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Editors
Malina Jordanova and Frank Lievens

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Preface

Dear Reader,

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

With 87 papers from 37 countries (Fig. 1), 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.

Fig. 1.

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

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

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

We are convinced that this book will provide useful information to those who are preparing to introduce Telemedicine/eHealth in their regions or countries. It will allow them to rely on the experience of others and will make them aware of the benefits and problems that were encountered

during and after implementation of systems or services, and as such help them to avoid mistakes and reduce potential problems.

Yet, it is necessary to underline that:

- The content of the book is divided in chapters covering various areas of Telemedicine/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 usually only the first co-authors is 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 advice, supported both authors and editors in the process of selecting, correcting and preparing for publication all papers included in this book.

Content

Sustainable Development Goals 2015 – 2030: From a Global Framework to Local Innovative Programs

Disease Management and Treatment Adherence

An Open and Interoperable Platform for the Follow-Up of Diabetic Riders

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Introduction

Chronic conditions like diabetes are not incompatible with sport practice; they can even be improved by such activities. Nonetheless, a physically committed sports practice, when suffering from such a condition, requires close monitoring of physiological parameters to stay within acceptable limits. Moreover, a better understanding of the relation between effort and the evolution of physical parameters during practice may be necessary, depending on the condition.

This was experimented during the 2015 mHealth Grand Tour (MHT), a cycling event across Europe, to which diabetic riders participated.

The Event

Following those organized in 2013 and 2014, the mHealth Grand Tour 2015 [1] took place from Sept 3rd to 12th 2015. Its main characteristics were:

- 9 riding days;
- An itinerary that went from Brussels to Geneva, via Paris;
- 1500 km long;
- 22 000 m climb.

23 diabetic riders participated to the whole tour along with non-diabetic riders, all regrouped in teams.

Supported by the GSMA, International Diabetes Federation, Association Française des Diabétiques, JDRF, Orange and Etisalat, with a study undertaken by Société Francophone du Diabète, the partners were again focused on addressing diabetes issues and challenges to help improve the lives of people with diabetes, showing what is possible, offering a constant follow-up and allowing a clinical study, and rising awareness.

The Remote Monitoring and Data Collection Needs

The clinical study's aim was to correlate the cardiac frequency variability with evolution of external and internal stress (as activity or blood glucose level and diabetes).

To provide both the required data for riders monitoring, and to be able to undertake the clinical study, the following data were to be collected:

- Questionnaires: one before the tour, and daily ones: data on food intake, mood, well feeling, sleeping;
- Automatically collected vital signs:
    - Blood glucose level (continuous and discretionary);
    - Weight (daily);
    - Body composition (daily);
    - Blood pressure (daily);
    - Heart rate and RR interval;
    - Insulin intake (through insulin pumps log data and questionnaires).

Remote monitoring also required the possibility for the tour doctor to consult the riders' data. For the riders themselves, it was also necessary to be able to consult the data collected and to have access to personalized advices to help them control their condition during effort.

The project context generated some requirements for the solution such as:

Uncertainty about the technical partners and devices at the beginning of the project, and need for the solution to be usable for other contexts (with unknown yet devices) implied that the solution design had to be flexible enough to adapt with the least development effort to changes in partnerships and devices to take into account. This resulted in the choice of a non SQL database storing JSON objects, instead of a structured database with a less flexible data model.

The variety of devices to take into account required the solution to be able to receive data in various formats given that not all the used devices were implementing interoperability features and standards such as the ones promoted by the Continua Health Alliance [2].

The need to make the collected data available to other platforms, for the clinical study for example, required that the solution exposed data through standardized format.

The variety of applications needing to use the platform required that it exposes APIs so as to allow applications developments independence.

Moreover, the goal was not to develop an event specific solution but one that could be the basis for future larger scale use cases.

Of course, all the solution had to take into account legal requirements related to privacy and personal medical data hosting.

Solution Description

The remote monitoring solution (see global diagram in Figure 1) developed for the mHealth Tour 2015 was organized around Orange's CHC

(Connected Health Center) platform. The upper requirements led to the following architecture choices for this platform:

- Data storage based on a Mongo DB database included in Orange's IoT data collection platform ISS.
- This data storage is complemented by the URM (users and records manager) module which role is to manage :
    - Data records associated to patients;
    - User accounts, among which those dedicated to health professionals who need to consult patients' data;
    - Patient consent for access to their data;
    - Security and authorizations for the whole platform, implemented with oAuth 2.
- Connectors to receive the device data according to the different formats used by gateways (some being interoperable: HL7 (health level 7) V2.6 for example).
- Use of FHIR (fast healthcare interoperability resources) as data format for input in platform core, objects to be stored, and data restitution API. A nomenclature was also defined to simplify the understanding of the measurements.
- Access to data stored in the platform through APIs that provide a clear separation between data collection platform and business applications.
- Detailed access log function to abide to health data hosting regulatory requirements.

On the input side of the platform, the data collection chain was organized according to the medical devices to take into account:

- Weight and body composition: Tapcheck device.
- Blood glucose was collected with 2 devices:
    - Dexcom G4 CGM (Continuous Glucose Meter) which data were displayed in real time to rider on a personal monitor, and transferred daily to CHC platform through a PC based interface.
    - Tapcheck BGM (Blood Glucose Meter) used to calibrate the CGM every few hours.
- Heart rate and RR interval: Polar HR7 device communicating in BLE (Bluetooth Low Energy) with an Orange gateway application on rider's smartphone (HL7 V2.6 output data format).
- Manually entered data: questionnaires implemented in Orange's application on rider's smartphone. For development convenience, the used output data format was the one of partner application Clininfo

that was used online to check questionnaires completion and after the event for the clinical study.

Tapcheck devices communicated through a NFC interface, and a Tapcheck application on rider's smartphone, with a proprietary output data format.

On the application side, several applications used the platform APIs to access to the riders' data:

- Portal for health professionals during the tour, developed by Orange;
- Mobile application for riders during the tour, developed by Orange;
- Partner applications:
  - Medwhat to provide personalized answers to questions from riders (it took into account the last data collected from rider to customize answers).
  - Clininfo is the application that was used for the clinical study after the tour: it copied the full set of collected data, and also had a direct input of data from the riders' insulin pumps.

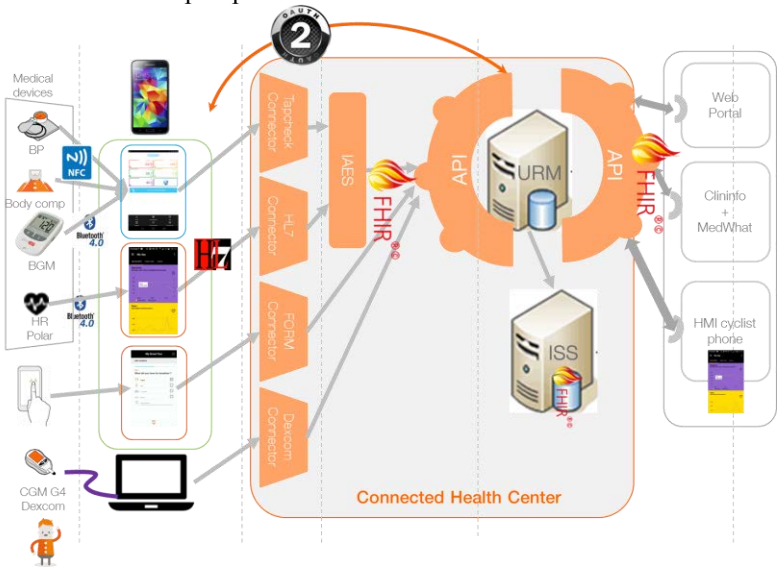

Figure 1: Platform Architecture

Conclusion

Despite a development done under tough time constraints, the Tour has been a technical success. All the data required for the regular follow-up of the riders and the post-tour clinical study have been collected and made available to applications. We also obtained some interesting feedbacks for future developments, for example that FHIR was not the most suited data model to develop powerful applications, due to its treelike organization.

The architectural and technical choices we did made it possible to develop a solution adapted to the specific needs of the event, which also proved flexible enough to adapt to the unavoidable project changes, and paves the way to use it for other pathologies with limited adaptation effort.

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Philippe Genestier (PhD) is working in Orange Labs since 1999 as a project manager. His current field of interest is e-health services, dealing mainly with telemonitoring and interoperability.

Olivier Graille is design engineer at Orange Labs. He has joined the health team in 2009, to follow standards, moreover IHE for medical imaging and Continua for e-health aspects. He is involved in the Continua's Technical Working Group, and has taken part in some plugfests (technical events).

Pascal Limeux is technical architect at Orange Labs. He has designed the technical architecture of a Continua compliant data collection chain and is specifically in charge of the implementing the server and security aspects of Continua guidelines.

Alain Prola is application designer/developer on android platform. He has co-developed Continua connector in e-health data collection chain. Previously he has developed several mobile apps for emerging countries. Prior to that, he has worked 10 years in research in microelectronics.

Complex InspectLife Platform for Imaging Patients with Lymphatic and Dermatology Problems

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Introduction

InspectLife is complex, extensible and still upgrading platform for providing telehealth, telecare and assistive living. InspectLife provides several services including Telemonitoring of glycaemia, Telemonitoring of blood pressure, Telemonitoring of ECG, Assistance surveillance of elderly people, etc.

New services for imaging patients with lymphatic and dermatology problems, teleconsultation and questionnaires were developed and tested.

Description of the Target Group and Challenges

Chronic patients with lymphatic and vein problems require specific treatment. The patients very often have difficulties to walk and to leave their homes but at the same time their condition need regular consultation and care by medical and home care worker. Very important is personal contact between patients and professionals to increase patients´ motivation and compliance. On the other hand the trained provider of direct home care needs to be instructed by the doctor how to manage each individual patient´s situation.

Services Design

InspectLife concept of care, for the above mentioned patients, consists of three services which combine objective and subjective types of information: imaging, questionnaire and teleconsultation. These services make synergy and therefore provide more complete picture about patient in long term scale and also in specific moments.

Imaging

The concept was started in 2014 with the *Imaging service*. With the help of smartphone or tablet and a special application, a nurse is able to capture images during visits at patient´s home, share them instantly with doctor in

hospital through internet and consult in real time. Images and notes are stored in the system which is important for evaluation of treatment in long-term point of view.

During the pilot project one nurse was visiting up to 5 patients at home per day. 9 patients were monitored and 87 photographs were captured, from which 92 % had acceptable or good-quality. The bad quality pictures were mostly not focused. Doctor was alerted by email when a new collection of images was stored at InspectLife system, where he could browse and study captured images in big resolution.

The result of the pilot project was that the doctor confirmed the advantage of regular distant consultation when he could see and compare condition of patient´s legs and remotely prevent possible complication.

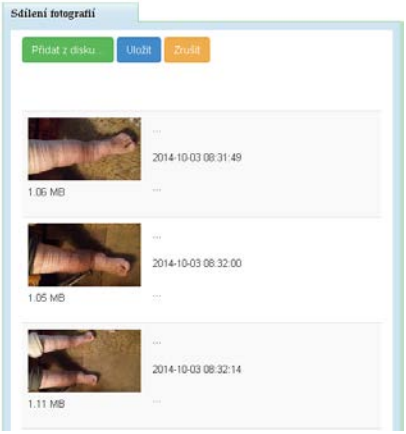

Fig. 1. Images of lymphatic patient´s legs captured by nurse at patient´s home.

Fig. 2. Detailed image of lymphatic patient´s legs captured by nurse.

Questionnaire

Currently the *Questionnaire service* is being tested in clinical practice in cooperation with the Center for Preventive Medicine specialized in lymphatic diseases.

The service helps the doctor to collect subjective information from the patients during one year period. The doctor is able to identify patterns of deterioration of conditions and prepare personalized treatment in advance. The patient is regularly automatically asked by the InspectLife system to answer questions about his or her pain, edema, cramps and inflammation.

The patient indicates how good or bad these aspects are during the previous period of time. Together with nurses in direct care, the questionnaires are designed for selected diagnosis – at this moment for the patients with lymphatic or vascular system problems.

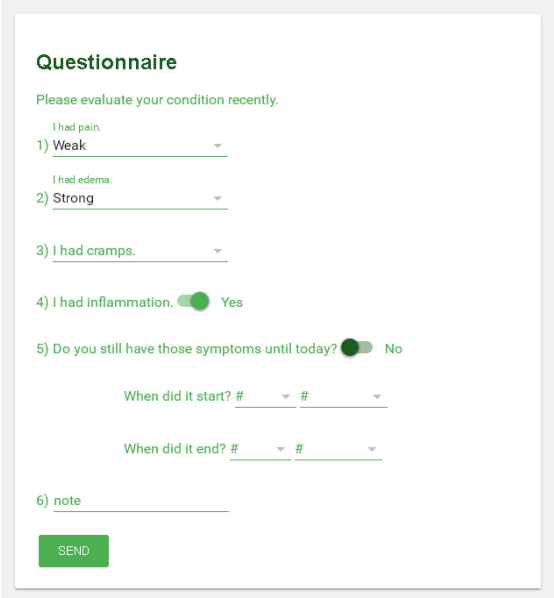

Fig. 3. Sample questionnaire for lymphatic patient.

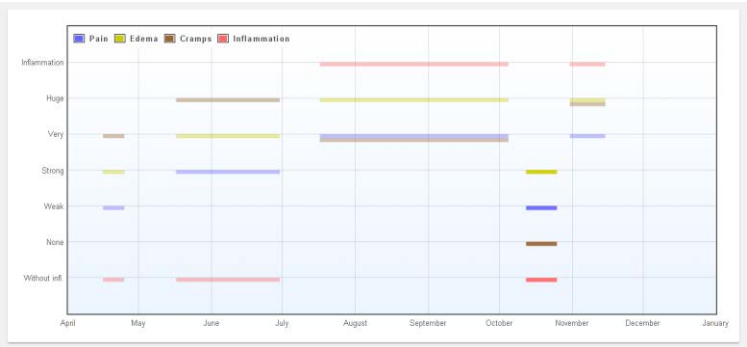

Fig. 4. Sample evaluation of questionnaire for lymphatic patient.

Teleconsultation

Besides the text communication the InspectLife systems actually provide video consultation – easy to use video chat. Doctor consult state of patient´s disease (visual check of skin, wound) and patient´s behavior, nurse can provide distant training of a patient and home care nurse can provide doctor with real time visual information from a distance from patient´s home. Moreover multi-user videoconference is possible – for example general practitioner + patient + specialist for second opinion. The doctor will be able to efficiently plan distant meetings with patients.

Conclusion

Telemedicine is progressive way how to effectively help chronic patients, especially with limited self-sufficiency. Telemedicine solution for chronic patients with lymphatic and vein problems was analyzed, developed and being tested. It consists of three components, namely Imaging, Questionnaire and Teleconsultation. These services are able synergistically to help both the patients at home with limited mobility and their carers.

It was concluded that InspectLife services are useful telemedicine tools focused on patients with lymphatic and dermatology problems.

Acknowledgment

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Jiří Potůček obtained his Ph.D. at the Czech University of Chemical Engineering (thesis: Modelling of Biological Systems on Hybrid Computer) in 1976. He worked as a scientist in the Institute for Clinical and Experimental Medicine, Prague, and was author or co-author of 170 publications in the field of biomedicine and bioengineering. He was research fellow on TU Delft (Holland) and visiting professor on California State University, Chico, USA. He is an external cooperator at Faculty of Electrical Engineering, Czech Technical University, Prague and 3rd Medical Faculty, Charles University, Prague. Now he is working on two projects: MWPharm – software for optimal pharmacotherapy and InspectLife – platform for telemedicine and assistive technologies.

Flexible System Architecture of PHR to Support Sharing Health Data for Chronic Disease Self-Management

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Abstract: **Health data sharing can benefit patients to self-manage the challenging chronic diseases out of hospital. The patient controlled electronic Personal Health Record (PHR), as a tool manages comprehensive health data, is absolutely a good entry point to share health data with multiple parties for mutual benefits in the long-term.**

However, sharing health data from PHR remains challenges. The sharing of health data has to be considered holistically together with the key issues such as privacy, compatibility, evolvement and so on. A PHR system should be flexible to aggregate health data of a patient from various sources to make it comprehensive and up-to-date, should be flexible to share different categories and levels of health data for various utilizations and should be flexible to embed emerging access control mechanisms to ensure privacy and security under different sceneries.

Therefore, the flexibility of system architecture on the integration of existed and future diversifications is crucial for PHR's practical long-term usability. This paper discussed the necessity and some possible solution, based on the reviewed literatures and the experience from a previous study, of flexible PHR system architecture on the mentioned aspects.

Introduction

Chronic diseases have become a main challenge to health sectors around the world. With the widely use of personal smart devices and portable medical equipment, self-management of chronic disease is getting much more desired than it used to be. In the meantime, various emerging health related applications have made the patient self-management feasible.

