making a diagnosis of illness or deciding on the optimal treatment, clinicians need first to have a good overview of the case (i.e. "sufficient" information) and then to utilize their professional skills and abilities to make an accurate decision unaffected by the environment where this process takes place. All these elements are incorporated in the designed mHealth kit.

## Conclusion

The overall development of mHealth will be driven by the consumer demand, value added service by the mobile phone industry and healthcare policy makers in the near future. Technological advances in the wireless broad band sector combined with development of rural wireless telephony will be acting as a boost. Depending on the policy approach taken, mHealth could either be used to bolster the overall quality of healthcare by providing an immediate and reliable source of medical help, it could be used as a cheap surrogate for medical services, or it could be marketed as a value-added service paid for by mobile phone subscribers together with their monthly charges. Clearly, the approach taken will determine whether mHealth reduces inequalities of access to health care services by making services available remotely and free or at low cost, or whether it widens inequalities by being marketed as a luxury for people willing and able to pay for a potentially high-cost additional service

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# Module for Legal References in Military Academy`s Hospital Information System

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***Abstract:*** **The term "legal information" integrates the process of producing, collecting, archiving and dissemination of legal data, facts and knowledge to inform citizens - individually and in different social groups, but mainly for officials and public authorities to develop legal science, changes in laws, regulations and proper application [5].**

**In this paper, we are presenting an innovative Module – part of a Medical Information System that assists taking decisions about legal cases in the medical practice.**

**The documents in the module are divided into thematic groups based on the following principles:**

- **A full range of currently valid regulations in the field of healthcare and medical services;**
- **Selected texts of health legislation and legal instructions;**
- **Synthesis of information and short description of basic procedures in the field of healthcare and medical services;**
- **Information (address, phone) about institutions in health and social sphere.**

**The Module also contains:**

**1. Glossary of legal terminology of the regulations in health legislation, and such common practice to medical specialists**

**2. Legal definitions of concepts and terminology in healthcare**

**3. Articles and annotations in the so-called Medical Law**

**4. Selected internal acts of the employer, which govern internal departmental rules and procedures for carrying out therapeutic and diagnostic activities in the hospital.**

**This paper would present a cross reference according to different selections in one medical institution – on the one side – the patients' cases, on the other – the most frequently applied legal instructions to solve the problems.**

## Introduction

Dynamic data life of BG-law reveals relationships between legal rules and legal facts. One of the most regulated activities in BG is the medical practice - which make doctors and paramedics constantly observed. The medical law introduces the expert views of the legislator on an issue, approved by him to achieve health goals and targets, and therapeutic effects of certain behavior. Official bodies and practitioners in the health care field need clear and accurate picture of the legal standards and regulations[6].

The design and programming of the HIS in MMA in the overall concept also forces the need for Legal Unit. It provides legal knowledge and information as an essential condition for the choice of legal and law-protected decisions in the applied field.

Computer processing of legal information is made in legal information systems, specialized in BG. When decisions are ensured with legal informatics and computer methods, and combined with those of the medical informatics, interdisciplinary achieves balance through assisted technology expertise for medical and hospital goals and objectives.

In the Hospital Complex of MMA, constructed on modular principle, are generated continuous information flows, separate into [1]:

A) Medical records, that are generated for patients, presented as information products.

B) Paramedical information, governing medical services group, which includes data, facts and information: site personnel, marketing, fiscal, management, knowledge, regulations and standards, many of which are legal in nature.

They are controlled by the legal regulatory mechanisms that boundaries the medical work, according to current legislation in BG. We have made selection for the normative-reference information from the Legal Information System Ciela, enforcing application of the relevant legal texts in the field of health. Their selection is consistent both with the provisions of health legislation in BG, and the frequency of their applicability in the daily activities of health professionals. Software found it easy to adapt this Legal Module (LM) to other working hospital information system, regardless of the number of workers in their specialized medical units.

By creating the Legal Module (LM) “MEDICAL”, as an integral part of the Hospital Information System of the MMA, we offer automated access to legal information, copyright structured and accessible from all other components of HIS. It combines a hierarchical and thematic basis of

existing legal acts - laws, rules, regulations, instructions, practices and decisions, subject to specialized topics and case studies. Usually, the legal software perform standards for legal advice, in which information is presented as a tree selection decision. By building a new legal culture and new knowledge of medical staff, the module ensures direct and indirect improvement of medical work quality.

Medical users are professionals from three expert groups; each of them seeks and finds different levels of legal information [2]:

a) The medical specialist - urgent decisions related to norms, laws, regulations and typical case studies
b) The experts in paramedical units - according to their profile
c) The lawyer - a quick reference to supporting information

LM "MEDICAL" provides visual and printed records of every document. Ease of operation is ensured by configuring menus, allowing setting different parameters, according to the users` preferences.

The software performs two searching mediums:

1. Local search is performed in random words in the titles of the current directory into the document text
2. Global demand - the whole database.

The components of the Legal Module are divided into 5 groups: MEDICAL STANDARDS, MEDICAL PRACTICE, MEDICAL PROCEDURES, MEDICAL GUIDE and LEGAL GLOSSARY [3].

As an example, we would present the content of MEDICAL STANDARDS:

- ACTS IN FORCE: Constitution, codes, laws, rules, regulations, instructions, medical standards
- ACTS OF BODIES: Ministry of Health, National Health Insurance Fund, Regional Health Centres of the Government, National Drug Agency
- ACTS OF EMPLOYERS: Rules for Procedure, Rules for internal labor policy, Code of Ethics and internal acts of the employer
- ARTICLES AND ABSTRACTS: Reviews, expert opinions and evaluations of complex medical cases by legal definition, health laws and etc.

The Module is implemented in practice since 2010 and consumers are asked repeatedly about the benefits of this type of information consumption.

Their answers can be generalized, that the Module supports and facilitates their daily activities for medical issues of legal nature, some of which are very urgent and often in critical situation.

The creation of LM is a necessary step, which increases the overall legal culture of medics and paramedics.

## Conclusion

A significant part of professionals, working with LM today, informs that they relied on the media and the Internet for legal information, which is usually outside their workplace and it is time-consuming. 73% of the users do not trust the legal experience of their colleagues and use the presented computer model as a professional source.

The majority of nurses question and seek an interpretation by a lawyer, but firstly they search the qualified legal information from the LM, because the system guarantees knowledge and experience of lawyers with medical specialization.

The realized sociological analysis allows us to make some conclusions, concerning usefulness and practical value for medical professionals of this solution, because it stimulates their transition to medical and health well informed and protected managers.

Medicine is one of the most significant and important spheres in humans life. Medical law concerns the rights and duties of the medical profession and the rights of the patient. Combination of medicine, law and informatics provides better and more secure services for each participant in the treatment process.

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# Two Short-Term Pilot Telemedicine Projects Completed by the Armenian Association of Telemedicine (AATM) in 2010: Results and Lessons Learned

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***Abstract*: Armenian Association of Telemedicine (AATM) successfully completed two pilot telemedicine projects in 2010. The first one, funded by the United States Agency for International Development (USAID) within the framework of Primary Health Care Reform (PHCR) program, was titled "Capacity building of the Armenian Association of Telemedicine to result in improved primary health care services in Armenia". The project consisted of four major segments: capacity building and expansion of the Association; research on the role of Telemedicine and eHealth in improving quality, accessibility and cost-effectiveness of health care system in Armenia; demonstrational telemedicine model system; evaluation and dissemination of the outcomes, including public awareness campaign. The most important part of the project was establishment of a fully functional model of telemedicine network consisting of two PC-based stations (the referral station at a rural primary care center in northern region, and the "consult station" at AATM's central office in downtown Yerevan), equipped with video-conferencing devices and commercially available medical peripherals, and connected via VPN, providing a minimum of 2 Mbps of symmetric bandwidth. Throughout the 8 weeks that the system was operational, overall 16 connection sessions were organized (on two days per each week), delivering a total of 93 teleconsultation (mean 5.81 per connection session) to 76 patients (mean 4.75 patient per connection session). Only 11 out of 76 (14%) patients were ultimately referred to a specialist for in-person consultation. During the period of operation of the pilot telemedicine system and upon completion, systematic assessment was conducted evaluating project's feasibility and impact on primary health care. The system was shown to reduce by more than 70% patients' visits to remote specialists, allowing timely**

**diagnosis, improving treatment outcomes, increasing patients' satisfaction, ensuring primary care personnel's professional growth, reducing health care costs, and contributing to overall development of the target rural community.The second project established similar telemedicine connection between a primary health care facility in Stepanakert, Nagorno-Karabakh Republic (NKR), and AATM central office in Yerevan. The system operated throughout one working week, from November, 29 to December 3, 2010. During this five-day program direct tele-consultations were delivered in cardiology (including real-time echocardiography), dermatology, ophthalmology (including real-time ophthalmoscopy), and diagnostic radiology (ultrasound examination), and patients presenting to the referral site were examined and consulted by leading specialists in Armenia.**
**The projects are supposed to become the first step in a larger initiative of telehealth network establishment, which is planned to commence next year.**

Armenian Association of Telemedicine (AATM) successfully conducted two pilot telemedicine projects in 2010. The first one, funded by the United States Agency for International Development (USAID) within the framework of Primary Health Care Reform (PHCR) program, was titled **"Capacity building of the Armenian Association of Telemedicine to result in improved primary health care services in Armenia"**. The project, which officially commenced on March 1, 2010 after a contract had been signed between the AATM and USAID-PHCR, aimed to contribute to further improvement of the quality of health care system in Armenia through development of a progressive medical association in Armenia, as well as introducing new technologies and expanding professional networks within Armenia and abroad. The project consisted of four major segments: capacity building and expansion of the Association; research on the role of Telemedicine and eHealth in improving quality, accessibility and cost-effectiveness of health care system in Armenia; demonstrational telemedicine model system; evaluation and dissemination of the outcomes, including public awareness campaign.

A proof of successful realization of the first major segment of the project is the growth of AATM membership comprising currently 72, increased availability of information about AATM, its vision, activities and plans, as well as about current trends in development of healthcare and ICT among health professionals and medical associations, medical teaching institutions and health care providers. This contributed to reactivation of other professional Associations, created a background for closer cooperation and

learning among medical and non-medical professionals and their organizations. During these three months, through multiple encounters, meetings, participations in local and international forums within and out of the framework of the work plan, the Association have enhanced and refined its role, made its voice heard in many sectors in Armenia and abroad. The AATM team has done their best to make AATM serve as an ultimate bridge to bring under one umbrella all stakeholders of the newly emerging field of adjacent specialties – among them ministries, state structures, governmental and non-governmental organizations, medical and non-medical businesses, professional associations and societies, doctors, nurses, all those who care about, organize and implement the development of healthcare in Armenia.

The most important part of the project was establishment of a fully functional model of telemedicine network consisting of two PC-based stations (the referral station at a rural primary care center in northern region, and the "consult station" at AATM's central office in downtown Yerevan), equipped with video-conferencing devices and commercially available medical peripherals, and connected via VPN, providing a minimum of 2 Mbps of symmetric bandwidth. The referral site was equipped with a set of medical peripherals, including: 5-parameter vital sign monitor (BP, HR, SaO2, 3-lead ECG, and body temperature); digital stethoscope with Bluetooth connectivity (3M™ Littmann®) and tele-auscultation software (Zargis Cardioscan™); standard 10-MP, 10-optical zoom digital still camera; an ultrasound scanner with ultrasound digitizing and sharing software (Symotec LLC). As an electronic patient documentation system we used an interface created on a basis of the Microsoft SharePoint™. Throughout the 8 weeks that the system was operational, overall 16 connection sessions were organized (on two days per each week), delivering a total of 93 teleconsultation (mean 5.81 per connection session) to 76 patients (mean 4.75 patient per connection session). Only 11 out of 76 (14%) patients were ultimately referred to a specialist for in-person consultation.

During the period of operation of the pilot telemedicine system and upon completion, systematic assessment was conducted evaluating project's feasibility and impact on primary health care. The system was shown to reduce by more than 70% patients' visits to remote specialists, allowing timely diagnosis, improving treatment outcomes, increasing patients' satisfaction, ensuring primary care personnel's professional growth, reducing health care costs, and contributing to overall development of the involved rural community.

The second project established similar telemedicine connection between a primary health care facility in Stepanakert, Nagorno-Karabakh, and AATM

central office in Yerevan. The design of the system was analogous to that in the first project (PC-based referral and consult stations), while the set of peripherals included besides the above mentioned, also a digital ophthalmoscope and an examination camera. For telemedicine encounter management the system utilized a dedicated server and database. The system operated throughout one working week, from November, 29 to December 3, 2010. During this five-day program direct tele-consultations were delivered to a total of 19 patients: tele-cardiology (including real-time echocardiography) – 3 patients; tele-dermatology (both real-time and store-and-forward) – 7 patients; tele-ophthalmology (including real-time tele-ophthalmoscopy and ultrasound of the eyeball) – 4 patients; diagnostic radiology (tele-ultrasound of the neck, breast, abdomen) – 5 patients.

The project was enthusiastically met by both local physicians and patients, as well as by authorities in the region who are planning to establish a regular telehealth connection between Stepanakert and Yerevan, which should then be gradually expanded to incorporate other medical institutions throughout the territory. Thus, the two projects are supposed to become the first step in a larger initiative of telehealth network establishment with direct participation of, and under coordination by the AATM, which is planned to commence next year.

The projects also demonstrated the remaining obstacles to deployment of large-scale telehealth programmes in Armenia. These are: some residual inertia in the regulating bodies and the society in general (despite significant efforts by AATM in the last two years, which contributed to much improved perception of telehealth by authorities, professionals and the public); lack of sustained financing; absence of legislative regulation of the telehealth; issues of interoperability of the equipment obtained through various channels; data security; and remaining connectivity issues.

The AATM team acknowledges participation of the following partners and collaborators in the two pilot projects: USAID-PHCR project; the Ministry of Health of Republic of Armenia; Union of Information Technology Enterprises (UITE) of Armenia (professional association of Armenian ICT industry); Armenian Medical Association (ArMA); Microsoft-Armenia; Sourcio (IT company with eHealth experience); Cornet (ISP company); GNC Alfa (leading fiber-optic provider); and Symotec (telemedicine R&D company), as well as all physicians at remote sites and consultants, patients, and media representatives who provided public awareness campaign.

Georgi Chaltikyan is general and laparoscopic surgeon with

more than 10 years of clinical and teaching experience and rather broad research interests. He did his undergraduate studies and training in general surgery at medical school in Yerevan, Armenia. He also attended considerable number of trainings, fellowships and internships in various institutions in Europe and North America. In 2009-2010 he did research fellowship as Fulbright Visiting Scholar at the University of Southern California. He is currently working as consultant general and laparoscopic surgeon at "Arabkir" Joint Medical Center in Yerevan, Armenia. His second area of interest is telemedicine, eHealth and Health ICT. Dr. Chaltikyan is co-founder of the Armenian Association of Telemedicine (AATM), and currently serves as president and CEO of the organization

# UV-B Radiation and the Correlation with the Content of Resveratrol in Two Varieties of Wine Grapes at the Valley of Tarija

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***Abstract:*** **The responses to three different solar ultraviolet-B (UV-B) radiation levels of *Vitis vinifera* L. cv. Cabernet Sauvignon and cv. Syrah are presented. Three different contrasting situations of sunlight exposure were prepared: full UV-B, semi attenuated UV-B and attenuated UV-B solar radiation for two wine grape plantations located at 1879 m above sea level (masl). A measurement of the total antioxidant capacity was determined using two contrasting methods; results were compared with a standard curve prepared with different Trolox concentrations. The content of phenolic compounds were evaluated using High Performance Liquid Chromatography (HPLC) standard techniques. Wines made from samples under semi attenuated UV-B sunlight showed the highest levels of trans resveratrol compared with wines samples of the two UV-B treatment.**

## Introduction

The sun emits radiation on a broad range of the spectrum, but ultraviolet radiation represents only a small part of the total sunlight intensity. Ultraviolet radiation (UV) is divided in three main ranges: UV-A (315–400 ηm), UV-B (280-315 ηm) and UV-C (280-100 ηm) [1]. Solar ultraviolet-B radiation is mostly absorbed by stratospheric ozone and atmospheric gases; however, a small amount reaches the earth's surface. This small portion

(around 5% of the total solar radiation) is potentially harmful for living organisms since high fluencies of UV-B photons can cause direct cellular damage. Nevertheless, moderate levels of UV-B radiation can stimulate protective mechanisms as responses to this level of aggression [2]. Thinning of the atmospheric ozone layer due to ozone depletion (expected to be overcome by 2050) and changes in the meteorology in the stratosphere leads to elevated levels of UV-B at ground level [3]. There are many studies suggesting that ultraviolet radiation reaching the earth's surface increases with the altitude [4] and some others indicates that the intensity of UV-B radiation has increased in the past twenty years. In some regions this can be related to the climate change, due the lower cloudiness during some months.

Tarija is located in the Southern part of Bolivia, South America (21ºS, 64ºW, 1887 meters above the sea level: -masl-) and its primary source of income is the wine grape cultivars (*Vitis vinifera*). The economical importance of these cultivars is very high since the 70 % of the total grape plantations of the country is located in Tarija. The most representative grape cultivars are: Moscatel de Alexandria; Red Globe; Cardinal; Italia; Syrah; Cabernet Sauvignon; Malbec; Merlot among others of minor importance in cultivated areas. Due to its altitude and latitude, the valley of Tarija has many days with solar UV radiation more intense than other places with similar grape cultivars [5].

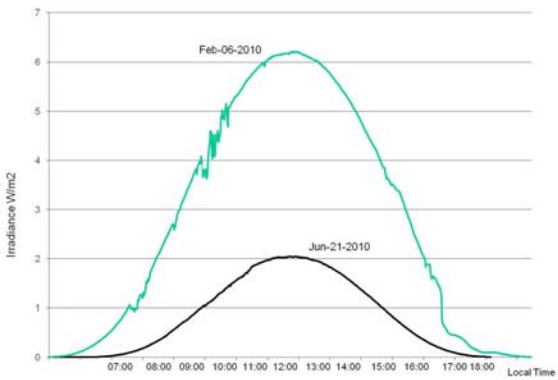


Fig. 1, Time dependence of solar UV-B for two clear sky typical days: one in winter and one in summer, measured using a YES UV-B1 pyranometer, (Yankee Environmental Systems, USA). The ground-based measurements were compared with an ESA satellite overpass data for the latitude and longitude of Tarija.

Grapes and wine contain a large amount of phenolic compounds. Among them, trans-resveratrol is one of the most important compounds because of its potential benefits on human health [6], the synthesis of trans resveratrol on grape cultivars appears as response to UV radiation and fungic infections. The high intensity on the incident UV radiation (UVR) allows the vitis to produce more synthesis of polyphenolic compounds normally in the grape berry skins. Red wines made from grapes cultivated with this elevated solar UV exposure have high content of resveratrol regardless of the winemaker procedure [7].

## Methodology

Three contrasting situations have been prepared: one with natural levels of UVR (0% attenuation, A0), a 20% of UV-B attenuation (A20) using a black anti hail net and a 60% of UV-B attenuation (A60) using a yellow 250 μm polyester filter. The attenuation factors were estimated using a Li-Cor, Lincoln Instruments Inc., light meter. The plantations are located at two mayor grape fields: La Cabaña, 1864 masl, (cv. Syrah) and El Monte, 1876 masl (cv. Cabernet Sauvignon) and under same harvest treatment. The total antioxidant capacity of the two wine samples was determined by the 2,2'-azinobis (3-ethylbenzithiazoline-6-sulfonic acid (ABTS) and 1,2 depnyl-2pierlhdrazyl (DPPH) radical scavenging methods. Table 1 show that the Syrah (Sy) wine presents more antioxidant capacity compared to Cabernet Sauvignon (CS). The samples analyzed exhibited a radical scavenging activity ranged from 8,5 to 13,6 expressed in mM Trolox.

Table 2 show the trans resveratrol content, that was determined using a High Performance Liquid Chromatography (HPLC) coupled with a diode array detector described in [8]. The results were carried out by retention time and quantification of standard resveratrol from Sigma Chemicals Co.

Table 1. Antioxidant capacity of the wines made from UV-B treated grapes. (CS Cabernet Sauvignon, Sy Syrah)

| Variety of grape | UV Treatment | DPPH (mM.) | ABTS (mM.) |
|---|---|---|---|
| CS | A0 | 9,7±4,35 | 7,5±5,78 |
| Sy | A0 | 10,3±2,56 | 12,6±2,28 |
| CS | A20 | 8,5±0,28 | 9,8±3,27 |
| Sy | A20 | 11,2±1,31 | 13,5±3,18 |
| CS | A60 | 7,5±0,67 | 8,7±4,57 |
| Sy | A60 | 9,2±1,31 | 8,4±3,31 |

Table 2. Trans resveratrol content in the analyzed wines. Values are expressed in mg. $L^{-1}$

| Variety of grape | UV Treatment | $mg.L^{-1}$ |
|---|---|---|
| CS | A0 | 4,9±0,23 |
| Sy | A0 | 9,3±0,45 |
| CS | A20 | 5,9±0,07 |
| Sy | A20 | 12,6±0,67 |
| CS | A60 | 3,6±0,04 |
| Sy | A60 | 2,8±0,56 |

The combined effect of the high altitude of the grape plantations in Tarija and the atmospheric conditions encountered in that region such as non contaminated air, large horizons and clear skies with high levels of UV-B, are responsible to give the "high altitude wines", their particular characteristics and potential health benefits.

## Acknowledgment

This study was supported by Fondo de Innovación Continua en Vitivinicultura, (FONICIV), Tarija Bolivia.

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# Mobile eHealth Solutions

# Applicability of Smart Phones in Telemedicine

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***Abstract*: Today is clear that telemedicine is a useful tool for diagnostics and therapy. It contributes greatly to the improvement of healthcare in various aspects. The ability to implement novel applications in telemedicine is a function of devices performance and applicability. Mobile devices can promote wellness, transform healthcare outcomes, reduce costs, extend health knowledge into remote areas and reduce hospitalizations. Today more than one billion smart phones are in operation. This is an increasing area for adoption of general tools for diagnostic and treatment support. This paper focuses on some aspects of smart phones application as smart peripheral devices for telemedicine applications.**

## Introduction

Nowadays healthcare providers are shifting towards treating patients in their homes and communities. People can be connected to medical institutions which are geographically distant. The ever increasing computational power of mobile communication devices such as Smart Phones, PDAs and the biggest market hit – new tablets, present even more possibilities, i.e. computer-based pre-diagnostics based on the wearable and mobile biosensor tools carried by the patient along with light-weigh analyses executed by the enough powerful communication device.

Currently in the non-military areas of application the most common mobile/wearable biosensors available on the market are: 1 or 3 lead ECG sensors, spirometers, pulse and blood pressure meters, thermometers, SPO2 meters and glucometers. Three to two years ago these devices had mainly wired connection to a computer. Their weight was not negligible, either. Today these types of devices are greatly improved. They have WiFi or Bluetooth wireless communication capabilities. The weight is tens of grams. Power consumption is also reduced. All this is a basis for increasing the remote acquisition of human vital data and doing some in situ pre-diagnostics or pre-analysis.

The aim of this paper is to present some results and analyses related to the possibilities to use smart phones as a vital data acquisition centre and on-

the-field pre-analysis and pre-diagnosis tools. These results are part of the work carried out by number of projects funded by the Bulgarian Science Fund and implemented by the Technical University of Sofia and the Medical University - Sofia. Some of these results were presented in [6].

## Basic structure of a remote data acquisition node

Today smart phones are equipped with Bluetooth and/or WiFi communications. Depending on the software platform and operating system they can execute Java applets and/or C/C# applications. Devices provided by different vendors support different communication protocols. This requests the installation of additional communication drivers on the phone (over Bluetooth or WiFi). The most common versions are based on Bluetooth communication. Depending on the drivers not every sensor can be connected to every smart phone.

Many providers offer closed multi-layer systems which does not allow their sensors to be used with other systems and also excludes the possibility to extend the system with other sensors. When such providers do not offer a full list of sensors, remote patient support becomes limited to the available peripherals.

Another problem is that some data acquisition drivers are very aggressive and start to connect and transmit acquired data to the upper system levels without user permission. This increases the exploitation price and lowers battery life.

A typical structure of a remote data acquisition node based on smart phone is shown on fig. 1. It includes the most common available today sensors for vital data.

Depending on the functionality of the sensors data can be received on demand or continuously (sessions with unlimited time length).

Modern mobile phones have large memories and can save very big amounts of acquired data autonomously. This reduces the need for permanent connection to the hospital servers.

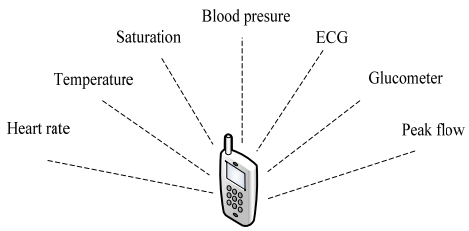


Figure 1. Typical structure of a vital data acquisition node based on a smart phone

Typical layered system is shown on fig. 2.

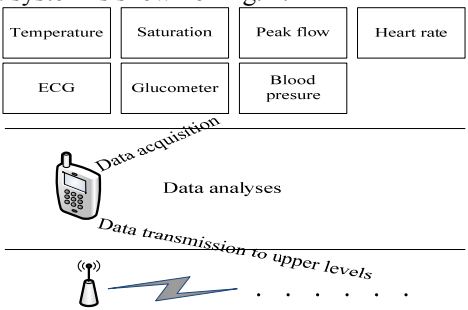


Figure 2. Layered structure of a vital data acquisition system

Figure 2 presents a new element – a data analysis module. Additionally a bi-directional connection to the upper system layers provides the possibilities to send commands to the phone-based system and to enhance the quality of data acquisition.

## Benchmark algorithms for mobile phone performance analysis

Smart phones today are mobile computers with built-in communication functionalities of different types. This allows computational performance tests to be conducted by well known benchmarks. One limitation is that phone processors are integer devices without hardware floating-point support. This presents a difficulty when applying many of the analysis algorithms.

The implemented basic benchmark test programs are versions of *Livermore Loops* customized to mobile phone platforms. The test is based on the *Livermore Fortran Kernels* written by Frank McMahon. The *mflops* driver program was translated from Fortran to ANSI C by Steven Langer [1]. The original software is Internet available [2]. We present here an example of a procedure generating calculation oriented to estimation of the processor performance with minimal influences from memory sizes and other external blocks. The code follows the original source and has very few adaptations to the experimental environment "C" compilers. Additional changes took place to implement similar codes on Java.

Some test results are presented below.

## Performance analysis results and discussion

Performance analysis of the computational power targets smart phones available at the beginning of this research. Continuous work on the carried projects switched to new models. Presented results include some "old" and

some new processors. The reason to present here results for these devices is that their processors do not change so fast as I/O and interface devices and SW services implemented on them. This makes the results presented below still representative.

Table 1 contains the list of experimental devices.

Table 1 – Target smart phones

| Model | Processor | RAM (MB) | OS | Model | Processor | RAM (MB) | OS |
|---|---|---|---|---|---|---|---|
| Nokia E90 | ARM 330 MHz | 128 | Symbian OS v9.2 | Asus P552w | Marvell Tavor 624 MHz | 128 | MS Win Mobile 6.1 Pro |
| HTC Touch HD | Qualcomm MSM 7201A 528 MHz | 288 | MS Win Mobile 6.1 Pro | Nokia N95 8GB | Dual ARM 11 332 MHz | 128 | Symbian 9.2, S60 rel. 3.1 |
| Xperia X1 | Qualcomm MSM 7200 528 MHz | 256 | MS Win Mobile 6.1 Pro | HTC Touch Cruise | Qualcomm MSM 7200 400 MHz | 128 | MS Win Mobile 6.0 Pro |
| Samsung I900 Omnia | Marvell PXA312 624 MHz | 128 | MS Win Mobile 6.1 Pro | Nokia N810 | TI OMAP 2420, 400Mhz | 128 | Maemo Linux based OS2008 |
| HP iPAQ 214 Enterprise | PXA 310 CPU | 128 | MS Windows Mobile 6 Classic | HP iPAQ 6510 | TI OMAP CPU | 128 | MS Win Mobile 6.0 Pro |

Table 2 presents results from experiments with mobile phones. Some of the above models are not included in the table. Currently JAVA implementations need additional modifications and results from “C” and JAVA programs are not comparable.

| | HP IPAQ 6510 (TI OMAP) | HP iPAQ (PXA 310) | ASUS P552w |
|---|---|---|---|
| Maximum Rate (MFLOPS) | 4,12 | 13,31 | 13,80 |
| | HTC Touch HD | Samsung I900 Omnia | HTC Touch Cruise |
| Maximum Rate (MFLOPS) | 12,65 | 14,25 | 10,20 |

Table 2 – performance results

The results presented in the above table can be interpreted in the following manner: In a single run the beat detection algorithm has approximately several hundred additions, multiplications and data movements for integer data. The sampling rate is less than 500 Hz. This means that every calculation loop has to be completed within 2 ms.