Personal Health Record (PHR) is a key to the care of patients paradigm shift from reactive to proactive and wellness maintenance [1]. The patient controlled electronic PHR is defined as a set of computer based or web based tools that allow patients to collect and maintain their lifelong health information, and share appropriate parts for collaboration [2].

PHR, which patient is promised the full control of own health records, contains different types of health data gathered from various sources which include a patient's different healthcare providers, pharmacy, self recorded health data, activity, diet, etc. [3]. It makes PHR an efficient method for sharing health data with a wide range of participants, including healthcare providers, family members and third-party organizations, to gain mutual benefits in the long-term [4]. For instances, if chronic disease patients share their health data to third party web based applications for analysis, they can receive useful feedback, suggestions or even decision support to help them to have a clearer understanding of their state of health. So, if patients volunteer to share their dairy health data to other healthcare research institutions or service providers, it will benefit the research of the chronic disease, and give improved and appropriate treatment to patients as well.

However, sharing health data from PHR system remains challenges. The sharing of health data has to be considered holistically together with the key issues such as privacy, compatibility, evolvement and so on. We take the flexibility of architecture as a key characteristic to a PHR system to handle these issues. This paper discussed the necessity of flexibility on data aggregation, sharing and access control.

Data Aggregation

One attribute, which makes PHR worth to a patient and as an efficient way to share data from, is that it is a summary of health and medical history of a patient. However, a big problem here is that the data usually belong to different systems. Though interoperability standards, like HL7, have had a great progress, the adoption hasn't fully covered all the fields, i.e. some systems might adopt Continuity of Care Document (CCD), while some are still using Clinical Document Architecture (CDA).

The health data recorded by off-the-shelf wireless medical devices and wearable devices are becoming an important part of a PHR, and are valuable to exchange among multiple parties. However, almost all this kind of devices are designed by specific providers for their own services, and usually are limited to exchange data only with their own applications [5]. It may make all the data from different devices become data silos. Though it seems unrealistic to let all those providers to give up their own interests to open the ports of data, the PHR systems should at least be capable to integrate with them. If the opening of their data ports can make their devices and applications providing better services, then their willingness will be much higher.

To support the integration of various different data providers, and leave the possibility of integrating future products as well, the system architecture

of a PHR should be flexible enough for the diversity. The interface connects to data providers cannot be predefined. Different data providers probably have different connection protocols, and sometime they are not willing to provide API details of their products for the sake of business or security. Therefore, the PHR system may need to have the feature of integrating connection components from data providers in a dynamic and heterogeneous manner.

Sharing

According to the study in [6], the patients prefer to share the health data on different levels of detail. A patient may share data with hospital, research institution or service provider, and the sharing preferences may differ among the instances. For example, a patient may only want to share diet data and activity to a third party application to calculate the nutrition intake and consumption, other than the data about medical test. In short, patients should be given the right to the fine-grained control of their health data, and most patients prefer the opt-in consent model [7].

As figured out in a previous study [8], a health record can be divided into segments, such as personal information, health status, physiologic measurements, non-physiologic measurements, general health measurements, medication, life style records, family health history, etc. Each segment has different privacy levels and different preferences of sharing receivers. To support this, storing and retrieving different segments of health data separately is an ideal option.

However, not all the shared data receivers expect the same detailed level of health data. If it is to share to a friend, a summarization of a bunch of data will be better than plain data. Only different levels abstract of data is not enough. The purpose of sharing health data with care providers is to make the process of healthcare more efficient. But a bunch of digits and timestamps are not efficient for a physician to look through. It's different to share data to a service application. The health information shared to a human being should be meaningful, or intuitionistic. This requires an extra "translation" layer. This layer should be flexible to adapt to different categories of health data, and also could be disabled when the sharing receiver need to check the original data for validity.

Access Control

To ensure that the sharing has being properly performed, there needs to have appropriate access control mechanisms to avoid unauthorized access. Traditional Role Based Access Control (RBAC) manages the access based on the roles or owner assigned relations to grant access to shared users [9].

It is suitable for sharing health data with clinical professionals and family members on a relatively static and coarse-grained level. Another risk aware task based access control model [10] dynamically controls access based on confidentiality, integrity and availability requirements. In addition, there are scenarios like emergency cases, which require immediate access to patient's health data rather than access privileges set by patient. It therefore asks scenario based access control [11].

There are more access control mechanisms proposed for different scenarios and requirements. A PHR system dedicates for sharing health data among multiple parties should not stick to one mechanism for very limited application scenarios. Therefore, a flexible architecture of PHR system is required to support different access controls for different scenarios.

As mentioned in the last section, separately storing and retrieving different segments patient data logically and physically is an ideal option for fine-grained control. This can make the system more flexible to integrate with current access control mechanisms and easier to adapt to new methods.

Possible Solution and Discussion

Dividing the system architecture into smaller components can make it flexible to different requirements, either vertically or horizontally. Dividing horizontally is considered more compatible with the models of current systems that need to collaborate. As discussed on the 3 big aspects, we suggest dividing a PHR system horizontally based on the health record segments. Micro services as a software application architecture style has become popular over the last few years. Applying Micro services is to develop a single application as a suite of small independently deployable services with lightweight communication mechanisms such as HTTP API and message queues [12]. It is therefore well suited to apply architecture style similar to Micro services to build the horizontally divided PHR system.

Every health record segment can be built an independent or semi-independent web service with its own URLs, database and access control model. There could be a service for personal information, a service for medication data, a service for diet data and so on. Only the personal information service contains data about real identity, other services will just have a unique string to identify a patient. Therefore, the personal information service can be hosted in a highly secure environment without affecting the performance of other services. Besides, each record segment service could use different database techniques since the data schema probably be different. For instance, continuously monitoring data are more suited for using NoSQL database. Beside, it is way simpler to integrate health data source by just deploying a small connecting service into the

micro services architecture. And it is more flexible to share health data by assigning one or more services' access tokens to a human being receiver or an integrated eHealth service. Furthermore, an architecture like this is cloud native, and is able to expand efficiently only with necessary services.

However, a PHR system like this has to put more effort on data representing standards, request routing, atomic operation and consistency of services.

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Gene Analyst – A New Approach to the Gene Expression Patterns Analysis in order to Confirm Disease Diagnoses

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Abstract: **Gene sequencing and gene-of-interest (GOI) identification using primase chain reaction (PCR) principle and quantitative primase chain reaction (QPCR) and some of the more recent techniques are promising methods in identifying various gene-related diseases. The analyses can also be used to predict possible reaction or sensitivity of an organism to exposition to certain diseases. In this paper will be discussed methods and approaches to quantitative GOI analysis in patients with different diseases, like cancer and diabetes.**

Introduction

Expanding availability of genetic databases related to various diseases genomics stimulates development of multivariate statistical models and new analytical methods. In this contribution we show how the computationally intensive methods can extract useful information from large data gained from PCR/qPCR analysis and genetic sequencing from tissue or blood. These analyses can also be used to predict possible reaction or sensitivity of an organism to exposition to certain diseases. In this report we discuss methods and approaches to quantitative GOI analysis in cancer patients. The genome data structure typically suffers from high dimensionality (number of genes, often in thousands) but small number of cases (patients, usually in tens to hundreds). To find a model that describes the response (patient's health) it is inevitable that the dimensionality must be less than the number of cases. One of most used techniques to overcome this problem is dimension reduction with tools such as PCA (Principal Component Analysis). Disadvantage of reducing data dimension in this way is that the PCA-related methods reduce the space without using the crucial response information (the disease). Therefore it is much more informative approach to include the response information directly in the dimension reduction process which is done by regularized regression, classification and other related methods and models.

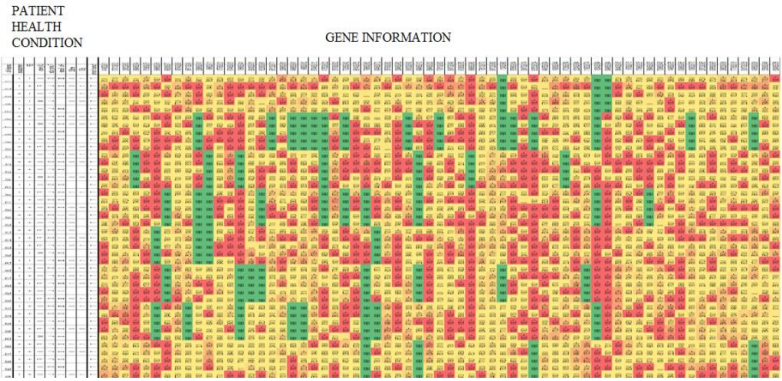


Fig. 1 Typical data structure

Classical statistical and machine learning methods like (PCA, PCR, Hierarchical Clustering, Regression Trees, Linear Discriminant Analysis, Kohonen SOM, Neural Networks, Support Vector Machines, Bayesian methods ...) are rutinely used in Affymetrix, QiaGen, Mayo Research, NIH, National Cancer Institute, Nara Cancer Research and othe institutions and commercial producers of PCR analysers.

The more recent methods have potential to predict more precisely including:

- LASSO Regression (Least Absolute Shrinkage and Selection Operator);
- LAR Regression (Least Angle Regression);
- Stagewise Regression;
- Differential Variable Selection (DVS Regression).

and some non-linear predictive methods based on variates identified by the previously listed methods like:

- Probabilistic Support Vector Machines Classification;
- Neural Network Nonlinear Discrimination;
- Adaptive Regression for Variable Selection.

Gene Expression Analysis

The data used for this study was taken partly from clinical database of the Czech Medical Society and from NCRI Cancer Research Database, Japan. The aim was to use and test the above techniques to identify genes that effectively and significantly contribute or relate to the patient status and/or

prognosis. The following figure illustrates the gene identification procedure using the Differential Variable Selection Regression.

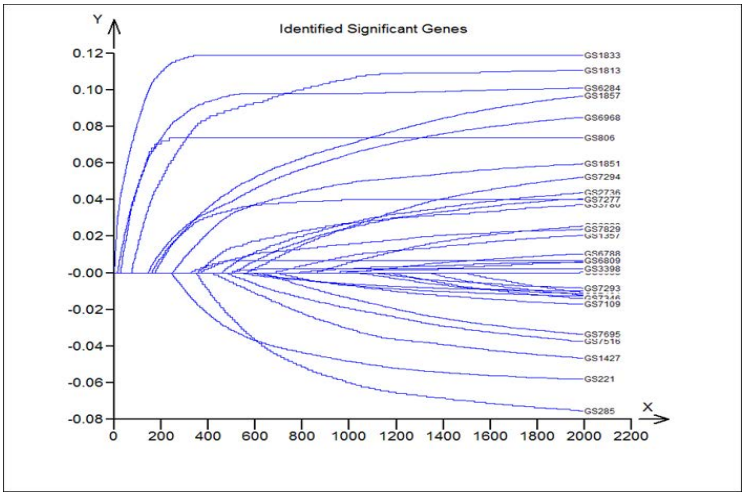
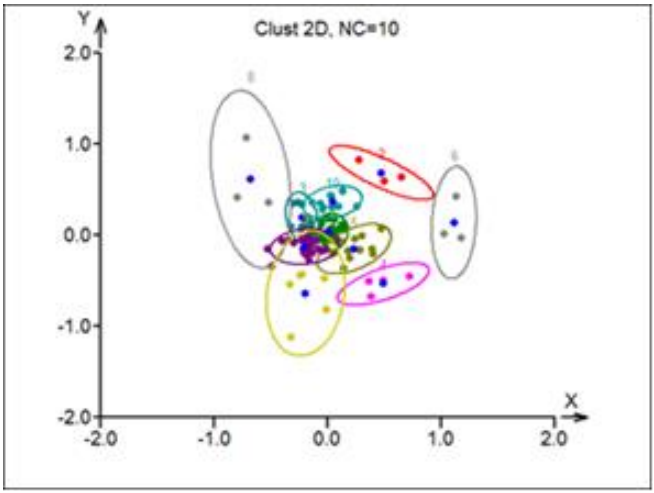


Fig. 2 Data driven EBM – identification of most influential genes related to breast cancer (data: NCRI)

The identified prediction genes can be then used directly in the corresponding regression or classification model. Identification of variables and classification of patients was significantly better by the proposed techniques than with classical approaches, even with further secondary use of non-linear models such as Support Vector Machines (SVM) or feed-forward Artificial Neural Networks (ANN). On Fig. 3 we show resulting classification results for 10 different states/stages in 10 and 12-dimensional space. Fig. 4 illustrates the misclassification rate in Support Vector Machine classification model at a very low level.

Conclusion

The new version of Gene Expression Patterns Analysis was developed under name GeneAnalyst. GeneAnalyst was successfully tested on several hundreds women with breast cancer. In 2016 the other applications for cancer, diabetes and cardiovascular diseases will be tested on additional several thousand patients.



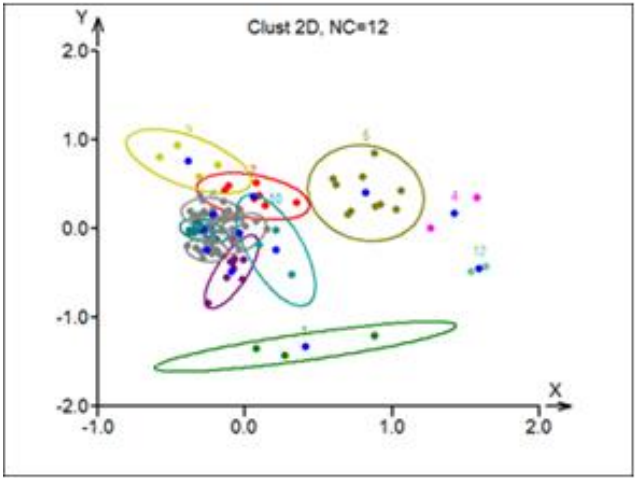


Fig. 3 Typical classification results in 10 or 12-dimensional reduced space with misclassification rate of 6 and <1% respectively, compared to more than 15% by classical approaches.

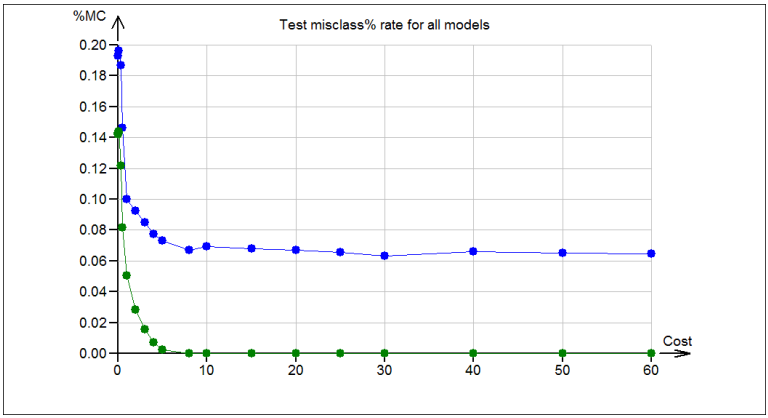


Fig. 4 Miss classification rate plot

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Integrated Telemedical System for Non-invasive Early Diagnostics of Peripheral Perfusion with Therapy Adherence Support

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Abstract: **The objective of this paper is to inform about the results of a new integrative program designed for the early detection of major cardiovascular and cardio-metabolic risk factors both in cities and in rural areas with specific focus on lower limbs perfusion and the corresponding improved chance for the patients to reverse the pathological processes in time. The program consists of both the preventive diagnostics, monitoring and support for therapy adherence of patients in their natural environment. The program also represents a new model of co-operation between healthcare providers of municipal and rural areas, companies operating in telemedicine and funding providers. This program is a result of a joint research and following implementation effected with the support of Vienna Point a.s. – Science and Technology Park and mainly its incubation program focused on telemedicine.**

Longer term sustainability as one of major objective was reached and the basic economic parameters are also discussed.

Introduction

Cardiovascular diseases are the most common cause of death and physical incapacity in many countries, with vascular obstructive stenosis affecting cerebrovascular, coronary and other arterial territories. High cardiovascular risk people, like smokers or those suffering from diabetes mellitus are victims of lower limbs arterial obstructive disease, which courses a long period in absence of both symptoms or clinical evidence. Early stage

diagnosis, obtained through non-invasive strategies has been proposed as a means of diagnosing incipient vascular occlusion.

Since 2012, as a result of public private partnership between a regional hospital in Zdar nad Sazavou (22 000 inhabitants, central Czech Republic, recording one of the highest incidence of diabetes mellitus, diabetic foot and related lower limb amputations), Vienna Point – Science and a private company Advanced Medical Solutions, a preventive telemedical program was prepared, implemented and put into operation with the below defined objectives and results.

Objectives

Generic objectives:

1. To analyze the applicability of a noninvasive diagnostic strategy for the early detection of arterial flow reduction in a rural population;
2. To introduce an integrative telemedicine platform allowing diagnostics, data storage, monitoring of patients in the natural environment and transmission for specialized second opinion;
3. To introduce a system of therapy adherence support;
4. To introduce a long term sustainable preventive program;
5. To promote technical qualification of remote professionals of health sector in the field of new technologies.

Specific objectives:

- Evaluate a population of more than 1 000 adults from the region with specific focus on the following target groups and priorities:
    - Elderly populations;
    - Diabetes mellitus + other major metabolic risk factors;
    - Family medicine.
- Monitor defined perfusion indicators in the natural environment of the patients with the aim to improve the therapy effectiveness thanks to personalization and updated adaptation;
- Prepare and introduce a therapy support system.

This initiative will allow us to:

- Introduce an innovative telemedicine platform allowing data collection, transmission and storage for subsequent analysis and report by specialists and, when needed, specialized second opinion;
- Investigate the applicability of a systematic, well-structured and non-invasive screening to support the early identification of atherosclerosis, peripheral arterial flow reduction and diabetic foot;

- Encourage and promote technical qualification of local health professionals supported remotely by specialists – angiologists, diabetologists, cardiologists, etc. - in the investigated areas enabling an effective screening using these new technologies;
- Introduction of new more efficient therapies and reverse the progression of the specified disease.

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

Methods

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

1. Measurement: Patients were measured by a nurse without the presence of doctor using the Computer aided plethysmography developed by Advanced Medical Solutions. The results of the measurement were sent together with the basic anamnesis to the Telemedical center for evaluation.
2. Evaluation: The evaluation of the data was done by an expert angiologists, who provided also the indication for further procedure and divided the patients into the following groups:
    a. Patients with physiological parameters without detected pathology;
    b. Patients with border values or detected risk factors however without immediate risk;
    c. Patients with pathological values or detected immediate risks requiring acute further procedure.

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

3. Verification with golden standard method - ultrasound:
   All patients with identified alterations and pathologies based on defined measurement were indicated for deeper evaluation based on ultrasound which as a golden standard allowed evaluating the sensitivity and specificity of the methodology.
4. Preparation and introduction of therapy adherence support program.

In September 2012, the system was first installed at the regional health center in Zdar nad Sazavou. After an initial pilot project and training a long term preventive application was started on a sustainable basis. The core focus of the method is to provide an early and non-invasive diagnostics of the peripheral perfusion which allows to evaluate the quality of the arterial, venous and lymphatic function and to detect the level of cardiovascular and metabolic risk factors.

Results

The preventive program was successfully implemented in Zdar nad Sazavou and is currently operated on a sustainable basis with the capacity of 10 patients a day per measurement spot. After the initial setup and training there were diagnosed 1791 patients, 962 women and 829 men. The basic characteristics of the patients are provided below. Based on the anamnesis the patients were divided into the following groups (Table 1):

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

Table 1

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

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

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

Table 2

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

Risk factors detected with the plethysmography diagnosis - evidenced as “abnormal peripheral perfusion indicators, e.g. arterial capacity and altered arterial waves” - were detected in slightly above 79%, and pathological values - above 12%. This relatively high incidence of detected suspicion and pathology is influenced by the group of patients with high presence of diabetes and symptoms. In total, 10 indicators related to the peripheral perfusion and the arterial wave analyses were evaluated. The difference between the normal values and those altered, corresponding to patients with detected risk factors, exceeded 50% in some cases.

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

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

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

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

Based on current results, the program led not only to a substantial decrease of lower limb amputation in the area but also has very positive economic results that led to an overall reduction of costs by more than 25% thanks to reduction of more serious and invasive treatment and introduction of less invasive approaches including therapy support system.

Discussion

Early detection of altered arterial flow indicators will help in the prevention of cardiovascular disease and avoid physical incapacity due to premature limb loss by early introduction of treatment interventions. The patients with altered values of the peripheral perfusion detected during the

program are given a better chance to improve and reverse the corresponding pathological processes. That can be especially valuable when applied to underserved areas of the globe, where specialized vascular evaluation facilities are, for obvious reasons, unavailable. Through the application of a low cost and easy to use computer aided arterial plethysmography method, preclinical vascular disease can be detected thus warning for the need of immediate complementary diagnosis and effective therapy. This is essential especially for the population living in remote areas.

Individual and social benefits are expected to be confirmed through long term evaluation of this strategy, deserving its application in a larger setting of patients. During the application of this program several non-invasive and micro-invasive therapies were also identified which might be used in rural areas, with the aim to assure a comparable level of care to major health centers in these remote regions.

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Co-founder of a Telemedical center with specific focus on early and non-invasive diagnostics of peripheral perfusion for patients with cardio-metabolic risk factors, like diabetes mellitus II

Patient Adherence: What Does It Mean, and Implications for Digital Health Systems

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Abstract: **Definitions of adherence are briefly reviewed. Resulting issues and challenges are noted – especially for multiple components to a patient agreed intervention. Behavioural change interventions are included. Particular challenges are noted with measurement and inferring what constitutes clinical and patient specific effectiveness. The paper goes on to discuss implications for implementation in digital health systems/services.**

Introduction

The measure of how closely patients follow prescribed health interventions is known as adherence [1, 2]. It is an important issue across much of healthcare [2] because failure to adhere implies patients' health and wellbeing may not be improved as much as it could be.

Digital health technologies: can operate automatically in the background without a patient knowing or doing anything most of the time, e.g. in an implanted drug delivery system – potentially delivering a very high intervention 'adherence'; can objectively measure health status or observe patients' following the intervention; can ask for subjective reporting from patients; and, can act as a behaviour change agent by persuading the patient to follow the intervention. With the desire for effective interventions comes the need to understand what are appropriate measures and levels of adherence – and in creating integrated digital health technology to be able to programme these in to present meaningful information to the user.

Definitions of Adherence

Historically the common understanding of adherence has implied that the healthcare worker tells the patient what they need to do and they follow those instructions with greater or lesser success for whatever reason [3] (referred to hereafter as 'Dictated intervention'). More recently a new definition has begun to be recognised. Namely, that while the healthcare worker still presents the 'best' intervention, they discuss it with the patient and arrive at a mutually agreed version (referred to hereafter as 'Agreed intervention') [4]. In an Agreed intervention it may be more likely that over

time there could be changes to it because it is dependent on the agreement of the individual patient. Thus Agreed interventions are more likely to vary over time. Note, throughout 'intervention' on its own is the collective more general term.

Within both of the above definitions, but not made explicit above, is that the intervention could have single or multiple components. In the situation of multiple components then each component could have an associated adherence level [4].

Issues Raised by the Definitions

While net adherence is often reflected in proportionate outcomes for a patient, there are many issues that the above definitions present, e.g.:

- They do not discriminate between causes of non-adherence, e.g. between events that change patients' capacities to adhere, negative wilful behaviour, inappropriate choice of intervention etc;
- Increasingly there is recognition of the benefit of personalising healthcare, which goes beyond patient choice and current routine practice. For example, there can be genetic factors that influence appropriate choice of intervention;
- How to account for time varying Agreed interventions;
- How valid/useful are intra-, inter- & aggregated subject adherence values?

Multiple component interventions raise more issues:

- Patients will tend to pragmatically choose the intervention components that suit their motivation and life style;
- How to appropriately measure each component;
- Knowing what are clinically significant and therefore desirable adherence targets for each component;
- Knowing how component adherence rates might be combined into an overall rating to relate them with goals/outcomes.

It may be worth noting that behaviour change is almost always present for patients. No matter how straightforward an intervention may be, if it is novel to the patient, then they make changes to their routine when adhering.

Illustrative Example of mHealth-facilitated Behaviour Change

In an as yet unpublished feasibility study the authors have been examining adherence as part of their research around multi-component interventions for weight loss and/or blood glucose reduction in Obesity and Type II Diabetes Mellitus. The components included mHealth, physical activity and dieting – with free choice of weight loss goal and diet [5].

While the definitions implied or stated in much of the relevant literature conform to the Dictated or Agreed intervention based adherence definitions above, trial reports vary in their pragmatic choice of measures – that are single component in some cases and multi-component in others. Some acknowledge their difficulty in addressing the issues raised above. In most cases it is evident that a simple measure/observation was chosen for inferring adherence; in reports from trials of mHealth technologies adherence was not discussed in much detail.

Examples of varying measures of adherence include:

- The number of days that energy between > 500 and <5000 kcal was recorded [6].
- "The proportion of weeks when participants recorded at least 50% of the daily calorie goal or any physical activity minutes, respectively" [7].
- In self-monitoring diet the participant was identified as adherent to self-monitoring for that week if weekly record indicated that a participant consumed more than 50% of the weekly calorie goal [8]. While for self-monitoring physical activity, it was "the number of entries reporting physical activity per week" [8].
- Physical activity self-monitoring adherence was calculated as the number of days the accelerometer was worn for more than 8 hours, divided by the total number of days while adequate dietary self-monitoring adherence was recorded if the individual had over 1000 calories per day [9].

Some common features are nonetheless present in the above. The important role of adherence to using the technology and/or the act of self-monitoring itself [7, 9, 10] is not always made clear. There is a consistent sense of trying to count only those days or weeks as adherent where a medically judged sufficient behaviour change was observed. It is also possible that the distinction between Agreed and Dictated interventions has become blurred, as participants may have some choice in some components and not in others. There may also be a difference between adherence as reported to an individual as part of their behaviour change success and that needed to judge adherence across and between trials.

Discussion: Adherence Implementation in Digital Health Services

In this discussion an assumption is made that monitoring of adherence (and outcomes) is part of a well-designed health service. It is important to consider who the user of the adherence information is. For an individual patient and their healthcare worker it is important to consider how well the patient is doing in following the agreed intervention over time. For

evidencing the benefit of a particular intervention trialists and service commissioning groups would need to know what constitutes clinically significant levels of adherence. Commissioning groups and those interested in determining the 'best' intervention for a particular disease/health status also need to be able to compare adherence outcomes across interventions and/or services. In this light the concept of an outcome parameter of an overarching adherence measure would be desirable. This could be based on comparison to clinical ideal targets within specific health status contexts, although aggregation across disease and services would have to be carefully considered.

With such ideal adherence definitions and measures, commissioners and others wishing to compare disease specific interventions should consider adherence as part of general effectiveness (including cost effectiveness in implementation). This could include a health worker and the patient when considering which intervention to follow. Once an intervention is selected, the behavioural change feedback could be in terms of adherence to the patient's Agreed intervention. However, in multi-component interventions a good understanding of how to infer and convey the most medically useful feedback across the components about adherence to the patient and their health worker is needed.

For most health conditions it is possible to identify a set of observations and data that can be collected to estimate adherence, so one set of tasks (in some cases challenges) is around how to use those data to generate meaningful adherence monitoring. Meanwhile it also needs to be remembered that in teleservices and even self-monitoring any calculated adherence is only going to be as good as the data recorded - and accuracy is likely to be greater in objective rather than subjective reporting.

Conclusion

The paper highlights many issues in adherence that remain challenges, especially in the context of relatively complex multi-component interventions with significant subjective self-monitoring. These are particularly relevant in behaviour change. Further study of adherence and the interplay with effectiveness of components or alternative interventions are needed. At least in the case of obesity and diabetes related behaviour change interventions, indications of adherence can be presented that are, within the individual trial context, useful. Broadening to a consistent definition and measure would be very helpful.

Acknowledgement

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The Road to Smarter Data: INTEGR8 Study Embeds Wearables in Digital Health Data Workflow

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Introduction

Life science companies are continuously looking for ways to improve clinical research to achieve faster time to market and reduce costs related to development and research.

Nowadays, advancements in computing power and predictive analytics tools enable the processing of vast amounts of information. The role of technology is to bring together disparate data sources so the industry can share data and use advanced analytics to make better decisions - all with the goal of getting more effective drugs and devices on the market even faster.

Big data analytics and new clinical technology - such as mobile health solutions and wearable devices - promise to significantly change how trials are conducted and to increase the value of data and insights that come out of these trials. Wearables, accessories incorporating computer and advanced electronic technology, are being developed and produced at an incredible rate, and become more efficient with every iteration.

BI Intelligence, an American business and technology news website, estimates that the global wearables market will grow at a compound annual rate of 35% over the next five years [1]. By 2018, this market will be worth some 12.6 billion U.S. dollars, approximately 5.5 billion more than in 2015, according to Statista [2].

Promising First Results for Digital Health

Several sponsors have already been integrating data coming from wearable devices or smartphones, and now Contract Research Organizations (CRO) are also showing interest, and looking into ways to ensure that data can be read and analyzed in Electronic Data Capture (EDC) systems.

With this in mind, genae, a global medical device CRO, launched its first study in summer 2015. The INTEGR8 study focused on core features, validating the integration of a wearable device (Microsoft Band, Microsoft) and an EDC system (edc2go, genae).

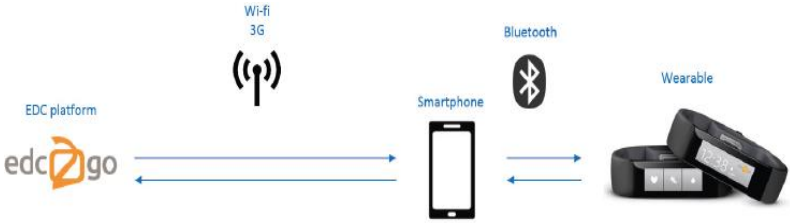

Fig. 1 Integration workflow

The INTEGR8 program combined daily Quality of Life (QOL) related questions sent from edc2go and answers transmitted to a smartphone (Bluetooth) and encrypted (3G/WIFI) to the edc2go from 19 subjects across 4 countries, and followed up for 1 month.

The study emphasized the true possibility of storing and processing real-time data from patient to data collection workflows. Not only did the study design demonstrate a two-way communication between the wearable and the EDC, but it achieved a next level of intelligence by correlating data entries.

Throughout the study, smart questions were triggered when subjects provided specific answers for three consecutive days. Furthermore, results show that subject compliance (i.e. number of answers that were captured in the database per subject) was close to 100% in the first week of the study, but eventually dropped to approximately 55% towards the end (cfr. Fig. 2.)

Capturing this real-time information allows more adequate and swift decision-making during the course of a study. As such, a sponsor can control the direction the study takes at any time, influence subject compliance, and provide tools to the physician to take better decisions for patients' well-being.

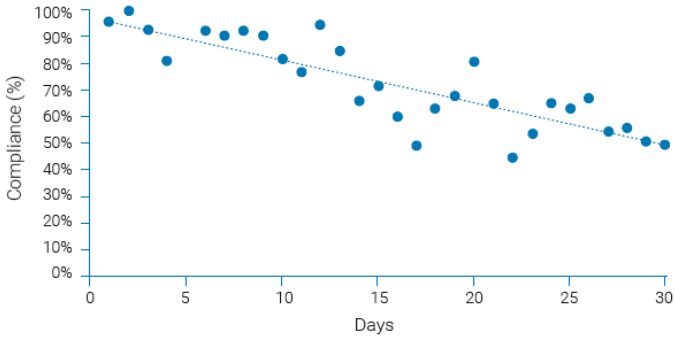

Fig. 2 Subject compliance (i.e. number of answers that were captured in the database)

A good example of this wearable technology in practice is the well-established six-minute walk test, which has been used for years in clinical trials involving cardiovascular, respiratory, and central nervous system diseases. Until now, patients were obliged to attend a hospital visit and start a six-minute snapshot of their walking ability.

In the future, patients can wear a device that continuously measures their activity and provides a complete, accurate picture of movement without going to the doctor's office, which may be difficult for some patients.

Adjustments Will Improve Data Quality

Wearable technology, such as smartwatches, is still in its early phase, and for it to be an overall success, sponsors must be able to rely on it and safeguard the privacy and rights of patients. This integration can only work if the technology does not put any extra burden on patients.

For instance, the battery life of the wearable is a key element as the patient may be required to recharge the device. Over time if this becomes onerous, it may negatively influence the use. The same holds true if the device does not fit comfortably, feels clumsy, or is difficult to use. A wearable will only generate useful data when it is worn.

The device needs to fit and be user-friendly. Moreover, the transmission mode should be absolutely reliable. The patient should not be concerned about the data transferred. And from a sponsor perspective, it should be obvious that data reaches the database.

genae has already initiated two follow-up studies to optimize data collection workflows and to expand data collection with tracked quantifiable and objective metrics such as the wearer's heart rate and steps walked. These studies will be rolled out in 2016 and genae aims at commercializing this novel technology in the next 12 to 24 months.

A Promising Path to Monitoring Health Remotely

Traditionally, patients' health and well-being are monitored in the hospital. The life science sector is more and more able to connect to data that was not accessible before. The technology demonstrated in this study is an important step towards simplifying the clinical study and routine follow-up workflow, enabling a real-time assessment of patients' safety and reducing costs by limiting the number of follow-up visits. Involving patients on a daily basis will ultimately increase their engagement during clinical trials and provide bigger and smarter data. This wearable technology may truly enable remote monitoring and ultimately improve patient outcomes.