Even with the slowest device we can conclude that the beat detection algorithm generates very small processor load and can be executed without data losses. The problems to be investigated are: (a) generated by wireless communication disturbances and delays and (b) influences from the other programs executed in parallel by the smart phone processor. In case of ordinary load we can conclude that the smart phones studied can run in real-time the here presented beat-detection analysis algorithms.

Our future research will be concerned with the running some QRS classification algorithms in real-time and the implementation of more complex analysis as the one discussed in [5].

## Acknowledgements

This work is funded by the Bulgarian NSF under D002/113-2008 and DRNF02/3-2009 projects.

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# Impact of Mobile/Wireless e-Health on Community, Maternal and Child Health Care

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## Introduction

Ref [1] In September of 2000 the United Nations (UN) Development Program was endorsed by 189 world leaders at the UN. All in attendance agreed to work together to build a safer, more prosperous and equitable world. The announcement was translated into a roadmap, setting out eight, time-bound and measurable goals to be reached by 2015 known as Millennium Development Goals (MDGs). The eight MDGs are as follows: 1. Eradicate extreme poverty and hunger 2. Achieve universal primary education 3.Promote gender equality and empower women 4. Reduce child mortality 5. Improve maternal health 6. Combat HIV/AIDS, malaria and other diseases 7. Ensure environmental sustainability and 8. Develop a global partnership for development. We believe that e-technology could have the greatest impact on MDG 4 (Reduce Mortality in Children Younger than 5 years by two-thirds) and MDG 5 (Reduce Maternal Mortality ratio by three-quarters and achievement of universal access to reproductive health). Ref [2] For the last few years there has been an attempt by individuals and institutions to increase the efforts and interventions of developing countries trying to accomplish their MDGs as there is less than 5 years remaining. At present there have only been 19 of the 68 priority countries that are on track in accomplishing their reduction of MDG 4 to date. Seventeen countries have reduced child mortality by at least half. Internationally 8.8 million children a year die before their 5$^{th}$ year of life and 40% (3.5 million) of these children die during their first 4 weeks of life. The accomplishment of MDG 5 is also a far reach away as 56 of these priority countries have high or very high maternal mortality. For most countdown countries their efforts have been insufficient. This is especially true for sub-Saharan Africa. Most

maternal deaths take place at some stage in child birth and in the immediate postnatal stage. The major source of maternal mortality in sub-Saharan Africa is hemorrhage associated with childbirth. The region has the lowest rates for caesarean interventions (3.5%), indicating a high risk of death and/or disability. The latest estimates indicate that the leading causes of maternal deaths are hemorrhage 35% and hypertension (eclampsia) 18%. Worldwide, child mortality has declined over the last 18 years (12.4 million in 1990 to 8.8 million in 2008) with a 30% reduction. Approximately 500,000 women died in 2005 from complications during pregnancy. None of the World Health Organization regions accomplished the 5.5% annual reduction. Less than 50% of the women during this time received skilled care during childbirth. Kenya is one of the countries that has not been successful in achieving these goals (MDGs 4 and 5). Ref [3] Kenya's death rate for children under 5 (MDG 4) is presently 74 deaths per 1000. This number is far from the targeted number for the year 2015 (32 per 1000). In 2005 the total number of maternal deaths was 7,700 alongside the 15,000 women who die each year from pregnancy related complications (MDG 5). In addition, another 300,000 to 500,000 women have long and short term disabilities caused by pregnancy-related complications.

*Project*: Kenya Methodist University (KeMU), Kenya and Stony Brook University (SBU), Stony Brook, New York, USA proposes a community-based health model for maternal and child health care. The project will provide two communities from these underserved and remote rural regions a new healthcare model that combines electronic medical records (EMRs), hand-held portable ultrasound, diagnostic vital sign e-health peripherals, POCT, e-health technology and a traveling nurse. Mothers and their babies will be visited by a trained e-health nurse during and after their pregnancy. The nurse will provide basic e-health training to community health workers (CHWs), consisting of data capture and operation of the ultrasound machine and other e-health peripherals that will be linked to primary and specialty care health professionals at distant clinics, hospitals, etc., using wireless e-health tablets. The CHWs will conduct health screenings and provide community-based health promotion and management during and after pregnancy. This combination of two proven models (e-health and CHWs) represents a new paradigm for providing access to individuals who are in remote areas and/or where there are too few health care providers. KeMU along with SBU will develop a curriculum to train nurses how to utilize state-of-the-art e-health technology for the measurement of vital signs (blood pressure, temperature) and diagnostic assessments made with a hand-held portable ultrasound system. In addition, a nurse will understand how to create an electronic health record (EHR) for each client utilizing a hand-

held tablet. Once the curriculum is developed, we will select one nurse to train using the above curriculum. The nurse will be assigned to four rural communities that have limited, to no access, to health care providers other than the local CHW in the Meru area. Two communities will provide usual care for maternal and child health care. All assessments and outcomes will be documented by the CHW. The other two communities will receive care via e-health and other diagnostic technology (e.g., hand-held ultrasound). The nurse in these communities will provide maternal and eventual new born childcare utilizing all appropriate technology. At the same time, the nurse will be training the local CHW. The nurse will be provided with a van that would house all of the following technology: e-health wireless tablet or iPhone and peripherals which will have functionality to record the patient's temperature, weight, blood pressure, blood oxygen, POCT results (i.e., glucose, urine dip stick, etc.), cardiac and lung sounds and electrocardiogram. Additionally, the van will contain a hand-held ultrasound machine capable of viewing the presentation of the fetus. All of the data, including standard questions of the patients, will be downloaded to the tablet or iPhone that will be downloaded to a server at KeMU. The van and driver will be available to the nurse 24/7 in case of emergencies. The first three months of the project will be devoted to community buy-in: an essential component of the project. KeMU faculty will hold meetings with the opinion leaders in the communities and other stakeholders in the Kenyan health sector to conduct the situation analysis, design IEC materials and outline the project implementation and activities. During this time, faculty at KeMU will select and train a nurse for the project. Months 3-6: A trained nurse will provide basic e-health training to the intervention CHWs consisting of data capture and operation of the ultrasound machine, etc. For the community with usual care, the nurse will design a data capture form for the CHWs. All CHWs will register all pregnant women from their respective communities randomly selected as intervention and Health System (control) groups. For the next 12-14 months, the nurse will provide leadership in health assessments and collect patient history and clinical data as described above to the intervention group. The nurse shall provide subsequent biweekly visits for measuring all appropriate vital observations during and after pregnancy. Similarly, the control group will be monitored and recorded for all activities during and after delivery. At the end of the project outcome analysis will compare descriptive data from the intervention group with the control group as well as national data to evaluate our project's sustainability and reproducibility regionally. Projected Outcomes: Demonstrate that a van equipped with mobile/wireless e-health technology and an e-health trained nurse can improve maternal and

newborn outcomes and contribute to reduction of deaths among them. Create a sustainable, reproducible model for the country and the region.

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# Mobile Media Rich Communication Systems for Emergency Telemedicine

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***Abstract:*** **This paper describes problems in delivering timely and quality healthcare in remote regions in Russia. The main obstacles are low level of qualification of emergency medical and rescue workers and lack of reliable communication channels. The project offered by Tradition Group and Bakoulev Scientific Center for Cardiovascular Surgrery of Russian Academy of Medical Sciences attempts to solve these problems by supplying the workers with specialized media communication protective equipment with access to expert knowledge bases and teleconsultation by various specialists located offsite.**

## Introduction

Russia is a country with the world's biggest territorial dimensions, remote region transportation and communication difficulties and also with huge professional qualification contrasts. These factors question the efficiency and viability of operations of a number of important industries and economic sectors, including the health care, building & construction, mining, logistics & transportation, rescue operation services, etc. Most of the workers in these fields have a low qualification level, which often serves as an indirect cause of various accidents, rock and landfalls and other man-caused failures. In case of the explosion that took place at the "Raspadskaya" mine in the Kemerov region taking away many lives including that of 19 rescuer workers, the investigation of the accident's possible causes has questioned the level of professional qualification of the rescuers.

Lack of medical staff qualified according to modern world healthcare standards is the main problem in health care industry in Russia. This translates into a high percentage erroneous and false diagnosis, one of the lowest in the world life expectancy of 59 years old for men and 73 for

women. This problem is most acute in remote regions and village hospitals. Needless to say, the results of treatment of most illnesses depend on a timely and correct diagnosis.

In the case of emergency situations when there is a massive inflow of injured or ill patients of which many are in a life-threatening condition and there is only one or two doctors attending many patients, it is in such cases that the doctor's qualification makes a difference because health and lives of tens and hundreds patients depend on the speed and accuracy of decision making.

Lack of reliable and quality communication in remote regions and villages, in mountains, mines and other remote areas is another cause of many casualties and accidents.

The project Arnega™ offered by Tradition Group Ltd. and Bakoulev Scientific Center for Cardiovascular Surgery of Russian Academy of Medical Sciences will allow to solve most of the problems discussed, improve the efficiency and timeliness of decision making in emergency situations when medical care is required by supplying first aiders, emergency, ambulance and rescue workers with specialized media communications protective equipment with access to expert knowledge bases and teleconsultation by various specialists located offsite.

## Materials and Methods

Arnega™ system has been developed for equipping special task forces and special services staff in order to help them solve unit management tasks, improve the effectiveness of interdepartmental cooperation, increase the security of the activities conducted and provide operational support of collective decision-making.

The system supports videoconferencing that can bring together different experts from anywhere in the world for real time brainstorming and decision-making.

The system has a modular architecture and has a wide range of options for solving various tasks. The basic version supports wireless audiovisual communications with the head office.

The extended version supports:

- Audiovisual communications with the other workers onsite and between the team members,


- Connection of additional autonomous metrological equipment for collecting local data and/or controlling physical and psychological state of a staff member;
- Additional equipment for real-time positioning of a staff member.

System Structure

The videoconferencing module as well as all other additional equipment is inbuilt into a specialized wearable vest, backpack or a belt; while the camera is inbuilt into a protective helmet.

Such construction keeps hands free providing the worker with a complete freedom of movement.

Audio and video data is transmitted from the equipped staff member to the coordination center; audio communication is bi-directional.

In addition, the system can be equipped with a micro display integrated into the glasses worn by the worker for a duplex video mode.

The System includes.

1. Mobile component:

ARNEGA-MAX (semi-rugged, fully rugged).

- Helmet equipped with an audio and video device.

- Unload vest (protective suit (2-6 ballistic protection category) or backpack with a power supply and additional equipment.

ARNEGA-MINI (Lightweight version to be used in environments that do not require physical protection of the worker).

- Video headset with an inbuilt video camera (monocular or stereoscopic)
- Backpack or waist belt with a rugged computer and a power supply.

2. Computing & communication device - protective case with switchboard equipment and autonomous power supply, rugged notebook or communication module.

Depending on the mission/task at hand, the surrounding environment and the required level of task completion control (interaction between the users, with the control center), the user is equipped with the following equipment:

Camera type – normal, wide angle, long-focus or universal

Light – lamp, infrared light

Laser pointer

Other auxiliary equipment:

- High resolution camera with a zoom;
- Glove manipulator (for remote system control, including remote-controlled airplane);
- GLONASS, GPS, GALILEO module, inertial tracker (for worker positioning).

The system can be configured to be used by a team where actions of the team or of one particular team member can be displayed.

Repeaters and cellular networks can be used for increasing the working range of the equipment.

The advanced version of the system supports media communication with a situation/crisis or dispatch center, where a remotely-located group of experts receives data from the staff onsite, analyses it and sends back spatial models and other visual instructions on completing the task in real time. The dispatch center is equipped with supercomputers for greater processing power and all necessary databases.

Acknowledgment

The authors greatly acknowledge the effort and the support provided by both students , medical, nursing and administrative staff of the Bakoulev Scientific Center for Cardiovascular Surgery of Russian Academy of Medical Sciences involved.

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# Mobile Psycho-Technology: Voice Messages by Mobile Phone for Emotional Regulation in Spanish Teenagers

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## Introduction

According to the Spanish National Institute of Statistics, 92.1% of Spaniards aged 15 used the mobile phone in 2010 [1]. This can be seen as a threat or as a potential fact for different reasons. Among the wide range of purposes that mobile phones are used for, besides covering needs for communication, networking or gaming, they can be used therapeutically. For instance, mobile phones have been used among teenagers for emotional regulation [2]. Thus, in order to further research the use of mobile phones advantages in the promotion of teenager mental health, we established three objectives in our pilot study. The first aim was to assess if voice messages sent to mobile phones could improve emotional regulation (depression, anxiety, helplessness, irritability and impaired thoughts) among Spanish teenagers. A second objective was to measure the messages effectiveness to increase academic records; and the third and final one, to evaluate the users' experience.

## Methods

A total of 29 adolescents took part in a Health and Performance programme developed at their high school that lasted three months (March, April and May 2010). Participants were randomly assigned to two different groups: the experimental group (n=15), aged between 13 and 16 years old (*M*=14.27, *SD*=1.16); and the control group (n=14), aged between 12 and 15 years old (*M*=13.79, *SD*=0.8) that did not receive any mobile voice

message. Students filled out the Educational and Clinical Questionnaire for Anxiety and Depression (CECAD) (Lozano, García-Cueto and Lozano, 2007) pre-post intervention. CECAD consists of 5 subscales: depression, anxiety, helplessness, irritability and impaired thoughts; and a total score. Academic records were collected at the second and third academic terms of the 2010 school year (before and after the programme participation), in order to analyse the messages effect on these teenagers school results. Our team of psychologists designed 24 one-minute voice messages with instructions for emotions self-regulation, attention training and time management improvement. Every message was sent randomly several days per week to students with a pre-established protocol made by psychologist experts. Emotional state and academic performance was evaluated in both groups pre and post programme.

A technology platform for telecom services named *VoiceCast* was used to send simultaneously mobile voice messages to the students. The experimental group received 24 messages through their mobile phones. *VoiceCast* is based on a self-developed framework. It counts with a comprehensive platform for building and deploying telecom value-added services. Based on JAIN SLEE specifications, it provides a single point of connection to back-end Telco systems such as SS7, SIP, SMSCs, MMSCs, and other OSS/BSS systems. *VoiceCast* allows delivering voice messages to multiple recipients, either to mobile or land line phones, not depending on specific terminal device features. Therefore, any voice-enabled terminal can be used to place and retrieve message.

## Results

Both, experimental and control group were equivalent in age ($p>.05$), gender ($\chi^2=1.66$, $p>.05$) and school year ($\chi^2=0.85$, $p>.05$). CECAD total score and its subscales of depression, anxiety, helplessness, irritability and impaired thoughts, together with academic scores, were also equivalent between groups ($p>.05$) at the beginning of the programme.

In order to achieve the first goal of this research, we implemented *U* Mann-Whitney analysis to compare grades between the experimental and the control group in CECAD subscales post-test. A statistical significant decrease was found in total scores ($U=50.5$, $p<.05$), depression subscale ($U=41.5$, $p<.01$) and impaired thoughts subscale ($U=45$, $p<.01$), among the experimental group post-test. The remaining subscales did not show any difference pre-post in none of the two groups of comparison ($p>.05$) (Fig. 1).

According to this result, we conducted an analysis in order to measure and assess whether the findings were influenced by the amount of listened

messages or not. Pearson correlation was used for this aim. Results showed that there was a positive correlation between the quantity of messages heard ($p$<.01) and CECAD total score; and a negative correlation was found for depression symptoms ($p$<.01) and impaired thoughts ($p$<.01). This implies that the more messages listened, the better benefits achieved, according to the total score of CECAD ($r$= -.77, $p$<.01), depression subscale ($r$=-.73, $p$<.01) and impaired thoughts ($r$=-.77, $p$<.01) post-test.

Regarding the second aim of this study, Wilcoxon analysis yielded an improvement in the academic grades of the experimental group, contrasting them pre-post test ($Z$=-2.42, $p$<.05), in comparison to the control group. Finally, in assessing the third aim of this study, 93% of the students reported that the received voice messages were useful to feel better, increase attention and improve their time management.

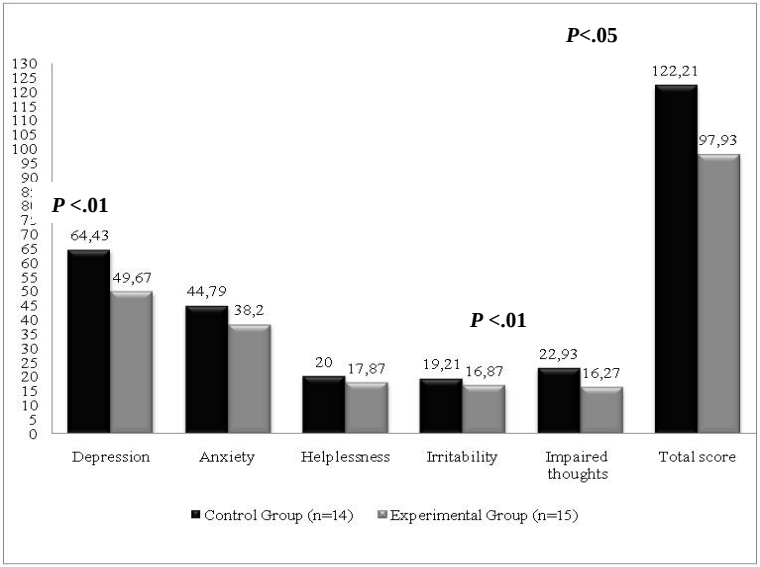


Figure 1. Comparison between mean scores post-test of CECAD. Control and experimental group according to $U$ Mann-Whitney test (N=29).

## Conclusions

According to the results of this study, we can conclude that mobile voice messages delivering instructions to better self-regulate emotions helped students to decrease anxiety and depression symptoms and improve academic performance. Similar results have been obtained by other authors

in studies trying to measure the mobile phone therapeutic effects in mental health [3].

The *Voicecast* platform is a useful ICT tool that facilitates a system to send simultaneously voice messages to users, with the reliable aspect of recording who listened the messages and when. Nevertheless, further research is needed on how mobile psycho-technology interventions can help teenagers at school; as well as to evaluate the positive effects on other psychological variables with larger and different participants' samples.

## Acknowledgment

We specially acknowledge the collaboration of the teacher Maria Jesus Quintana and the volunteering school students from Perez-Galdos Junior High School (Canary Islands, Spain), where this study was conducted.

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# SMS and Web Based Tele-Homecare System for Chronic Pulmonary Patients Care

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***Abstract:*** **Patients' changing need drive biomedical environment. In this concept, tele-homecare is emerged. Tele-homecare is becoming an increasingly important part of the healthcare service and it plays a vital role in costly treating of chronic diseases such as chronic pulmonary diseases. This paper presents the introduction of SMS and Web based tele-homecare system for pulmonary patients that have been developed by using Visual Studio programming environment. The system uses spirometry for patient self-testing of lung parameters, cell phone and computer. Computer transmits PFT results from patients to a web server via XML web service and monitor PFT (Pulmonary function tests) results on the web. Cell phone receives emergency alerts with SMS. The SMS alerts generated based on PFT results' evaluation. In addition to this, web site was created on the internet in order to provide continuously following the patients, exchanging information, sharing statistical PFT data and SMS based feedback.**

## Introduction

By using information and communication technologies between remote centers, sending and storing of physiological signals, delivering health services for diagnosis, treatment, monitoring and evaluation purposes is called Telemedicine[1, 2]. The factors such as the increase of health care costs with population, the need of reducing the frequency of patient's coming to hospital, effective usage of doctors, obtaining long-term statistical information about the disease, determining more effective treatment methods have led to initiation and expansion of telemedicine applications. In this context, tele-homecare is emerged. Tele-homecare is remote monitoring of chronic patient's physiological data by using the information and communication technologies. Fundamental aim of tele-homecare is to improve chronic patient's disease management in the comfort of home environment [3, 4]. Chronic obstructive pulmonary disease

(COPD) and asthma take the first place among the chronic lung diseases that cause mortality and prevalence. COPD will increase by more than 30% in the next 10 years and it will be the third leading cause of death among diseases in 2030[5]. According to the 2005 reports of WHO, 300 million people are injured from asthma and 255,000 people died [6].

## Methods

*The structure of the SPSS (spirometry based pulmonary diseases support system)*

Patient's lung capacity (FVC), air volume which a patient can blow in a second (FEV1), breathing power (PEF), FEF25-75 and FEV1/FVC has been measured through Spirometry. In our study, these results are transmitted from spirometry to the computer and then data are transmitted from the computer to the remote SQL database that is located on the web server via XML web service.

*Software that is developed with .NET Platform*

After all patients performed PFT test from their homes, transferring the data to remote SQL database that is located on the web server is provided with developed software. Thus, statistical data about the development of the disease is reached. During the process of transferring data, the previously transmitted data is checked with the method that is developed in the software so as to avoid transferring the same data again. In order to distinguish data, a different user ID (Client_ID) is given to each computer that transmits data. By using XML Serialization and Deserialization process, software takes the SQL database settings where the information will be stored, patient’s mobile phone number. Furthermore, with this procedure, database settings are protected and same settings can be re-used in the subsequent study of software after terminating application.

*Evaluation of PFT results*

If three acceptable tests are performed, then the mean value of test result is taken. After the PFT is being performed by the patient, the patient’s reference values are calculated depending on the patient's gender and age. The Asia-Caucasus reference values, which are determined by Hankinson, are used in the calculation. There have not been any finalized reference value tables for Turkey yet. It is believed that this study provides progression in terms of establishing PFT reference values. It is thought to be beneficial for Turkey to obtain its’ own reference values. After that, average of measured PFT results are compared with the PFT reference values and GOLD (Global initiative for chronic Obstructive Lung Disease) and

GINA(Global Initiative For Asthma) rules, then result is sent to the patient, the doctor and the related person with SMS[7]. All process is done with developed software on web server unit.

*Sending SMS for emergency and information purposes*

As it is well known, the most effective method that provides two different applications to work together is XML. XML which is an open standard language of XML provides easy transfer and sharing of data over the Internet. In the developed software, sending of PFT data to database and conversion of the result of the evaluation data to SMS XML template is done automatically.

With the intervals of 5000 milliseconds, software performs the evaluation of acceptable PFT results with thread. Thus, the software crash is prevented. Using the HTTP get-post method, software sends SMS information that is packaged with XML to related people and the center via the SMS gateway of a private company.

## Web-Based Monitoring of All the Data and Web-Based SMS Sending

Another important component of this system is web-based monitoring of all data and web-based SMS sending. For this purpose, the secure entrance to the web page that is developed with ASP.NET technology is achieved with a password and a user name.

Web-based access and tracking of patient’s acceptable PFT results that are performed at patient's home are provided for the doctor and the patient. This page provides access to all PFT data, so the doctor can make comments about the progression of the disease.

After the doctor examined the statistical data of the patient, the doctor can send web based SMS for patient’s treatment such as patient's medication order. The patient may also send web-based SMS to the doctor so as to get detailed information about the disease. It can be reached informative articles related to chronic lung disease with another page.

## Conclusions

According to the World Health Organization reports, chronic lung diseases take the fourth place among the leading cause of death and diseases that affect the quality of individual’s life. Remote tracking the patient’s and the frequent occurrence of mistakes in patient’s following of their own care show that a new approach is necessary. Furthermore, due to the long lasting illnesses, not to be treated exactly, new system should be developed so as to track COPD patients.

Developed system provides significantly greater improvement with reducing visiting numbers of doctors, health expenditure in the field of chronic pulmonary patient's treatment. With this study, a new system is developed that is accessible at home for doctors, brings doctor and patients together between remote centers to monitor disease and eliminate time and place. Thanks to the developed chronic pulmonary patient life support system in accordance with expert doctor's information, patients are continuously monitored and informed, so the order of drug usage and treatment of the disease can be determined.

With this study, PFT data which are vital for chronic lung disease are monitored on the web site and SMS is sent to the related person or center to inform the person or in case of emergency. In addition to this, chronic pulmonary patients are informed and awareness about their diseases is made, the quality of life of patients is increased, reducing of the costs of treatment is tried. It is believed that this study provide effective self control and remote management of pulmonary patients.

## Acknowledgment

I would like to give great thanks to Prof. Dr. İnan GÜLER for careful supervision, to give me opportunity to carry out this research and very kind help. This work was supported by Gazi University scientific research project (BAP-07/2010-55).

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# Technical Solutions for Adaptation of Housing for Elderly Persons with Physical Disabilities and Cognitive Impairment

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***Abstract:*** **Limousin is characterized as the oldest region of France. The adaptation of housing constitutes an actual opportunity for the help to the preservation at home. In our study, we derive specific and useful parameters to be applied for home environment adaptation. The study is made in partnership with Habilim, a Real estate developer in cooperation with the gerontology service of the University Hospital and researchers in the field of ICT for elderly and disabled people.**

## Introduction

Limousin is characterized as the oldest region of France with a mean age of 43.8 years in 2008, four years more than the national average. The part of the population of more than 75 years old is about 11 % in Limousin (7.2 % at national level. There are in France 1 117 000 dependent persons of more than 60 years and this figure will continue to grow. There are approximately 540 000 places in nursing homes, and eight French out of ten wish to stay at home as long as possible. Preservation at home clearly appears as a real challenge of public health and housing adaptation constitutes an actual opportunity. Aging is accompanied by the appearance of gradual physical and psychological fragilities. The objective of our study has been to identify the physical and mental specificities of the elderly in order to derive adequate adaptation of the housing environment.

Declining abilities with age may be severe handicaps. The main options available to recover the person's living initial conditions focus on the development of suitable prostheses and several adaptations of home or furniture equipments. For the elderly people, the functional abilities reduction concerns mainly the sensory capabilities, the capacity of thermoregulation, the motor capabilities with a high risk of falling, the capacity of arousal and alertness.

## Visual capabilities

The visual system with age has less ability to modify its sensitivity to analyze the stimuli received: the sensitivity of the retina is changed, the perception of light is reduced, contrast sensitivity, visual acuity, the ability to discern details and speed of visual perception are reduced, visual fatigue occurs more rapidly.

In practice, the visual acuity and visual comfort are directly influenced by the intensity of lighting. The ability to discern the details recorded by the eye in a given time increases with the lighting (for reading and sewing, for example). It will therefore be necessary to dispose of directional and intensity adjustable bulbs.

Visual function itself also depends on the lighting and should therefore avoid an excessive difference between the illumination of an object and its background. Visual fatigue occurs more rapidly with aging: eye blinking, less moisture in the cornea... It will be prevented, attenuated or avoided by the use of proper lighting associated with the use of soothing colors for walls and floors.

Particular emphasis will be given to natural lighting in which the elderly are more sensitive and positively through which they visually compensate more easily. Daylight gives the feeling of contact with the outside while aging is rather perceived as a withdrawal. It also helps to identify during the day through its variations. It establishes a necessary correspondence between the circadian cycle (and beyond, the seasonal cycle) and the physiological rhythm.

## Hearing ability

The human auditory system works in the 20-20 000 Hz range. With age, it suffers a significant decline since the upper limit of the range may fall to 12 000 Hz. Hearing loss particularly affects the high frequencies of 1000 to 8000 Hz resulting in considerable discomfort for discriminating certain sounds such as consonants. Several parameters and precautions are thus to be considered:

- The rooms, including entertainment areas, should have a good acoustic volume through floor coverings and walls.
- It is necessary to eliminate or reduce the phenomena of resonances that limit the effectiveness of the auditory system or prostheses.
- Background noise hindering the identification of sounds useful to understand the words (especially high frequencies) must be avoided.
- Noise which reduces the ability of auditory perception must be also eliminated to expand the auditory comfort zone.

- Visual cues can be associated with audio signals.

The difference between the perception threshold and the threshold of intolerance decreases with aging. Simple precautions should then be taken:

- Bedrooms or living rooms must not be located next to elevators or lifting motor.
- The toilet flushing and the water pipes shall be soundproofed.

### Thermoregulation ability

Aging causes in many cases bloodstream problems including reduced peripheral bloodstream. Therefore, the architectural design of housing must take account of these data with standards of indoor temperature in winter between 21 °C and 24 °C.

During sleep, the moderate reduction of the temperature of the air inhaled promotes profound inhibition of thermal regulation so that the sleeping person, when covered enough, can have a more restful sleep. The home automation equipment must allow a suitable automatic variation of temperature at day and night.

Floor thermal isolation and vertical heating can help to attenuate the feeling of cold feet. Direct heating system through the floor, are however not recommended because of poor circulation in the legs they induce.

The air humidity inside the housing should reflect the fact that older people are generally poorly hydrated. However, a high humidity ratio produces a sensation of cold. The humidity comfort of the elderly must be adapted to physiological needs and lifestyle. An automatic system can here also help.