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eHealth Economics

Applicability and Economic Assessment of Teleophthalmology Screening for Diabetic Retinopathy in Southeastern Brazil

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Abstract: **Early diagnosis and prompt therapy of diabetic retinopathy (DR) are essential to prevent visual loss, but access of the diabetic population to regular fundus examination by an ophthalmologist remains a challenge.**

This prospective comparative study including two referral health centers in MG assesses applicability and economic viability of fundus photography-based teleophthalmology screening for DR in the state of Minas Gerais (MG), Southeastern Brazil. 1488 eyes of 744 patients were examined at both health centers. Mean age was 61 years, with 451 (60.6%) females. Quality of fundus photographs was acceptable for 1007 eyes (67.7%). Presence of DR was disclosed in 513 eyes (34.5%) of 331 patients (44.5%), with 45 eyes (3.7%) of 30 patients (4.1%) having evidence of advanced disease (severe nonproliferative or proliferative DR). For the situation studied, teleophthalmology is viable and cost-effective, under the perspective of the public health service, compared to ordinary ophthalmology examination. In addition, teleophthalmology allowed resolution of repressed demand for fundus examination of diabetic patients locally at the two sites, with early DR diagnoses and referrals. Fundus photography-based teleophthalmology was a viable, effective and significantly cheaper strategy for the screening of DR.

Introduction

Prevalence of diabetes mellitus (DM) has been increasing globally [1], reaching up to 8% of the Brazilian population between 40 and 69 years old and 20% of those over 70 [2]. Diabetic retinopathy (DR) is a major microvascular complication of DM, being disclosed in 50% of diabetic individuals during their lifetime and representing a leading cause of irreversible blindness in the Western world [3].

Early diagnosis and prompt therapy of DR are essential to prevent visual loss [4, 5]. Indeed, yearly fundus examination for screening of DR has been consensually recommended [6, 7]. However access of the diabetic population to regular fundus examination by an ophthalmologist remains a challenge. In this context, teleophthalmology may be an interesting and cost-effective alternative for screening of DR, using fundus photographs that are remotely read by specialists [8, 9].

This study aims to assess applicability and economic viability of fundus photography-based teleophthalmology screening for DR in the state Minas Gerais (MG), comparing its cost with that of an ordinary ophthalmology visit to an available reference clinic/hospital.

Methods

Study design

This is an Institutional Review Board approved prospective comparative investigation including two referral health centers from different cities in MG (Viçosa and Santo Antônio do Monte) with repressed demand for DR screening in diabetic patients. Because of lack of professionals for fundus examination locally, patients had to be taken to a remote referral city. For the purpose of the study, the following situations were compared:

Situation 1. Ordinary DR screening performed by an ophthalmologist (fundus examination) at the remote referral city.

Situation 2. Teleophthalmology DR screening using fundus photography at each health center, with images being transmitted online to our university hospital-based telehealth center for subsequent remote analysis/report by trained ophthalmologists.

Implementation of teleophthalmology service

Teleophthalmology service was based on the telehealth infrastructure at our university hospital, part of the Teleassistance Network of Minas Gerais (TNMG) [10].

After software development/customization/testing, a team of health technicians was trained in each health center, so as to operate the fundus camera and to use software for image capture and transmission.

Two ophthalmologists were responsible for the reports, which were immediately sent to the respective health center.

Economic analysis

Referral costs can be classified in fixed costs and variable costs. Fixed costs do not depend on the number of patients transported, such as staffing cost. Costs, such as fuel for vehicles transporting patients, are classified as variable because depend on the number of patients transported.

Since the aim of the study is to compare costs for the two situations and not their absolute value, it is not necessary to know the value of fixed costs, as will be demonstrated below. Mathematically, the cost difference between the two situations can be expressed as

$$\Delta \text{ Cost} = [C_f^1 + C_v^1 \text{ x } n_p] - [C_f^2 + C_v^2 \text{ x } n_p] \qquad (1)$$

where Cf1 = fixed cost for Situation 1 (US$/month), Cv1 = variable cost for Situation 2 (US$/patient), np = number of patient per month, Cf2 = fixed cost for Situation 2 (US$/month) and Cv2 = variable cost for Situation 2 (US$/patient).

Since the fixed costs are the same for the two situations, the cost difference per patient (US$/patient) can be calculated as

$$\Delta \text{ Cost/Patient} = \Delta \text{ Cost/ } n_p = C_v^1 - C_v^2 \qquad (2)$$

Another reason for not considering fixed costs is that Situation 2 will not completely eliminate patient referral (there will be always emergency referrals) and consequently costs like staffing salaries will be kept.

To calculate cost difference expressed in equation (2), the nine municipalities participating of the project were visited during the period of January to March 2015. During these visits the following data were collected to calculate variable costs: number of patient transported per vehicle, cost and consumption of fuel, cost and consumption of tires, cost and frequency of vehicle maintenance, total monthly distance travelled and travel expenses for drivers and patients.

From this information it was possible to calculate the following parameters: (i) cost with fuel, expressed in US$/km; (ii) cost with maintenance, US$/km; (iii) cost with tires, US$/km and (iv) travel expenses, US$/patient. Information regarding the referral distances was obtained through Google Maps considering the route used by each municipality to refer the diabetic patients.

A prior study on referral costs in municipalities participating of the TNMG showed that costs related to transportation vehicles and travel money represent about 86% of referral variable cost [11]. Considering this estimate, the above parameters and referral distance, it was possible to calculate the variable cost for Situation 1. The variable cost for Situation 2 (transportation cost per patient) was directly obtained from the Intermunicipal Health Consortium administration, responsible for patient transportation to the health center where fundus photographs were taken.

The Break Even Point (BEP) is defined as the number of patients examined in Situation 2 for which the savings (Δ Cost) are equivalent to the total cost to perform the exam. Mathematically

$$n_p^{BEP} (C_v^1 - C_v^2) = C_f^R + C_v^R . n_p^{BEP} \quad (3)$$

where n_p^{BEP} is the number of patients at the BEP, C_f^R and C_v^R are the fixed and variable costs to perform the fundus photographs. From equation (3), the number of patients at the BEP can be calculated as

$$n_p^{BEP} = C_f^R / (C_v^1 - C_v^2 - C_v^R) \quad (4)$$

The number of patients at the BEP represents the minimum number of patients to make fundus photographs (Situation 2) cost effective. This number was then compared to repressed demand of exams.

Results

Implementation of teleophthalmology service was uneventful at both sites, taking 3-4 weeks from the first technical visit to the first fundus photography report and rapidly resolving the local repressed demand for DR screening.

Overall, 1488 eyes of 744 patients underwent fundus photography at both health centers during the study period. Mean age was 61 years, with 451 (60.6%) females. Quality of fundus photographs was acceptable for 1338 eyes (89.9%) of 678 patients (91.1%). Presence of DR was disclosed in 513 eyes (34.5%) of 331 patients (48.3%), with 45 eyes (4.0%) of 30 patients (4.3%) having evidence of advanced disease (severe nonproliferative or proliferative DR) – Table I.

Table I. Preliminary results of fundus photography-based diabetic retinopathy screening, Viçosa and Santo Antônio do Monte, Brazil

Results of teleophthalmology	**No. of eyes (%)**	**No. of patients (%)**
Assessment of image quality		
Acceptable	*1007 (67.7%)*	*512 (68.8%)*
Limited	*331 (22.2%)*	*166 (22.3%)*
Insufficient	*150 (10.1%)*	*66 (8.9%)*
Absence of diabetic retinopathy	910 (61.2%)	489 (65.7%)
Presence of diabetic retinopathy (any stage)	513 (34.5%)	331 (44.5%)
Mild nonproliferative stage	*221 (14.9%)*	*124 (16.7%)*
Moderate nonproliferative stage	*158 (10.6%)*	*105 (14.1%)*
Severe nonproliferative stage	*23 (2.5%)*	*16 (2.2%)*
Proliferative stage	*22 (1.5%)*	*14 (1.9%)*
Not classified (including post-treatment)	*221 (6.0%)*	*55 (7.4%)*
Total	1488 (100.0%)	744 (100.0%)

Peliminary economic results presented here are for the health center of Viçosa. Data for Santo Antônio do Monte are still being collected. Referral distances and number of diabetic patients for municipalities around Viçosa are shown on Table II.

Table II. Referral distances for Situations 1 and 2 and number of diabetic patients in each municipality

Municipality	Number of diabetic patients	Situation 1		Situation 2	
		Local of reference	Distance (km) (1)	Local of reference	Distance (km) (1)
Araponga	326	B. Horizonte	276	Viçosa	51
Cajuri	150	B. Horizonte	243	Viçosa	14
Canaã	185	B. Horizonte	269	Viçosa	38
Paula Candido	384	B. Horizonte	229	Viçosa	25
Pedra do Anta	135	B. Horizonte	258	Viçosa	36
Porto Firme	332	B. Horizonte	199	Viçosa	30
S.Miguel Anta	270	Juiz de Fora	190	Viçosa	24
Teixeiras	410	B. Horizonte	218	Viçosa	14
Viçosa	1362	B. Horizonte	228	Viçosa	0
Total patients	**3554**	**Aver. dist.(2)**	**230**		**18**

(1) Including internal distances in the local of reference. Source: Google Maps. (2) Weighed by umber of diabetic patient

Based on referral distances, information cost collected during the visits and considering that these costs represents 86% of total variable referral cost for Situation 1, it was possible to calculate the variable referral cost for each municipality. The average referral cost for Situation 1 was 30.48 US$/patient and for Situation 2 was 1.72 US$/patient.

To calculate the cost to perform fundus photography the following data were considered: investment (equipment): US$ 58,000.00, salaries and benefits: US$ 1,500.00 per month, maintenance: 5% per year of investment value, equipment depreciation: 20% per year of investment value.

These values resulted in a fixed cost of 2,700 US$/month (salaries, maintenance and depreciation). The variable cost to perform the exam was 4.62 US$/exam (exam report and infrastructure costs). Using these values and the cost difference, it was possible to calculate the BEP as 112 exams/month or 1344 exams/year.

Conclusion

In this particular situation, with a demand of 3554 exams/year, teleophthalmology is a viable and cost effective alternative under the public health service perspective. In addition, it allowed rapid resolution of

repressed demand for fundus examination of diabetic patients locally, with early DR diagnoses and referrals, and possible impact on cost of treatment.

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Economical Evaluation of Eclair'Age Geriatric Hot Line

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Abstract: **Population ageing and medical desertification raise economic concerns regarding elderly healthcare. As a solution, e-Health and telemedicine in particular are explored to support elderly suffering from chronic diseases and/or multipathology. But before promoting ICT implementation and expansion throughout the health care system, it is important to assess their economic viability and feasibility.**

The aim of this short paper is to evaluate the tele-expertise service named Eclair'Age before its deployment. It is the first geriatric hot line for elderly impaired residents living in nursing homes (called EHPADs). For this purpose, an *in situ* and *in vivo* non-randomized trial has been carried out in 5 EHPADs situated in Essonne department, Ile de France region, for one year (August 2014 - August 2015). To develop a more comprehensive method of evaluation, we mobilize a detailed impact analysis approach, adding contextual factors and a social dimension (accessibility and acceptability) to the analysis of stakeholders' involvement (based on a preliminary functional analysis of the system studied). The preliminary results of the detailed impact analysis show that the new tele expertise service is accepted and accessible from the EHPADs nurses' point of view. Furthermore, the performance of Eclair'Age's interventions is considered fully relevant by medical experts.

The Eclair'Age Tele-expertise Concept

The deployment of telemedicine projects offers a technical and organizational solution to overcome several barriers: demographic aging related to the increasing number of patients suffering from chronical diseases and multipathology, medical desertification, uneven distribution of health care services and forced budgetary cuts. The tele-expertise service Eclair'Age is a geriatric hot line for EHPADs' residents during weekdays. In case of an alarming situation, the nurse contacts EHPAD's coordinator physician or the resident's attending physician. If available, the case is treated. If not, the nurse calls the emergency service or Eclair'Age. Two main advantages are noticed with Eclair'Age geriatric hotline (see fig 1).

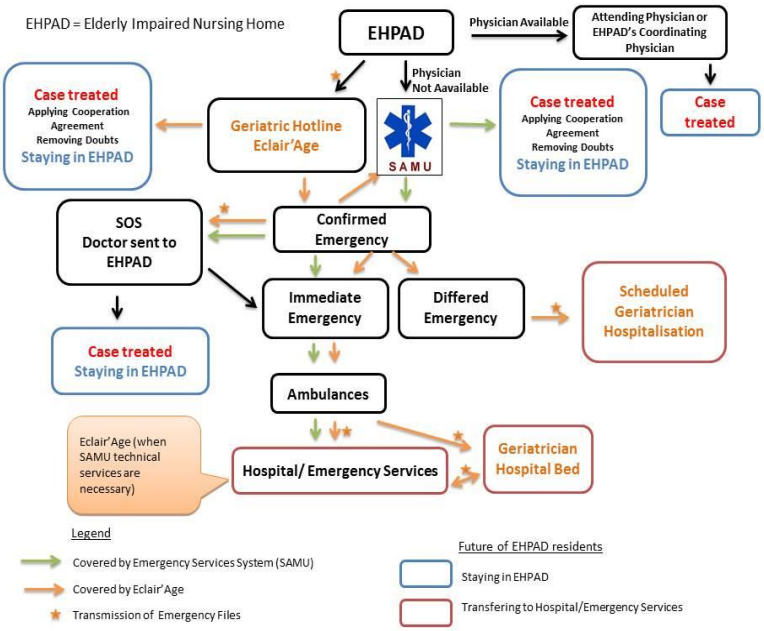

Fig. 1. Flow Chart of Eclair'Age

Firstly, based on the immediate transmission of Eclair'Age Emergency Files (containing the complete medical record of all residents), the on-call geriatrician is able to make personalized medical decisions to treat the case, avoiding transfers to the hospital or Emergency Services System (SAMU) to the largest extent possible. In the case of confirmed emergency, Eclair'Age can initiate an intervention of SOS Doctor (private emergency service), so a physician is sent to the caller EHPAD. Hence, the case is treated without transferring the resident. Secondly, when transfers are unavoidable, the pre-diagnosis performed by Eclair'Age's geriatrician and the transmission of resident's emergency file may shorten the waiting time at the reception desk of hospitals or Emergency services. In the case of differed emergency, the on-call geriatrician can schedule a hospitalization and help find a hospital bed in geriatrics saving time and improving resident's reassurance.

Methods

To assess the feasibility and viability of Eclair'Age, an *in situ* and *in vivo* non randomized trial in 5 French EHPADs situated in the south of Essonne

department (Ile de France region) for one year (August 2014- August 2015) has been conducted. We used a detailed impact analysis approach adding contextual factors [1] and a social dimension (acceptability and accessibility) to the analysis of stakeholder's involvement (based on a preliminary functional analysis of the system) [2]. Anonymized data collection was performed over the one year period before (T_0) and during Eclair'Age experiment (T_1) from: 5 EHPAD's annual reports, SAMU of Essonne data base, and Eclair'Age dashboard of geriatric calls. We also relied on typical sources of data for qualitative research: semi-structured interviews, questionnaires, participation in working groups and relevant medical staff meetings and Eclair'Age consortium documents.

Results and Discussion

The preliminary results of the detailed impact analysis show that EHPADs' nurses find Eclair'Age 'essential, adapted and reassuring'. Emergency first aid and geriatric training (especially for dementia and Alzheimer) provided by Eclair'Age contributes to nurses' skill improvement. So, the acceptability and accessibility of the new tele expertise service is essential to successfully implement Eclair'Age and ensure greater sustainability at the regional level. The efficiency equivalence proof (Eclair'Age versus standard use case) is provided. The performance of Eclair'Age' interventions are considered fully relevant by medical experts at EHPADs, SAMU monthly meetings. In addition, by integrating contextual factors into our analysis, we shed light on the use of Eclair'Age geriatric hot line. We classify the 5 experimental EHPADs according to their specific features: EHPAD's status and capacity; residents' average age, AGGIR scale and PMP. We also analyze residents' age bracket of the most frequently calls. EHPADs where residents are old and dependent, but with known pathologies and treatments, are less reliant on emergency services and Eclair'Age. EHPADs where residents are sufficiently independent and know their pathology and treatments are slightly more reliant on emergency services and Eclair'Age. Finally, EHPAD where residents are less old and less independent, with pathologies and treatments not well-defined yet, are the most reliant on emergency services and often call Eclair'Age. For an efficient deployment on a larger scale of Eclair'Age, we recommend to focus on this last type, more likely to use this new tele expertise service.

Conclusion

From this research we can conclude that including contextual factors can provide some insights on the successful adoption of the tele expertise

service Eclair'Age in EHPAD and some further recommendations for its implementation on a larger scale.

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Evaluating the Economical Impact of Telehealth as a Routine Activity

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Abstract: **The Brazilian Constitution determines that everyone has the right to public health care and the municipalities are responsible for. However, in many situations, specialized health care is not available in small municipalities and the patient has to be referred. Referral costs for small and poor municipalities may represent up to 30% of its health budget. The Telehealth Network of Minas Gerais (TNMG) provides teleconsultation and telediagnosis services for around 1 000 sites in the public health system having performed more than 2,5 million activities since 2006. Economical studies previously developed since 2008 showed that the telehealth service promotes substantial savings for the municipalities reducing the number of referrals but also revealed, in the municipal administration, a complex cost structure making difficult routine evaluations. As consequence, a simplified model was developed in order to allow each municipal manager to evaluate the savings resulting from the use of the system based on 10 parameters collected from his accounting system. It is an additional motivation to increase utilization of the services. Educational material and an online saving calculator is available as support tools in the TNMG website to promote a telehealth economical culture between municipal managers.**

Introduction

The Brazilian Health System (SUS) was created in 1988 by the Brazilian Federal Constitution to guarantee integral, universal and gratuitous access to health care for more than 180 millions of Brazilians. It covers from a simple ambulatory care to organ transplantation. The initial access to health care is made through the Primary Care Services (Health Centers, Health Stations, Family Health Units or Basic Health Units), all under responsibility of the municipalities, financially supported by state and federal governments. When the municipality does not have a specific health care, there is a pact

with surrounding municipalities to provide the service. In such cases, the patient's municipality is also responsible for his transportation. Referral costs, particularly for small villages, can represent up to 30% of municipal health budget.

The Telehealth Network of Minas Gerais (TNMG) provides teleconsultation and telediagnosis services for around 1 000 sites mainly in the Primary Health Care level, having performed more than 2,5 million telehealth activities since 2006 [1]. After each activity, the user is asked by the system if the referral has been avoided. About 80% of activities avoided patient referral with significant impact on municipal budget. In fact, the avoided referral savings have been used as an important argument to increase adherence to the telehealth system and to justify the investment by the government. However, internal studies developed by TNMG [2] about referral cost in these municipalities have demonstrated that its evaluation as a routine is very complex, mainly due to deficiencies in cost control by municipal managers. To take full advantage of this important argument it is necessary to develop a simple way to evaluate the economic impact of telehealth in these municipalities.

Referral Costs

Referral costs can be divided in two categories: variable cost, when it depends on the number of referrals, and fixed cost. Fixed costs, such as staffing salaries, do not depend on number of referrals and consequently are not affected by telehealth. Besides, even a very efficient telehealth system is not able to completely reduce referrals because always there will be emergencies. To eliminate the necessity to know referral fixed costs is an important conclusion because its evaluation is not an easy task.

The types of referral variable costs found during the study developed by TNMG in 66 municipalities were:

1. Travel Expenses For Drivers, Nurses And Patients;
2. Combustible, Lubricants, Tires And Maintenance For Vehicles Used To Transport Patients;
3. Consultations/Exams;
4. Telephone;
5. Vehicle Rental.

One of the difficulties found to evaluate some of these costs was that there is not a clear separation of the expenses directly related to patient referral. However, it was observed that on average costs types 1 and 2 (those more related to referrals) are responsible for 86% of total variable cost.

Travel expenses for drivers, nurses and patients, expressed in $/month, are easy to evaluate because there are specific daily values for each one ($/day) and the number of days expended with travels during the month (days/month) is known. Cost type 2 requires somewhat more elaboration. For instance, dividing combustible price ($/liter) by vehicle consumption (km/liter) it is possible to calculate the combustible cost per km ($/km). The same can be done for lubricants and tires. For maintenance costs it is also possible to be expressed in $/km dividing the cost of each maintenance ($/maintenance) by the frequency (km/maintenance). Adding all these cost per km and multiplying it by total monthly distance travelled for referrals we have monthly expenses ($/month) relative to combustible, lubricants, tires and maintenance. Finally, adding to them travel expenses ($/month) and dividing by the number of patients referred in the month, we have these costs by patient. Considering that these costs represent 86% of total variable cost it is necessary to divide this number by 0.86. Although this is not a precise calculation, it is relatively easy for the municipal manager to have a rough evaluation of the monthly saving resulting from the use of telehealth.

A Rough Evaluation of Telehealth Saving

Using the described methodology above, the savings resulting from the use of the telehealth system in a small typical city in the system were evaluated. Table I shows the calculation (in *italic letters*) made from basic information (in **bold letters**) collected in the administration sector of the city:

Table I. Example of referral variable cost calculation

Combustible price ($/liter)	**1,16**
Combustible consumption (km/liter)	**7,00**
Combustible cost ($/km)	*1,16/7,00 = 0,166*
Lubricant price ($/liter)	**11,54**
Lubricant consumption (km/liter)	**10.000**
Lubricant cost ($/km)	*11,54/10.000= 0,001*
Tire price ($/tire)	**200,00**
Tire life (km/tire)	**20.000**
Tire cost ($/km)	*200,00/20.000=0,010*
Total ($/km)	*0,177*
Travel distance (km/month)	**4.840**
Vehicle cost ($/month)	*0,177*4.840=856,68*
Travel expenses ($/day)	**26,92**

Travelling days (days/month)	**22**
Travel cost ($/month)	*26,92*22=592,24*
Total monthly cost ($/month)	*856,68+592,24=1.448,92*
Monthly number of patients	**66**
Total ($/patient)	*1.448,92/66=21,95*
Correction factor	0,86
Total variable cost ($/patient)	*21,95/0,86=25,53*

During that month the city made 234 telehealth activities (teleconsultations and telediagnosis). The system informed that 80,3% avoided the patient referral and the total saving for the municipal health system was:

Monthly saving = 234 x 0,803 x 25,53 = $ 4.797,14

It is important to observe that it is a rough estimative of the savings, but good enough to evaluate the impact on municipal budget and to promote more intensive use of the system. It is also important to note it is an analysis under the perspective of the municipal manager. Savings for the patient, such labor losses due to travel, were not considered. Summarizing, the municipal manager is able to calculate telehealth savings based on only ten parameters easily obtained from his accounting sector: combustible price ($/liter), combustible consumption (km/liter), lubricant price ($/liter), lubricant consumption (km/liter), tire price ($/tire), tire life (km/tire), travel distance (km/month), travel expenses ($/day), travelling days (days/month) and monthly number of patients.

Using Saving Evaluation Model as a Motivation Tool

One of the objectives to develop this simplified model is to make possible for the municipal manager to evaluate the savings resulting from the use of TNMG telehealth system. In this way, two actions were taken:

1. To prepare a short video course about how to evaluate the economic impact of telehealth. This video is available for registered users of the system through the TNMG website.
2. To develop an application, also available in TNMG website, where the municipal manager can calculate the savings relative to his municipality. The application uses information introduced by the manager, such combustible consumption, prices, etc. and system information as number of activities and number of avoided referral. The application stores all information in a data base for posterior analysis.

Conclusion

During the implementation process of TNMG, economical evaluation of the system has been an important argument not only to increase adherence to the system but also to convince financial supporters to expand the system.

However, a complete and precise economic analysis is a complex and time consuming process, inadequate for routine evaluations. Besides, the participation of municipal managers and consequent involvement were low. The use of a simplified model to calculate telehealth savings permits the municipal manger to calculate them as a routine activity. Moreover, it will provide an important tool analysis to TNMG administrators.

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Impact Assessment in the Case of ICT Solutions for Managing Cognitive Impairment among Senior Citizens

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Abstract: **Information communication technology (ICT) is understood to have a key role to play in supporting independent living for seniors with cognitive impairment. Inter alia, ICT assist in daily household tasks, travel, communication, social activity, mobility and health monitoring. The benefits from such interventions are predicted to accrue not only to the individuals concerned and their families in terms of improved quality of life outcomes, but also to national public health systems through reduced care costs and lower rates of institutionalisation. There is, however, a paucity of evidence on the cost-effectiveness of these ICT interventions.**

This paper puts forward quality-adjusted life-years (QALY) as an appropriate methodology for evaluating cost-effectiveness in this context. Overall, the paper makes its contribution by beginning to answer the question of how we can assess the impact of ICT interventions on cognitive impairment. It has direct relevance for academic debate in the area of e-healthcare, as well as for policy makers, industry, medical professionals, and other public healthcare stakeholders.

Introduction

Cognitive impairment, particularly among senior citizens, is one of the biggest challenges facing public health systems. In the United States alone, there are estimated to be 16 million people living with some type of cognitive impairment [1]. Research from the UK has put the prevalence rate for cognitive impairment conditions, including Alzheimer's disease, dementia and stroke effects, among the over 75 cohort of the population at 18.3% [2]. Notably, rates of cognitive impairment are predicted to rise across all developed countries in the coming years in line with 'population greying'.

The financial costs associated with managing the health and care needs of persons suffering from cognitive impairment are considerable. The cost of care for a dementia sufferer in the United States over the final five years of their life is $287,038, compared to $175,136 for heart disease and $173,383

for cancer [3]. Of course, financial costs are only one part of the problem. Cognitive impairment has ramifications for the quality of life of those it affects [4, 5]. It also imposes a significant burden on the family members of those suffering from it, particularly in its advanced stages [6].

ICT is recognised as having an important role to play in managing cognitive impairments [7, 8, 9]. While not a panacea, ICT tools can form part of an overall suite of pharmacologic and non-pharmacologic approaches aimed at improving the life quality of sufferers while reducing care costs. In respect of the clinical detection of Alzheimer's disease, for example, spatial memory tests that have a 93% accuracy rate are currently being developed as iPad applications [10]. ICT products and services also have utility in helping to palliate the effects of cognitive impairment. Relevant here is online exercise programmes designed to help suffers keep physically active and motivated, satellite navigation tools that support independent travel outside the home, audio and visual media to stimulate mental recall, and vocabulary e-libraries that facilitate communication. The use of ICT to manage cognitive impairment is still in its early stages, however, and much remains to be known on its potential effects. In a systematic review of mild cognitive impairment, Eghdam et al., [11] identified only seven published articles. Of these, only one attempted to evaluate the impact of the ICT intervention. The remainder of this working paper will examine the rationale for using ICT to support people with cognitive impairment and a suitable methodological strategy to determine its cost-effectiveness.

Cognitive Impairment

Cognitive impairment refers to any condition which leads to deterioration in memory, language, attention, visuospatial skill, perceptual speed and executive functioning [12]. These symptoms can have a direct and significant effect on quality of life outcomes for individuals and their families. Cognitive impairments fall along a continuum, ranging from mild to severe. In cases of mild cognitive impairment, individuals experience some loss in memory and spatial awareness but are still able to live independently. As the condition worsens, however, cognitive functions related to communication, recognition and reasoning start to fail. Under such circumstances sufferers become incapable of living independently and require care and medical support on an on-going basis [4]. While cognitive impairment exists across the population, the likelihood of its incidence increases with age [13]. At present, there is no curative treatment for the degenerative effects of cognitive impairment conditions like Alzheimer's disease. The emphasis at this point in time is placed on its early detection

and subsequent attempts to manage and mitigate its symptoms. While deaths from other major diseases, including heart disease, stroke and HIV continue to fall, deaths from Alzheimer's disease increased 68 percent between 2000 and 2010 [14].

Economic Effects of Cognitive Impairment

Over twenty years ago it was estimated that the cost of caring for an Alzheimer's patient in California was $47000, whether at home or in an institution [15]. In the intervening years this figure has increased, and total spending by government, health insurers and individuals on Alzheimer-related care over the next 40 years is forecast to be in the region of $20 trillion [14]. Part of the reason for this is that Alzheimer's sufferers are more likely to have other chronic health conditions than the population as a whole. The treatment of the latter is made more difficult as a result of the former. It is not surprising, therefore, that instances of hospitalisation are up to three times higher for them than patients with other medical conditions. As well as the direct financial costs involved in caring for Alzheimer's sufferers, there are also substantial indirect costs. These are primarily the time and associated opportunity cost of informal care giving by family members. Langa et al., [6] estimated that persons over 75 and suffering from severe dementia received 41.5 additional hours of care from family members relative to those with no cognitive impairment. In financial terms this level of caregiving equated to $17,700 at the time of the study.

ICT Supports for Cognitive Impairment

ICT is recognised as having a role to play in attenuating some of the effects of cognitive impairment and, ultimately, improving the quality of life outcomes of those living with it [8, 9]. Results from a number of preliminary studies give some indication of its potential use in this regard. Stavros et al., [16] demonstrated that computer-based training can bring about improvements in attention span, verbal fluency, visual memory, verbal memory and learning through feedback of persons with mild cognitive impairment. A pacing aid system was shown by Paradise et al., to be beneficial in assisting a woman with acquired brain injury to manage her morning routine [17]. Not altogether different, Miyawaki et al., [18] tested a multi-modal interface for instructing cognitive impairment sufferers in food preparation and cooking. The results pointed to the effectiveness of such an intervention. As well as directly benefiting the individual in carrying on with routine daily activities, ICT applications of this type have the potential to reduce the burden on formal and informal care providers [9]. Leading on, economic savings can be realised by limiting dependency on care providers

and supporting more autonomous living arrangements for those suffering with cognitive impairment.

Impact Assessment of ICT Supports

Notwithstanding growing interest in the applicability of ICT to managing cognitive impairment, there remains a dearth of reliable evidence on its actual benefits and cost-effectiveness [11]. Moreover, there is no consensus on how its impacts should be measured.

One way forward is to use quality-adjusted life-years (QALY) to measure its effects [19]. Taking this approach allows for a comparison to be made between the benefits and opportunity costs of investing in or purchasing ICT solutions for cognitive impairment conditions. QALY is a generic measure of health gain used in cost effectiveness (CE) studies [20]. It combines two dimensions of health: life expectancy (mortality) and health-related quality of life (HRQoL) (morbidity). To capture QALY data is required on both of these dimensions. Life expectancy is measured in years. HRQoL is measured on a 0-1 utility scale, usually by getting patients and/or their carers to complete a questionnaire on five quality of life indicators. Once the data has been obtained, the QALY associated with a particular medical intervention, in this case an ICT product or service, can be calculated. Policy makers, health professionals and researchers will then be in a position to make an informed and evidence-based decision on the efficacy of the investment decision.

As part of the *InLife* project, funded under Horizon 2020, ICT products and services for treating and managing cognitive impairment among senior citizens are currently being piloted in six EU Member States. Impact assessments will be carried out over the course of the pilot. Observed gains for the patient will be expressed in terms of QALY. This will represent among the first systematic attempts to evaluate the cost-effectiveness of ICT interventions across the spectrum of cognitive impairment disorders. The results of this exercise are expected to be made available in early 2017.

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Measuring the Long-run Effect of Telecare on Chronic Diseases: An Application of DID-PSM

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Introduction

The traditional method of evaluating the effectiveness of new clinical intervention is the Randomized Control Trial (RCT), in which subjects are randomly selected and categorized into a treatment and a control group, and the effect is compared between two groups. The most serious problem of RCTs is avoiding bias between the two groups, which is referred to as sample selection bias. One of the methods of overcoming selection bias is the propensity score matching (PSM), which enables the inclusion of as many criteria as necessary. A propensity score related to biased characteristics is first calculated for each individual, and then outcome variables, such as medical expenditures, are compared for individuals whose scores are close. One treatment subject is matched to one control subject who has similar characteristics, reducing sample selection bias. The effect of time trends including development of medical technologies, improvement of patients' environments, and aging of the population are particular to the long-term data. In econometric sense, adopting panel data analysis is one of the ways to cope with such unobserved time effects, but they cannot be effectively analyzed by only PSM.

Data

This paper is based on the data from 2002-2010 of Nishi-aizu Town, that is, in addition to the data of the authors' previous papers [1-3]. The survey on the characteristics of the two groups was conducted in 2012 and new data on their receipts from 2007 to 2010 were obtained. The same samples listed in both surveys were selected. Two surveys and 9 years data can capture changes in trends of health situation and usage of e-Health.

There two kinds of data for analysis, namely receipt data and responses of questionnaire. The receipts for each month are kept at the Nishi-aizu town office, and include a range of information. In the current study, the following data was used: (i) name of patient, (ii) birth date, (iii) regular outpatient treatment or hospitalized patient treatment, (iv) name(s) of major disease(s), (v) date of initial treatment, (vi) number of days of treatment needed, and

(vii) charges of medical treatment. The samples of the user group were selected from the list of e-Health users of the town. One the other hand, Non-users were selected by stratified sampling from the list of subscribers to the National Health Insurance. The questionnaire sent to these samples asked about characteristics such as sex, age, and the individuals' use of the e-Health system, which is data not included in the receipt data. Among these replies, valid despondences were selected, which were 199 users and 209 non-users collected for the years 2002 to 2006, while for the years 2007 to 2010, 272 users and 247 non-users were selected. Finally, samples which appeared in both data were selected, which were 91 users and 118 non-users.