### Deep sensitivity

Deep sensation in the feet decreases with aging. It follows that the sensitivity of the foot to the objects is then reduced with a consequent increased risk of falls, imbalance or inadequate reflexes.

This reduced deep sensitivity can be prevented or improved through the use of appropriate and differentiated flooring on which the elderly may even be encouraged to walk barefoot with a pleasant feeling.

### Reduction in motor skills and fall prevention

Aging causes a progressive decline in functional abilities including moving inside the housing. Various arrangements can promote the gestures and movements of users of canes, crutches, wheelchairs but also people with osteoarthritis.

Many simple adjustments are possible which depend only on simple ergonomics principles. In different parts of the housing, these developments relate to the positioning and sizing of appropriate spaces of passage and mobility aids (stairs, handrails ...), the appropriate use of color contrasts at the floors, walls and furniture according to current standards, the use of graduate lighting systems, automatic lighting and additional lighting in areas most at risk, the avoidance of protruding areas, the use of specific additional equipment (for example in the bathroom), compliance with regulations relative to electrical equipment installation.

Wakefulness and vigilance abilities

To maintain at the highest possible level the wakefulness ability, the architectural design of housing must follow some guidelines:

- The windows, balconies and terraces must enlarge the visual field, preferably on natural scenes such as streets, gardens, store entrances…
- Wall calendars can encourage action at specific times or days.
- Telephone, visual or auditory stimuli, adequate natural or electric light can also be of help.

The state of vigilance plays an essential role in self-preservation and in the immediate responses that must be made in many situations. This vigilance can also be assisted by external system to avoid or prevent for the most significant risks: falls, accidents, illness which are even more serious when alone and isolated (for example, televigilance and telecare systems, telealarm systems preventing from fire risks).

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# Regional Initiatives in Telemedicine and eHealth

# AMI-4EUROPE: Advanced, Cross-Disciplinary & Integrated Medical Imaging for all EUropeans through a Network of Regional Clusters and DevelOPment StratEgies

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***Abstract:*** **AMI-4EUROPE is to co-ordinate, integrate and set up a newly defined EU-based Value Chain on Advanced, Cross-disciplinary and Integrated Medical Imaging by taking full advantage of all strengths that European stakeholders have while targeting the market niches that are arising as the Next Generation Medical Imaging unfolds itself out of the convergence of Nanomedicine, Pharmaceutical and Biotechnologies for healthcare and taking advantage of the ICT developments!**

## Introduction

Medical Imaging has transformed medicine. It has dramatically changed how physicians measure, manage, diagnose, treat, and even think about medical illnesses and conditions. The result is seismic change in the landscape of health care—in how and where care is delivered, in the quality of care, and in the structure of the health delivery system.

Medical Imaging has transformed medicine because innovations have made imaging faster, more precise, and less invasive. This has led to broader use of imaging for more conditions and for more patients. While Imaging was once thought of primarily as a diagnostic tool, today it is also used on the front line of treating, managing, and even predicting disease.

Medical Imaging has become essential for virtually all major medical conditions and diseases. It is a standard of modern medical care for cancer, stroke, heart disease, trauma, and neurological conditions, among others. It

is used by a wide range of medical specialists, from oncologists to internists.

## Potential for Increased Growth and Competitiveness

The broad applicability of Medical Imaging has increased its growth. This is a logical consequence of physicians integrating imaging into the standard treatment patterns for more conditions, settings, and patient groups. To ascribe this growth primarily to financial motives of medical providers ignores these deep, patient-centered changes.

Understanding the transformation that medical imaging has brought about is important in understanding why imaging use is growing. Policy changes that single-mindedly attempt to stop imaging growth could easily reverse its positive effects on patients and quality. A better approach to managing utilization is to rely upon sound evidence and physician-developed practice guidelines.

Policy decisions intended to manage growth in imaging utilization must take into account this broader view of imaging value and utilization. They must recognize that much of the growth emerges from deep, systematic, patient-centered changes that Medical Imaging has fostered.

## Cross-Disciplinary, Scientific Issues

Molecular imaging and image-guided therapy are now basic tools for monitoring disease and in developing almost all the applications of in vivo nanomedicine.

Molecular imaging has had a late start in Europe. One of the challenges has been to define research partnerships between the imaging industry and the contrast agent industry, which bring complementing competencies to the table.

Ref [1] The convergence of nanotechnology and medical imaging opens the doors to a revolution in molecular imaging (also called nano-imaging) in the foreseeable future, leading to the detection of a single molecule or a single cell in a complex biological environment. Besides the use of nano-agents for in vivo imaging of molecules or cells, the use of nanoscale agents for diagnosis and manipulation may lead to an improvement of surgical techniques in the clinic. This may be achieved, for example, through a better mapping of cancer distribution using near-infrared imaging and applying photo thermal therapy or heat treatment, the characterization and non-destructive removal of cells or tissue in a specific area, the tracking of specific cell types used in therapy, as well as the visualization of bio-therapeutic agents.

E-health, data management, telemedicine, and networking rely on the acquisition, management, analysis and exchange of biotech/life science data and on the integration of this data with information from clinical sources. To determine which procedures and clinical protocols are most effective, it is crucial to understand the underlying relations and patterns in this collected data.

Modeling and computational tools are required to improve the design and manufacturing of devices with molecular constituents such as proteins and nucleic acids. Computer simulation represents a useful tool for technological investigation.

In parallel to technological development, new diagnostic markers specific to diseases have to be identified so that in vitro diagnostic techniques can enable an earlier and personalized diagnosis for patients.

The ultimate objective of in vivo imaging is to get highly sensitive, highly reliable imaging techniques usable for diagnosis in personalized medicine for delivering drugs, following their distribution, and monitoring therapy. This concept is called theranostics (therapy and diagnostics), and is based on the “find, fight and follow” approach.

### Integrated/Trans-national Approach

Research on all these fields is unusually spread across regional, national, industrial, clinical and academic sectors. For real progress improved co-ordination and communication is required between all parties. Unfortunately, the healthcare sector is quite diverse and collaboration has been difficult as a result, so the challenge is to build expertise in the development of integrated systems that address unmet clinical needs while providing a solid and consistent network of R&D + Innovation groups.

### Socio-Economic and Cost-related Issues

Medical Imaging is growing at roughly the same rates as other areas of health spending. Unfortunately, the off-setting savings created by imaging—through less-invasive care, quicker recovery, and fewer complications—tend to be overlooked in assessments of growth in imaging spending.

The ageing population, the high expectations for better quality of life and the changing lifestyle of European society call for improved, more efficient and affordable health care.

Part of the complexity in understanding the increased use and spending associated with Medical Imaging is that such increases are not always associated with higher costs. Indeed, they often lead to new efficiencies and cost savings.

With all data at hand, and despite the economic downfall, the socio-economic impact of Advanced, Cross-disciplinary and Integrated Medical Imaging can be measured in tenths of billion Euros and hundreds of thousands jobs likely to be created in Europe should we take full advantage of the strengths and opportunities we face.

## AMI-4EUROPE Objectives in a Measurable and Verifiable Form

AMI-4EUROPE aims to acquire a comprehensive insight into the design, implementation and impact of existing Medical Imaging and associated Health-related Technologies research and innovation support programs and initiatives in Europe. The scope of this objective is to create the Common Co-ordination and Knowledge Base necessary to enter the identified market niches and then establish appropriate scientific advice and sustainable support mechanisms to assist the EC and national, regional policy makers to better define a Strategy and show the way for future research actions in favor of AMI, Regions of Knowledge and the European Research Area (ERA) to maximize their socio-economic impact in support of the health-related economy.

More specifically, AMI-4EUROPE project has the following S&T objectives:

- Provide a comprehensive, authoritative, evidence-based, quantitative and qualitative study on the overall state-of-play in Medical Imaging in Europe
- Structure and Define what Advanced, Cross-Disciplinary and Integrated Medical Imaging (AMI) is all about.
- Define the AMI-4EUROPE Joint Action Plan.
- To start creating “AMI Infrastructure” to support a quick and full development and implementation of AMI for maximum socio-economic impact

## Acknowledgment

European Commission; Regions of Knowledge; FP7 Programme.

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# Baltic Heart Study as a New Activity of eHealth for Regions Network

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EU BSR Interreg project "ICT for Health"

***Abstract.*** **The main propose of the network is to facilitate transnational cooperation on health by improving the availability and accessibility of eHealth services and raising acceptance of eHealth by citizens, medical professionals and other stakeholders in the regions. The BALTIC HEART study designed by eHealth For Regions Network members as international eHealth initiative part-financed by European Union aims to assess effects of telemedicine and distance learning applications in the prevention of further hospitalizations in patients with chronic heart failure. Transnational cooperation in this study opens the mind for innovative ways of eHealth deployment in different health conditions and for sharing knowledge and resources across borders. With this study it is expected to evaluate the feasibility of telemedicine and distance learning applications for CHF patients after hospital discharge. Also to evaluate the efficacy of telemedicine and distance learning applications on mortality, morbidity, symptoms and quality of life compared to standard care and to evaluate safety and patient satisfaction on selected telemedicine and distance learning applications used for patient home care model.**

## Introduction

Chronic heart failure (CHF) is a chronic condition where appropriate disease management is critical (1). Effective disease management requires the patient to take an active role in his/her health. Indeed, CHF is an area where patient empowerment is very important. Unfortunately, many CHF patients do not successfully manage their disease; thus, rehospitalisation and high mortality rates prevail (1,2). Frequent communication between the patient and health care professionals, intensive education programs, and home health monitoring can help reduce hospitalizations and mortality rates (3). Despite the dismal prognosis, there are several examples of CHF patients living beyond the years normally expected. These successes are

usually attributed to patients taking an active role in disease management, facilitated by appropriate diet, exercise, daily self-measurement (e.g., weight scales and blood pressure devices), medication compliance, smoking and other behaviour control, education, recognition of disease-related symptoms (1, 3, 4).

Basic technological solutions for better integration of medical professionals and patients in health care processes are available in many cases. However the deployment of information and communication technologies in the regional health systems has been severely lagging behind compared to other sectors of European economies. Although there are many reasons to cooperate transnationally in health care, the use of eHealth is not very exploited yet.

The BALTIC HEART study designed to assess effects of telemedicine and distance learning applications in the prevention of further hospitalizations in patients with chronic heart failure. Transnational cooperation in this study opens the mind for innovative ways of eHealth deployment in different health conditions and for sharing knowledge and resources across borders.

## Objectives

Primary objective of the BALTIC HEART study is to test the hypothesis that standard care supplemented with telemedicine and distance learning applications in patients with NYHA II-III chronic heart failure is superior to the only standard care model after hospital discharge.

Secondary objectives are:

- To evaluate the feasibility of telemedicine and distance learning applications for CHF patients after hospital discharge.
- To evaluate the efficacy of telemedicine and distance learning applications on mortality, morbidity, symptoms and quality of life compared to standard care.
- To evaluate safety and patient satisfaction on selected telemedicine and distance learning applications used for patient home care model.

## Methods

This study designed as a prospective, non randomized concurrent control, multi-centre design study. Total follow – up period in this study is 12 month.

*Study participants*

Study involves patients who have had diagnosed CHF (II-III NYHA) and hospitalisation not more 1 year before involvement to the study.

*Key criteria for inclusion*

1. Written informed consent obtained.
2. Male and female patients over 18 years of age.
3. Chronic heart failure diagnosed at least before study involvement. Treated with relevant long-term oral treatment.
4. Relevant NYHA II-III symptoms at screening.

*Key criteria for exclusion*

1. NYHA I or IV at screening
2. Therapeutic education impossible
3. Severe renal insufficiency (serum creatinine >450 μmol/l [5.0 mg/dl]) or on dialysis
4. Severe anemia (blood hemoglobin <10 g/dl) at screening
5. Other serious diseases limiting life expectancy considerably (e.g. end-stage cancer)

This study investigates the superiority and effectiveness in 3 arms:

*1 arm: SC + TM + TE:* the standard home care program plus a 6 month telemonitoring program and plus 6 month tele-education program

*2 arm: SC + TE:* the standard home care program plus plus 6 month tele-education program

*3 arm: SC only (Comparator):* only standard home care.

Patient allocation to groups will be based on patient possibilities to use telemedicine applications, availability and competence for internet use. Those who do not have internet connection or are incompetent users are assigned for the standard care.

Table 1. Patient concurrent allocation requirements.

| **Group** | **Minimum requirement for selection** |
|---|---|
| SC+ TM + TE arm | 1. If have internet connection;<br>2. If has sufficient competence to use internet;<br>3. If agree for tele-education<br>4. If agree for telemedicine application |
| SC+ TE arm | 1. If have internet connection;<br>2. If has sufficient competence to use internet;<br>3. If agree for tele-education |
| SC arm | 1. If agree to participate only for standard care |

Key baseline characteristics to be balanced between arms: age, gender, educational level, LVEF, NYHA class at baseline, hypertension (documented by medical records), overweight (KMI > 30)

Telemedicine and tele-education applications

The telemedicine set includes a telemetric scale and telemetric blood pressure monitor with possibility to transmit clinical data to the telemedicine center via telephone line.

*Telemetric BP measurement device*

The Communication BP monitor - Stabil-O-Graph will be used in the active implementation period (0-6 month). The communication BP measurement device is equipped with a Bluetooth interface, which enables the transfer of measured data to an online database.

*Telemetric scale*

The Communication Scale - Libr-O-Graph will be used in the active implementation period (0-6 month). The intended use is measurement the body weight of a user at home. The communication scale is equipped with a Bluetooth interface, which enables the transfer of measured data to an online database.

*Tele-education content*

Distance learning program will be used for CHF patient basic distance learning on disease. Patients on tele-education beside tele-education program will receive short educative messages on individual risk factors at the regular basis (every 2-3 weeks).

Investigational and reference home care models

*SC + TM + TE group:* The patients at the SC + TM + TE group will receive local standard of care supplemented by telemonitoring and tele-education.

During active implementation phase the patient starts the Web based training. The patients continue self measurements and reporting with his allocated telemedicine devices during all telemonitoring period. The patient will be also advised for behaviour change according to individual risk factors.

*SC + TE group:* The patients at the SC + TE group will receive local standard of care supplemented by tele-education program.

This group of patients during active implementation phase the patient starts the Web based training.

*SC group:* The patients at the SC group will receive local standard of care. The patient adviced for self measurements and behaviour change according to individual risk factors.

Data analysis

The PP (per-protocol population) will be used for supportive analyses. The analysis will be presented, by treatment group, to summarize the primary, secondary and all other variables. Additionally, multifactor analyses will be performed for each of the components of the all events and risk factor profile changes.

## Acknowledgment

The study is part funded by the European Union's Baltic Sea Region Programme 2007-2013. Study protocol prepared by EU BSR Interreg project “ICT for Health” members.

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# Project 9.4. Reorganization of Welfare Functions and Related Services in Piedmont Decentralized Areas

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***Abstract:*** **a growing literature indicates in tele-home-monitoring a modern approach to patients with chronic diseases (CD). Information and communication technologies (ICT) can provide support to streamline the health care provided, ensuring the timeliness and the quality of care with a positive impact on cost containment. In Italy the number of frail elderly people is increasing and those over 65 represent about 19% of the population. The prevalence of CD has reached considerable numbers. Populations living in decentralized areas are affected by the aggravating logistical situation and discomfort due to less chance of access to services. The Agency for Regional Health Services (Agenzia Regionale per i Servizi Sanitari, AReSS), coordinated an innovative telemedicine project in decentralized areas of the Local Health Unit (Azienda Sanitaria Locale) TO4.**

## Introduction

In Italy the number of frail elderly people is increasing and those over 65 represent about 19% of the population. The prevalence of chronic diseases has reached considerable numbers: more than 2 million people live with diabetes and it is estimated that 500.000/1.000.000 are not diagnosed yet. Approximately 500 000 patients are suffering from Chronic Heart Failure (CHF); over 2.5 million patients are suffering from with Chronic Obstructive Pulmonary Disease (COPD).

A growing literature indicates in tele-home-monitoring a modern approach to patients with chronic diseases (CD). Information and communication technologies (ICT) can provide support to streamline the health care provided, ensuring the timeliness and the quality of care with a positive impact on cost containment, through the on-line management of medical information.

The expression “Connected Health” brings together the concepts of telemedicine and eHealth to mean a network of integrated health information from different interoperable clinical applications.

## Methods and objectives

*Macro-objectives of the project*

- The project 9.4, articulated on three clinical arms, aims to provide the Piedmont Region of an agreed methodology for the implementation of telemedicine services, in particular about the telemonitoring of patients suffering from chronic heart failure (CHF), respiratory failure (RF) and diabetes in non-urban areas.
- Validate this methodology in a specific territory.

*Sub-objectives of the project*

- Properly analyze the needs of the population living in remote geographical areas.
- Share the methodology for telemedicine applications with a multidisciplinary perspective.
- Use medical technologies and ICT to improve the quality and access to services by citizens.
- Ensure continuity of care implementing a qualified and innovative model of care.
- Test the results obtained in the pilot project for the validity and possible extension to other geographically decentralized areas.
- Assess the impact of a telemedicine (telemonitoring and teleconsultation) model on clinical, organizational and economic issues in remote areas.
- Ensure, leaving the decentralized health expertise, adequate medical care to patients away from hospitals of excellence, making the best use of available resources with an uniform offer and equitable health services in remote areas.
- Involve public and private health workers, local communities, producers of technology services, and centres of excellence in ICT.
- Support health care workers, in the activity of diagnosis and continuity of care, helping them to rationalize the use of resources.
- Promoting telemedicine at the regional level through appropriate training.

*Testing Area and Logistics*

Testing Area. The District of Cirié, in the territory of the Local Heal Unit (Azienda Sanitaria Locale, ASL) TO4, includes the experimental site of the Valli di Lanzo, where are located 21 small mountain municipalities in

which 23 General Practitioners (GPs) and 2 paediatricians (PLS) serve, is the selected decentralized area.

Macro-components and Technology Platform

- Telemedicine Service Centre (TSC). This is the place where all technical activities coordinated; the headquarters is based outside the ASL and it works as the backup site.
- Coordination and Referral Centre (CRC) is based at the Local Hospital or at the Local Health Unit (District site) and it works as central server. It receives information from each home telemedicine workstation (PDT) or other services located on the territory (*Postazione Territoriale*, PT). CRC provides the presence of health workers and trained medical personnel able to meet the needs of patients, giving assistance via video-conferencing systems and telemonitoring. CRC is the reference point for all health services; it is in charge of the complete management of all medical problems of patients.
- Home telemedicine workstation (HTW). It is the contact instrument at home, *Postazione Domiciliare di Telemedicina* (PDT) with biomedical devices and telecommunication systems for the automated collection and transmission of physiological parameters to the Coordination and Referral Centre (CRC) and the Telemedicine Service Centre (TSC). The system integrates the functions of video-assistance, to see and talk with the doctor and telemonitoring. Through the installation of a specific decoder, patients will use their television as a tool for dialogue with health care providers.
- The technical infrastructure is based on an integrated platform (HW + SW + web.) conceived for the construction of a flexible model meeting different needs of the users. The virtual connection will be through the net ensuring security and reliability of data during the transmission of health information. Encryption systems and tools such as smartcard for access authorization guarantee the privacy.

*Main actors*

- Patient. The main beneficiary to whom all services are addressed. The patient, through the PDT sends automatically the biomedical parameters (e.g. blood glucose, blood pressure, weight, etc.) measured by supplied medical devices, selected on their usability to an operator or caregiver. The patient interacts directly with the operators of the Service Center (CST and CRT) and / or physicians (GPs, specialists, consultants, etc.) in audio and video; the territorial workstation (PT) represents an alternative for those people who do not have a

workstation at home. All biomedical devices shall be arranged in the other community site (e.g. pharmacy, surgery, etc.) and are designed to offer the same service.

· Doctors: General practitioner: the main actor of the home care plan. He guarantees the correct protocol of prevention, diagnosis and care plan. Consultant: the expert to be contacted for a second level advice. Both have the authority to:

- Enrol the patients in the protocol and, therefore, enter the patient's clinical data in the system;
- View clinical data and personal information about the patient;
- Define/agree, on the agenda, the planning of contacts/measures/therapy sessions and the video assistance information;

## Expected benefits

· Improve the quality of the GPs work in order to facilitate the integration of initiative medicine and home care.
· Share the information between health professionals involved in order of continuity of care through greater integration with the specialized resources of the area and the hospital network.
· Validate feasibility/rating/satisfaction of GPs and hospital specialists.
· Validate feasibility/rating/patient satisfaction with particular attention at the improvement in quality of patient's life.
· Improve the quality of life of patients and their families, helping to raise awareness - empowerment - with respect to their disease and their ability to manage independently.
· Reduce the improper access to the emergency room.
· Integrate the structures that operate in the territory in support of social and health welfare.
· Assessment of access to specialist services.
· Assessment and control of costs.

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# The "Home Automation and Health Pole" of Guéret: An Example of a Regional Initiative for eHealth

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***Abstract:*** **This paper shows a regional approach for e-health in the frame of the "home automation and health" pole of Guéret. The Community of Cities of Guéret Saint-Vaury has initiated the deployment of home automation and ICT packs and has evaluated the benefits both for preservation at home and for medical institutions. This deployment is done in conjunction with academic programs, craft market institutions and a home automation resource centre. Results of the experimentations are reported and recommendations are derived.**

## Introduction and context [1, 2]

The initiative "Pôle Domotique et Santé de Guéret" is an example of a regional approach aiming to take benefit of the opportunities that home automation and ICT services could bring to meet social, academic and economic needs in the area. A core issue for the region was to tackle the demographic challenge of a low density, rural and ageing population. The project was set up to improve the quality of life of inhabitants, to promote the implementation of new services, to create new jobs and to trigger the growth of a new market for innovative technologies. The key action points of the project are to create professional qualifications in home automation and ICT, set up a dedicated resource centre, develop products and packages of services that target people with reduced autonomy, set up a trial of products and services in a centre for dependent people, structure a network

of local companies, organize events to communicate about the project over the local area and to expand partnerships at national and European levels.

## Deployment of home automation and ICT healthcare packs in private and medical housing

*Evaluation of four major domains*

In this frame, the deployment of home automation and ICT healthcare solutions has been driven through packs for private housing and medical institutions. The evaluation of the impact of the proposed solutions has been done referring to four major domains (motor disability, security, social link and actors' coordination). Equipment packs have been designed depending of the house type and patient troubles for different scenarios:

- Pack A: Comfort and communication
- Pack B: Security
- Pack C: A + B
- Pack D: enlarged B
- Pack E: A + D

*The experimentation approach*

Two experimentations have been driven: one concerns private housing, and the second one medical institution. The method used to survey is based on a qualitative survey by semi-directive conversations adapted to the different targets. The sample sizes for the two experimentations are 10 private houses with 5 packs and 30 beds in medical institutions. General recommendations have been derived from the analysis with several ways to develop the offer:

- A gradual development of the offer for a better acceptance;
- A basic offer (automatic lighting and remote monitoring) increased by more specific options (health, autonomy/movement);
- A "Relational" development of ICT for the old person;
- A family mode for the private sphere and a "social" mode to stay in connection with a community;
- A "practical" mode to stay connected with a doctor or a medical institution.

After the experiments conclusions, the General Council of the department of Creuse has started a public service delegation to deploy a "base pack" in 2000 homes.

## Major results

The evaluation of the impact of the different packs has been then made for private house and for institutions. The results are as follows:

Appropriation and interest at home:

- The major part of families' wishes to maintain the equipment and imagine a system of coverage mutualized for a better financing.
- The equipments of home automation are better accepted than the "communicating equipments" (which did not work well).

Appropriation and interest in medical institution:

- Persons in a single room take better benefit of the equipments.
- The professionals show a better image of themselves.
- Decline of the stress for people in charge of disoriented persons.

Improvements in private housing:

- The video conference systems badly worked and disappointed families.
- They have caused stress to the old people.
- Remote monitoring do not really interest the old people (refusal) otherwise to be directly connected with assistance;
- ICT: a wished but still unsuitable system that can lead to a feeling of disappointment.

Improvements in medical housing:

- An individual video conference system installed in each room is preferred to a common video system in a living room.

Improvements of the coordination:

- A need for a communication system more suitable for the medical staff, more opened and shared and more interactive, to allow transmissions and traceability.

Learning from the expectations and recommendations

Many important points and conclusions can be outlined:

- Training and information for a good appropriation;
- Take into account the context and accompany in time for old persons;
- Emphasize the competences and gains acquired;
- Maintain an adequate share between technology and human needs;
- Ethical dimension is a condition of success;
- Consideration of the human being: need of user-friendliness, personalization, dignity and respect;
- Mediation between families and old persons;
- Specifications guaranteeing the person against a not-corresponding use;
- Take into account the basic needs of health (risk of fall).

Several general recommendations can be derived from the experimentations and their major results. Several ways to develop the offer have to be considered:

- A gradual development of the offer for a better acceptance:
- A "Relational" development of ICT for the old person

Another objective is to develop specific trainings [3, 4]:

- Academic trainings merging ICT and home automation technologies, health, old person sociology, medical influencers, financial support and house design;
- Trainings for craftsmen, medical staff…

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# Welfare Tech Region: Creating Growth through Innovation in the Health Care Sector

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***Abstract:*** **Welfare Tech Region is a regional venture promoting cross-sectorial cooperation between businesses, hospitals, universities, and public authorities within Ambient Assisted Living and telemedicine.**

MedCom is a project organisation situated in Odense in the Region of Southern Denmark. The international department of MedCom is participating in several EU funded projects with focus on telemedicine, AAL, and standardization of electronic communication in the health care sector.

Currently, MedCom is participating in the regional Ambient Assisted Living (AAL) and telemedicine initiative "Welfare Tech Region" based in the Region of Southern Denmark. Welfare Tech Region is part of the regional venture within AAL (velfaerdsteknologi.nu).

As every nation in Europe, Denmark is facing the demographic challenge of an increasingly aging population and an increase in the number of people suffering from chronic diseases such as diabetes, Chronic Obstructive Pulmonary Disease (COPD), and heart failure. Combined with a decreasing labour force and tight fiscal policies, this challenge creates market potential for AAL-technologies.

The Welfare Tech Region project is utilising the market potential by creating projects that are promoting business growth and new jobs through collaboration between industry, research, and government to develop, produce, and implement technological products for healthcare, rehab, and eldercare that are useful to society and improve the daily lives of its citizens. The projects focus on telemedicine, assistive technology, robotics, and information technology. During the course of three years, the goal is to create 50 new companies, 500 new jobs, and 100 new projects in the region.

Alongside the project, the Welfare Tech Region Association is open to members actively participating in the development of AAL services in the region. Members include companies, knowledge institutions, and public organisations.

http://www.welfaretechregion.dk/en

Lotte Beck holds a Master of Arts, International Business, Modern Languages, and International Relations (cand. Negot.) from the University of Southern Denmark. She speaks Danish, English and German. Since 2009 Lotte Beck is a consultant at MedCom and project manager of several EU-projects with focus on Ambient Assisted Living and telemedicine including ICT for Health and Welfare Tech Region.

# Telecardiology

# A Novel 12-Lead ECG Telemedicine System Based on Cloud Computing

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***Abstract:*** **Several clinical trials indicated that 12-lead ECG telediagnosis can effectively reduce the door-to-balloon (D2B) time to treat emergency patients with coronary diseases. However, the application of 12-lead ECG telemedicine is impeded by clinically-used ECG instruments and information systems, because these instruments and systems do not allow clinicians to retrieve ECG reports ubiquitously. The major purpose of this study is to develop a cloud computing based 12-lead ECG telemedicine system, which expands the applicability of 12-lead ECG telemedicine and enhances the efficiency of ECG database management. In this study, we implemented a 12-lead ECG processing and visualization application service on a Microsoft-based cloud-Azure. First, the XML based ECG files and waveform data recorded from clinically-used ECG instruments were transmitted to the cloud. Next, the ECG processing and visualization service running on the cloud received ECG files and performed the tasks including (1) ECG waveform noise removal, (2) ECG report generation, (3) ECG file storage and management. With this system, clinicians can retrieve ECG reports via web or cell phones by the cloud connection anytime and anywhere. System evaluations indicated that this cloud based 12-lead ECG information system can be easily applied onto ECG tele-consultation and pre-hospital ECG telediagnosis**

## Introduction

Mobile based telemedicine can improve the present medical service quality, which is the new focus of the medical industry. However, the development of ubiquitous 12-lead ECG telediagnosis is impeded by clinically-used 12-lead ECG data formats and vendor-specific ECG information systems. The heterogeneous 12-lead ECG data formats and

incompatible ECG information systems developed by ECG manufactures result in major difficulty in 12-lead ECG record management, ubiquitous 12-lead ECG diagnosis, and 12-lead ECG records interoperability. The international academic organization, OPEN-ECG, has promoted the development of computerized ECG records by providing members with technical references of various ECG data formats in 2002 [1]. In 2009, we developed 12-lead ECG telemedicine applications in clinical practice, including ubiquitous 12-lead ECG teleconsultation between Emergency Department (ED) physicians of and cardiologists [2], pre-hospital 12-lead ECG transmission in an ambulance [3], and the integration of various 12-lead ECGs in a Picture Archiving and Communication System (PACS) [4]. These novel applications have been proved to improve the medical service quality for patients with syndromes coronary diseases. In this study, we expend the telemedicine applications onto the collaboration of inter-hospitals, which realizes 12-lead ECG interoperability.