Method

DID-PSM (**D**ifference **I**n **D**ifference **P**ropensity **S**core **M**atching) is used so far in estimating effects of intervention or public policy including public financing or employment issues. No example thus far is found in the field of medicine. DID-PSM is used so far in estimating effects of intervention or public policy including public financing or employment issues, and so on.

DID-PSM is derived from the existing analysis of treatment-effects, in which outcome variables are compared between treatments (entities affected by intervention or policies to be evaluated) and controls (entities not affected). The propensity score matching (PSM) enables to estimate difference between treatments and controls with individuals with similar characteristics. DID can control unobservable influence related to time trends including development of medical technologies, improvement of patients' environments, and aging of the population which are particular to long-term data. By adopting DID and PSM in the 0-th (t=0) period, and comparison of increments until the t-th (t=1) period on outcome variables between treatments and controls, both sample selection bias and effects caused by time trends are excluded.

Results

The results of DID-SPM are shown in Table 1 below, which can be summarized as follows:

Result of DID-PSM: Effects on All Diseases

At first, the effect of e-Health on outcomes of all diseases and the results of estimation on treatment days and medical expenditures are examined. "Difference in difference" shows the final estimation of the effect of e-Health. The results are compared according to "All users," "Users of 5-10 years," and "Users over 10 years."

According to results, all coefficients have negative sign, but they are not significant. On the other hand, the users with over 10 years' use treatment

days and medical expenditures are larger in 2006, but there is no significant difference in 2012. Therefore, it is difficult to obtain the definite result, but the effect of e-Health is not necessarily denied.

Result of DID-PSM: Effects on Chronic Diseases

Next the e-Health's effect on treatment days and medical expenditures related to chronic diseases are examined. Among the results of treatment days and medical expenditures, the significant effects are as follows: (1) treatment days of users with 10 years' use (-2.946, $p<0.1$); (2) medical expenditures of users with 10 years' use (-4197.479, $p<0.1$); and (3) medical expenditures of all users (-3455.417, $p<0.1$). Moreover, after using more than 10 years, those users reduce treatment days by 2.9 days, and medical expenditures by JPY41,975 (approximately USD350.00) per year per user, respectively.

Table 1. Effect on e-Health

Outcome	All users	Users (5 < Years < 10)	Users (Years > 10)
Treatment days (all diseases)			
Difference in difference	-2.880	-4.909	-3.195
	(2.248)	(3.862)	(2.349)
Medical expenditures (all diseases)			
Difference in difference	-3578.356	-4729.191	-3481.913
	(2826.485)	(3694.450)	(2792.470)
Treatment days (chronic diseases)			
Difference in difference	-1.723	-1.340	**-2.946***
	(1.432)	(1.984)	**(1.752)**
Medical expenditures(chronic diseases)			
Difference in difference	**-3455.417***	-2357.771	**-4197.479***
	(1882.958)	(2570.000)	**(2251.042)**

Conclusion

As a result, e-Health does not contribute to a reduction in treatment days and medical expenditures for all diseases significantly, but for chronic diseases especially for those who have longer experience of usage, namely users over 10 years.

Table 2 compares the effects obtained by the other authors' estimation methods, such as simple OLS [1], System GMM [2], and Propensity score matching without difference-in-difference, used in authors' previous papers [3]. The effects of e-Health are underestimated when sample selection biases are not controlled.

Table 2: Comparison of results using alternative estimation methods

	OLS [1]	System GMM [2]	PSM [3]	DID-PSM
Medical expenditures for chronic diseases	JPY 15,302 (US$ 170.02)	-	JPY 25,538-39,936 (US$ 283.76-443.73)	JPY 41,975 (US$ 466.39)
Days of treatment for chronic diseases	1.6 days	2.0 days	2.6-4.0 days	3.0 days

When bias is not eliminated, the estimation obtained deviates from the true value. These findings indicate the value of DID-PSM in evidence-based research, and the rigorous scientific methodologies required to conduct it. An analysis in this paper provides significant evidence for the diffusion of e-Health.

Although DID-PSM offers major benefits in the evaluation of e-Health projects, it has its own limitations. First, it requires a large number of samples, and several previous studies have in fact used samples in the several tens of thousands range. Moreover, as the difference-in-difference requires panel data of two periods, collection of data becomes much more difficult. In this study, samples are omitted to great extent due to death, quitting the system usage, and so on. It is necessary to expand this kind of studies to the other local governments than Nishi-aizu Town.

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Strategic and Economic Considerations for the Implementation of Telehealth/ Telemedicine for Remote/Underdeveloped/Poor Areas of Developing Countries

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Abstract: **The development and advancement of technology for telehealth /telemedicine have shown rapid phase in many developed countries. Its uses and applications, however, are considered relatively slow especially in remote/underdeveloped/poor areas in developing countries. Several key factors in the implementation of telehealth/telemedicine will be presented and discussed. Technical and cost considerations appear to be the main challenges in developing strategic implementation of telehealth/ telemedicine in the poor regions.**

Telehealth/telemedicine is one of the most effective, and practical healthcare applications in the remote, underdeveloped, or poor areas, in which doctor or healthcare provider are not available. The challenges in the implementation of telehealth/telemedicine in these areas or villages in developing countries are many including, among others: availability of broadband signal, lack of funding (i.e. limited budget), limited availability of skilled labor, and even power sources. These challenges require strategic planning and consideration for practicality, efficiency, and cost effectiveness.

Implementation of telemedicine typically requires the acquisition of system devices and software. The software, in most cases, needs to be purchased as subscription and paid in regular basis. The current costs of these equipment and software, for the poor areas, are relatively very expensive – in the range of about $30K to $40K plus software subscription. Lowering the cost of equipment and software subscription (preferably none) is necessary in order to be economically feasible.

Illustrative study and evaluation for a relatively poor area in a developing country in Asia will be presented. Some suggestions on how to lower the cost will be discussed.

Introduction

By definition telemedicine is the practice of healthcare utilizing information and communication technology over distance. Although the reasons for using telemedicine are vary, from convenient to urgent situation, the main purpose is a distribution of healthcare from an area where healthcare is available to an area where it is lacking or not available. The successful implementation of telemedicine and its impact is depending on many factors.

Telemedicine is probably the most effective way of delivering healthcare to the rural and poor areas, where healthcare is lacking. However, the implementation of telemedicine in these areas usually encounters challenges, such as: infrastructure, cost, and availability of qualified manpower. This paper will briefly describe and evaluate these challenges and propose the strategy for cost effective implementation of telemedicine

Discussion

This author [1] has suggested that the synergy among the availability of telemedicine and tele-education and access to internet could offer economic improvement to poverty-stricken areas. Local individuals and communities would be empowered through knowledge/skill and healthcare. And in conjunction with internet access, job or employment may also be accessible or created – hence economic improvement in the form of wealth distribution. Table 1 summarizes these empowerments and synergy. In many rural and poor areas telemedicine does not only provide healthcare, but it is an important factor for community's empowerment towards economic development and welfare.

Table I. Empowerment and synergy towards alleviation of poverty

Type of Service/ Access	Empowerment	Distribution of
Telemedicine/Telehealth/eHealth	health	**healthcare**
Tele-education/ tele-training	education	**knowledge/skill**
Internet/ ICT	knowledge/skill	**job/ wealth**
(combined)	**(combined)**	**WEALTH**

Strategy for implementation of telemedicine in rural/poor areas

In considering the implementation of telemedicine, one needs to evaluate the condition and situation of the location. In the case of rural areas, the following key factors must be considered (among others):

- Availability of communication signal;

- Economic feasibility;
- Availability of qualified manpower.

These three key factors will be discussed briefly in the following:

Communication signal

There are basically three types of delivery method for telemedicine:

- Live -- direct, real-time communication;
- Save and forward;
- Monitoring.

In the rural areas, the broadband signal for telemedicine is often not available for real-time communication between patient and healthcare provider - and for instantaneous delivery of health data to the provider. Some scenarios, such as the use of satellite system – although expensive— may be worthwhile to consider, especially if overall benefit, such as those mentioned in Table I outweighs the costs. The government should make strong efforts in providing broadband access to rural areas.

Alternatively, the use of lower quality communication signal may be used to deliver healthcare data. Healthcare information can be transmitted through hand phone (SMS and phone calls), which may be suitable for the poor rural areas. Save and forward method of delivery for telemedicine can also be used to provide healthcare services.

As more smart phones are becoming available and their users are increasing in number at a rapid rate – even in the rural areas - broadband signal is expected to be available soon in many of these areas. This will certainly expand the use of telemedicine.

Qualified manpower

The practice of telemedicine that involves the use of medical devices for vital measurement or for observation of the patient, especially in the rural areas, will likely require the assistance of a nurse or nurse assistant. The implementation of telemedicine therefore needs to incorporate appropriate training programs for nurses or nurse assistants as well as for the healthcare providers. These training programs should be comprehensive and thorough, and that they should cover both the clinical as well as the information and communication technology (ICT) aspects of telemedicine. The healthcare provider also needs to be trained for operation and understanding of ICT. These training programs should be well structured and that they should be a strong, integral part of the telemedicine operation. The establishment of good certification program is recommended.

Economic feasibility

The current cost of a set of telemedicine unit, depending on what capabilities are included, varies from USD$20,000 to $40,000. The system

that consists of primary care unit only (typically includes: otoscope, microscope, stethoscope, temperature measurement, ophthalmoscope, oximeter, and blood pressure measurement) may cost about $20,000 to $30,000. The system that includes EKG and Abdominal Ultrasound (in addition to primary care unit) may cost about $30,000 to $40,000. All of these systems usually include software for data collection, integration, and transfer; for electronic health records, and for video conferencing. Some of these software are charged on a subscription basis, ranging from about $10-$100 per month. Furthermore, additional cost may be imposed per patient basis, which could cost about $10-$30.

In poor rural areas in developing countries, many people are at or below the poverty level with income as low as $2 per day. Going to a doctor may cost them $4-$8 per visit. The purchase costs of the telemedicine unit described above are too expensive for these areas – and that it is not economically feasible. There is a need for affordable telemedicine systems for these poor rural areas.

Recent advances and trends in technology allow the manufacturer to produce medical devices that are equipped with a capability to interface directly to a computers/laptops/tablets/smartphones (i.e. telemedicine-capable system) with its own software package (such as: save and forward files and data, for electronic health records – eHR). Many of these new devices can be purchased at relatively lower cost.

Procurement of telemedicine device system

In the following is the proposed strategy for implementing affordable telemedicine device system for rural/poor areas. It is based on the utilization of each device system that is capable to operate independently.

The telemedicine system to be acquired consists of a packet or a collection of individual devices that can interface, such as: through USB connection, with a computer/ laptop/ tablet system. The manufacturer's software of each device will allow saving, recording, and forwarding of data and be compatible with video conferencing software system.

Attempt should be made to have most (if not complete) diagnostic testing typically done in the primary healthcare, including testing that may need to be done manually (e.g. blood sugar). This may include: stethoscope, otoscope, microscope, ophthalmoscope, oximeter, etc.

If needed, additional purchases for EKG and for Abdominal Ultrasound can be added. It is not necessary to purchase EKG and Ultrasound units for every packet of primary care unit, as EKG and Ultrasound are considered specialization. For example, if there are several villages in nearby areas, it is not necessary to purchase additional EKG and Ultrasound units for each village as they may be shared. Table II shows the list of each device, price

range, and estimated price for the estimation of return on investment (ROI), which is given in Table III. These estimates indicate that reasonable ROI can be obtained even at low healthcare cost for the patient.

Table I. Estimation of Price Ranges for Medical Devices, USD$

Device/ function	Price Range	Estimated
Stethoscope	450-550	**500**
Otoscope	350-450	**450**
Microscope	100-350	**350**
Ophthalmoscope	300-600	**500**
Oximeter	100-300	**200**
Thermometer	50-200	**100**
Blood Pressure	80-120	**120**
Blood Sugar	80-120	**120**
EKG	2200-2500	**2500**
Ultrasound	**4500-5500**	**5000**

Table III. Estimation of Return on Investment -- Primary/EKG/Ultrasound

Packet system	**Primary Only**	**+ EKG**	**+EKG +Ultra**
Estimated Cost/Investment	USD$3,000	USD$6,000	USD$12,000
Operation /No. of patient –per day	10 h/ 20/ day USD$4	10 h/ 20 /day USD$4	10 h/ 20 per day USD$4
Fee per patient	USD$80	USD$80	USD$80
Revenue, per day	USD$24,000	USD$24,000	USD$24,000
Total revenue@300days/year	USD$6,000	USD$6,000	USD$6,000
Assumed Profit 25%	**6 month**	**1 year**	**2 year**
Return on Investment (ROI)			

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eHealth in Primary and Emergency Care

ADAMILO: Automated Diet and Activity Monitoring for Intelligent Lifestyle Optimisation

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Introduction

In their 'Global Strategy on Diet, Physical Activity and Health' report published in 2005, the World Health Organization pointed out that "unhealthy diets and decreasing levels of physical activity are among the leading causes of the major non-communicable diseases, including cardiovascular disease, type 2 diabetes and certain types of cancer, and thus contribute substantially to the global burden of disease, death and disability" [1-3]. Digital Health and the Internet offer new opportunities in addressing these key risk factors (poor diet and physical inactivity) [4-5], and by doing so, can positively contribute to reducing the future burden of non-communicable diseases in Europe and globally. However, user compliance and adherence with current diet and exercise management apps are generally poor, as these apps require an extensive deal of thorough manual inputting, logging and (often inaccurate/incomplete) estimation of daily food and drink intake and activity/exercise types/duration undertaken by users, e.g., MyFitnessPal app http://www.myfitnesspal.com/.

This approach is not sustainable in the long run as a permanent-use solution, and users tend to give up after some time. Also, the quality of the advice given by these apps is always dependent on users having correctly and fully entered all the requested details (which cannot be guaranteed). Some apps, e.g., Rise https://www.rise.us/, have tried to partially automate this by sending food plate photos captured by the users using their smartphone camera to a remote human nutrition expert for advice. However, such an approach is again incomplete in terms of the data gathered, as well as being costly due to the involvement of a human expert at the other end (who might not be always available in real time to provide instant feedback, which presents another limitation of this approach). Other forms of automation apps such as ShopWell http://www.shopwell.com/ and Fooducate http://www.fooducate.com/ are similarly incomplete in terms of the automated data (only food item barcodes) they are able to gather and reason with.

In ADAMILO (Automated Diet and Activity Monitoring for Intelligent Lifestyle Optimisation), the author is proposing a one-stop comprehensive P4 (predictive, preventive, personalised and participatory [person-centred]) precision health solution, integrating almost fully automated (but still very reliable and accurate) calorie composition and intake (ingested foods and drinks) and calorie expenditure (activity) monitoring and logging with intelligent cloud-based decision support (DSS) for lifestyle (diet and exercise) optimisation, that can be used by a layperson on his/her own and is tailored per individual needs, age, comorbidity, etc. The DSS acts on real-time user data, covering diet, activity, body weight, blood pressure, and other parameters.

ADAMILO has been conceived as an open, standards-compliant, flexible, expandable and future-proof platform and 'ecosystem' to accommodate future clinical evidence updates and further future initial profiling and classification of enrolled patients with obesity according to their gut hormone levels, genetic makeup (*cf.* IBM Watson's approach described in [6]), etc. (with the DSS taking this knowledge into consideration when recommending a personalised diet), additional future sensors (e.g., a portable blood lipid measuring sensor, a glucometer, etc.), additional functions developed by third parties (e.g., digital games and exergames using ADAMILO's gaming API—Application Programming Interface) and other modifications (e.g., optional attending clinicians 'in the loop' for conditions requiring it) as necessary. (The proposed API will provide relevant standardised inputs to applicable third-party games such as how healthy a person's diet is [to offer in-game rewards/badges, etc.] and get relevant outputs from those games for use/display by the ADAMILO smartphone app - *cf.* Kinect PlayFit http://www.xbox.com/en-GB/Kinect/kinect-play-fit supporting and pooling data from a range of PlayFit-compatible/aware games.)

ADAMILO will not just benefit people with overweight and obesity, but also healthy people to maintain a healthy lifestyle, as well as people with conditions influenced by diet and/or activity. For example, in older people, big weight reduction as such might not be always desirable, as the person risks losing precious and irrecoverable 'lean muscle mass' and bone mass (exacerbating osteoporosis) in the process. But older people would still benefit from dietary and lifestyle modifications that could decrease their chances of developing clinical complications, e.g., those subjects with hypertension would benefit from a diet low in sodium to help control their blood pressure, etc.

Objectives of ADAMILO Project

Objectives 1-3 are illustrated in Fig. 1.

Fig. 1. ADAMILO's main components (Objectives 1, 2, 3).

Objective 1

To develop a unique IoT (Internet of Things or Internet of Food) hand-held food scanning device or smartphone attachment connected wirelessly to ADAMILO's specialised smartphone app component for diet composition and volume (portion size) recognition and for ingested calorie estimation, integrating and triangulating (for the first time ever under one service), among other existing commercial and pre-commercial techniques:

(i) A smartphone NIR (Near Infrared) spectroscopy food composition scanner [7] (serving as 'SHAZAM' for food and drink items), e.g., can tell users the amount of sugars (including their types, e.g., sucrose, fructose, etc.), salt, saturated fats, etc. per 100 gms (rather than per plate/meal) in their diet, coupled with a good quality (crowdsourced/cloud-based) lookup database of food item spectra;

(ii) An advanced machine-vision-based food volume/portion size calculation algorithm using camera in hand-held scanner and/or smartphone camera [8], e.g., can tell users how many grams of that pasta or rice they currently have on their plate. Used with (i) above, we can then compute the total number of calories, grams of saturates, salt, etc. in a given meal (rather than per 100 gms);

(iii) Barcode scanning for known commercial food and drink items, e.g., a Mars chocolate bar, giving exact bar weight, composition and calories from a good quality (crowdsourced/cloud-based) lookup database of barcodes of commercial food items and all their variants/packaging sizes (each variant will usually have a unique barcode); and

(iv) The following additional features: The crowdsourced databases (spectra and barcodes) will grow over time to include non-European foods and drinks, e.g., Middle-Eastern, Indian and Chinese, as these are increasingly imported to the West, with specialised ethnic food restaurants also opening in many European cities and people travelling to these regions for tourism or longer stay for other purposes. The hand-held scanning device/app will have buttons (in software) to enable user to add key information. For example, a button to scan a plate prior to starting to eat and another button to scan what is left in the plate after eating (not all people finish all what is on their plate; the calories ingested will be: [all food/drink before eating/drinking - minus food/drink left after eating/drinking]). A numeric pad (in software) can allow users to enter how many of a scanned item, e.g., cereal bars, they are going to eat (or could not eat, at the end of a meal).

Objective 2

To develop a unique IoT activity tracking wearable and associated sensors for the detection, segmentation and quantification of exercise and quantification of calories burned by the user. The wearable will connect wirelessly to ADAMILO's specialised smartphone app component for real-time activity tracking, triangulating wearable and smartphone sensor data from GPS (Global Positioning System), pedometer/accelerometer, external temperature/weather, galvanic skin response and heart rate. Additional wireless sensors (need not all be part of the wearable) will also be used such as muscle strength sensor (to monitor user's fitness progress), blood pressure meter and electronic body weight scale. Mobile 'indirect calorimetry' will be optionally used to further calibrate and increase the accuracy of the quantification of total calories burned per individual user. Indirect calorimetry will also be used during development, as the gold standard for benchmarking and optimising ADAMILO's activity tracking and energy expenditure algorithms.

Objective 3

To develop a cloud-powered decision support component (DSS) interfacing with ADAMILO's app on user's smartphone (also interfacing with an optional mini-robot coach) to help users achieve and maintain an ideal body weight and generally healthy lifestyle, particularly regarding

food and its composition and exercise. The DSS will inform users regarding their calorie intake and composition (e.g., saturates, salt, etc. per day) vs. their calorie burning/expenditure balance. ADAMILO's mobile app (decision support component interfacing with the cloud DSS) will spot and suggest appropriate, individual-user-tailored ways of rectifying any identified issues or unhealthy patterns using the latest available best medical, dietetics and exercise science evidence and existing, validated, computer/digital clinical predictive risks models and algorithms, e.g., Framingham risk score [9], the SCORE [10,11] and CORE [12] indices, FINDRISC (FINnish Diabetes RIsk SCore [13]), ACC/AHA ASCVD (atherosclerotic cardiovascular disease) Risk Estimator http://tools.cardiosource.org/ASCVD-Risk-Estimator/, the Globorisk model for predicting cardiovascular disease risk http://www.globorisk.org/, etc., all compiled from trustworthy medical literature and established guidelines.

The DSS via the smartphone app will monitor and predict any relevant clinical risks and/or unfolding and future complications based on user's current diet and activity and other (e.g., blood pressure) sensor readings and patterns, as well as known individual patient characteristics/clinical profile. The DSS via the app will then respond by prescribing (and presenting in an attractive and motivating way to the user) appropriate, personalised prevention or mitigation plans, e.g., to delay onset of clinical diabetes in pre-diabetes or help control hypertension, consisting of diet and exercise modifications that are tailored to patient condition and preferences and are also flexible ('user negotiable'), e.g., suggest healthier but also affordable (within a price range selected by user) food choices, nearby healthy food outlets (using GPS/location services on the smartphone) and interesting meal recipes/variations and alternatives where applicable or requested by user ('supermarket shopping companion'). (Dynamic Diet algorithms [developed by MeTeDa srl, Italy] enable the dynamic prescription of healthy alternative and equivalent diet options [food items and portion sizes], according to user's preferences, while maintaining the original prescribed nutritional goal unchanged. ADAMILO's automation of the assessment of a meal's food composition and quantity will help users verify if they have correctly observed the negotiated and agreed diet modifications.)

The DSS working via the app will also continuously update the patient about their risk levels, e.g., decreasing risk levels following successful lifestyle modifications. Thanks to NIR spectroscopy, ADAMILO will additionally be able to monitor and advise users about any essential ingredients lacking in their diet (under-nutrition) and their intake of substances with cumulative toxicity in daily food (e.g., mercury in canned

tuna), so that they can always stay within the recommended limits. Users will also be warned regarding allergens or any other food intolerances in food they are about to ingest, based on their known medical history of such conditions (e.g., lactose intolerance, gluten sensitivity, peanut allergy, etc.).

'Measured doses of calorie burning via exercise' will be prescribed in the form of tailored physical activities/exercise regimes, custom workouts, digital exergames, etc. as necessary. The nature, type(s) and amounts of exercise will be determined based on not just users' BMI, current calorie intake and expenditure/activity patterns, but also their general health condition and other individual requirements such as hip/knee joint issues, old age and frailty, pollen allergy (workout routes prescribed based on latest pollen forecasts and where needed alternative routes are suggested), etc.

Objective 4

To involve a heterogeneous sample of EU populations in the design/development and testing/evaluation of ADAMILO via different sites across Europe representing populations north and south of Europe (e.g., Scotland UK, Denmark, Spain and Greece in the original ADAMILO proposal) and spanning a good range of user characteristics, local cuisines/food products in supermarkets (e.g., Greek/Mediterranean diet vs. Danish diet), dietary and physical activity habits/customs, and age groups (young, middle aged and older people). Healthy people will be included, in addition to patients with one or more of the following: overweight, morbid obesity, select clinical complications/conditions in which obesity is a prominent risk factor, select cardio-metabolic conditions and risk factors, such as metabolic syndrome, dyslipidaemias (certain types), insulin resistance/pre-diabetes and mild to moderate hypertension, in which diet and activity play important roles in aetiology/pathogenesis as well as treatment/overall management and prevention, and in which a lifestyle optimisation DSS can be used by lay patients on their own without an attending clinician 'in the loop'.

Objective 5

To carefully consider and where applicable address issues related to the success and sustainability of ADAMILO in non-technical user environments and its ultimate market viability as a real-world, mainstream consumer solution beyond the current project duration. Specifically, the project team will investigate a range of critical horizontal issues, including possible linkages to EHR (Electronic Health Records), cloud privacy/security issues, ergonomics and interface usability/user-friendliness for ordinary lay people, standards (e.g., Continua Health Alliance Kitemarking guidelines, HL7's Fast Healthcare Interoperability Resources

[FHIR], etc.) for future expandability, regulatory compliance and certification, e.g., CE marking (important for future commercialisation) and suitable business model(s) for exploitation.

Current Project Status

A full, detailed research proposal and programme of work to develop and evaluate a prototype of ADAMILO has been prepared during 2014/2015 and submitted in April 2015 to Horizon 2020, the EU Framework Programme for Research and Innovation, but was not selected for funding, despite receiving very favourable reviews and scores [14]. The high failure rates of the increasingly oversubscribed and relatively underfunded (vs. demand) Horizon 2020 programme are well documented [15].

While looking for alternative sources of support and funding, preparatory and exploratory research is currently being undertaken by the author together with colleagues specialising in areas covered by ADAMILO, e.g., this recent study by Kamel Boulos *et al.* on 'Food Ontologies for the Internet of Food' [16], which attracted good media coverage by the BBC (http://www.bbc.co.uk/news/uk-scotland-highlands-islands-35159565) and other outlets. The author is also considering the potential and possibility of integrating ADAMILO's vision with other emerging precision medicine and health developments that utilise cognitive computing to factor a person's genetic makeup into diet and exercise recommendations [6].

Acknowledgment

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Analyzing of Functionality of Most Useable Emergency Medical Services Software Products

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Abstract: **The development of a new generation of software systems for medicine requires a critical assessment of the advantages and disadvantages of existing systems. The first major goal of these studies is to determine the critical functionality, characteristics, and constraints.**

This paper, a result of the starting stage of collaboration project between Medical University of Sofia and Technical University of Sofia, explores our preliminary results of analyzes of basic functionality and characteristics of top software systems oriented to emergency medical services.

Introduction

In the last two (or three) decades national health system is subject to continuous increasing patient number to care and more complex conditions to operate [1-2, 5]. The most serious problem is the uninterruptedly decreasing system resources such as human resources (physicians, nurses and other staff), as well as a numerous infrastructure constraints. That's why all these years the healthcare managers are looking for a solution that both can facilitate the analysis of the problems and can offer new solutions. Many researchers think that such a solution can be found in the increasing share of computer technology in medicine and related activities [2-4, 6].

The history of computer technologies in medicine is very old, but for a long time IT is limited exclusively to support accounting. With the need arises to monitor the patient's status and medical activities in the period 1980-1990 hospital computer systems gradually began to turn in the hospital information systems.

The next stage (1995-2005) of computer medicine systems growth is joined to the beginning of activities oriented to assist the patient flow and to create a medical decision making applications. The practical use of these

types of systems result in a need to address two major issues: increasing the interoperability of medical systems and personalization of medical services according to the individual patient. Telemedicine, m-Health, and p-Health are just some examples of these new development directions. Regardless of these advances, progress toward widespread adoption of IT in the healthcare industry has been slow. This slow progress is even more interesting, especially if you compare it with the data on the use of computers by physicians in their daily activities: physicians are increasingly reliant on computer-based resources within their offices but usage rates for specific medical IT applications remain low. This problem is even more serious when talking about IT systems oriented to improve the quality of emergency care.

This paper explores our preliminary results of analyzing basic functionality and characteristics of many IT systems oriented to emergency medical services. All these activities are a part of the starting stage of collaboration project between Medical University of Sofia and Technical University of Sofia. The next stage of these investigations is oriented to define and to describe minimally necessary set of functionalities and major constraints of new generation Emergency Department IT services.

Our Study

Before starting our study we know that Emergency Department is a special and a unique element of healthcare system:

- It presents an increasing number of challenges;
- Its tasks are complex;
- Its environment and management are chaotic in many cases.

This defines our first task: we need to understand "Why ED is classified as complex and chaotic environment from management point-of-view?" Now we can say that there are two main reasons:

- Limited patient information: The Emergency Department (ED) staff frequently needs to make critical decisions without having the minimum necessary information for the patient (patient records/medical history/...);
- Stressing available resources: many times crucial decisions are made under pressure with limited resources and continual readiness for new arrivals.

This allowed us to change some of our preliminary views on existing patient data and information flows. The result is a clear definition of role of ED systems in healthcare IT architecture: to enhance the quality of ED computer systems we need to think about this system both as a consumer of available past patient data and as new patient information source. This has

allowed creating a prototype of the meta-model of data and information flow in a new generation ED services system. We determined the following main groups of physicians' activities who should be covered by it infrastructure:

- Examining a patient;
- Searching and taking a past patient history;
- Ordering tests;
- Interpreting test results and considering diagnoses;
- Creating a patient treatment plan;
- Exchange/communication with other departments.

Some Preliminary Results

In the first stage of our project we study and analyze characteristics, functionality, constraints, and limitation of over 170 software products on market in last 3 years that can be used in IT infrastructure of ED: 54 general purpose EMS, 21 medical alert systems, 67 medical office systems, over 30 ED-oriented Telemedicine systems and applications. This allowed us to identify some mandatory basic functions groups that should have each new generation EMSS:

1. Monitoring and management patient flow and following-up hospital patient care activities: this includes variety of systems characteristics and functions oriented to patient tracking, data/information exchange, and seamless communications between hospital departments and laboratories.
2. Documentation and archiving of medical/clinical data, information, and knowledge: all emergencies require documentation of the specific details of the visit but this task is a time-consuming and nobody like it.
3. Medical decision support: all types of adverse events and activities that prevents physicians in time-critical decision activities.
4. Interoperability between ED and other healthcare providers: in this group we select all medical information functions that are used to "ED-patient" and "ED-other health provider" communications and data/information exchange.
5. Real-time patient health status monitoring.

For some of the defined functional groups we have done a study of existing computer and communications technology and interfaces of ED medical devices and systems. On the basis of these studies were defined following set of mandatory computer and communications technologies:

- Wireless registration, monitoring, and communication;

- Digital audio/video communication: at least host-to-host, but better teleconference;
- Handheld devices and mobile computing;
- Telemedicine devices support;
- Electronic dashboard: centralized with remote connections;
- New generation decision support systems;
- Digital image creating and archiving: supporting different standards and devices of digital radiography;
- Hi-speed secure and safety pre-hospital data and information transfer;
- RFID tracking: at least passive, but better active.

Conclusion

The Emergency Department is a very spatial and unique location at which patients are guaranteed 24 hours/7 days access to health care. Social changes produce a number of challenges to the provision of high efficient and quality emergency care. Today, two factors are cited as key to the continuing push for improving quality of emergency care:

- For many citizens the ED is the only public portal to access medical services;
- Another key factor is the 'life-and-death' nature of emergency care.

These challenges set new tasks for modern computer systems to support, to manage and to control the ED medical activities.

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Initiating and Promoting Usage of Structured Biology Reports and LOINC Codes in a Pilot Region (Alsace, France)

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Abstract: **This article presents the results of ALBIOM project which intended to initiate and support the production of biology structured reports by public and private pilot laboratories of the Alsace region.**

Meanwhile, the development and implementation of a solution in ability to use coded information extracted from those reports has also been performed. This solution has been deployed in several prescribers' practices and allows them to have an aggregate view of results (charts and tables) for a same patient, based on reports coming from different laboratories.

This project is now fully operational on the initial project perimeter and its deployment in other regions is being prepared, based on the same specifications and methodological approach.

Introduction

ALBIOM project started in December 2013 and has been conducted by Alsace e-santé, with the support of ARS Alsace (Regional Agency for Healthcare) and and ASIP Santé (Agency of Healthcare Information Systems).

ALBIOM main goal was to address the specific need of the sharing of laboratory results in a more efficient way and to address the problematic of comparison of results coming from different laboratories.

As most laboratories are using their own local coding systems, it remains difficult to aggregate easily, for a same patient, results of biology tests coming from different laboratories.

This difficulty is relevant for the management of patients with chronic diseases. It may also be critical for the coordination of actors during hospital stays.

To achieve this result, ALBIOM project could rely on the French National Patient health record (Dossier Médical Partagé - DMP) as a repository for sharing biology reports.

It also benefited from already existing document specifications and related semantics defined on the national level:

- The Interoperability framework defined by ASIP Santé for health data sharing;
- The CDA R2 specifications for health documentation;
- Complementary specifications to manage biology domain characteristics (CDA R2 structured reporting for biology's specifications;
- Related terminologies and LOINC value set for France (BIOLOINC), selected and translated from the international LOINC base.

As every conditions were defined and commonly available to achieve the project objectives, the main challenge of ALBIOM project was to demonstrate the possibility to make it operational in a defined perimeter as a first proof of concept.

Materials and Methods

Operationally, project objectives were divided in three main categories.

First one was to have laboratory information systems able to produce structured reports in compliance with the requirements of the project.

Second objective was to have prescribers' information systems in capacity of receiving and parsing structured reports shared by laboratories.

Third objective was to handle organisational issues to define a set of rules (to be implemented in information systems) that allows secure comparison of structured data shared by laboratories.

This article deals only with the third point of this project.

First challenge was to find a solution to address the problematic of transcoding local biological codes used by laboratories with a pivot terminology that can be used by all laboratories.

Using LOINC nomenclature allow to address this problematic, but LOINC offers a wide variety of codes that expands every year.