## Methods

In this study, a cloud computing technology is developed to provide hospitals with services of 12-lead ECG processing, storage, visualization, and management. Either hospitals or ambulances can transmit generated 12-lead ECG files to the public cloud, cloud-ECG, which is based on the Microsoft Azure platform [5]. The ECG-cloud provides clinicians with instant 12-lead ECG record browsing and management anytime and anywhere. The ECG data stored in the cloud share the same schema of the database, where the 12-lead ECG interoperability is facilitated. With the ability of virtualized machine in the Azure platform, clinicians can use heterogeneous operating system based mobile devices to retrieve 12-lead ECG records via web access.

## Results

Fig 1 shows a cell phone retrieving 12-lead ECG by a cardiologist. As shown in Fig 2, the 12-lead ECG telemedicine application is expended onto multiple purposes including (1) 12-lead ECG management service as utility computing, (2) 12-lead ECG teleconsultation, (3) pre-hospital 12-lead ECG diagnosis in the ambulance, and (4) 12-lead ECG e-learning. To offer 12-lead EC management service, we use public cloud instead of hospital hardware systems to provide infrastructures, which realize computerized 12-lead ECG visualization and management. With this service, large hospitals such as urban medical centers or smaller rural clinics can all benefit from it by transmitting 12-lead ECG files to the public cloud. To

practice 12-lead ECG teleconsultation, on-site ED physicians and off-site cardiologists use cell phones to co-diagnose patients' ECG. To realize 12-lead ECG pre-hospital diagnoses in the ambulance, emergency medical technicians deliver 12-lead ECG files to the public cloud, which transfer the files to an off-site cardiologist's cell phone for real-time diagnoses before the patient's arrival to the hospital. To facilitate 12-lead ECG e-learning, we provide clinicians with 12-lead ECG cases for consultations and discussions via a facebook link.

## Discussions

Since 2009, we developed several clinical applications of 12-lead ECG telemedicine in real cases to improve the medical service quality, such as ECG teleconsultation between ED physicians and cardiologist, pre-hospital 12-lead ECG diagnosis in an ambulance, and the integration of heterogeneous 12-lead ECG. However, these applications were limited to be used by a single hospital due to the installation of private ECG information system. To overcome this limitation, this newly developed 12-lead ECG based on cloud computing can integrate heterogeneous ECG data formats and ECG database in a unified system, which realizes the 12-lead ECG interoperability of 12-lead ECG records.

Fig 1. The use of 12-lead ECG in a cell phone

## Acknowledgment

This study is financially supported by National Science Council of Taiwan under contracts NSC98-2221-E-155-018- and NSC99-2221-E-155-026

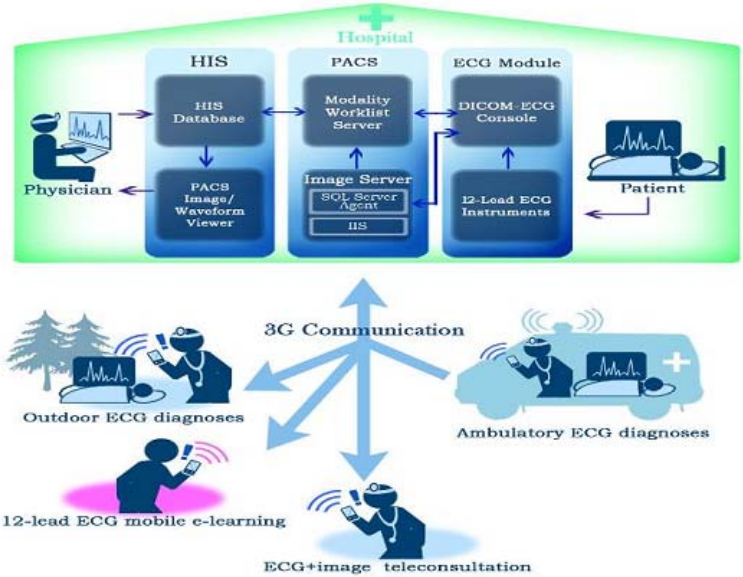


Fig 2. The clinical applications of 12-lead ECG telemedicine

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# A Pilot Project on Telecardiology Services by Ministry of Health Malaysia

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***Abstract:*** **The initiative to develop telecardiology derived from the need to provide specialised opinions in areas not accessible to specialised healthcare. The aim of the project is to create a platform capable in delivering medical images and video clips between clinicians without compromising patient confidentiality. The information hence can be used to assist in providing definitive diagnosis and appropriate managements which not available at the presenting hospital. To date, 158 cases have been sent for teleconsultation including pre-operation assessments, doubtful electrocardiographs, difficult echocardiography interpretations, coronary artery bypass surgery referrals, valvular heart disease and congenital heart disease consultations. In summary, the telecardiology provides clear and accurate information transfer between clinicians which result in delivering quality patient care.**

## Introduction

Lack of specialists in rural hospitals and high numbers of specialists in cities leave many patients without optimal management strategies. There are only 5000 specialists in Malaysia to cover a population of 28 million [1]. Currently, 186 registered cardiologists are working in Malaysia with only 26 working with the Ministry of Health [2]. Most of the cardiology cases are managed by physicians and medical officers. The development of telemedicine in Malaysia has been geared towards the achievement of vision for healthcare as stipulated in the Telemedicine Blueprint Malaysia (as cited in [3]). Telecardiology serves as a tool to narrow the gap in providing equal healthcare.

## Telecardiology Services

A pilot project was initiated by Ministry of Health to produce a teleconsultation portal tailored towards the needs of the clinicians. It was decided that the program produced should be user-friendly and simple to use without consuming much of the doctors' time. Subsequent success would rely on the ability of the clinicians to sustain telecardiology usage by restructuring their clinical routines to incorporate telemedicine into their practice [4]. The team implementing telecardiology services (clinicians and software developers) therefore agreed that the following features are vital in ensuring the success of telecardiology.

1. Ease of use and a user friendly system.
2. Time saving in gathering and transmitting information.
3. Prioritising urgency of the cases discussed using telecardiology.
4. Patient privacy and confidentiality.
5. An ability to resume data uploading when interruptions occur during emergencies.
6. Reply 'on-the-go' for the receiving doctors.

The initial pilot project involves 4 hospitals in the northern part of peninsular Malaysia and 4 hospitals in the state of Sabah. Three hospitals (sites) have interventional cardiology facilities but only one has residing cardiothoracic services back-up**.** Large travelling distances, costly travelling expenses and a lack of good roads in Sabah due to forests and mountains makes telecardiology highly relevant in ensuring that the population receives specialised care. The system adopts an asynchronous method in which the (sending & receiving) clinicians do not need to be simultaneously present ('live') during consultations [5, 6]. This removes all restrictions on busy clinicians' schedules [6].

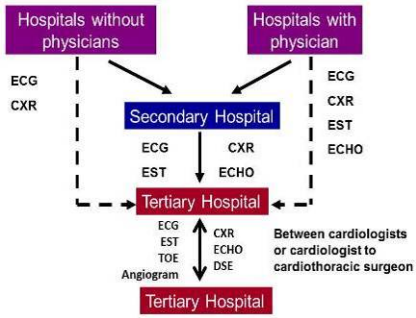


Fig 1. Concepts in which the telecardiology flow occurs between hospitals in Malaysia when referring for specialised consultation. These are the images necessary to assist effective consultation between clinicians which can be transmitted through the telecardiology portal. (ECG-electrocardiography, CXR-chest x-ray, EST-exercise stress test, TOE-transoesophageal echocardiography, DSE-dobutamine stress echocardiography, ECHO-echocardiography).

Telecardiology Facilities

The equipment for the sending site include computer workstations, x-rays digitizers, digital cameras, 3-in-1 printers, scanners and fax and broadband internet connections. The replies to referrals can also be done using workstations, web-based browsers or using mobile devices such as blackberry phones or iPhones. The sending sites need to send data through their workstations to ensure patient confidentiality.

The system was created without compulsory fields which are obligatory to be filled in except for the name, identification number and demographic details. The compulsory fields are there to ensure patient safety. Patient medical histories, medication lists and investigations can be entered or attached as scanned document files.

The images include electrocardiograms (ECGs), stress ECGs, radiological images. The video clips include echocardiograms and angiogram clips which can be obtained either via cardioPACS (cardiology picture archiving and communication system) or directly from compact discs.

The cases are classified as urgent, semi-urgent and routine. The classification of the cases is made in order to stratify the response time needed by the receiving site specialists to decide how quickly they should respond to the referred cases. The classification allows for the notification of urgent cases through the mobile devices or alerting with phone calls. In response, prompt replies can be made either from web-based browsers or by telephone calls.

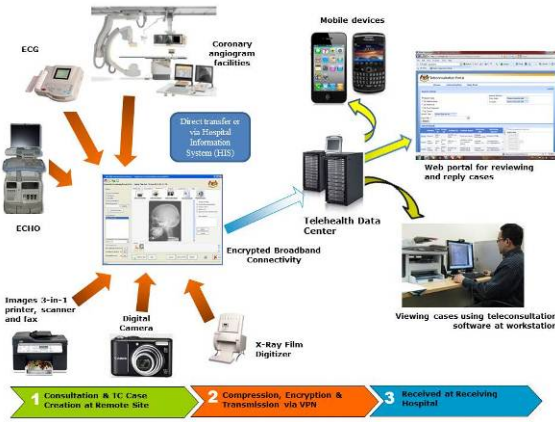


Fig 2: Retrieving images and video clips by various methods depending on the supported appliances. Viewing and replying can be done via mobile devices, web portal or teleconsultation workstation.

The urgent cases may just contain simple images with the patient's history conveyed over the phone; for example a patient with chest pain with doubtful electrocardiogram(s). The urgent cases should be responded to within an hour of transmitting the cases. Semi-urgent cases should be replied within 2 working days and the routine cases within 5 working days. Notification of the last two groups is done through email.

## Confidentiality

Patient's confidentiality and data protection are vital elements in telecardiology [7]. It uses a secured line with encrypted transmission which can only be done by a registered user. Moreover, it was decided that written consent was not required as it could slow down the whole teleconsultation process. Verbal consent is deemed to be adequate to ensure patient awareness about the case discussion. Transmitted patient data are stored in a secured central server. The mobile device notification contains only necessary information with thumbnail images. Images that are viewed in mobile devices or on the web will be stored back to the central server.

## Results

Since May 2010, 158 cases have already been sent through telecardiology in which 64 were urgent cases, 71 semi-urgent and 23 routine cases. The numbers of district hospitals equipped with echocardiography have also increased. Hence, echocardiography images and video clips were the top items sent through the telecardiology for second opinions mainly because each of these cases had an average of 10-15 images and most of the medical officers are not trained to interpret echocardiography.

## Conclusions

Improved visualization of case consulted through advanced communication tools helps in providing best medical attention despite the distance. Telecardiology is proven beneficial in reducing unnecessary travelling and in achieving definitive management. Discussions between clinicians are also served as educational tool in improving experiences and clinical judgments.

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# A Telemedicine System to Increase Patient's Access to Specialized Cardiac Care for Assisting Remote Diagnosis

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***Abstract:*** **The purpose of this project is to compile a system that will optimize the assistance that can be offered by cardiac specialists to diagnose cardiac patients remotely at Tygerberg Tertiary hospital from Worcester Secondary Hospital (Western Cape, South Africa). This system must achieve effective and efficient communication between medical personnel of different facilities in an attempt to maximize the amount of cardiac patients diagnosed remotely.**

## Introduction

Cardiology refers to the specialized study of heart disorders and is a focused field of knowledge practiced by cardiologists. Due to the specialized nature of cardiology, treatment is not given as widely and effectively in populated and under-resourced areas, like South Africa [1]. In the public medical sector there are too many cardiac patients and not enough doctors with the necessary expertise to attend to their needs [2].

Cardiac specialists that are situated only in urban areas in South Africa, cannot attend to the needs of all the rural cardiac patients Therefore, cardiac specialists assist rural doctors in diagnosing patients remotely. The assistance currently offered is not optimal and patients do not get the needed tertiary specialist care that is available in urban areas. The different factors that limit a patient's access to tertiary cardiac care is the patients location relative to the specialist, the methods used to access specialist, human error, limited information transfer capabilities, the cost and the limitations of technology used.

Tygerberg Tertiary Hospital and Groote Schuur Tertiary Hospital are the only hospitals in the Western Cape that provides tertiary, highly specialised cardiac facilities for patients. This explains why the majority of cardiologists in the Western Cape are located in one area. Patients from surrounding rural areas requiring specialized cardiac care are

accommodated by these tertiary hospitals. Worcester Secondary Hospital is one such hospital which refer cardiac patients to Tygerberg.

The purpose of this project was to design a system that will optimize the assistance that can be offered by cardiac specialists to diagnose cardiac patients remotely at Worcester Secondary Hospital. This system had to achieve effective and efficient communication between medical personnel of different facilities in an attempt to maximize the amount of cardiac patients diagnosed remotely at Worcester Secondary Hospital.

## Methodology

The current situation was assessed and the structure used for communication between the two institutions was documented. The restrictions which limit the current system were identified. It was found that the technology is being used to share patient data, such as facsimile and telephone calls, results in an unnecessarily protracted process. The outdated technology is used because there is no faster communication network that support complex, large patient data files.

### *A. Alternatives considered*

Existing and potential technology was explored to formulate alternatives namely: (1) electronic transfer of files in Digital Imaging and Communications in Medicine (DICOM) format, an industry standard for transferal and storage of radiologic images, (2) compressing the DICOM files to Moving Picture Experts Group (MPEG) or Joint Photographic Experts Group (JPEG) format before electronic transfer; (3) implementing a Picture Archiving and Communication Systems (PACS) intranet between hospitals; and lastly (4) to use DICOM viewers on clinical workstations to view the DICOM patient data files.

### *B. Evaluation method*

The alternatives were compared as to how well they fulfill each of the following objectives. (1) to effectively transfer patient data; (2) to minimize the duration of the data transfer procedure, (2) to find a cost-effective and user-friendly solution, (3) to eliminate the legal and ethical issues concerned and to find a solution that offers secondary or tertiary educational benefits. Ultimately, the possible solutions and their feasibility was explored using the Analytical Hierarchy Process (AHP) technique.

## Results

It was found that emailing original or compressed DICOM files are most cost effective alternative, but the process is still protracted and the capabilities of this solution is limited [3], [4]. A more expensive alternative

is implementing a PACS intranet. The PACS entails the least effort and will minimize the duration of the data transfer [5]. Lastly it was found that a DICOM viewer offers the most capabilities for processing data and making accurate diagnosis. All alternatives enhance education, since files are at least electronic, but the DICOM viewer offers the biggest learning capabilities since files can be processed off site [6]. All alternatives share the ethical issue of communicating confidential patient data, but this can be altered by antagonizing data. The feasibility of alternatives was explored using the Analytical Hierarchy Process (AHP) to illustrate that a DICOM viewer in conjunction with a PACS intranet is the best solution to increase a remote patient's access to a specialist's knowledge.

## Conclusion

If a PACS in conjunction with a DICOM viewer is implemented the effectiveness of data transfer procedure is increased, since data is always accessible via the PACS intranet and the DICOM viewer software allows post processing of DICOM files. The duration of the procedure is decreased for the doctor at Worcester Secondary Hospital, since files are automatically transferred to the central PACS server after study is completed; and for the specialist at Tygerberg hospital, since he can view the diagnostic images on mobile device. The cost of the solutions mostly be to implement a network between the hospitals and acquiring the PACS software license.

The DICOM viewer software is free for download. The alternative is user-friendly, since minimal effort has to be endured to transfer data and DICOM viewer user interface is simple to operate. This option enhances secondary and tertiary education most since DICOM files can be viewed on any standard of the self hardware connected to the network via Wi-Fi. Ethical or legal issues can develop with exchange of confidential patient information, but due to patient data only being connected to the patient MRN in the PACS system of Tygerberg, no patient's confidentiality will be breached.

## Future research

During the study it was found that, although DICOM files from different modalities are not able to be post processed, they are stored in the same format. The exact reason for DICOM files currently not transferring with all metadata able to be reached for post processing is still not certain. The three dimensional time series data cannot be shared via network (since network capacity is to low) and therefore DICOM data has to be written to CD to share for experimental purpose. It is uncertain to whether it is the DICOM

format or the program that writes the files to CD that currently causes meta-data to be lost. This is an area for future study.

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# Barriers and Potential Solutions towards the Implementation of a Public Telecardiology Network in Southern Brazil

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***Abstract:*** **Since 2008, a Tele-ECG system (Phase I) has been established in 11 villages of Rio Grande do Sul, Brazil, coordinated by the eHealth Centre of the Instituto de Cardiologia do RS (ICFUC-RS). Besides Tele-ECG diagnosis, this method offers live cardiological second opinion and a qualifying program in cardiology. Now, a larger public telecardiology network - Phase II, including 90 cities - is being established in RS. This paper explains the obstacles and presents the potential solutions for the implementation of a telecardiology multicenter public project in remote areas of southern Brazil.**

## Introduction

In the last few decades e-Health has emerged as an important tool for the pre-hospital diagnosis and counseling treatment of many diseases. Heart diseases, mainly coronary heart disease, are the most common causes of death in many countries [1]. Timely assistance of acute cardiac urgencies is critical for a successful therapy and patients' recovery. Optimal treatment of S-T Elevation Myocardial Infarction (STEMI) should be based on the implementation of an emergency medical system (EMS) [2].

The state of Rio Grande do Sul (RS) - southern Brazilian state - has a population of around 11 million inhabitants distributed in 496 cities. Most of them are very small - around 200 villages with less than 5,000 inhabitants -, being critically underserved in medical specialties, including cardiology. Since 2008, coordinated by the eHealth Centre of the ICFUC-RS, a public telecardiology project was implemented in 11 more towns located in 2 different and remote regions of the state. A face-to-face based telecardiology qualifying program was part of this strategy, counting on the participation of IC-FUC professionals and both undergraduate and postgraduate students [3].

Several barriers, represented by technological, administrative, geographical and financial aspects were encountered throughout Phase I of this telecardiology project. This paper explains the most important obstacles

and presents some potential and adopted solutions towards its successful implementation in remote areas of southern Brazil.

## Objectives

The report aims: (1) To describe the most relevant barriers encountered during the implementation and 2-year operation period of Phase I telecardiology project; (2) To report the adopted solutions for the ongoing project and to describe both the technical and academic initiatives to be deployed during the upcoming project's expansion.

## Methods

The implementation of Phase I of this project began in 2008, counting on both federal and state level funding support. The system provides ECG diagnosis and lives cardiology second opinion for potential emergencies, over a distance, to small and remote villages located in two different regions of the state: 6 in the northwestern and 5 in the southeastern region. Also, thrombolytic therapy - tenecteplase - for intravenous infusion, for cases of acute myocardial infarction, was distributed to all participating hospitals and outpatient care units, with its respective cost, supported by the project. The remote cities were selected based on the criteria of distance (more than 100 Km from the capital city), lack of cardiology "on-duty" emergency services on site, difficult road access, and a lack of previous telecardiology infrastructure in the selected regions. In order to qualify the involved professionals, a face-to-face training program was organized by the eHealth Centre of ICFUC-RS. Aiming to identify and to adopt proper solutions for the upcoming project, a report containing a list of the most important difficulties and barriers was prepared by the ICFUC eHealth team. Also, some relevant aspects of IT and communication infrastructure in RS state are described.

## Results

During 6 months, the IC-FUC RS Tele-ECG team promoted a series of training activities towards the qualification of professionals working in the remote participating centres. The first step adopted for the implementation of a telecardiology project, included a selection of professionals interested in the field and, after that, organizing a series of training activities for both the qualifying team and for the cardiologists of the two referral centres, a task which demanded a period of two months. A total of 121 professionals were qualified, via face-to-face activities, in all institutions: 67 in the north-western and 54 in the south-eastern region [4]. Travelling costs, represented

by transportation plus hotel daily rates and food, demanded organizing regional training activities joining neighboring villages, usually putting together 2 remote teams during each on-site session.

In two villages, a 6-month period elapsed for the installation of local Internet access infrastructure. In another place - Taim reserve - it was not possible to obtain a satisfactory Internet bandwidth.

A total of 41 technical and administrative occurrences were reported in our activities, namely: 1) 25 in the technical area: 6 specifically in computer science skills, related to digital ECG and telecardiology software operation problems, and 19 related to hardware problems (modem, CPU, no-break) and local Internet network interruption; 2) 15 issues with involvement of the administrative sector, including: delay of medical reply for ECG diagnosis and for live cardiological second opinion requests; 3) 1 episode of Internet provider failure, due to a thunderstorm in the northwestern region, which damaged the Internet access for 5 days (Tab.1). Administrative issues also included replacement of hospitals and outpatient care unit professionals during the ongoing project, which demanded organizing additional qualifying sessions.

Table1. Technical and administrative issues

| | | | |
|---|---|---|---|
| **41 Occurrences** | Technical **26** | 6 | Software related problems |
| | | 19 | Hardware problems (Modem, CPU, No-Break) and local Internet network interruption |
| | | 1 | Natural disaster: Internet provider out of service |
| | Administrative **15** | Excessive workload in the Emergency Department of referral centres:<br>- Delayed ECG analysis<br>- Delayed reply for video consultation | |

## Discussion

The establishment of new paradigms of public health assistance - through telemedicine and eHealth applications - can raise the quality of patient care, being vital for the nations' development [5]. Implementing and sustaining a public telecardiology network in two different regions of the RS state - Brazil - imposed barriers of different complexity. Technological infrastructure in distant villages still needs considerable improvement, varying from a total lack of Internet service in some villages to a shortage -

only one company offering internet services - in many others. Moreover, monthly costs of qualified Internet access are still quite expensive, being U$ 200,00 per month for a 512 Kbps bandwidth and around U$ 400,00 for 1 Mbps.

A series of technical issues were reported during the ongoing project, being necessary to request technical support from professionals located in distant cities. Aiming at addressing and fixing technical aspects, in Phase II, a local IT technician was incorporated to each remote telecardiology team, as a counterpart of the participant institutions. Excessive workload in the emergency department of the two referral centres was the reason for a delay in both the ECG analysis and specialized video consultation, in 15 opportunities. This demanded organizing a new telecardiology service, located out of the emergency area, to operate during the upcoming project expansion.

Geographical distance was a limiting factor for delivering a presence mode qualifying program. Aiming at the successful implementation and sustainability of eHealth services deserves paying special attention to human factors and, web-based educational opportunities, for isolated professionals, can be of utmost importance to reduce the digital divide which is a key component for the project's sustainability [6,7]. In order to reach out to a larger number of professionals, during Phase II, a qualifying program composed of multipoint live web conferencing sessions combined with the traditional presence mode training activities will be delivered on a regular basis.

Dealing with financial aspects is of major importance for all stages of an eHealth program as small cities in Brazil have a budget shortage for routine demands, especially when considering innovative actions. During this 2-year project, financial support came from both federal and state level research funding. The expansion and sustainability of this eHealth initiative, transforming a research project into a government program, imposes organizing all long term financial estimates.

The preliminary results of this innovative project are motivating the expansion of the method (Phase II), to be implemented in RS as part of a public health program named "Saúde Perto de Você" (Health Near You), during the next 2 years [8]. Addressing identified major barriers, Phase II includes: a 24/7 Telecardiology Central Unit located in Porto Alegre (capital city of the State), counting with 9 on-duty cardiologists; a new data processing centre; a qualifying team composed of cardiologists, nurses, IT experts and administrative personnel. A partnership established between the IC-FUC and the State Government - through its Secretariats of Health and of Science and Technology - provides financial and technical support for

Phase II, including payment of on-duty telecardiology services, costs of the qualifying team, the web-conferencing program license and also supporting the costs of building a Telecardiology Central Unit at IC-FUC RS.

## Conclusions

In developing countries, administrative, cultural, technological and financial barriers need to be addressed, in advance, aiming at both a successful implementation and guaranteeing the sustainability of eHealth programs. Lessons learned during the first two years allow the coordinating centre (IC-FUC RS) and the RS state government to move on from theoretical possibilities to a more real and tangible scenario.

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# Cardiovascular Causes of Death on Board Ships Assisted by Centro Internazionale Radio Medico (CIRM)

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***Abstract:*** **This paper has investigated the cardiovascular causes of deaths on board ships assisted by Centro Internazionale Radio Medico (CIRM). CIRM is the Italian Telemedical Maritime Assistance Service (TMAS) and provides free medical assistance to ships of any nationality, sailing in all seas of the world. In the years 1999-2008 CIRM has assisted 1,074 patients suffering from cardiovascular problems. Among these individuals, 72 deaths occurred (6.7%). In the same period of time, the Centre has assisted 12,465 patients. Deaths were 205 (1.64%) and involved 192 crew members and 13 passengers. Compared to the total number of fatalities, cardiovascular causes account for the 35.12% of total deaths and therefore represent the first cause of deaths on board ships. Ischemic heart diseases (ICD-10 I20-I25) were at the first place (n = 37, 51.39%), followed in the order by other forms of heart diseases (I30-I52) (n = 29, 40.28%), hypertensive diseases (I10-I15) (n = 4, 5.56%) and cerebrovascular diseases (I60-I69) (n = 2, 2.78%). Analysis of causes of deaths may contribute to identify situations of high risk for seafarers and could contribute to undertake possible preventive measures.**

## Introduction

Cardiovascular diseases are the main cause of deaths in industrialized countries where they represent more than the 40% of all deaths. This percentage is lower in developing countries where deaths for cardiovascular causes account approximately for the 25% of all deaths [1]. Deaths for cardiovascular causes are also at the first place among seafarers, a category

of workers with a slightly higher prevalence of cardiac risk factors compared to the general population [1].

Analysis of causes of deaths in shipping are difficult as these events may be not considered in routine national mortality statistics, but are included in separated registrars depending on the flag of the ship or on the country of the port where the corpse landed. Some studies have reported the incidence of deaths among seafarers. Cardiovascular causes accounted for the 54% in Swedish shipping [2], between 55 and 71% in British and Danish merchant marine [3,4] and approximately 75% of all natural causes of deaths in Polish shipping [5].

Deepening a previous study of our group [6], this work has investigated the cardiovascular causes of deaths on board ships assisted by Centro Internazionale Radio Medico (CIRM) in the years 1999-2008. CIRM is the Italian Telemedical Maritime Assistance Service (TMAS) and provides free medical assistance to ships of any nationality, sailing in all seas of the world. The present analysis derives not from a post event evaluation of mortality reports, as in previous studies on the topic, but from actual data of the reasons for deaths when patients were still alive or immediately after the event. This may be relevant for the identification of situations of high risk of death for seafarers and for undertaking possible prevention measures.

## Epidemiological analysis

Retrospective analysis embraced all deaths among seafarers assisted by CIRM between 1st January 1999 to 31st December 2008. Analysis was made by reviewing the files of patients assisted by CIRM during the time chosen. Presumptive diagnosis of CIRM physicians was classified according to the International Classification of Diseases (ICD)-10 [7]. When possible, causes of deaths were referred to the age of individuals, their rank on board, to the circumstances and to the number of crew members in the ship where it occurred. Extrapolated death data were analyzed statistically by assessing cause specific mortality rates, relative risks, and Spearman's rank correlation coefficients.

## Results

During the period under observation, CIRM has assisted 12,465 patients. Deaths occurring were 205 (1.64%) and involved 192 crew members and 13 passengers. Table I summarizes causes of deaths among seafarers assisted by CIRM between 1st January 1999 to 31st December 2008. As shown, diseases of the circulatory system were on the first place followed by symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified, external causes of morbidity and mortality, injury,

poisoning and certain other consequences of external causes and certain infectious and parasitic diseases. Other causes resulted for less than 5% of total causes of deaths (Table I).

Table I: Causes of deaths among patients assisted by CIRM in the years 1999-2008 according to the ICD-10 classification.

| Chapter | Blocks | Title | Number | % |
|---|---|---|---|---|
| I | A00-B99 | Certain infectious and parasitic diseases | 12 | 5.85 |
| IV | E00-E90 | Endocrine, nutritional and metabolic diseases | 2 | 0.98 |
| V | F00-F99 | Mental and behavioural disorders | 8 | 3.90 |
| VI | G00-G99 | Diseases of the nervous system | 1 | 0.49 |
| IX | I00-I99 | Diseases of the circulatory system | 72 | 35.12 |
| X | J00-J99 | Diseases of the respiratory system | 4 | 1.95 |
| XI | K00-K93 | Diseases of the digestive system | 5 | 2.44 |
| XIV | N00-N99 | Diseases of the genitourinary system | 2 | 0.98 |
| XVIII | R00-R99 | Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified | 43 | 20.98 |
| XIX | S00-T98 | Injury, poisoning and certain other consequences of external causes | 21 | 10.24 |
| XX | V01-Y98 | External causes of morbidity and mortality | 35 | 17.07 |
| | | TOTAL | 205 | 100.00 |

On referring our epidemiological analysis to cardiovascular diseases, during the period analyzed CIRM has assisted 1,074 patients suffering from cardiovascular problems. Among these individuals, 72 deaths occurred (6.7%). On referring this figure to the total number of fatalities, they represent the 35.12% of total deaths (205) and therefore they account for the first cause of deaths on board ships as well.

Analysis of diagnosis/symptomatology referred according to the ICD-10 epidemiological code revealed that ischemic heart diseases (I20-I25) were at the first place (n = 37, 51.39%), followed in the order by other forms of heart diseases (I30-I52) (n = 29, 40.28%), hypertensive diseases (I10-I15) (n = 4, 5.56%) and cerebrovascular diseases (I60-I69) (n = 2, 2.78%).

## Conclusions

Data of CIRM telemedical assistance confirm, in agreement with published studies on the topic [2-5], that acute cardiovascular diseases represent the first cause of death of sailing seafarers. The incidence of fatal cardiovascular events was in general lower in our statistics compared with data published in literature [2-5]. We have not plausible explanations for this apparent discrepancy.

The high incidence of cardiovascular deaths in seafarers is probably related to specific cardiac risk factors quite common in this activity. They include time pressure, long working hours, or high stress factors onboard [1]. In general, sailing ships do not carry medical doctors or adequately trained paramedical staff and can need time to reach a port for medical reasons. In view of this, campaigns of cardiovascular disease prevention and more attentive seafarers' medical surveillance examinations hopefully based on the availability on board of telemedical devices for exploring cardiovascular function would be appropriate.

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# eBlood: A Web 2.0 Simulation System for Blood Safety

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***Abstract:*** **Nowadays, improving quality and sustainability is a main concern on health care and simultaneous inputs, from business, technology, design and health fields are essential for progress. This paper describes a web 2.0-based simulation system for blood transfusion – the eBlood system -, that enables to propose and to discuss the reengineering of the whole transfusion chain. The simulation process is based in an interactive video model of the actual process, where each step has been associated to costs and errors in real context. The system allows the contribution of experts who can agree or disagree with the information about errors or costs, and add their own tacit knowledge. eBlood has been implemented in two hospitals in the region of Barcelona with the aim to help them to adopt new technologies to enhance transfusion safety, and facilitate the commercial relation with service providers.**

## Introduction

Reducing medical errors and improving patient safety is an area where information technology has a major impact [1]. In the blood safety arena, there is a need to develop systems for enhancing the quality of transfusion process and increase the security of patients [2] [3]. Besides, even when incident reporting systems are required within transfusion medicine, there is a lack of strategies and tools to help study what occurred, and what actually caused the mistakes [4].

Another difficulty in this arena is the problem to develop empirical essays of new technologies. It's not the technological aspect which represents the biggest difficulty but the organizational one. This paper presents a web 2.0-based simulation system – the eBlood system - that enables to make virtual reengineering essays of new process in the blood transfusion chain

## eBlood

### *Specifying the eBlood Design Process*

Four phases have been defined to develop the eBlood system prototype.

In the first phase, several aspects have been studied: the current blood transfusion process in two spanish hospitals, the available technology for future process, and scientific literature about similar experiences. This first step can be achieved only when all the technical components of eBlood are available. The key tasks in this phase include designing and developing: the mathematical model; the simulator' databases; the interactive video production process; the system interface design, programming applications, and alpha and beta tests.

In the second phase, the aim is to describe the current blood transfusion process clearly. It includes: defining all the steps in the process (each step is defined as a scene); identifying the scene at which errors occur; the allocation of costs to each of the scenes, and the assessment errors' costs in the various units. The research work is based in hospitals visits, interviews and meetings with selected experts. The final outcome is a detailed description of the blood transfusion represented in a multimedia video format. This version of the system includes also a first approach of data with their identification of costs and errors in the different parts of the process. Data is provided by experts.

Once the simulator is built and prepared with real data, users can interact with eBlood. Users have different profiles. Some of them can watch the whole scenes which compose the multimedia video. This is the case of visitors to the web. However, blood experts can participate in a consensus dynamic for sharing information and modify data in the scenes. They can discuss to achieve a consensus of the whole blood transfusion chain. So, eBlood acts also as a platform to gather explicit and tacit knowledge from all the participants. This represents the third phase, and a test is developed with local experts in Spain. The validation of the current model and the consensus tool are the outcomes of this stage.

Finally, once the system prototype has been improved through the past three phases, discussion is promoted with the aim to achieve a consensus about one or more options of new processes supported in technology. In this case, the application of eBlood to the assessment of a process renewal

proposal will probe its potential in the moment an empirical essay be consider. Then, the result will consist in a new consensual theoretical model which can be tested in real context and with more guarantees of success, because it has been defined with a better awareness of current process and because all the human agents involved in the blood transfusion chain have participated.

*The eBlood System*

Taking as a reference the film production language, a first operational prototype for eBlood has been developed. Fig. 1 represents its general structure model. A "Take" is the simulator central entity.

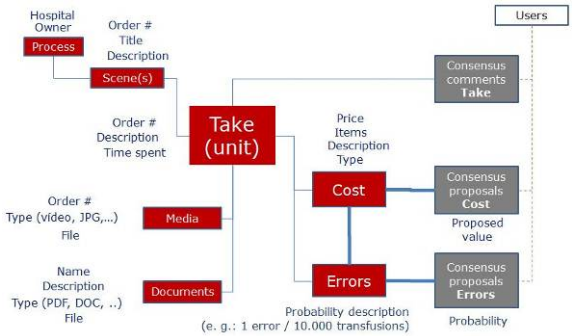


Fig.1 eBlood Data Structure Model

The blood transfusion process is presented by chains of different steps, which we call takes, and which are grouped in scenes. A scene can be composed of several takes. Both scenes and takes are ordered according to execution in real life. Takes are registered in video or other digital means. See Fig. 2.


Fig. 2 eBlood Data Structure Model

The eBlood system covers the following requirements:

a) Visualization. Support learning through visualizing only the original blood transfusion process (Available for users with a visitor profile).

b) Consensus and Discussion about processes. It supports adding comments to the content in the system. Users can comment each take, suggests new values for costs and discuss about error probabilities.

c) Process Edition. Users with a tutor profile can modify values in relation to costs and errors. They can also manage take and scenes.

## Future Work

The proposed work is still in progress. It has taken a year for discussing about the opportunity of a simulator like this. We have already designed the first prototype model with the collaboration of an interdisciplinary team. More than 5000 thousands hours have been necessary to justify the opportunity of the project, design the prototype, achieve consensus about the model, to reproduce in video the real process, and so on.

Nowadays, we are validating the proposed model with a first trial of the system where experts, physicians and nurses discuss about the actual process. Results of this experience will provide improvements to the system before a second trial with a more wide health community.

Finally, we will invite technology providers in the health sector to utilize this model to define and validate new processes by theoretically simulating the use of new technology.

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# Electronic Patch for Wireless ECG Monitoring: The Experiences of Heart Patients

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***Abstract:*** **Heart patients who have tested a prototype of an electronic patch for ECG monitoring in their homes report (1) an absence of skin reactions; (2) "Wear and forget"; (3) a feeling of freedom and security; (4) more awareness of own symptoms; and (5) feelings of frustration with the lack of technical capabilities of the prototype. Wearable wireless sensors seems to be a promising concept for monitoring 24/7.**

## Introduction

Wireless wearable biomedical sensors can monitor vital signs of healthy people, those who are chronically ill and elderly patients. The new technology poses a challenge to the organization of healthcare services, health delivery and to the patients' own perceptions. A new wearable wireless sensor for monitoring electrocardiogram (ECG) has been developed as part of the innovation and research project called "The Electronic Patch" (EP). The purpose of the EP project is to develop and test a wireless ECG sensor for home monitoring as part of the daily routine of heart patients diagnosed with heart failure or arrhythmia. The EP has been developed on the basis of the following assumptions: that heart patients are able to achieve a more accurate medical adjustment in their home surroundings and everyday activities, a shorter hospital stay, fewer visits to the heart failure clinic compared to traditional monitoring of heart patients, a better quality of life and improved conditions for rehabilitation.

Our research focus in this paper was to assess the diagnostic relevance of the use of a wireless patch for ECG monitoring compared to well-known home-based diagnostic solutions for arrhythmia detection, such as a Holter monitoring. This article describes the experiences of heart patients who have tested an electronic patch for ECG monitoring as part of their normal

home life. There is a lack of studies that focus on patients' experience wearable sensors in their everyday life [1 - 2].

## Presentation of the EP and clinical scenario

The Electronic Patch is a prototype of a genuine platform for long-term monitoring which is a compatible with many types of sensors: e.g. for saturation, pulse, temperature, ECG, etc. The sensors and electronics are encased in hard plastic "wafer", the size of a coin. The plastic wafer protects the electronic circuits and sensors from human perspiration and moisture. The hard plastic wafer is then embedded in the adhesive. The patch has a disposable top part and reusable bottom part (see figure 1).

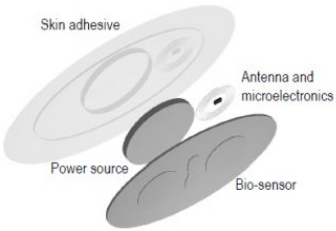


Figure 1 The components of the electronic patch

The heart patients wore the EP for 5 24-hour days during daily activities. ECG signals were transmitted from the EP to a coordinator with a Bluetooth connection and further, via GPRS net, to a smart phone connected to a telehealth database at a heart failure clinic, in this case the Vendsyssel Hospital. The healthcare professionals had access to the patients' ECG in their electronic patient record. The ECG was transmitted at 8:00am, 2:00pm and 8:00pm. A call center separate from the hospital monitored the technical transmissions, such that if the ECG was not transmitted, an alarm would be activated and the call center would contact the patient by phone.

## Methods

Participatory design [3] was applied as the overall methodology of the study. Using workshops that brought together engineers, doctors, nurses and researchers, a clinical scenario was developed and then tested in two phases: an initial testing phase of conducted at the Laboratory at Aalborg University and a second implementation phase conducted at the Heart Failure Clinic, Vendsyssel Hospital and in the patients' homes. In the laboratory setting, 6

healthy males (average age 24.5 years) tested the patch for technical capabilities. Following the laboratory test, the EP was then tested in a clinical setting by 10 heart patients diagnosed with heart failure or arrhythmia. The patients included: 6 males (average age 67.8 years) and 4 females (average age 56 years). The patients tested the EP for five full days: at work, sports and in everyday routines such as bathing, sleeping, and other activities.

The experiences of the heart patients using the EP was evaluated through the daily observations from healthcare professionals through the patients' feedback. Semi-structured qualitative interviews were conducted with all 10 heart patients after the 5-day trial with the EP. The qualitative data was analyzed using a combination of deductive and inductive methods, inspired by Kvale et al. (2009) [4]. The process was carried out in dialogue with research colleagues in order to create validation throughout the research process of collecting, condensing and analyzing the qualitative data. The study was performed according to the Declaration of Helsinki.

## Findings

The heart patients' experiences using the EP in their everyday lives can be classified into the following five themes:

*Absence of skin reaction*: Nine of the patients had no skin reactions after wearing the EP for 5 days during daily activities such as bathing and sports, including swimming and running. All patients reported that after removing the EP, the 5-day smell of sweat disappeared after washing with soap and water.

*"Wear and forget"*: All heart patients stated that a few hours after having the EP applied to the skin, they had "forgotten" they wore the patch. The patients believed that the EP was robust enough to withstand all kind of daily activities. The females reported that were not able to wear a T-shirt with an open front, as they did not want to reveal they wore wearing an EP.

*"Feeling of freedom and security"*: The heart patients expressed the view that even though they were monitored 24 hours a day and during everyday life, they had a feeling of "freedom and security" by being monitored. The EP design made it possible to pursue sports and walking the dog and still feel that they were being looked after by healthcare professionals or the call centre.

*Frustration of technical capabilities*: The patients expressed that they had many expectations to the EP, even though they knew they were testing a prototype device. They reported frustration about the battery capacity of the coordinator that was transmitting the signals which had to charged every 5 hours.

*Increased awareness of symptoms*: Patients expressed the view that being monitored 24 hours a day during their everyday life stimulated them to reflect on their lifestyle and to become more aware of their symptoms.

## Discussion

The development of wearable sensors is still focused on technical issue, so there are few clinical studies [5-6]. Wearable wireless sensors such as the EP for ECG monitoring of heart patients has the potential to alter the role of the patient in the future. Patients will now be able to be monitored during their daily activities. While being monitored, the patients stated that they were able go to work, participate in activities and carry out cooking and cleaning chores at home. The patients had not been in contact with the hospital while being monitored for 5 days, but they felt free and secure about having the possibilities to contact the hospital or call centre if they needed it. This new way of carrying out wireless monitoring of heart patients could reduce the need for heart patients to make physical visits to the heart failure clinic, thus increasing the effectiveness of the workflows in the clinic as well. In this way, they might identify certain key symptoms so that doctors can carry out diagnosis and treatment based on evidence of the heart's reaction during daily activities. The question for the future thus becomes: "When does a patient need to go to the hospital?" [7]. Further research is needed in order to explore the consequences of wearable wireless sensors, and the opportunities and restraints they pose from the patients' perspective [8].

## Conclusion

Heart patients who have tested a prototype of an electronic patch for ECG monitoring as part of their everyday life report that they have not had adverse skin reactions; they suffer no discomfort from wearing the patch, and it gives them a feeling of freedom and security. Patients expressed the view that being monitored 24 hours a day stimulated them to reflect on their lifestyle and to become more aware of their symptoms. Wearable wireless sensors seems to be a promising concept for monitoring 24/7.

## Acknowledgment

The project was funded by The Danish Agency for Science, Technology and Innovation and carried out with patients at the Vendsyssel Hospital, Frederikshavn, Denmark in collaboration with the Electronic Patch Consortium (see further details at http://eplaster.dk/).

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# High Signal Resolution Pulse Wave - Hope for a Fast and Cheap Home Care Monitoring Patients with Cardiac Diseases

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***Abstract:*** **The paper presents High Signal Resolution Pulse Wave (HSR –PW) analysis, an innovative diagnostic tool used for home care telemonitoring patients eligible for heart transplantation. This method HSR-PW is based on a special computer program, which increases the resolution of the pulse wave signal and sets the parameter values that inform about the state of the circulatory system. The resolution of pulse wave signal is enhanced by special software using the method of linear transformation based on Fourier analysis and deconvolution of original pulse wave. Thanks to this method, it becomes possible to show the details of the pulse wave, which are invisible in standard record. Based on the analysis of individual peaks, computer calculates values of some parameters defining the state of the cardiovascular system. The pulse waves were recorded using a standard wireless electronic pulsoximeter CMS-50E, which allows measurement of oxygen saturation in the range of 35%-99% with a resolution 1 % for SPO2. Measurements were performed on the index finger of the left hand. To interpret the obtained results, the ultrasound examination and other biochemical patients data were compared to HSR pulse wave parameters of the same subjects. The input data, which come from standard pulse oximeter, were collected from patients staying at home through a system of telemedicine network MONTE. Thirty five people were monitored during a four months in the eight selected for heart transplantation. The rest of patients were after cardiac surgery, mainly after aorta valve replacement. During the monitoring recorded the**

**number of incidents related to arrhythmia, the oxygenation deteriorated, with the work of a pacemaker was detected. By monitoring cardiologists could take the appropriate medical intervention. Monte provides better care for patients discharged from the hospital and improves control of patients staying at home.**

## Introduction

The aim of the paper was to investigate the usefulness of home monitoring telemedicine patients scheduled for heart transplantation using selected diagnostic tools to optimize heart transplant program in the Poznan, Poland. In addition to the planned development of new methods of medical telemonitoring we have used advanced numerical analysis of biomedical data such as ECG records, pulsewave, etc. to allow to obtain more detailed information about the patient state.

## Materials and Methods

Monitoring of the patients staying at home was carried out in accordance with the system MONTE (www.monte.net.pl). We monitored records of pulse oximetry, blood pressure, temperature and body weight, glucose levels, rate well-being, occasionally, ECG, and once a week, patients were requested to submit a survey in which spoke about his health. These data were automatically transmitted via the Internet to the Department of Cardiac Surgery, University of Medical Sciences, where they were collected and monitored. The pulse waves were recorded using a standard wireless electronic pulsoximeter CMS-50E, which allows measurement of oxygen saturation in the range of 35%-99% with a resolution 1 % for SPO2.To interpret the obtained results, the ultrasound examination and other biochemical patients data were compared to high signal resolution pulse wave (HSR-PW) parameters of the same subjects. The resolution of pulse wave signal was enhanced by special software using the method of linear transformation based on Fourier analysis and deconvolution of original pulse wave [1-4] (Fig.1). Thanks to this method, it becomes possible to show the details of the pulse wave, which are invisible in standard record (Fig.2). Based on the analysis of individual peaks, computer calculates values of some parameters defining the state of the cardiovascular system.

## Results and Discussion

In this work 8 patients scheduled for heart transplantation were continuously monitored, 2 patients with ischemic heart disease, 21 patients with congenital aortic valve, 35 patients underwent implantation of

coronary artery bypass graft CABG and 5 patients diagnosed with aortic aneurysm.

Taken as groups study 50 healthy subjects to determine the fundamental norms and standards for selected parameters, the results of advanced analysis of heart rate and ECG.

a)

b)

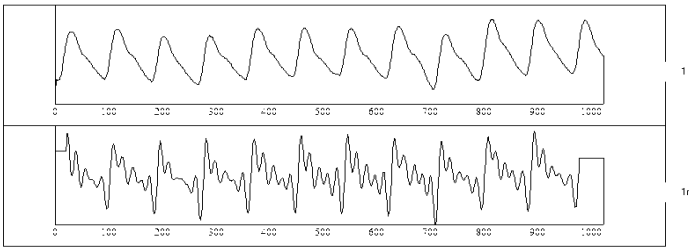

Fig.1. Pulse wave before a) and after b) high signal resolution processing

In healthy people, in the averaged HSR pulse wave recording, the amplitude of the first peak is clearly higher than the second peak amplitude.

In people with heart disease such as valve problems, it is observed the reverse situation - the amplitude of the first peak is lower than the amplitude of the second peak (ratio of amplitudes is <1). This change represents also volume ratio of the left ventricle to the volume of the aorta > 6 (Fig.2).

a)

b)

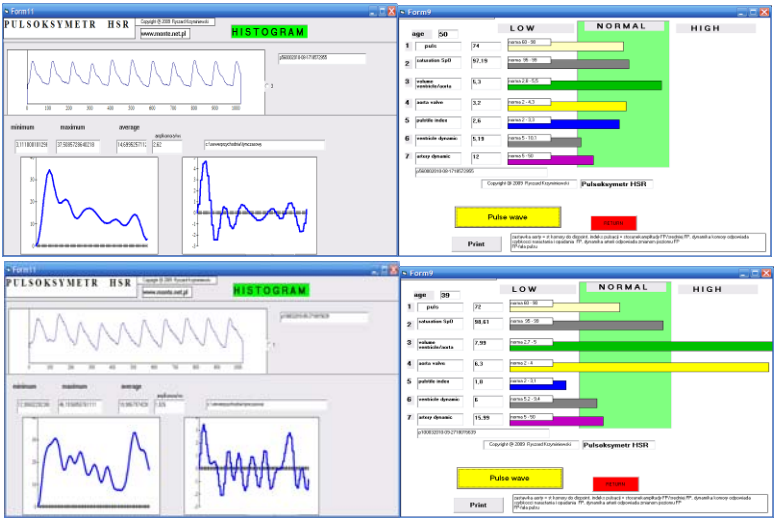

Fig.2. Pulse wave analysis result of HSR (numerically increased) a healthy person a) and qualified for a heart transplant b). Standard pulse wave looks like the same in both cases

The HSR –PW shows very well changes of the pulse parameters after heart transplantation (Fig.3). We can observe how, after heart transplantation and other cardiac operations, some of the parameters of the circulatory system are normalized.

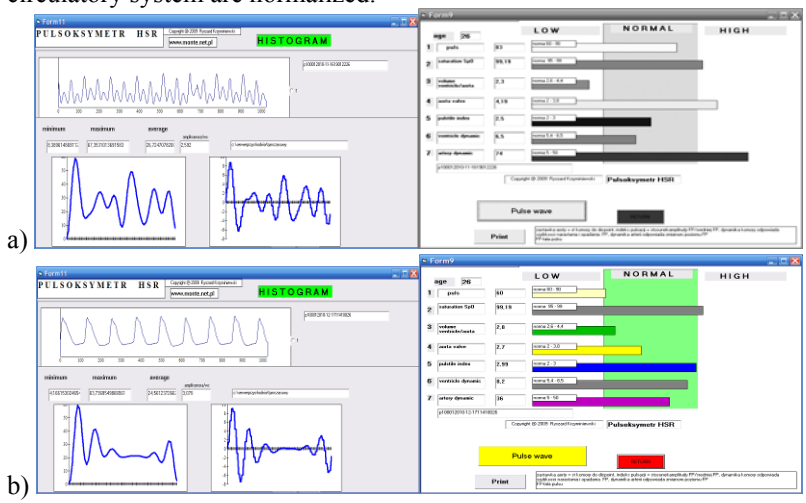


Fig.3. HSR pulse wave analysis of the patient before a) and after b) heart transplantation

## Conclusions

The High Signal Resolution Pulse Wave allows fast, inexpensive and non-invasive diagnostic of cardiovascular system diseases, for example: heart ventricle disorders etc. The telemedical system Monte provides better care for patients discharged from the hospital and improves control of patients staying at home.

## Acknowledgment

This project was partially funded by the President of Poznan (Rom/3420-2/10 Fn2625/10).

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# Web-based Signal Processing Application to Enhance the Abdominal Fetal ECG

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***Abstract:*** **This paper presents an online signal processing application that interfaces with a growing fetal ECG signal database, offering its registered users the possibility to analyze the signals and interpret the results.**

## Introduction

For the past years, there has been a constant concern for developing algorithms, models and devices that would allow the monitoring of the human heart starting even with the fetal development stage. Early detection of heart anomalies would lower the number of infantile deaths and premature child births and even diminish the risk of subjects' confrontation with heart diseases later in their lives. The desired goal is to be able to provide a permanent, non-invasive monitoring of the fetus and improve the existing methods. A possible solution for recording the fetal electrocardiogram (fECG) considers electrodes' placement over the maternal belly. The resulting signal is called an abdominal signal and is a sum between the desired fECG signal and a series of disruptive signals that alter the waveform of interest. The fetal information is gathered after a complex digital processing of the recorded abdominal signal. An optimal configuration for such a recording is not defined yet, but the ones proposed until now in specialised literature usually include a large number of electrodes, because the information about how the fetus is positioned in the maternal womb is rarely known. It is then desirable to have a multi-dimensional view over the small fetal heart by recording its electrical activity from different directions; i.e. it is reasonable to assume that the more electrodes are considered, the higher the possibility of detecting potential fetal cardiac problems.

## Reasons for a web based application

A large number of electrodes record a large amount of data that needs to be stored and processed. This stands especially when a large sampling frequency is considered for the recording. Also, abdominal monitoring should be considered as a long term recording strategy to investigate the fetal heart; but the larger the period, the more data needs to be collected. Resulting data has to be organised in time, safely stored and easily available, if needed for reference. It is desirable to be able to have a fECG signal history for each patient under observation, since this would make the detection of clinical changes with time easier and also allow the monitoring of the fetal recovering process, when medication is considered to treat the detected anomalies. As a result, this study considers the idea of designing a web application, as an interface to a fetal ECG signal database. The application is also designed to offer specific features to registered users, such as filtering algorithms.

## The web fetal monitoring application

The first step taken in the development of the application was to correctly identify target users in order to respond to their needs.

### *Assumptions regarding the database*

A user can be either a doctor, or any other person interested or involved in the fetal monitoring field. If a doctor, a registered user can develop his own database of patients, and load recorded abdominal signals for each and every one of them. A patient is always a pregnant woman. For each patient in the database there must be at least one loaded associated signal. A user may or may not load signals to the database; however, any signal in the database must be uploaded by a user. An uploaded signal can be declared as public or private; if public, it is available for analysis to all registered users of the database; the signal attribute that controls the type of access is called "*permission*" and is mandatory.

### *Implementing the idea*

MySQL is used to design the database even if it has no glossy interface to work with, since it is quite suited for web-based applications being fast and efficient. Among the graphical interfaces available, phpMyAdmin is considered, because it is free and also the default method most hosting companies provide for accessing MySQL. The web application is designed to extract and store content in the database and is developed in PHP, a scripting language that runs on the web server and is platform neutral. PHP is also the language used to interface with the Matlab environment,

dedicated to signal processing applications and used in our study, using the command:

```
system('matlab -nodesktop -nojvm -nodisplay -r "eval (\function_name(\'\''.$parameter1.'\'\',\'\''.etc. '\'\')\');"');
```

often followed by a "*sleep(nr of seconds)*" command.

*The proposed ERD*

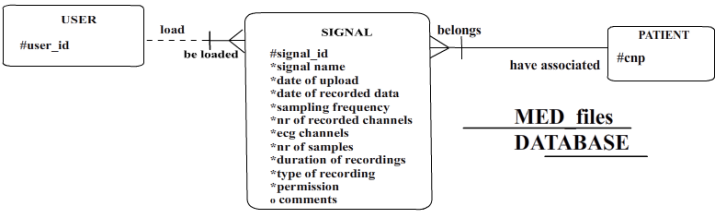


Fig.1 The proposed Entity Related Diagram

*Important features of the application*

Any registered user can start out a database of patients and upload abdominal signals ("*.mat*" files) to it. An uploading process is completed only after the user is asked to fill in some information (those impossible to compute) about the upload signal (ex: the sampling frequency, which of the recorded channels corresponded to maternal ECG (if any), type of recording – unipolar/bipolar). The rest of the needed information, such as number of samples or duration of the recorded signal is computed automatically, using Matlab. A registered user has access to all the signals he uploaded in the database and also to those signals, uploaded by other users if the "permission" attribute is "public". Once uploaded in the database, a signal's details can be altered, if its owner decides so. A signal for which no details have been submitted is declared invalid and cannot be used by anybody until its owner submits details. By selecting a signal from the available list, the user is taken to a page where he can visualise the signal in time, and also apply a filtering algorithm to it. By using the "Apply algorithm" button, a representation of both the noisy signal and the filtered one is presented [4].

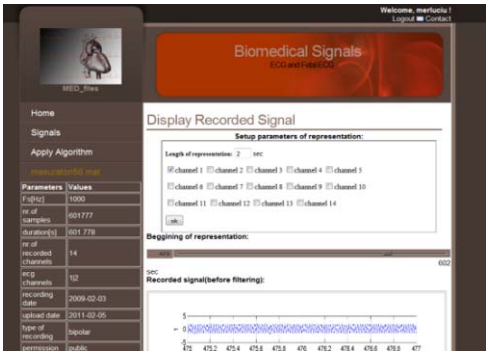

Fig. Display Recorded Signal Page

## Acknowledgment

This study was supported by the grant PNCDI II - IDEI, ID_1723/2009.
Note: *These authors contributed equally to this work

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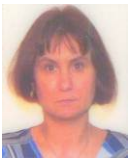

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# Telemedicine for Low Resource Settings and Developing Countries

# Implementation Experience of e-Prescription System in Developing Country: An Indonesian Community Health Center Case

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***Abstract:*** **This paper presents the implementation experience of our e-Prescription system in an Indonesian Community Health Center, for more than nine months of daily clinical applications. The e-health system has been developed to provide electronic patient recording and reporting system with adverse drug event alerts, paperless prescription and generation of different types of patient and medicine reports.**

## Introduction

From a number of publications in developed countries, we learnt that adverse drug event cases have been reported which resulted in significant number of injuries, deaths and financial consequences [Ref. 1]. Although there is no quantitative data reported yet, we believe that similar cases also exist in Indonesia. As discussed in Ref. [1], the e-prescription system is expected to provide a number of benefits, especially at community health center level.

## System Design and Configuration

The e-prescription system that we developed is basically a web-based e-health system with these two main functions: to enhance daily general recording and reporting process, as well as to provide paperless prescription which minimizes adverse drug event cases. To enhance general recording and reporting process, the following sub – functions have been designed: automatic patient numbering, new patient data recording, retrieving of registered patients' data, building of electronic medical record data base, and generating up to 7 (seven) different types of regular reports for clinical/administrative purposes. The paperless prescription has been

designed to perform the following sub – functions, which include: to provide important pharmaceutical information for more than 210 standard drugs; information on possible allergy, overdose and drug interactions; simple dosage calculator; to provide drug – drug interaction tests; warn adverse drug reactions; drug inventory and reporting.

Moreover, the e-prescription system has been designed, so that it can be implemented according to various community healthcare environments, i.e. from an e-health system consisting of just a single personal computer (PC) to a system with 9 PCs or more in a local area network [Fig. 1]. An internet access through an ADSL (asynchronous digital subscriber line) modem or a wireless modem has been provided. These facilities have been designed to provide future additional applications, namely: on-line reporting to/from remote "stations", tele-consultation and tele-education, further telemedicine activities. Before field (clinical) implementation, the e-health system has successfully passed a two week laboratory test stage.

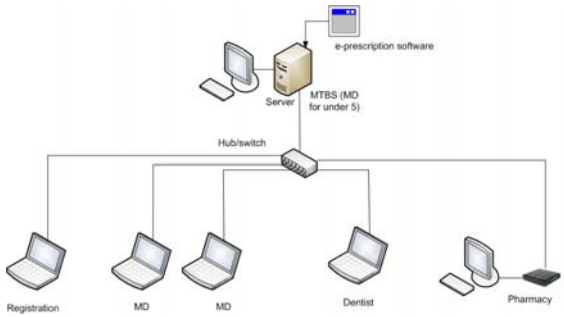


Fig. 1. Simplified block diagram of the e-prescription system with 6 PCs (or more)

## Human Resource Development and Site Preparation

Since human resource development is of primary important, prior to the e-health system implementation, both class type and personal hands-on trainings for all the healthcare providers have been conducted. After completing the three month trainings, they have sufficient competence in the e-health system usage.

Although electricity was already available before implementing the e-health system, the power was not sufficient as it was only 900 VA. About three months were needed to have it increased up to 13,200 VA to supply the power requirements for the e-health system and the existing dental equipment, as well as other existing medical equipments and support electric appliances. New electricity installation, administrative and financial

problems had to be overcome, before solving the electricity power requirement.

## System Implementation Experience and Lessons Learnt

All the hardware and software modules of the e-Prescription system has successfully completed both laboratory and clinical tests, and then installed at Babakan Sari Community Health Center (Bandung). The e-prescription system has been used for two week familiarization and then for day-to-day community healthcare services since March 2010. During the period of familiarization and early stage of system implementation, a number of improvements have been made from the bugs encountered, users' feedback and suggestions.

After more than 9 (nine) months of continuous daily clinical applications of the e-prescription system, the following points can be especially noted:

- At least, two week familiarization period were needed; during the initial period, at least one "technical supervisor" was required to help in solving any technical problems that may arise. The "initial application period" was critical; therefore the availability of a technical supervisor was found necessary.
- Users' feedback and suggestions have been utilized in continuous improvements of the e-prescription system.
- The system has shown its intended functions in: new patients' registration and patient's data retrieval, patients' medical examination, improved prescribing process with "adverse drug events" alerts, drug preparation at the pharmacy unit, preparation and generation of different types of daily and regular reports, as well as further research activities using the resulted data base.

Until recently, more than 25,700 patients have been processed using our e-prescription system, in more than nine months of system implementation. The system has clearly shown its effectiveness in patient and drug data recording and reporting, retrieving already registered patients' data, as well as generating at least seven different reports in much less time.

Although the e-health system provides supportive drug information and prescribing tools for medical doctors (during prescribing process), it does not reduce the time required for medical examination.

## Conclusion

Based on the encouraging results, e-prescription system implementations in two more community health centers are in progress. Further benefits are expected in using of the data base for supporting future community health-

care research activities. Therefore, in the long run, it is suggested that the e-health system could be beneficial to support the currently existing 8600 community health centers in the country.


## Acknowledgment

The authors would like to express their gratitude to the IDRC (International Development Research Center) Canada and PANACeA (Pan Asian Collaboration for Evidence-Based eHealth Adoption and Application) for the research grants to support the activities. Continuous full involvements of the healthcare providers from *Puskesmas Babakan Sari*, and Bandung Health Office, as well as supportive commitments from Biomedical Engineering Program – Institute Teknologi Bandung, have been most helpful. We are very grateful for all of them.


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# Information, e-Health and Point of Care Testing Technologies: Opportunities for the World

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## Introduction

Ref. [1] "With each passing year, the economic divide between the world's developed and developing countries become significantly larger. A declining economy, inflation, and disparities in healthcare have been and still are problems being faced by the countries of the world, just in different proportions. More recently, governments have developed increased concerns about the ever-increasing costs of providing health care to their citizens. The world's population continues to grow at ~850,000 a month, and at the same time, life expectancy continues to increase (United States, 78 years; Japan, 82 years; Australia, 82 years), which in turn brings an increase in chronic disease, all of which consumes larger percentages of declining healthcare dollars. The primary difference between most developed and developing countries is the origin of the problem and the ability to address it. For example, Africa and India have enormous health care disparities among their citizens; decades of foreign aid, along with efforts from nongovernmental organizations and national governments to implement reforms and decentralize health systems, have all fallen short in addressing inequalities. Severe shortages of healthcare professionals, poor administrative infrastructures, lack of healthcare facilities, and too few public health programs have impeded these nations' ability to meet even the most basic human rights.

On the other hand, most developed countries have an understanding of their healthcare disparities, which are typically complex and multiple, and, for the most part, have the financial capabilities to address many of them. However, politics, special interest groups, and economics, to name only a few factors, typically hinder or inhibit the ability to address the problem. The one thing we know from experience and historical data is that increased dollars does not necessarily improve healthcare, at least in the United States. With all its wealth and technology, life expectancy in the United States still ranks 45th in the world and falls below the Organization for

Economic Cooperation and Development's (OECD) overall average lifespan of 78.6 years of age (United States, 77.8 years). The United States continues to have a long history of an obvious discrepancy between expenditures and achievements in health. According to the Centers for Medicare and Medicaid Services (CMS), the United States spent $2.1trillion on healthcare in 2006, or approximately $7,000 per person. Compare that to the similar figures of $26.9 billion and $141 dollars spent in 1960. As stated in the description by Bashshur et al. of the article by Davis et al. entitled, "Mirror, Mirror on the Wall: An Update on the Quality of American Healthcare Through the Patient's Lens," "patients in the United States were most likely to visit an emergency department for a condition that could have been treated by a primary care physician. However, once discharged, patients in the United States were less likely to be re-hospitalized because of complications. Also, records and test results were the least likely to reach a doctor's office in time for an appointment, and patients in the United States were more likely to be sent for duplicate tests compared with patients in four of the other countries—United Kingdom, New Zealand, Canada, and Australia. Among the six OECD countries, per capita expenditures on health care were highest in the United States: nearly double those of Canada and Germany [$6,102 versus $3,165 and $3005 respectively].

In order to meet these challenges, there is a new paradigm developing, with digital health offerings, health promotion, disease prevention, disease management, health records, e-health technology, diagnostics, and more, all at one's fingertips. The United States has driven this initiative with the electronic health record (EHR). The EHR has the ability to contain pertinent patient health information such as medical history, radiology, diagnostics including POCT, and present medications, to name a few. If fully successful, the goal of this initiative is that all patient information will be accessible at any given time and place [e.g., physician's office, clinic, emergency department, home, and hospital] for healthcare providers. However, its implementation has been challenging to say the least. Yet, at the same time, world leaders like Vice President Mahama (Ghana) and President Obama (United States) encourage the use of digital health to address provider shortages and improve healthcare access, thereby strengthening developing countries' economic base and healthcare infrastructures."

## Information, e-Health and POCT

The immersion of experience and literature in evidence-based health care information, such as POCT and e-health technology, over the last few years, has been substantial. The use of information and telecommunications

technologies to support long-distance clinical health care, patient and professional health-related education, public health, and health administration has been well documented. For example, e-health monitors that require web access or a simple telephone line connection can now reside in a patient's home, community health clinic, or healthcare provider's office. When the technology resides in the home, voice prompts assist patients with medication adherence, appointment scheduling, and the transmission of temperature; weight; blood pressure; blood oxygen; POCT (e.g., blood glucose); cardiac and lung sounds; and electrocardiogram results. Advanced monitors now offer virtual home visits and web access via digitized technology. This offers patients and practitioners the ability to share real-time interactive video sessions and transmit pictures of wounds and/or body parts for review. Once in receipt of this information, healthcare providers can offer immediate diagnosis, treatment, or referral. As a direct result, this technology can perform multiple diagnostics for millions of care providers, particularly those individuals in the world who live in remote areas, require home health, and have health disparities because of economics and/or insufficient numbers of healthcare providers.

The latest e-health technology offers multiple individuals access via one system, thus reducing technology costs significantly. Such connectivity offers providers the opportunity to effectively monitor an individual's disease state(s) while allowing the individual to remain in their own community for much of their general health management. POCT and e-health technology has the ability to detect and manage many health care issues without having a high level healthcare professional (physician) on site.

The two initiatives presented are focusing on the following clinical areas*: chronic disease, maternal and child health, clinical sciences, rehabilitation, diagnostics, education, social services, economics and POCT and e-health technology as it relates to early detection of disease, management of disease, cost savings, improved quality of life and sustainability.* The diverse professional composition of the teams, especially in Kenya, offers an environment conducive for an interdisciplinary team approach to health care.

## Community-Academic-Health Facility Partnerships

Community-academic-health facility partnerships will directly respond to the challenges of population health and well-being with reference to the epidemic of chronic disease as well as maternal and child health and other health care issues relevant to the area. *Project #1:* Stony Brook University along with its Medical Center has begun to implement a Regional Health

Information Organization (RHIO). Today RHIOs are also referred to as Health Information Exchange Organizations. Stony Brook's RHIO is made up of hospitals, nursing homes; assisted living facilities, doctors' offices, and will soon include some patients' homes. Our RHIO offers a secure computer network to share information about patients in an effort to provide better health care. The RHIO provides the patient an opportunity to transfer his/her electronic medical record (EHR) and other health information (e.g., radiology) from any clinician or healthcare facility to another. If successful, the EHR could serve as the catalyst for a comprehensive healthcare platform that could provide a compatible infrastructure that disseminates information from a variety of digital health outputs. The project is now beginning to introduce e-health technology to a patient's home. This will provide an opportunity to manage and monitor patients with chronic disease or after they are discharged from the hospital.

*Project#2* Ref. [2] "The Turkana Basin Institute (TBI), in the Turkana District in Kenya, is a collaborative program of inter-disciplinary scientific research working in affiliation with Stony Brook University, the National Museums of Kenya, the United States International University in Nairobi and others. TBI is a privately funded, non-profit initiative, founded by Richard Leakey. The primary research focus is human prehistory and related earth and natural science studies within the Lake Turkana Basin. TBI provides logistical support to researchers, greatly facilitating fieldwork in this remote and extensive area of northern Kenya. TBI also aims to provide a valuable online resource to a broader community interested in the region. A major commitment of TBI is to safeguard the extensive fossil deposits in the region through engagement with the local communities. In addition to the employment and training of individuals from the local community, the TBI community program includes the provision of student bursaries and scholarships, teacher salaries at local schools and a mobile outreach health service."

TBI Community Health Project for Illeret Location Summary

Ref. [3] "The community health project aims to increase accessibility of diagnostic, preventive and curative services to remote communities lying outside of Illeret town, Marsabit District, who in the past have had to walk long distances to seek medical attention. Other than a small Sub-Health Centre in Illeret Location (fig. 2), the nearest hospitals and larger health centres are over 200 kilometers away, contributing to high death and infant mortality rates. A previous attempt to initiate a mobile clinic by the community was not sustainable due to the presence of only one nurse in Illeret. The goal of the project is to improve access to quality healthcare in

Illeret location in an effort to combat Malaria and other preventable communicable diseases by providing basic health care, such as vaccinations and health education to remote communities through a mobile clinic, and building the capacity of the local clinic. By visiting remote communities every week and assisting the local clinic, a nurse and community health workers (CHWs) will support close to 12,000 people with a primary focus on the health care of children under five years and women. Our goal is to add e-health technology to the mobile clinic which would enable the healthcare providers to take medical history from individuals and measure vital signs, digitized pictures of wounds, etc., and create an EHR for each individual. In addition the technology will provide connectivity to hospitals and medical personnel outside the area."

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# Rural Health Care Delivery- Experiences with ReMeDi Telemedicine Solution in Southern Tamilnadu

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***Abstract:*** **This paper presents the results of a pilot taken up as a study in effectiveness of delivery of health care by deploying an end to end low cost telemedicine solution using ReMeDi kit (Remote Medical Diagnostics kit) developed by Neurosynaptic Communication Private Limited (NCPL). The low-cost and multi-tasking aspects of the ReMeDi kit make it very attractive to rural healthcare providers and the kit is already being used extensively by other programs in India. Project center's were identified from villages around Tirupathur Taluk, Sivaganga District of South Tamil Nadu based on the need for health care in those villages, availability of the connectivity, availability of a hospital for backend consultation and operational feasibility. The 1st phase of the project began in March 2008 with 6 villages namely Sevalpatti, Sirugudalpatti, Eryinur, Madhavarayanpatti, Velangudi and Valayapatti. This pilot study evaluated the cultural acceptability of tele-health in the villages, scalability of health care delivery, patient traffic per center per month and explored various revenue models to make the project self sustainable. However while completion of the project, the number of centers were reduced to four due to insufficient patient flow reasons varying due to competition from a local rural medical practitioner's, choice of location did not target a significant number in population, took longer time for stability and also attrition of ANM's involved in the centers.**

## Introduction

'Teli-Medicine' – the pilot project was implemented to provide and support Healthcare delivery using ReMeDi- a low cost solution for rural areas. This kit developed by NCPL in collaboration with IIT-M, Chennai is a completely indigenous technology and can measure and transmit 6 clinical parameters via the internet namely non-invasive Blood Pressure, pulse,

temperature, 12-lead ECG, Oxygen saturation and heart and breath sounds. The kit also has videoconferencing facility where the doctor can see the patient using a audio-video link on Internet and works on a rechargeable battery. This pilot project was a multi-party initiative deployed in collaboration with NCPL, IITM's Rural Technology and Business Incubator (RTBI), Piramal Healthcare Limited (PHL) a leading pharmaceutical company based in Mumbai and one of India's leading infrastructure development and finance company.

## Methodology

Initially the model involved a trained kiosk operator as a healthcare provider at the Telemedicine center, however given the context of health and healthcare delivery, the model evolved in recruiting Auxillary Nurse Midwife's (ANM's) from the surrounding villages. They were trained in handling ReMeDi kit, soft skills of patient handling, diagnostic procedures and related issues. All the village kiosks were equipped with basic amenities such as a bed, weighing machine, glucometer, disposables, BSNL landline phone connection, desk top PC with camera, speaker, mike, examination table, IV stand, mattress, medicine pouch, height chart, dressing tray, access to clean water along with ReMeDi kit. Investigations on ECG, blood sugar were done at subsidized rates. Medicines were dispensed and injections administered as and when required to the patients by ANM's, as per the instructions/ prescription provided by the doctor at the Nodal Center. The nodal center located at Tirupattur town, had two doctors commissioned who took turns for providing e-consultations from 9 am to 5 pm. The nodal center also had two Project Manager's and two Field Executives/ Field Coordinators to monitor the entire project and ensure smooth functioning of the healthcare delivery at every kiosk.

## Analysis

### *Sustainability of the Project Centers*

The pilot project was started with 5 centers in March 2008, and later in September 2008 one more center was inaugurated. However while completion of the project phase the numbers of centers dwindled to 4. Several reasons that accounted for the reduction of centers were insufficient patient flow due to competition from a local Rural Medical Practitioner and choice of location did not target a significant number in population. It was found that those village kiosk centers that had VHP's who were good in handling the patients, supportive in nature, dedicated and had acceptable communication skills produced good footfall of patients in centers.

*Cultural acceptability of the project*

The pilot study had 65% of the patient foot fall from the female section of the population. Initially the 'Teli-medicine' centers were run by male Kiosk Operators. This did not attract the female population, as the people in villages consider it a taboo for a female patient to receive or approach a male operator who assisted in delivery of health services. Hence the model used female Auxiliary Nurse Midwife (ANM) which indicated an increase in the numbers of the female patients approaching for health services. One of the reasons for lesser male patients was the center timing was not favorable to them, as the center was operational up to 5pm after which most men returned from work. A study on the age-group of the patients visiting the centers shows that people between 51-60 years of age visited the centers more often followed by 60 and above.

*Incidence Rate*

The incidence rate was calculated on the assumption that a patient falls ill 2.6 times per year and by considering the serving population of the villages as given in Table I. For example in Sevalpatty village centre with a population of 1500 people had an average of 565 patients visiting the center per year, the incidence rate was calculated as 1500 * 2.6 = 3900; 565/3900*100 = 14.48% incidence rate.

Table I Serving Population of villages and Incidence rate

| Serving village | Population statistics | Total number of new patients | Average no. of new patients /year | Incidence rate% |
|---|---|---|---|---|
| Velangudi | 3000 | 104 | 156 | 2.00% |
| Sirukoodalpatty | 1800 | 116 | 199 | 4.25% |
| Eraniyur | 3000 | 370 | 370 | 4.74% |
| Valayapatty | 1700 | 630 | 582 | 13.16% |
| Sevalpatty | 1500 | 612 | 565 | 14.48% |
| Madhvarayanpatti | 1500 | 280 | 336 | 8.61% |

*Marketing Initiatives*

Several initiatives were taken up to invoke awareness in the people of the concerned villages. The most prominent ones were the house-call activities which were taken up by the concerned ANM's of the respective centers who talk to the villagers about a certain health subject and introduce the Teli-Medicine Center and its facilities. The others were by conducting awareness camps and health camps at schools.

*Revenue models*

The sources of revenue generation included consultation charges, providing medicine, injection/dressings, diabetes check up, ECG, referrals, IV Drips and other sources such as monthly incentives/packages. Highest revenue was generated by sale of medicines followed by injections/dressing and consultations. Although Diabetes was a concern, very few people came for undergoing diabetes test. Interestingly, ECG and other referrals barely made any revenue. This can be attributed that for chronic ailments, patients still preferred to go to the town hospital as routine follow-up was required.

## Discussions and Recommendations

Based on the experience and outcome of the pilot project, to ensure the long-term success in the next phases of the project and to have self-sustenance the following recommendations are made. In order to motivate the VHP's and staff members of Teli-Medicine who serve as a backbone for the success of a center, performance based incentives shall be given based on the increase in number of patient's footfall in the specified time.

The confidence of the villagers which is another prime factor for sustainability of a center can be boosted by having one doctor from the nodal center can visit each center on weekly basis. The authenticity of prescription can be improved by including a digital signature of the doctor using the software on the printed prescription along with stamp of the center. The other important findings are that the mindset of villagers was such that, they preferred and sometimes insisted on giving those injections and IV drips than medications. The people in the villages had always seen nurses in uniforms and they think it's their qualification and experience. So uniforms may be provided to the VHP's. They should also be properly trained in verbal communication, mathematical skills, operating computer and basic technical skills as they are the face of the organization. While recruiting the VHP's, it should be made mandatory that the VHP has attempted or cleared the 12th standard exams. Performance review meetings should be held monthly or quarterly and appraisal system should be followed.

As the villagers are very much connected to cable TV's and Radio, aggressive marketing should be done through local media channels and by advertisements in radio regarding the services offered at Teli-Medicine. Local edition papers in regional language can be used for advertising. Sticking posters and banners at public gatherings like bus stops, tea stalls, temples will increase the awareness among the villagers. Press release should be undertaken during the launch of the new center. The internet connectivity which was another issue could be rectified by requesting the internet providers to provide a steady bandwidth of 128 or 64 kbps. Since in

videoconferencing systems a larger bandwidth is used to spread or "dither" the signal in order to prevent interference.

Also, the time taken for a center to stabilize has to be taken into consideration. Consistency in services and its quality would have seen a gradual increase in patient foot-fall. Tie-up with already existing rural medical practitioners, is another means by which the healthcare delivery can be strengthened.

## Acknowledgment

This research paper is supported by Indo UK Advanced Technology Center (IU-ATC) project, funded by the Department of Science and Technology (DST), Government of India and the UK EPSRC Digital Economy Program. The authors would like to thank the team representatives from NCPL, RTBI, PHL and infrastructure development and finance company for their support and Dr. Ganesan of RTBI who helped in data consolidation and analysis.

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# Telehealth Resources Incorporation in Rural Internship: Student's Perceptions

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***Abstract:*** **Since 1978 undergraduate students are sent to remote municipalities to accomplish their rural internship. They are supposed to provide primary care to local people, supervised by teachers and local medical staff. In recent years, telehealth activities were introduced to support these students through store-and-forward teleconsultations. The overall process is monitored by a teacher from the medical school. In order to evaluate the student's perceptions about telehealth resources incorporation, a project was designed. The aim was to improve the student's performance and identify the main factors which interfere with such process.**
**Method: A semi-structured questionnaire with open and closed questions was applied to 123 students in 33 municipalities, during the first semester of 2010. SSP and QDA software were respectively used to perform the statistical analysis of closed and open questions.**
**Results: The overall student's perception about the project was positive regarding the use of telehealth, as an important tool to facilitate their internship. Since the beginning of the project they feel more confident reducing their distress level. About 83.7 percent of the students have said that the project contributed to improve the quality of assistance deployed. Concerning the teleconsultants, 83.4% of them reported that the responses were in accordance to their doubt and has solved the problem. The following difficulties were detected: connectivity problems in some municipalities; need to reduce the response time in some specialties and sometimes strenuous integration with the local staff.**

**Conclusion: The implementation of telehealth resources was well rated by students. Telemedicine was considered a powerful tool to support the students during their internship in remote areas.**

## Introduction

The School of Medicine of Federal at the Federal University of Minas Gerais (UFMG), Brazil has an increasing experience concerning formulation, implementation and evaluation of telehealth projects [1]. Since 1978 undergraduate students during their last year of the medical curriculum should go to remote municipalities to accomplish their rural internship. During three months they are supposed to provide primary care to local people, supervised by teachers and local medical staff. The municipalities usually are located 100 to 700km far from the Medical School.

A survey promoted by the World Health Organization in 2009, concerning telehealth activities pointed out that in developing countries the most frequent telehealth use has been in teleconsultations [2].

Brazil currently has a large national telehealth project in progress, already deployed to 900 municipalities in 9 states and nowadays expanding to the whole federation [3]. This experience turns out that the public universities must consider the telehealth incorporation as a part of the students training.

Currently, at the Federal University of Minas Gerais-School of Medicine the students are using telehealth resources during their internship training. They are supported by 72 experts (teachers) who perform on-line and store-and-forward teleconsultations.

This ongoing process has contributing to raise the strategies for human resource training in telehealth. This study aims to evaluate the students' perceptions about the process of incorporating telehealth resources in medical education in the rural internship period, identifying their main problems.

## Method

The students, before going to the rural internship, during their last year of the medical curriculum were trained to use the telehealth communication system online and store-and-forward teleconsultation. After using the system during three months the students were stimulated to answer a semi-structured questionnaire with open and closed questions. The Likert scale was used to measure the closed questions.

The questionnaire was applied to 123 students accomplishing their internship in 33 different municipalities in rural areas, during the last semester of 2010. SSP and QDA software were used to perform the

statistical analysis of closed and open questions, respectively. In qualitative analysis at a first stage, the responses from open questions were read with the goal of having a global vision. In a second stage, the questions were read in blocks, achieving the relevant facts. This process has come to recurring themes, which were processed and organized into categories. Finally the data were analyzed using qualitative analysis software QDA.
Results and discussion

In general, there is a positive perception about the potential contribution of telehealth resources both for assistance demands and to resolving the medical education (83.4% and 81% on average). When the students were asked about their concrete experience of using telehealth resources to solve the problems they have faced during their rural internship, on average 83.7% say that the experience was positive. This study showed that only 36.7% of patients treated through teleconsultants had to be referred to other levels of complexity of the health system. However, 27.3% of the students have difficulty using the system, despite consider it easy.

Qualitative analysis was used primarily to identify the main problems perceived by students, coming from the answers of open questions. The following problems were detected by the students: connectivity problems in a few municipalities; need to reduce the response time in some specialties and sometimes strenuous integration with the local staff.

Students reported as positive the telehealth utilization as a tool to provided quick access to their teachers at the medical school. They also highlight the high level of the case discussions and high quality of the responses of teleconsultants to clarify their doubts.

In the context of a continental country like Brazil, access to specialists can be an issue and telemedicine has advocated been in situations where the health professional on duty has little or no access to expert help [4]; it is able to offer remote physician otherwise unavailable access to specialist opinions, [5] providing reassurance to both doctors and patients. Telemedicine is able to decrease directly and indirectly the number of referrals to off-site facilities and reduce the need for patient transfers [6,7]. Telemedicine programs have the potential to motivate rural practitioners to remain in rural practice through augmentation of professional support and opportunities for continuing professional development. In the student's perception this potential was confirmed.

Telemedicine also provides opportunities for learning and professional development by enabling the provision and dissemination of general information and the remote training of health-care professionals [8]. A positive perception from the future doctors about the potential of telehealth

is an important element for the success of telehealth projects in different organizational realities.

## Conclusion

The implementation of telehealth resources was well rated by students. This project has enabled a process of training future doctors of telehealth in providing concrete experiences on the benefits of telehealth for the care process.

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# Telemedicine in Turkey: Potential, Initiatives and Obstacles

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**Abstract: Large cities in Turkey have well-equipped hospitals with experienced doctors, whereas health services in some cities are poorer and especially eastern and south-eastern regions have limited facilities in terms of medical equipment and staff. Since most doctors don't prefer to work in these cities, ministry of health has made it necessary for recently graduated practitioners and specialists to work there for a reasonable period. Although this obligatory task aims to promote health services in underdeveloped cities, it imposes an undemocratic compulsion. The solution of this problem lies in telemedicine. Since the introduction of the internet to Turkey in 1993, a fast growth in the internet use has been observed. Today 41,6% of residences are connected to the internet and Turkey is the 12th county in terms of internet use. The speed of the internet connection is 5Gbps among three big cities, whereas each city has an internet connection. The internet speed provided today and interests in the Internet use are promising factors for telemedicine in Turkey. Several telemedicine attempts have been initiated by the government, academicians and civil society organizations since 1997. The first telemedicine attempt was the National Medical Communication Network Project (UMEDIA) which was initiated by the joint effort of Scientific & Technological Research Council of Turkey (TUBITAK) and a civil organization. Unfortunately this project has failed due to financial problems. Several preceding attempts have been performed by the academia and the government (e-Health Project), resulting in advances in tele-radiology and tele-pathology. However technological, organizational, financial and legal obstacles have prevented widespread adoption of telemedicine for different disciplines. For instance, no legal measures have been set for data protection and information security of the internet yet. In addition, initial investments for investigation of technological aspects introduce financial obstacles. Finally, several recommendations are given for Turkey to benefit from telemedicine. Firstly security and**

**privacy issues introduced by internet and telemedicine should be set on legal bases. Afterwards interest in telemedicine studies should be promoted in the academia by establishing a 'telemedicine engineering' discipline that forms a technological workforce nationwide. On the medical side, medical training should be developed so as to capture informatics teaching.**

## Introduction

Telemedicine is considered to be a promising tool for serving health-related activities in the developing countries, where resources are scarce in terms of health personnel and equipment [1]. Turkey, which is considered as a developing country, has a great potential and need for telemedicine. The aim of this study is to present an overview of telemedicine potential for Turkey, the initiatives undertaken in Turkey up to now, the inherent obstacles and recommendations to overcome these obstacles.

## Telemedicine Potential

Turkey is a large country located between Europe and Asia accommodating 72 million people in an area of 783.000 $km^2$. Large cities in Turkey have well-equipped public or private hospitals with experienced doctors. On the other hand, health services in some cities are poorer and especially eastern and south-eastern regions have limited facilities in terms of medical equipment and staff. Hence, most doctors don't prefer to work in this undeveloped region. The ministry of health has made it necessary for recently graduated practitioners and specialists to work in cities with limited resources for a reasonable period. Although this obligatory task aims to promote health services in underdeveloped regions, it imposes an undemocratic compulsion. The internet speed provided today and the interests in the internet use are promising factors for telemedicine in Turkey.

## Initiatives

Several telemedicine attempts have been initiated by the government, academicians and civil society organizations (CSO) since 1997. The first telemedicine attempt was the National Medical Communication Network Project named as UMEDIA, which was initiated by the joint effort of TUBITAK and Ankara Chamber of Medicine in 1997 [5]. After the UMEDIA Project, several attempts that have been performed by the academia that focus on remote consultations [6-9], distant medical education [10], a national medical database for journals [11], internet usage by civil care organizations [12], security and ethics on the internet medical

sector [13] and telemedicine applications on various disciplines: tele-pathology [14], tele-radiology [15], tele-dermatology [16-19], tele-cardiology [20, 21]. Today, nine universities in Turkey have graduate programs on medical informatics. Moreover, the Ministry of Health initiated the second group project named e-Health Project in 2003 and a civil organization named Turkish Medical Informatics Association, which is a member society of the International Medical Informatics Association and European Federation for Medical Informatics [22].

## Obstacles

Technological, organizational, financial and legal obstacles have prevented widespread adoption of telemedicine for different disciplines. For instance, no legal measures have been set for data protection and information security of the internet yet. In addition, initial investments for investigation of technological aspects introduce financial obstacles. The attempts that have been performed up to now resulted in advances especially in tele-radiology and tele-pathology. Although much has been done since 1997, telemedicine studies in Turkey are conducted separately by the academia, government and a civil organization. These independent and small scale studies shift the realization of telemedicine in Turkey to a further date. For success in telemedicine a collaboration of the government, universities, medical institutions and civil organizations is required.

## Recommendations

For Turkey to benefit from telemedicine, security and privacy issues introduced by internet and telemedicine should be set on legal bases. Secondly, the technological barriers might be considered by detail and efficient ways to overcome them must be encouraged. Thirdly, strong leadership is needed to conduct telemedicine studies. The government, industry, and academia should work together and with professional associations with experience in health and information technology to educate the broader health and health care communities about the ways the internet can benefit them. Finally, quality initiative associations must be formed and standards developed to rate and control health related web sites.

## Conclusions

Turkey has a great potential and need for telemedicine and many initiatives are performed in order to realize telemedicine since 1997. However, there exist technological, organizational, financial and legal obstacles that prevent widespread adoption of telemedicine. Several

recommendations are presented in this paper for the success of telemedicine in Turkey.

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# Telemonitoring for Screening and Surveillance

# Ambulance Biosignals Telemonitoring: 2.75G versus 3G in Thailand

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***Abstract:*** **Real-time telemedicine in moving ambulances facilitates the initial treatment, enabling improvement in medical readiness of the emergency department at Phramongkutklao Hospital. 3G networks can supply higher data rates, however at present their coverage areas in Thailand are limited compare to GPRS/EDGE, 2.75 G networks with nationwide coverage and seamless service. Our current investigation focused mainly on biosignals monitoring (ECG, blood pressure, heart rate, SpO2, and CO2) that requires much less bandwidth than video monitoring. A series of 20 biosignals monitoring tests were carried out across the country during 6 months period (June 2010– November 2010). Ten were conducted in areas that have both 2.75G and 3G links while the others were conducted in areas that have only 2.75G networks. The data transmission at various speeds of ambulance (0-120 km/h) was monitored. The duration of each transmission test was approximately 60 minutes. The patterns of data transfer were similar in both 2.75G and 3G links (average transfer speed 8 Kbps with delay time less than 2 seconds at all speeds). At stationary states, there were few disconnections and freeze/lag in both 2.75G and 3G links. At high velocity, the disconnection and freeze/lag rate in 2.75G networks were no more than in 3G networks. Due to low bandwidth required, biosignals were successfully transmitted from moving ambulances in both 2.75G and 3G links. Under the current situation in Thailand, 2.75G networks with nationwide coverage and seamless service have more advantage than 3G networks. This initiative of Phramongkutklao Hospital clearly provides a novel and useful model for EMS in Thailand.**

## Introduction

Many studies have demonstrated the benefits of prehospital telemedicine. Real-time telemonitoring of patients in ambulances reduces the time to initiate treatment and allows the emergency crew to be better prepared.[1] Phramongkutklao (PMK) Hospital, the largest army hospital of the 37 army

hospitals in Thailand, launched a PMK Teleambulance Project in April 2010.

In addition to basic radio communications, the PMK Teleambulance system has GPS tracking, biosignals telemonitoring and video telemonitoring. GPS tracking provides the exact location, speed, arrival time of ambulances. Biosignals monitoring (ECG, blood pressure, heart rate, SpO2, and CO2) requires relatively low bandwidth compared to video monitoring.[2] To minimize the effect of data transmission congestion, two different streams were utilized; one for biosignals and the other for video transmission.

Fig.1 depicts two configurations of the real-time biosignals telemonitoring systems utilized in PMK Hospital. Transmission of data from a mobile unit (ambulance site) of both configurations requires effective cellular networks; the available bandwidth and seamless service of the networks along the entire path is essential.

With nationwide coverage and seamless service in Thailand, EDGE, 2.75G networks provide available data rates of 100-200 Kbps. While 3G networks can provide data rates of 384 Kbps – 7.2 Mbps, at presence its coverage area is very limited in Thailand. Our objective in this paper is to study on biosignals telemonitoring using 2.75G versus 3G networks in Thailand.

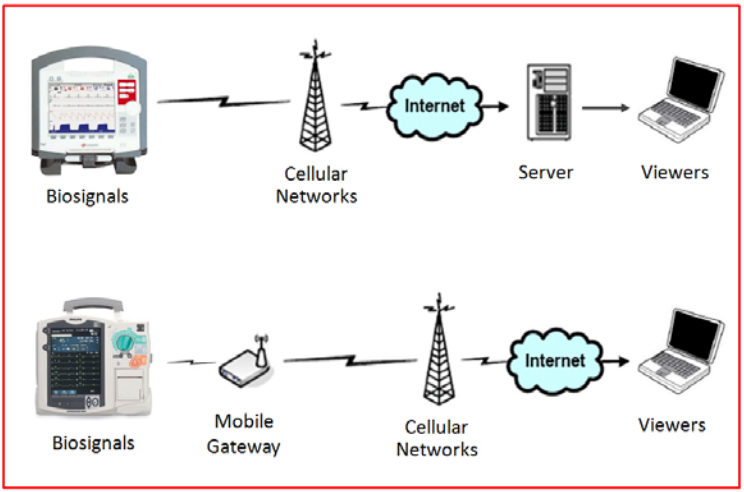


Fig.1 Configurations of the real-time biosignal telemonitoring systems

## Methods

During a 6 month period (June-November 2010), 20 biosignals telemonitoring tests were carried out. In limited areas with both 2.75G and 3G networks, comparison of performance and efficiency of both 2.75G and 3G were conducted using dual telemonitors with different SIM cards. In areas that have only 2.75G networks, 10 tests were performed across the country.

The duration of each transmission test was 60 minutes. The delay, disconnection rate, and freeze/lag rate were detected using two corresponding timers with two camcorders; in an ambulance and at the base. The data transfer was depicted using Bandwidth Meter Pro and data transmission at various speeds of vehicle (0-120 km/h) was monitored.

Three additional tests were conducted on a flying helicopter to study the affect of heavy vibration, and high attitude on biosignals telemonitoring.

## Results

The patterns of data transfer were similar in both 2.75G and 3G links with the average transfer speed of 8 Kbps (range 3-30 Kbps) and the delay time less than 2 seconds at all speeds of the vehicle.

At stationary stages, there were few disconnection rates and freeze/lag rates in both links. At moving stages, the disconnection and freeze/lag rates increased but were indifferent along the entire route for both links. The disconnection rates were no more than 3 times during 60-minute test duration. The bandwidth fluctuation occurred more in traffic congestion during rush hours than in the night on the same route.

The test conducted on a helicopter in flight revealed that the biosignals can be transmitted at altitudes below 500 feet above ground level despite heavy vibration. Beyond 500 feet altitude, the telemonitors as well as cellular phones were totally disconnected.

## Discussion

Handover occurs when a mobile station move from one cell site to the other. Usually, each handover introduces a loss of link level connectivity. Moving at high speeds increased handover rates. Overall in our tests, speed had a minimal effect on biosignals monitoring. The bandwidth fluctuation occurred more often in congested traffic areas. This could be attributed by heavy usage of cellular phones, depleting the available cellular resource.

The telemonitoring systems had no motion-sensitive hard disk normally found in portable laptops, so it can work in heavy vibration. In Medivac

testing, telemonitoring was nonfunctional at attitudes greater than 500 feet above ground level.

Biosignals were successfully transmitted from moving ambulances in both 2.75G and 3G links due to low bandwidth required (average 8 Kbps). Under the current situation in Thailand, 2.75G networks with nationwide coverage and seamless service are more practical than 3G networks.

## Conclusion

Knowledge of bandwidth requirement and optimum conditions to maximize the performance of wireless networks in the relevant areas is essential for ambulance telemonitoring. "Window of opportunity" medical delivery can greatly benefit the outcome and prognosis of the treatments. In high conflict areas having biosignals being monitored by the far-end physicians and specialists are highly valuable and is vital to the moral and combat readiness of our troops.

## Acknowledgement

The PMK Teleambulance Project was funded by the Royal Thai Government under the Thai Kem Kang Project 2010. We express our gratitude and appreciation to the VIP Aviation Division of the Royal Thai Army Department of Transportation for the use of helicopters. Lastly we would like to thank RX, Weinmann, Zovic, and Philips for technicians & data support.

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# Housing Technical Solutions of Localization at Home for the Prevention of Falls of Elderly People

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***Abstract:*** **In France, people aged over 60 represent 20% of the population (more than 80 years: 3.4%). Because of their age, they are fragile, frail and isolated, so it is necessary to implement systems that overcome these disabilities. Today, there are about 800,000 people dependent in France (1.2 million in 2040). In this context, techniques for locating the person can limit the risk of falls and assist the person by observing his life scenarios. These techniques take into account the project life of the elderly by including particular needs and consequences of falls. Various technologies exist for localization. The impact of these technologies is illustrated by several technical solutions and in particular by the example of smart floors.**

## The fall in the elderly

An elderly person is a person whose age is advanced and has the social and physiological attributes of old age in the civil society representation. The WHO defines an older person to age 60, age withheld for certain services. In France, life expectancy is 83.7 years for women and 76.7 years for men. Seniors have several types of needs identified:

- The innate physical needs (food, breathe ...). Seniors have priority needs to rest.
- The psychic needs: mainly social needs that are described for example by the Maslow pyramid of needs [1] (need to feel safe, to feel useful).

The accidental fall is defined as the act of falling to the ground unexpectedly and uncontrolled by the will. Falls are the leading cause of accidental death among those over 65. It lists 8500 deaths per year. In addition, 91000 hospitalizations per year are related to fractures of the femur and lower limbs, that occur on average one out of three (27% for 65-70 years and 44% for over 90 years). In addition to these fractures, falls can lead to many neurological and psychological pathologies.

## Solutions conditioned by the environment and the habitat

The environment surrounding the individual loss of autonomy determines the way in which he will live and understand his space. Furthermore, by its own structure, this environment does not always allow an evolution of support solutions that follow the evolution of loss of autonomy.

*In private housing*

Spatially speaking the loss of autonomy will lead to a movement with the increasing limitation: to go upstairs becomes impossible, and some parts of the house become inaccessible and lose their functions. Traditional houses are not suited to home care, so that the whole issue can allow people to live well and as long as possible to their homes.

*In medical institutions*

The medical staff, doctors, and seniors live together. The buildings are organized around open space for walking and offering views to life. Some rooms looks like traditional private living spaces. A common meeting room helps to maintain social ties within the structure and promotes the activity and movement of the occupants.

## Technological solutions to the service of the person

The location of a person in a house, in many cases, may prove crucial. It can help to ensure a level of security and well-being leading to a vital sustainable home maintenance. With a GPS system for example, it is possible to have real-time indications of the person from an actimetric point of view and fast enough to diagnose a potential fall of the person.

The indoor location technological solutions are numerous today and use various techniques:

- Techniques based on ultrasound,
- Radio-frequency identification (rfid),
- Triangulation techniques based on infra-red technology,
- Triangulation techniques using radiofrequency sensors [2].

## The floor for intelligent assistance and activities monitoring

Floor-based solutions for the localization consist in placing a thin layer of sub-sensors under resilient flooring (Linoleum or PVC). The sensors are connected to an electronic outsourced, itself managed by a specific software which allows to launch real-time alert in case of fall of the person (e.g. with TapisMetric from Vigimetric company [3]). The system is able to identify all falls even those for which the resident is recovering without immediately visible sequel. In addition, a major advantage of these solutions is that the

process is not intrusive because not visible to the person. It may be better accepted by the elderly. Through its electronics, the floor can be interfaced to automatic or computer organs.

Depending on the location of the person in the house and along the path he takes, the detection of his presence in the floor allows for example to automatically control lighting.

In the absence of a person in a room, lighting and appliances on standby can usually be turned off, reducing power consumption and promote energy conservation.

With the same principle, the system equipped with floor sensors can also easily and intelligently manage the heating mode for comfort in occupied rooms and in economy mode in the non-occupied rooms, or even offline (e.g. for guest rooms). Different scenarios can be created for optimal management of habitat.

Connected to an intelligent system, the floor can also easily be used to track activity of the person. The overall system connected to the Internet can handle emergency or alarm (e.g. a fall) and automatically notificy by various means (sms, phone call, email) family and medical caregivers (family, neighbors, home help, doctor).

In the same way, it may assist the individual in his daily tasks, controlling the automatic start of some appliances or multimedia (e.g. TV), or automatically by opening some doors.

## An example of scenario

Different scenarios can be created for optimal management of habitat by simultaneously assisting the person at home. These scenarios are solely based on the ability of the floor to help localize the person in the house.

An example of scenario dedicated to the assistance of the person is:

1. At 8 am the person gets up.
2. The floor detects its position and gradually turns the light on and gradually also to the bathroom or kitchen, and depending on the outside lighting.
3. Coffee maker is automatically put into operation.
4. The shutters open.
5. Heating system enters in power save mode in the bedroom and in comfort mode in living rooms.

Other scenarios of the same type can be constructed, for example during a fall at night or when the person receives children or friends. In the latter case, the occupancy of parts of the house will condition automatically the proper management of lighting and heating.

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# Intelligent Telehealth Monitoring using High Speed: Broadband Networks at MCMC-MMU Digital Home Lab

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***Abstract:*** **This paper briefly presents the current on-going telehealth monitoring research projects at MCMC-MMU Digital Home Lab.**

## Introduction

In order to increase Malaysia's competitiveness in today's borderless highly competitive business environment, the Malaysian Government has put a lot of emphasize on information and communication technologies (ICT) development since 1990s. In order to bring Malaysia's overall competitiveness to the next level with the use of ICT, the Malaysian government had introduced several key initiatives, among which was the introduction of the MyICMS 886 blueprint in 2006 and the formulation of the National Broadband Initiative in 2007 which puts in place a national strategy that will bring broadband to the whole nation. The National Broadband Initiative resulted with the implementation of the high speed broadband (HSBB) program which saw through a partnership with Telekom Malaysia (TM), a government linked company to roll out high speed broadband infrastructure at selected areas.

The Digital Home project was introduced in the MyICMS886 blueprint as an integral part of the 5-year plan for the introduction and development of the information, communications and multimedia industry from 2006 to 2010. Digital Home constitutes one of the 8 service areas in the MyICMS and is considered an integral part of the demand stimulation aspect of the National Broadband strategy, in terms of attractive applications, contents and devices. The main objective of the Model Digital Home Lab is to showcase the latest digital home and lifestyle technology using high speed broadband networks to the general public. In addition to the promotion of digital home and lifestyle to the general Malaysian public, Digital Home

Lab also serves as a research and development (R&D) lab at Multimedia University.

It is the main objective of this paper to present the current on-going telehealth monitoring research projects at MCMC-MMU Digital Home Lab and the paper is organized as follows. In Section 2, a low cost elderly healthcare monitoring system using open source software is presented. This healthcare monitoring system is for the elderly; especially elderly with chronic diseases to key in their daily health readings (blood pressure, body temperature, glucose level, etc) using Android tablet and their health conditions will then be closely monitored by physicians. In Section 3, an intelligent visual based home control and monitoring system using internet protocol (IP) surveillance camera will be presented. The visual based monitoring system is able to monitor the length of TV watching time, number of toilet visits, the number of fridge opening, etc. In case of any unusual pattern arises, the in-home monitoring system will alert the nearest hospital. The paper is then be followed by presenting visual based fall detection system in Section 4 and finally conclusion is presented in Section 5.

## Low Cost Healthcare Monitoring System

A healthcare monitoring system using open source software has been developed. This healthcare monitoring system is for the elderly, especially elderly with chronic diseases, to key in their daily health readings (e.g.

Fig. 1. Screenshot of the low cost healthcare monitoring system

blood pressure, glucose level, body temperature, etc.) and their daily health readings will then be closely monitored by medical doctors. This low cost healthcare monitoring system has vast potential as a survey carried out by McKinsey in 2009 showed that many consumers were willing to pay USD 15 to 39 a month for remote monitoring solution [1]. A screenshot of the healthcare monitoring system is as shown in Fig. 1. In order to make the healthcare monitoring system more user friendly to the elderly, as some of the elderly may not know how to operate a computer, a user friendly Android Tablet based healthcare monitoring system that is optimized for the elderly users is being developed and will be ready in a few months' time.

## Intelligent Visual Based Home Control and Monitoring System

In order to fully utilize the IP surveillance camera in Digital Home Lab, an intelligent visual based home control and monitoring system has been developed. The visual based home control and monitoring system is able to detect the number of persons sitting on the sofa, length of TV watching time, whether a person is walking towards kitchen or a predefined danger zone and the number of toilet visits. This system is very useful for the elderly living alone as their activities of daily living are monitored closely by the system and in case any unusual pattern arises (e.g. sudden increase in the number of toilet visits), the system will automatically send an alert signal to their children and caregivers. Computer screenshots of the visual based home control and monitoring system are shown in Figs. 2 and 3 respectively.

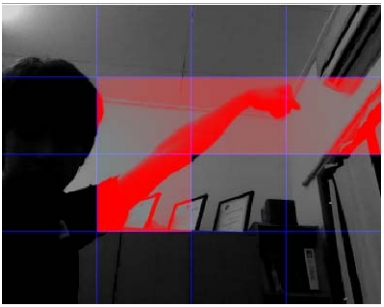

Fig. 2. Screenshot of the visual based home monitoring system prototype.

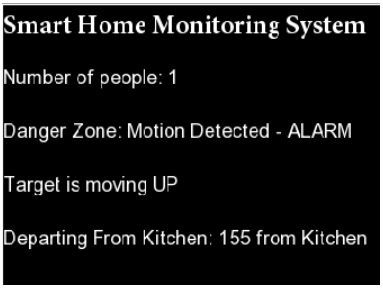


Fig. 3. Screenshot of the visual based home monitoring system prototype.

## Intelligent Visual Based Fall Detection System

In addition to the above mentioned visual based home control and monitoring system, a visual based fall detection system using IP surveillance camera has also been developed. The visual based fall detection system works by detecting a sudden change in the bounding box's aspect ratio. In comparison with the existing commercial wearable fall detection product using accelerometer, the visual based fall detection system has the advantage that there is no need to wear the fall detection device all the time.

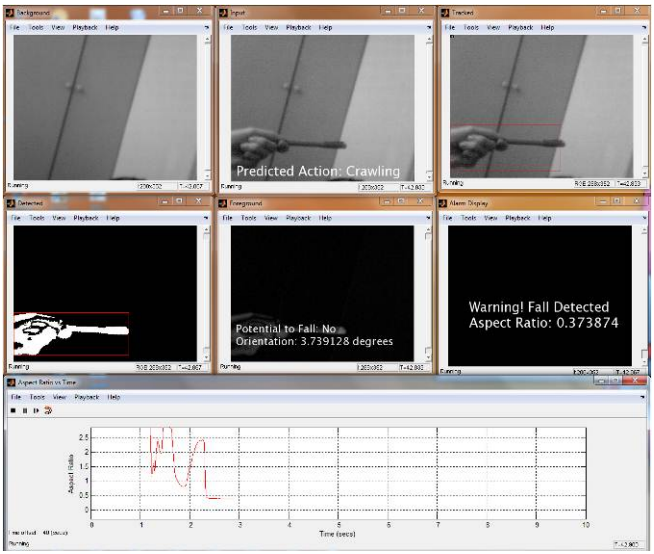


Fig. 4. Screenshot of the visual based fall detection system.

## Conclusion

In this paper, the current on-going telehealth monitoring research projects at MCMC-MMU Digital Home Lab is briefly presented.

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Malini Ramalingam is Deputy Director at the Malaysian Communications and Multimedia Commission, leading the Digital Home/Digital District Initiatives. She is also the project coordinator for the Connecting1Malaysia Entry Point Project (EPP) cluster under the Economic Transformation Program(ETP), a government transformation program that targets to propel Malaysia into a high-income nation by 2020.She holds a 1st Class Honours in Statistics from University Putra Malaysia.

# Is It Feasible Or Not To Offer Telemonitoring Service in Switzerland?

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***Abstract:*** **In 2007, cardiovascular disease was responsible for 37% of all deaths in Switzerland. A significant number of these were 45-64 year-olds, people in arguably their most productive years. While this percentage has been falling in recent years, the disease is still the principal cause of death in this country. At 120 SFr per patient per month, the payback period on the required investment for a Remote User Monitoring system can be achieved in less than 2 years. This is based on first year sales of 108,000 SFr reaching 4.5 million SFr by the fifth year of operation. Modeling the service demand as a more or less straight-line growth from zero to a maximum of 3500 patients over the first five years, and using a waiting-line model to predict the number of staff required, The sales figures are based on cardiovascular patients only, but the service is extendable to other departments of the hospital, such as pulmonary, diabetes, obstetric, etc. If the system is integrated with the existing cardiology ward however, staff can be free for other tasks when not busy with the remote monitoring. Patients will benefit through convenience, time savings both in traveling and in the waiting room, lower costs and, eventually, lower medical insurance premiums. The patient gains also the psychological comfort of knowing they can monitor themselves when problems begin occurring and not have to wait to get to the hospital, or worry about whether or not they should call an ambulance.**

## Introduction

One of the most important areas for remote monitoring is cardiovascular disease. In 2007, 61,089 deaths were registered amongst the resident population of Switzerland with the main causes of death being cardiovascular disease, cancer, and dementia. While the rate has been declining, cardiovascular disease still accounts for 37% (23.7% of men and 12.5% of women) of these deaths, or 161 deaths per 100,000 people, and the disease is still the principal cause of death in this country. A significant

number of these were 45-64 year-olds, people in arguably their most productive years.

According to the study made by the American Heart Association (AHA) in 2006, cardiovascular diseases claimed 831,272 lives (34.3% of all deaths in the USA). They also quote estimates of 81.1 million Americans having one or more forms of cardio-vascular disease. This means that for every death due to cardiovascular diseases in the USA, 97.6 other people have a monitorable condition. Applying this same ratio to Switzerland, there are potentially 69,100 people with a monitorable cardiovascular condition in the canton of Geneva alone.

Bearing this in mind, the number of cardiovascular patients actively seeking medical attention at any given time will comprise a significant proportion of the population. Switzerland currently has 28,812 physicians of whom 472 are cardiologists, equating to 7.5 cardiologists per 100,000 people. Most of these cardiologists (7 out of 12) work in the public sector (e.g. hospitals), and most also work in larger population areas with few opting to practice in rural areas.

## Business model

Let us try to develop a business model and make a market study in the canton of Geneva and the Swiss Romand region. For example, a hospital could decide to embrace the concept of telemedicine in the area of remote monitoring. Initially, it decides to expand its cardiology department to include remote monitoring of cardiovascular disease patients as a complement to its existing (traditional) monitoring methods. A hospital needs only install a Remote Patient Monitoring (RPM) system for cardiovascular monitoring, equip travelling nurses with professional monitors capable of performing the required tests, and provide patients (on a rental basis) with personal monitors capable of performing the required tests with the accuracy needed. The data is transmitted by the patient to the hospital. The remote monitoring system makes the data available to the doctor for analysis and his/her recommendations, which he/she transmits back to the patient. Patient data can also be forwarded to specialists when referrals are called for, or when the doctor is unsure of the problem or the appropriate treatment.

Once, as they expect, the service proves successful, they could plan to install RPM systems in other departments.

Financing for this venture is almost wholly related to staffing. Startup costs not related to staffing amount to between 50-100K SFr, depending on the cost of the monitoring system chosen. Staffing costs are directly related to the numbers of patients, except that at least one doctor and one nurse

must be available on a 24/7 basis.

A pricing sensitivity analysis has been conducted at 80, 100 and 120 SFr per patient per month. Given the general high cost of medical bills in this country, it is felt that patients in Switzerland will happily pay a service fee of 120 SFr per month for weekly monitoring. This is effectively a 30 SFr payment to not have to show up at the hospital, being instead able to conduct the testing themselves in the privacy of their own home. In Geneva, 30 SFr will not even cover a taxi fare to and from the hospital for most people.

At 120 SFr per patient per month, the payback period on the required investment for a Remote User Monitoring system can be achieved in less than 2 years. This is based on first year sales of 108,000 SFr reaching 4.5 million SFr by the fifth year of operation. Modeling the service demand as a more or less straight-line growth from zero to a maximum of 3500 patients over the first five years, and using a waiting-line model to predict the number of staff required, a total loan of 1,070,000 SFr would cover the costs of the new service up to the break-even point (in just under two years). The sales figures are based on cardiovascular patients only, but the service is extendable to other departments of the hospital, such as pulmonary, diabetes, obstetric, etc. If the system is integrated with the existing cardiology ward however, staff can be free for other tasks when not busy with the remote monitoring.

Patients will benefit through convenience, time savings both in traveling and in the waiting room, lower costs and, eventually, lower medical insurance premiums. The patient gains also the psychological comfort of knowing they can monitor themselves when problems begin occurring and not have to wait to get to the hospital, or worry about whether or not they should call an ambulance.

If we examine the industry of remote monitoring for medical patients using Porter's 5 Forces (new entrants, substitutes, industry rivalry, buyer bargaining power and supplier bargaining power), we find that new entrants to this market are a powerful force. Supplier bargaining power is quite high but is quickly being eroded, and substitutes, industry rivalry and buyer bargaining power are all relatively low forces.

Doctors subscribing to these types of services offered by these types of Telemonitoring Centres can offer patients these services. Therefore, new entrants to this market are a powerful force.

In Switzerland, industry rivalry in the medical domain is relatively low and there are currently no remote monitoring medical centres. The market is highly regulated and prices are tightly controlled by the various associations representing doctors and insurers, and the related government departments.

Likewise, buyer bargaining power is relatively low due to the same market forces.

Supplier bargaining power on the other hand, is quite high. Currently, only a few big suppliers of cardiovascular remote monitoring systems exist in the market. However, this power will be eventually eroded by new entrants into the marketplace.

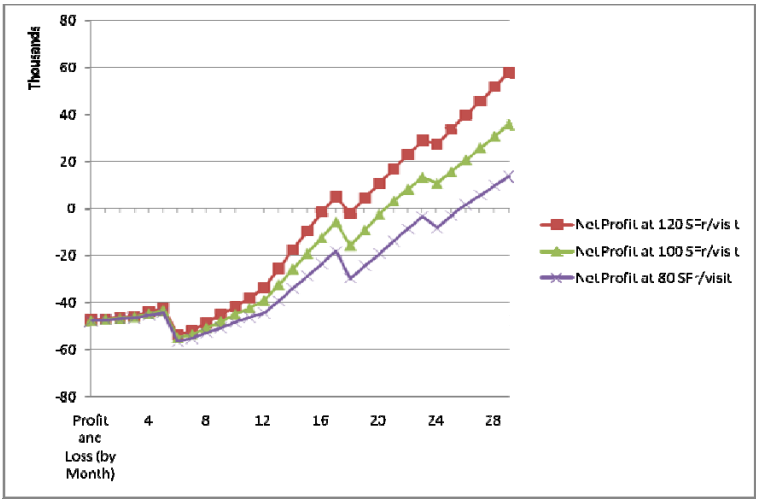
## Conclusion

This is a growth industry in its infancy. New and better products are being developed at a rapid pace and investors are beginning to realize the potential market opening up in the domain of eHealth/telemedicine

There are no real substitutes available for remote medical monitoring. Certain tests – blood pressure, blood sugar, weight, ECG's, etc – are typical regular tests required for many patients. However, alternative business models exist. New internet and computing concepts such as “cloud computing” and software as a service (SaaS) may eventually offer some new, competitive alternatives to the way this business is conducted.

With modern technology, and in particular information and communication technology (ICT), advancing at such a dizzying pace, the possibilities for round-the-clock monitoring of at-risk patients as well as significant savings in time, costs and increased productivity are substantial.

While legal impediments may prevent cross-border operations and such service providers are not yet available in Switzerland, it will not be long before these services are available in this country.



Leonid Androuchko, PhD, Professor and Research Director of the International University in Geneva. The Chairman/Rapporteur of Study group on “Telecommunications for eHealth” in the International Telecommunication Union – Development Sector Study Group-2.

Vladimir Androuchko is working in the field of eHealth/Telemedicine from the year 2003. At that time he was working in the International Telecommunication Union and he has been involved in the organization of the first ITU-T/ITU-D Workshop on Standardization in eHealth. Then he was participating in the development of ITU Initiative on Mobile eHealth. Currently his main interest is related to the development of different business models with the private sector involvement for the implementation of eHealth services.

Charles Mohun IT specialist in the Red Cross Organization in Geneva. He is also working on management and development of business model for the implementation of eHealth services.

# Patient Safety Devices, Security of Premises and Attendance Management of Employees for a Therapeutic Day Care Centre

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***Abstract:*** **"Soins et Santé" (Care & Health) association is a non-profit medical structure. In the structure, a therapeutic day care center offers many activities to elderly with Alzheimer's disease. This center has chosen to implement technical solutions enabling the secure monitoring of patients through indirect control of the employees.**

## Introduction

Today, thanks to medical advances, life expectancy has increased, which has the main consequence of an increasingly aging world population. The main cause of dementia in the elderly is Alzheimer's disease. It is a neuro-degenerative brain disease related to cognitive impairment. It causes progressive and irreversible deterioration of mental functions including memory, judgment, understanding, and reasoning. The number of people with Alzheimer's disease or related diseases in the world could rise from 24 million currently to 42 million by 2020 and 81 million in 2040. For France, in 2020, this number could reach 1.3 million, a person over 65 years in four. There are 160 000 new patients per year in France.

## Appropriate structures

The "Soins et Santé" (Care & Health) association is a non-profit medical structure. Its mission is to provide quality nursing care maintain and improve the quality of life for patients at home. The association participates in public health actions, social actions and information campaigns and training in the field of health. The structure is divided into three services: a care centre providing home care or institutional care, a department of nursing at home for the elderly which provides care for people over 60 years dependent and / or chronically ill, and a therapeutic day care center

for old people with cognitive disabilities living at home. This day care center helps people to maintain social links, by stimulating therapeutic activities adapted to slow down the effects of the disease and also relieve the family by providing periods of respite. The therapeutic day care offers many activities such as memory, gymnastics, gardening, and multi-sensory stimulation workshops to help patients find their way into space and maintain their independence.

### Increased responsibilities and ethics

Within the medical and social structures, directors have the duty to organize the safety of patients they serve. If damage is caused to a patient and results from carelessness or negligence of staff or access to unsuitable premises, the responsibility of the head of institution is directly engaged. The therapeutic day care is facing the problem of surveillance of those who are entrusted. These patients are in a state of fragility that requires the institution in its mission to adapt its monitoring by the "state" of the person. Alzheimer's disease causes cognitive deficits growing to doubt the capacity of the affected person to choose and decide his life, both in the simplest facts of everyday life in the most critical decisions. People with dementia have this tendency to wander and may be prone to running away more often due to the disorientation that the will to run away. They therefore require special monitoring. To assure this surveillance, some structures make use of wireless systems. Demented patients carry with them a device (jewelry, bracelet, pendant…) that causes an alarm on detection of the patient in a non-authorized zone. However, every act of assistance that may be offered even to a cognitive impaired person has to be done with the full consent of the person.

### Security through indirect access control

“Soins et Santé” association has chosen to implement technical solutions enabling the secure monitoring of patients through indirect control of the employees. A disposal for patient safety has been established for simultaneously securing sensitive premises (offices, treatment rooms and utensils and care products storage places) and the timetable attendance of the employees. The goal is to allow safe and non-controlled natural ambulation of the patients, respecting their integrity, and thus defending the values of respect for the human person. Freedom and security are complementary.

Previously, access control was minimal and done by mechanical code locks. This system was binding, impractical and did not permit traceability

of access. Replacing these locks by proximity card readers now combine ease and traceability. The project was custom made in collaboration with Legrand [2], the global electrical infrastructure and digital building. Software Access Control Access System Legrand Java now provides an automatic scheduling of controlled access.

Before the introduction of the system, each member of the healthcare team (nurses and aides) should fill in a daily activity sheet handwritten justifying his schedule. With the new system, monitoring of staff and establishment of forms of activity is continuous and automatic, thus freeing the staff of a heavy workload. This monitoring applies when entering the main building but also upon entry into the vehicle by the main portal site which allows controlled access of persons outside the whole structure.

Control access to the main entrance of the main building can now prevent untimely and unintended release of patient disoriented. A sound signal alerts when someone without a badge now crosses that access. The presentation of the badge of a staff accompanying the person now inhibits the alarm.

### Comfort and flexibility through home automation

In addition to the access system, several other amenities of comfort have been made towards the caregivers and patients.

A multi-sensory room allows residents to work their natural senses in peace. Until now, no signs had been put in place to serve the occupation of this room whose activities could be interrupted at any moment. The establishment of identification light, operable from inside the room by the staff that manages the activity can report the use of the premises. In the same room, the main light (classical on/off switch-driven) was particularly ill-suited to activities. Notably, brutal lighting at the end of activity session dazzled patients and could disorient and even lead them to lose balance.

The use of LED mood lamp allows a gradual return to a non-aggressive normal brightness level without risk of glare or disorientation.

Access to toilets for residents was also a problem. The solution to a pervasive lighting toilets had been chosen to allow patients to better locate and thus to better orient themselves in space. Considered too energy-consuming and poorly adapted, the previous solution was replaced by a presence sensing automatic light in addition to a more suitable door signage.

All these simple solutions have enabled caregivers to better devote their time to care and support for patients, while securing the building in terms of signage and intrusion.

## Experimentation feedbacks

The solutions implemented have been selected to be transparent to patients. The assessment was made by the staff of the day care center.

The first results concern the access control system. The majority of staff only sees qualities in the system: it is simple for 72%, convenient for 50% and useful (33%), while being safe (27%). For 80% of the staff, the system saves time. 95% of the staff still considers the manual mechanical lock to be a complementary solution in case of problem on the automatic system.

According to staff, patients do not feel they are being monitored because the system has only an indirect influence on their way on going through the building, as it was meant to be by the day care centre.

Improvements have to be performed on the main entry security alarm. As explained, when a patient exits without a badge, the alarm sounds. It represents a security for the staff, but is aggressive (80%) for patients.

In conclusion, staff is partly satisfied by the different systems for 54%, and completely satisfied for 33%.

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# Telemonitoring for Assisted Living Residences: The Medical Specialists' View

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***Abstract:*** **Telemonitoring is regarded as a means to maintain a relatively high quality of life for independently living elderly. This paper discusses a requirements study of a system to, foremost, telemonitor activities of daily living (ADL) of the elderly. The study utilizes literature and in-depth interviews with medical specialists. From the interview results can be concluded that, besides from elderly's own input, monitoring different aspects of movement, food consumption and sleep pattern are regarded as most beneficial to the medical specialists.**

## Introduction

The growth of the elderly population and the exponential increase of medical expenditure [1] have presented society and health care institutes with a challenge. Elderly and policy makers desire to sustain the elderly's independence from care as long as possible, while preserving the accustomed quality of life. To this end, medical specialists may use telemonitoring systems to gather and analyze information about the elderly's activities of daily living (ADL). Deviations in these ADL reveal information that may lead to preventive measures. However, there is no consensus on the importance of the various ADL. This study focuses on the needs and requirements of a telemonitoring system that is aimed at collecting information of the elderly's ADL. Through conducting in-depth interviews with the medical specialists and investigating current technology, the boundaries of the system for the present domain are set.

## Related work

ADL are considered as one of the main constructs of elderly disease diagnostic and widely utilized by medical specialists [2]. Additionally, every medical specialist has their own approach towards ADL. Geriatrics

and physiotherapists for instance, make use of ADL in order to determine whether the elderly in question are active enough and still able to perform their daily tasks on a regular basis. Occupational therapists on the other hand, pay more attention to how these activities are executed and whether the elderly face difficulties in performing their tasks. Furthermore, it has also been established that the ADL are not all equally affected by the aging process and mostly depend on the type and severity of the disease [3].

Studies concerning the monitoring of elderly, cover a wide variety of technologies, such as accelerometer-based systems [4], vision-based computing [5], and wearables for physical activity monitoring [6]. Other studies of relevance were based on pattern recognition and data-mining techniques [7]. Other issues with regard to telemonitoring for the elderly are the following: (1) privacy and information sharing [8] and (2) maintaining the elderly's dependence [9].

## Methodology

This study used semi-structured in-depth interviews. and aimed the following: (1) To investigate the underlying reasons for hospitalization and their relation to ADL, (2) to determine the changes in ADL as a result from ageing, (3) to select a number of ADL which are considered most important for monitoring.

The group of participants consisted of 11 medical specialists from various fields in elderly care. This group of interviewees included physiotherapists, geriatrics, occupational therapists, speech therapists and domiciliary care professionals to cover a wide variety of perspectives on elderly care and disease diagnostics. The interviews consisted of a series of open questions relevant to the main question, our focus mainly being the importance of monitoring ADL and lifestyle changes. During the interviews the participants were also provided with a list of ADL which they rated on a 7-point Likert scale and valued the necessity of each to be monitored.

## Results

The rating of the ADL as illustrated in Figure 1, indicates that monitoring different aspects of movement (functional transfers) and eating habits (food consumption, cooking) were considered more relevant than monitoring a single specified ADL, such as toilet visits. As for the changes in ADL, the medical specialists suggest that the deterioration process in the lifestyle of the elderly considerably affects mobility and cognitive abilities. Also hospitalization is in most cases caused by negative changes in cognitive abilities which pose a danger to the elderly's life or their surroundings.

According to the majority of the interviewees, monitoring the sleep pattern can play a notable role in assessing their overall well-being and should be performed alongside monitoring ADL. Also, all medical specialists confirmed that involving the elderly in the diagnostic procedure is essential to establish a correct diagnosis. Unlike the hospitalized elderly, the independently living elderly are often capable of explaining their needs.

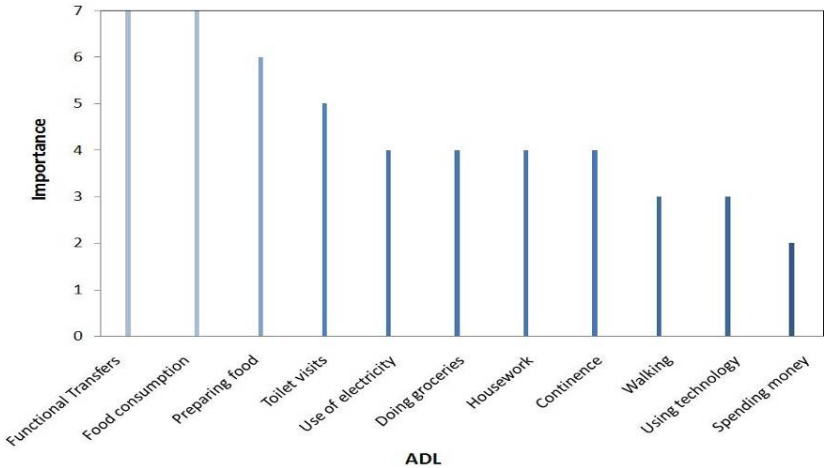


Fig.1 Importance of ADL

## Discussion

Results indicate that monitoring ADL is relevant for the medical specialists, particularly when focused on the consumption of food, functional transfers, sleep pattern and reports from the elderly. The focus should be set upon a select number of ADL. It was proposed that the desired telemonitoring system acts solely as a medium which gathers and analyzes data; interpretation and further analysis of the gathered data should be a task performed by the medical specialists themselves, though, naturally, with the assistance of automated techniques. The main purpose of such monitoring system would be determining the relevant aspects in the elderly's lifestyle and notifying the medical specialists when deviations occur. The desired telemonitoring system should also encourage the deployment of medical specialists in the earlier stages of changes in the elderly’s lifestyle.

## Conclusions and future work

Based on the study, it can be concluded that monitoring ADL can be a substantial asset to medical specialists. Via telemonitoring, the medical specialists will have the opportunity to go one step beyond the traditional diagnosis and notice the gradual changes in the elderly lifestyle as they happen. However, it is evident that telemonitoring does not provide the means to replace medical specialists; therefore the emphasis should be laid on the informative functions. For future work, we recommend studying acceptance of telemonitoring within the elderly living environment. In this regard, co-design methods that involve elderly during the design process may be instrumental.

## Acknowledgements

The project has been supported by the SIA project "Smart systems for smart services" and the Pieken in de Delta project "Zorgen voor morgen".

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# Tele-Monitoring for Neurological Patients: Lessons Learned

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***Abstract*: This paper presents results on living lab experiments of a proof-of-concept clinical trial of the Alpha tele-monitoring system for elderly patients with neurological disorders. The system itself is flexible to host any new type of sensor, but the base configuration used in the current living lab experiments is as follows: physiological and activity sensors are Bathroom scales, Blood pressure meter, one lead ECG recorder, Blood glucose meter, Wrist-worn fine motion sensor, passive infra-red activity sensor network. The living lab experiments evaluated the prototype system with the inclusion of 11 elderly patients for two months. We conclude that living lab experiences have shown that the presented measurement setup together with the Home Hub and the Data Center is a viable solution for monitoring elderly neurological patients.**

## Introduction

The ongoing process of integrating home telemonitoring into the traditional healthcare system [1] requires studies on applicability and efficiency of such systems. Most of these systems target subpopulations with hypertension [2,3] or diabetes mellitus [4], but there is a lack of systems targeting generally the elderly patients or more specially patients with neurological disorders. Even more there is a debate over the added value of telemonitoring systems without decision support mechanisms [5], doctors and physicians in conventional healthcare report the challenge of manually extracting important trends of parameters from the tele-measurements. The telemonitoring system developed by the ProSeniis consortium is an answer for such need. The research has come to a stage where living lab experiments have been conducted and data collected has been evaluated.

## Objectives

The purpose of this paper is to assess the usability, patient and doctor acceptance of the system and to present results on the evaluation of the collected data with respect to sensor stability, communication reliability, data collection performance, data processing results.

## Methods

The system is being developed by a consortium including academic, healthcare and industrial / sensor manufacturer partners. The system is based on a Home Hub which is a robust laptop category computer with only a touch screen and internet connection, and wireless links to the sensors installed in the home or worn by the patient. Data is collected from several Home Hubs representing a patient each, by the Data Centre. The centre provides a web GUI for the supervising medical personnel, analysts, and the family.

The first two phases of living lab experiments (4 months total) had a total of 11 elderly patients enrolled (9 female, 2 male, age: 69,7+-6.4 yrs). From these 6 patients were without neurological disorders, 1 suffered from Parkinson's disease, 1 from Alzheimer's disease, 3 were stroke survivors. The patients received the following devices:

- for patients without neurological disorder: Bathroom scale, Blood pressure meter, ECG recorder, Blood glucose meter, Wrist-worn fine motion sensor, passive infra-red activity sensor network
- for patients with Parkinson's or Alzheimer's disease: Blood pressure meter, Wrist-worn fine motion sensor, passive infra-red activity sensor network
- for stroke survivor patients: Blood pressure meter, ECG recorder, Wrist-worn fine motion sensor, passive infra-red activity sensor network

## Results

The efficiency of data collection is summarized in the following table (Table 1.). The expected amount of data was determined by doctors for the given patient (group). Received rates indicate the amount of data that arrived on the Home Hubs and finally to the Data Center. Valid rates refer to data that was evaluated by physicians and has been labeled as physiologically acceptable. In case of the passive infra-red and Wrist-worn

fine motion sensors every day with at least 8 hours of evaluatable measurement were considered valid.

| Sensor | Ratio: expected versus received | Ratio: valid versus received |
|---|---|---|
| ECG | 40% | 80% |
| Wrist-worn fine motion | 95% | 47% |
| Passive infra-red | 50% | 43% |
| Blood pressure | 100% | 99% |
| Body weight | 83% | 93% |
| Blood glucose | 95% | 88% |

Table 1. Efficiency of data collection in living lab home telemonitoring scenarios

During the in-depth analysis of data collection it has been identified that the relatively low ratio of received ECG measurements occurred due to the faulty communication of the ECG recording device. The low ratio of received data for Passive infra-red sensors was identified to be caused by fault sensors and (Zigbee) network errors.

Furthermore, the analysis discovered that patients had a rather low compliance to the wrist-worn fine motion sensor (watch-like device) which resulted in low numbers in hours the sensor was used per day and episodes of the sensor lying on (most probably) the table. Passive infra-red sensors produced even less valid data mostly accountable to the repetitive sending of signals and the effect known as “hyperactivity” of the distinct sensor devices. ECG, Blood pressure, Body weight and Blood glucose devices performed well overall.

## Conclusion

We conclude based on the living lab experiences that the presented measurement setup together with the Home Hub and the Data Center is a potential solution for gaining experience with monitoring elderly patients with or without neurological disorders, but further efforts are required to stabilize the device communications within the system. The 9-month-long living lab phase started in December 2010 with the further developed version of the system will provide more insight into the applicability of tele-monitoring. Important conclusions include the difficulty of finding patients affected by dementia over the age of 60 with MMT score 19-26, this means

our initial inclusion criteria were too strict. Furthermore the intrusion of the monitoring system into the well established daily activities and lifestyle of elderly patients is also a factor to consider besides the technological barrier the patient is facing when having to handle all the modern devices. More information is available on the project website at http://www.proseniis.com

## Acknowledgment

The work presented was funded by the National Innovation Office, Hungary (project No. OM-00191/2008 AALAMSRK).

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# Telemonitoring for Screening and Surveillance of Type 2 Diabetes and Related Conditions on Saipem's Offshore Vessel

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***Abstract:*** **Diabetes is a chronic disease with increasing frequency and a heavy load for health. The workplace is an ideal environment to carry out screening programs that can prevent this disease. Diabetes is also recognized as an area of primary application of telemedicine by the European Community. The present communication concerns a preliminary assessment about the feasibility of a telemonitoring program oriented to surveillance of diabetes risk for workers on offshore vessels of the Oil and Gas Industry.**

## Introduction

Nowadays the culture of 'health and safety' of the employees is fundamental in any industrial organization including oil and gas industry. This is not only to fulfill the contractual requirements, but also to provide a complete healthy physical and psychological working atmosphere to the employees. The health care facilities for the employees become distinctive signs of the company, putting health and safety in the centre of the production process. An increased surveillance and treatment of chronic diseases such as diabetes among the workers means the reduction of morbidity in the workplace due to diabetic disease. Primary prevention, early diagnosis, proper disease management and therapy, which includes the education and delivery of responsibilities on the workers with diabetes will lead to the prevention of acute and chronic diabetes complications and the reduction of the hospital admission.

The intention of this study is to find out the importance of the development, implementation and evaluation of a telemedicine supportive system for diabetes management through "Telediabetology". This project proposes an innovative approach in the subject of protection, prevention and promotion of worker's health and safety in their workplace, through adequate control of hyperglycaemia. It initiates effective assessment, monitoring and evaluation of hyperglycaemia among the workers by periodic checking of blood sugar values and electronically transferring from the offshore vessel to the diabetic centres for monitoring, evaluation and treatment suggestions.

## Methods

A telemedicine system, providing a two-way communication between the medical service onboard (SAIPEM ENI fleet) and the Diabetes Centre, has been set up. The blood sugar telemonitoring allowed the acquisition of capillary blood sample collected by workers on the ship, the transmission to the database and the automatic return of the clinical evaluation directly to the medical service on board. The teleconsultations, depending on needs, were carried out in both "store and forward" and "real time" mode. All results, apart to the vessel doctor, were sent - via e-mail - to the senior medical personnel and to GIPSI (Saipem's electronic medical records data base) for automatic archive in personal file of the employee. The protocol provided a pre-screening based on the Diabetes Risk Score Questionnaire (DRSQ) (adopted from American Diabetes Association)[1] for the classification of the employees into three different classes such as Normal, Low and Medium to High, based on the risk to develop Type 2 Diabetes Mellitus (T2DM) in the next 10 years. Known diabetic employees were classified according to the therapy they were receiving.

Based on the risk class, the protocol also provided a graduated series of monitoring and interventions: frequency of blood glucose profile, indication for changes in lifestyle, tips for a more detailed diagnosis and subsequent treatment advice. The blood glucose monitoring was carried out with (a) Fasting blood sugar (FBS), (b) Before and after one meal – meaning few minutes before and two hours after any meal and (c) Six point profile – meaning few minutes before meal and two hours after every meal (3 meals) in a day.

The Telediabetology Program (TB) was initially implemented onboard vessel Saipem 3000.

## Results

The survey was completed in 2 months due to the different working rotation of employees. A total of 99.1% (214/216) of the employees voluntarily participated by answering the DRSQ: the individual "Diabetic Risk Score" (DRS) was then calculated and every worker attributed accordingly to a different risk class and consequently to a monitoring program. 171 of the screened population (80.0%) were found eligible or positive for tele-diabetic blood sugar monitoring program, and 43 (20.0%) were identified with no risk to develop T2DM in next 10 years and hence excluded from TP. 106 (62.0%) employees resulted the score between 1 to 6 and were placed in "monitoring class 5" or with low risk. Then, 53 (31.0%) employees were at slightly higher risk (7 to 11 score); they were placed in "monitoring class 4". 7 (4.0%) employees belonged to the medium risk group (12 to 14 score) and 2 (1.0%) high-risk employees (15- 20 scores) were also placed in "monitoring class 4". No employees were found above 20 points score (very high risk group). There were 2 (1.0%) employees already diagnosed with diabetes in diet-therapy; they were placed under the "monitoring class 3". The last "one" (0.59%) diabetic employee with oral medication was placed under the "monitoring class 2". There were no employees onboard with diabetes mellitus on insulin therapy. Overall 20 employees withdrew or discontinued from the TP. Some of the participants were reclassified based upon their respective glycaemia values monitoring. Hence, 95 workers passed to the "class 5", 58 to the "class 4", 7 to the "class 3" and 1 employee under the "class 2".

It is noted that during the first analysis, there were 12 employees having slightly high glucose level and 8 employees with very high glucose level. This result implies that they were probably not aware of their blood glucose status that could lead to early complications. During the TP the referral diabetologist centre provided advises to the employees with abnormal results on how to control their glucose level. Just after a short period of three months, 13 employees normalized their blood glucose tests, 9 are slightly high and only 1 had very high results. In 7 cases the diabetologist gave special, individual recommendations. 127 employees showed normal glucose level during the entire monitoring period.

## Conclusion and recommendations

This pilot study demonstrated that the application of telediabetology services in offshore operating vessels in oil and gas industry is efficient. It can provide a new perspective in the telemedicine management of known cases of diabetes and those at risk of developing T2DM due to the lack of

awareness, monitoring and/or inadequate management. The following are the problems encountered during this pilot study with recommendations on how to improve the system:

1. Lack of backup programs – Telediabetology has to reinforce with other health related program such as diet control, exercise program and diabetic awareness campaign; this strategy will increase the morale of involved employees. Saipem has launched "BE.ST" (Better lifestyle) Program on S3000, a life style and nutritional program that allows employees to have a healthy and balance diet.
2. Lack of monitoring continuity during vacation period – Alternative solution has to be addressed such as involving the employee's family doctors in monitoring process.
3. Dropouts from the program due to job security concerned if detected as diabetic during the monitoring process – Well oriented awareness campaign and counselling has to be established to gain and maintain the confidence of involved employee in the entire Telediabetology program.
4. No facility to the employees to view personal glycemic records in web environment – Facility to access individual records has to be provided to employee by TP provider, by respecting the security and protection of data.
5. Frequency of monitoring schedule even for low risk population – The actual number of monitoring schedule has to be studied exhaustively to determine the reasonable and balance frequency of blood glucose testing with respect to the different risk groups.

The Telediabetology Program could be implemented by other laboratory and clinical tests such as lipid profile and cardiovascular assessment.

Furthermore, future studies has to be carried out focusing on the improvement in quality of metabolic status of diabetic workers, reduction and prevention of critical situations, industrial accidents in workplace due to diabetic disease. Improvement in life quality of diabetic employees, prevention of occurrences of complications in diabetic workers and reduction of health care cost for the company are also to be considered for future studies.

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# Winner
# of the
# 2010 ISfTeH Student Videoconference Session

# Youtube Clips for Remotely Mentored Hip Osteoarthritis Telerehabilitation: Preliminary Study

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***Abstract:*** **Osteoarthritis (OA) is among the five most disabling diseases, having a remarkable public health impact due to pain and disability. The prevalence of OA touches more than 10% of population in the industrialized countries. Exercise can be any activity that enhances or maintains muscle strength, physical fitness and overall health. Attending to daily exercising offered by professionals can be somehow restricted in practice. Patients may receive the home based remotely supervised exercise program utilizing video clips for mentored physiotherapy. The aim of the study was to assess the potential usefulness of video clips available on YouTube for remote mentoring telerehabilitation for hip arthritis and/or postoperative rehabilitation focused on patients after total hip replacement. Searches for videos with hip arthritis exercises instructions content were conducted on the YouTube website. Only eighteen videos were finally assessed using 0-5 scale. The rehabilitation exercises instructional videos, particularly for hip OA patients are relatively rare on the YouTube. The video ratings and view counts suggest the presence of a community of YouTube users uploading at least sufficient quality clips for patients with hip OA.**

## Introduction

Osteoarthritis (OA) is among the five most disabling diseases, having a remarkable public health impact due to pain and disability. Attending to daily exercising offered by professionals can be effective for diminishing

disability. The home based remotely supervised exercise program utilizing video clips for mentored physiotherapy can be an effective. The aim of the study was to assess the potential usefulness of video clips available on YouTube for remotely mentored telerehabilitation for hip arthritis and/or postoperative rehabilitation focused on patients after total hip replacement.

## Material and Method

Searches for videos with hip arthritis exercises content were conducted a few times on the YouTube website from October 2009 to Jan 2010. We searched YouTube (www.youtube.com) using the keywords hip replacement rehabilitation and hip arthritis exercises for all unique videos with English and Polish language content. Each video was watched. Total number of views, video assessments was recorded in an Excel spreadsheet. After the initial screening, the video clips were watched by researchers independently. We extracted information on the type of video, clip length, and physical therapy aspects. We measured the users' interaction with these videos using view counts and the viewer reviews indicated by the Likert type of assessment expressed by star rating system from 1 star (poor) to 5 stars (awesome). Statistical analysis was performed using statistical software Statistica 8.0 (StatSoft).

## Results

The search returned 18 videos. Videos were directed and presented by amateurs - 6, professional-physiotherapists – 7. Five video clips were animated. Descriptive statistics is presented in the Table 1.

Tab 1. Descriptive video clips data and Internet surfers rating.

| Variable | Descriptive Statistics (YouTube) | | | | |
|---|---|---|---|---|---|
| | N valid | AVG | Min. | Max. | STD |
| Time | 18 | 132,389 | 55,0000 | 597,00 | 137,98 |
| Frequency of viewing | 18 | 8756,722 | 112,0000 | 52055,00 | 12970,33 |
| Content scientific value | 18 | 4,833 | 3,0000 | 5,00 | 0,51 |
| Visual content value | 18 | 4,667 | 4,0000 | 5,00 | 0,49 |
| Content Understandability | 18 | 4,667 | 4,0000 | 5,00 | 0,49 |
| Number of comments | 18 | 38,111 | 1,0000 | 101,00 | 46,00 |
| Surfers assessment | 18 | 36,722 | 3,5000 | 101,00 | 46,77 |
| Comment rate | 18 | 0,693 | 0,0000 | 3,69 | 0,96 |

Video clips value was averagely assessed by investigators on 4,546 in a range from 3 to 5. Rank Spearman Correlation varied from 0.54 to 0.845 marked * at $p < 0.05$.

## Discussion

The symptomatic hip osteoarthritis (OA) occurs in 3% of the elderly [1]. Treatment options for OA include exercise [2,3] and patient education among other methods. Telerehabilitation (TR) applied in orthopedics is mentioned rarely [4-11] but it may have an impact on hip OA treatment. The popularity and influence of TR is growing recently. YouTube is a video-sharing Internet Web site created in 2005 that provides free video streaming. It allows users to share multimedia clips that contain information related to the hip joint rehabilitation due to arthritis or after hip replacement. To our knowledge, no studies have examined the content of these videos. We conducted a descriptive study to characterize the available video clips about hip rehabilitation on YouTube. Video clips are considered as useful media to support teaching physical activity and specific movements. Video show may improve patients understanding of physical therapy tasks particularly if instructed remotely. YouTube was conceived as a specific multimedia mart for the sharing of amateur videos. The Internet access and technology Web 2.0 and the social computing phenomena (including YouTube and other portals) are changing users from consumers of Web-available information and resources to active creators of information and content [12-16]. As with the current active life campaign, YouTube could be used as a specific warehouse for physical exercises targeted to various types of kinesiotherapy.

## Conclusions

The rehabilitation exercises instructional videos are accessible on YouTube for hip OA patients. The low number of available videos dedicated to hip arthritis posted on YouTube may show relatively low impact for this portal users. The video ratings and view counts suggest the presence of a community of YouTube users uploading at least sufficient quality clips for patients with hip osteoarthritis.

## Acknowledgments

This study is supported by project CLEAR (ICT-PSP-224985) Clinical Leading Environment for the Assessment and validation of Rehabilitation Protocols for home care.

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