Even if a specific data set of values has been defined to address French specific use cases, 46554 LOINC codes remain available in BIOLOINC, and finding the right code for a specific test may be difficult as many possibilities are offered. It may be confusing for the biologist who takes the responsibility of making this transcoding. Finding a methodology to help biologists initiating this transcoding would facilitate their engagement.

Defining how LOINC coded laboratory tests can be compared in a safe way was the second problematic to address.

Using LOINC codes to identify laboratory tests does not guarantee ex post comparability by a third party system. For instance, 2 laboratory tests

identified with a same LOINC code should not be compared, since the techniques used to do the test do not generate results that can be compared.

Laboratory tests results comparison can be allowed if:

1. The two results to compare are identified with the same code LOINC,
2. The HL7 message that carries this result shows the following additional information: The UCUM unit, the reference values, and optionally the method (analysis technic) as the "Method" parameter is too generic in LOINC.

Third problematic was to define main rules to facilitate implementation in the producer systems (Laboratory Information system) and in the consumer application (prescriber's information systems)

Results

With the help of a workgroup composed by biologists and referring physicians, we adopted a pragmatic approach to rapidly propose a first set of LOINC codes covering the most commonly prescribed laboratory tests (l50 laboratory tests were identified which cover more than 80 % of the most referred laboratory tests).

Based on this first set of values, this workgroup then defined for each test:

- The LOINC code to consider,
- The other information to be included in addition to the LOINC code, to allow ex-post comparison;
- The possibility to compare tests identified by different LOINC codes.

We also provided a mapping table, and a methodology to help biologists to find the right LOINC codes that will be mapped with local codes. This mapping table includes also the mapping with the French Biology Billing Terminology (NABM - Nomenclature des Actes de Biologie Médicale) which is commonly used by biologists.

This workgroup also considered other recommendations to guide implementation in system such as:

- Prioritizing LOINC codes using scale dimension expressed in SI (Système International d'Unités) units;
- Allowing biologists to prohibit ex post comparisons of the test results transmitted (even if all the conditions are acquired to allow this comparison). This management is permitted based on the properties of the CDA format R2N3;
- Defining management rules to implement in consumer IT systems based on Level 3 properties of the CDA specifications.

Discussions

ALBIOM demonstrated the feasibility of using CDA structured document and using LOINC nomenclature for coding results, to enable subsequent comparison and ergonomic presentation of biology test results for a same patient.

Several issues were raised and managed during this project:

- The management of comparability limitations through the use of LOINC codes;
- The need to define business rules to be integrated into laboratory and prescribers information systems in order to manage comparison of tests from different laboratories in a safe way;
- Organizational and management needs associated with the implementation of the LOINC nomenclature and business rules.

With the support of ASIP Santé, all these results are now part of the French Interoperability Framework (Jeux d'amorçage) and are now proposed in a perspective of generalization in other regions.

With the cooperation of IT systems providers, the project is now operational for more than 6 months in Alsace and demonstrates the possibility to deploy a CDA / LOINC approach in an easy way if prerequisites are already defined.

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Treatment and Rehabilitation of Drug Addictive Patients through Telemedicine in Punjab, Pakistan

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Pakistan, a country already tormented by regional insurgencies, is fighting a losing battle against a different kind of foe i.e. drug addiction. Afghan opium and Cannabis cultivation accounts for 85 percent of the world's production. The Pakistan and Afghanistan border is vulnerable to illegal smuggling and crime. This results in easy access to dangerous drugs for the population of both countries and contributes to the staggering numbers of deaths. To make matters worse, profits generated from the dependency on these drugs are used by Afghan Taliban to fund their operations. A report by the U.N. Office on Drugs and Crime (UNODC) reveals that Pakistan faces a tremendous challenge in dealing with opiate and cannabis trafficking from Afghanistan. The report concludes that 45% of Afghanistan's opiates are trafficked through Pakistan. This gives Pakistan's 6.7 million drug users easy access to substances dangerous to their health [1]. Pakistan's illegal drug trade is believed to generate $2 billion a year. The Mafia and terrorists receive $70 billion from narcotics in Afghanistan of which $2 billion go to the Taliban in Pakistan [2].

Drug Consumption in Punjab

Drugs are easily accessible in Punjab. Dealers have strong distributing networks in semi-urban and rural areas of the province. Their business runs fearlessly and sometimes even under the protection of law enforcement agencies. Wild Cannabis is abundantly available in upper and central Punjab during spring season [3]. It is also available at Holy shrines to everyone without any police intervention. The reason is that cannabis is considered a spiritual drug and has been consumed at shrines by *Majawars* since Pakistan was part of the Subcontinent. In Punjab, there were an estimated 500 drug addicts in 1980. Their number crossed the million mark in 1990 and now it is estimated to be at 4.9 million. This expanded use of drugs has created social, economic, and family problems. Before the Afghan war, most of the drugs used in Pakistan were Marijuana (or

hashish), raw cannabis, opium and alcohol. The Afghan war brought Heroin, ice, crack, sedatives, cocaine and tranquilizers etc [4].

Rehabilitation Services in Punjab

Punjab's poverty, low literacy, and inadequacy of trained professionals warrant a revision of its approach towards attaining its goal for public health and psychiatric care. Even in the 21st century, patients are still at the mercy of fake and scam healers. Brutal and inhuman treatment of psychiatric patients prevails. Patients are chained, beaten, burnt and scared with serious consequences [5]. It has been estimated that there are 6.7 million chronic drug abusers in Pakistan and according to NSDA (National Survey on Drug Abuse), 81% of the addicts are dependent on opiates and cannabis. Drug rehabilitation programs and other treatments were provided for only 8,000 of the province's addicts in 2014. The population of Punjab exceeds 135 million. Most of the treatment and rehabilitation centers are located in urban centers away from the reach of poor populations. Only 5 government run treatment and rehabilitation centers are available in the district of Punjab. The quality of treatments and interventions provided is low due to a lack of basic facilities, funds, staff, resources, and ineffective referral systems [6]. These limitations hinder in the achievement of public health goals. The private rehabilitation centers offer expensive treatment which is beyond the reach of middle poor class, the most affected from drug abuse. Another barrier is the lack of awareness among the population about the rehabilitation services [7].

Rehabilitation and Treatment of Addicts through Telemedicine

The department of Telemedicine at Mayo Hospital Lahore in collaboration with the Academic Department of Psychiatric & Behavioral Sciences at KEMU (King Edwards Medical University) started a comprehensive program for the treatment and rehabilitation of drug addicts for the districts of Rajanpur, Gujrat, Jhang, Sahiwal, Khushab, Attock, and Dera Ghazi Khan. The Telemedicine system was utilized to serve regions with no treatment and rehabilitation centers available. Marijuana was the most used drug by 139 patients from lower middle and middle class of Rajanpur, Gujrat and Attock regions. The second most abused drug was heroin affecting 60 patients belonging to urban middle and lower middle class of district Attock, Gujrat and Dera Ghazi Khan with an age range of 15 to 41 years, of which half were married. The third most consumed drug was opium affecting mostly rural residents of lower middle and middle class from district Jhang and Khushab. Out of 50 cases recorded, 39 were married and 11 were unmarried. Ages of the affected patients were between

19 and 47. Opium use was followed by cannabis which was mostly consumed by people residing close to big shrines and affected the poor class of district Rajanpur, Jhang and Sahiwal. Among the 43 cases documented, 27 were married with ages ranged between 14 and 37 years. An additional 13 cases recorded addictions to Tranquilizers, Sedatives and Opiate painkillers used by people who were under treatment for their mental issues in the past and developed permanent dependency on these drugs. The population most affected by this substance, of which 10 were married and 3 were unmarried, were lower middle and middle class of Gujrat, Khushab and Jhang districts with ages ranged from 23 to 34 years. The last addiction substance treated was bonding glue which affected mostly child laborers between 12 to 16 years from Rajanpur, Attock and Dera Ghazi Khan districts. (See Table 2&3)

Table 1: Psychiatry Patients consulted via Telemedicine

TOTAL NUMBER OF PATIENTS				
Total Number of patients were treated	**Psychatry**		**Others**	**Total**
	973		**30,610**	**31,583**
Percentage %	**3.08%**		**96.92%**	**100%**
TOTAL NUMBER OF PATIENS ADDICTIVE				
Total Number of patients were treated	**Addictive**		**Others**	**Total**
	316		**657**	**973**
Percentage %	**32.48%**		**67.52%**	**100%**

Table 2: Addiction Cases Recorded by Patient Demographics

Type of Addiction	Female		Female Total	Male		Male Total	Grand Total
	Married	Unmarried		Married	Unmarried		
Cannabis	0	0	0	27	16	43	43
Heroin	0	1	1	30	29	59	60
Marijuana (Hashish)	0	3	3	82	54	136	139
Opium	0	0	0	39	11	50	50
Solvents (Bonding Glue)	1	0	1	0	10	10	11
Tranquillizers and Sedatives	0	0	0	10	3	13	13
Grand Total	1	4	5	188	123	311	316

Table 2: Addiction Cases Recorded by Social Class Status

Type of Addiction	Lower Middle Class	Middle Class	Poor	Rich	Grand Total
Cannabis	12	7	24		43
Heroin	18	22	13	7	60
Marijuana (Hashish)	55	53	26	5	139
Opium	15	21	11	3	50
Solvents (Bonding Glue)	4	3	3	1	11
Tranquillizers and Sedatives	6	5	2	0	13
Grand Total	110	111	79	16	316

Consultancy Mechanism

Two days a week were designated for the treatment and rehabilitation of drug addicts. The patients were registered at remote regions where doctors presented their assessment and history to the psychiatrist at Hub hospital. The patients and their guardians were thoroughly interviewed before initiating treatment. Information was recorded for each case including socio-economic background, family dynamics, behavior and attitude, education level and the level of responsibility held by the addict in the family. Inquiries were collected regarding the initiation to substance abuse, quantity consumed, financial support for addiction, and the level of patient's motivation for recovery. The guardians of the patients were briefed on the treatment and recovery process of addiction rehabilitation and advised to keep the patient at close observation. They were also educated on the types of changes to be expected from the patient during their recovery as well as the appropriate ways to support a recovering addict. Consultants interacted freely with the patients and their guardians. Both psychological and psychiatric treatments were provided to the patients through telemedicine. To monitor the improvement levels of patients, the consultants at hub station communicated with both guardian and patient on regular intervals since their arrival for treatment. Medications for drug rehabilitation were made available at remote centers for free.

Factors Responsible for Success of the Program

The factors responsible for the successful operation of telemedicine psychiatry in seven remote DHQ hospitals were availability of trained staff, formulation of a comprehensive plan and its follow up, and staff competency in collecting assessment and demographic data from each patient. The privacy and confidentiality of the patients was given top priority during the treatment phase. Before and after the initiation of psychiatric telemedicine clinics, awareness and outreach programs were launched to attract and facilitate the affected persons and their families.

Prominent personalities such as moderate religious figures were invited to highlight the prohibition of drug use in Islam and advice users to take full advantage from rehabilitation and treatment program launched by telemedicine department of their respective DHQ hospitals.

Conclusion

For developing countries like Pakistan, telepsychiatry has emerged initially as an offshoot of telemedicine and is still at a preliminary stage. Through the system betterment and rehabilitation programs can provide education, better understanding towards psychological disorders and their treatment. With the many applications that telepsychiatry can adapt to, drug addiction treatment and telepsychiatry has the potential for a great pairing. Through the use of online video sessions, telepsychiatry give individuals the opportunity to receive the help they need. In the treatment of drug abuse, a specialized area of care where there is a specific need for patient follow-up, counseling, support, and communication, telepsychiatry is emerging as an extremely useful tool. The use of telepsychiatry is an opportunity for the doctor to experience the patient's behavior in real time, giving him/her the same information as a face to face meeting without having to be at a facility. As telepsychiatry grows in usage, there are more and more patients who are realizing that there is no difference in the quality of care between telepsychiatry sessions versus in-person meetings. Patient's satisfaction with telepsychiatry has been observed consistently high during sessions, especially when the doctor is trained in the area they have been treated for. The patient and the guardian felt that and the care was personalized and the communication between them and the doctor was close and comfortable.

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US Healthcare: The Telemedicine Imperative

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Strategic Inflection Point [1]

The implementation and integration of telemedicine is much more than another option or an appealing idea. In the current U.S. healthcare environment, it is an imperative whose time has clearly arrived. Telemedicine is rapidly evolving beyond limiting conceptions of technology that only enables remote patient access. It is emerging as a transformative healthcare delivery platform and an integral part of a blended healthcare model that contributes to broader coverage and access to care, improved quality of care, enhanced health outcomes and associated cost reductions. The successful implementation of telemedicine requires changes in focus and language away from the narrow, stand-alone perspective of telemedicine to one that incorporates the technology as a complementary component in primary care, strengthening the infrastructure and care delivery. A "strategic inflection point" or a tipping point [2] has arrived. The compelling and multifaceted value of implementing a telemedicine platform within various healthcare delivery models is not marginalized any longer. This paper explores the factors contributing to the improved acceptance and roll out of telehealth initiatives in the United States.

Several critical drivers are responsible for expediting the adoption of telemedicine leapfrogging the typical implementation trajectory curve. Economic imperatives coupled with the prospects of improved and expanded quality of care are at the heart of these critical drivers.

New Healthcare Economy

Rising healthcare costs are on an economically unsustainable path. The United States is in the midst of a healthcare paradigm shift. A system traditionally focused on "sick care" rather than "health care" has resulted in costs that are now roughly 17.4% of the GDP; 2.5 times more than most developed countries. Healthcare GDP is expected to increase to 19.6% by 2024 [3]. The country is faced with a growing and aging population - 43.1 million 65 and over in 2012, projected 83.7 million (nearly double) in 2050 - increasing the need for medical specialists and the staggering costs of chronic disease management. The 2010 enactment of the Patient Protection and Affordable Care Act (ACA), expanded eligibility and medical insurance coverage for various demographic groups. Roughly 17 million people are

newly insured; ushering new demands for primary care - the entry point to healthcare within this delivery system [4, 5].

Heightening the US healthcare crisis is the physician shortage - both primary care and specialties - in the midst of increasing demand. High levels of medical school student debt and lower salaries compared with other medical specialties have been cited as major obstacles to recruiting physicians to long-term careers in primary care [6]. Training over the course of 5 to 10 years further contributes to the short supply of physicians not meeting the rising demand. According to the Association of American Medical Colleges (AAMC), by 2025, the U.S. will face a shortage of 46 100 – 90 400 physicians [7]. Midlevel provider growth continues to outpace physician growth annually. The growing reliance on nurse practitioners, physician assistants and other midlevel providers as part of an integrated team approach is a viable solution to address this shortage. Telemedicine becomes a compelling mechanism enabling physicians to perform remotely in a supervisory and collaborative role to effectively leverage midlevel practitioner capacity and provide greater reach to a larger patient population.

Adaptive Capacity

The need for all medical practices to quickly adapt to new, integrated health care delivery models driven by government regulation, is expediting the advance of telemedicine through the normal adoption lifecycle. Accountable Care Organizations (ACO) currently receive bundled payments for delivering quality care to assigned, large groups of Medicare patient populations, while assuming the risks for quality and cost of care [8]. Hence, primary care providers are now the nucleus of this model driving improved health outcomes. The key components comprising targeted outcomes include physician and hospital collaboration with coordinated care efficiencies, building provider delivery capacity with credentialed mid-levels, the establishment of disease management programs and transitioning from the historical, authoritative practice environment to the team- based Patient Centered Medical Home (PCMH) paradigm. Utilizing and integrating telemedicine for example - by widening quality care and access through mid-level capacity building and potentially reducing hospital readmissions and emergency department visits via remote home monitoring - is central to reducing overall healthcare costs. The newly implemented bundle payment model incentivizes cost reduction and the strategic incorporation of telemedicine to achieve these goals is a natural and logical system adaptation.

Emerging Paradigm

The shift from the traditional medical practice to the Patient Centered Medical Home has allowed for the intuitive integration of telemedicine into a blended health care delivery model. Crafted by primary care professional organizations in 2007 [9], the team based care model places an emphasis on patient engagement and empowerment, evidence based quality initiatives, prevention and wellness through the use of mid-levels, chronic disease management nurses, healthy lifestyle coaches and mental health professionals. Mandated by the Affordable Care Act, the transition from paper records to electronic medical records has opened the door for an unencumbered entry-point for telemedicine. With modern, ubiquitous technological tools as e-prescribing and patient portals, comes the progression to virtual visits; fast becoming reimbursable at the same rate as in-person visits. Payment parity laws continue to be enacted throughout the United States. In addition, other forms of telemedicine evolving as part of innovative, quality improving and cost reducing healthcare delivery models are imminent [10-11].

Occupational Health Context

The corporate workplace has emerged as a focal point for integrated implementation as more employers become self-insured and establish onsite or near site medical clinics as part of their corporate approach to workplace wellness and reducing healthcare costs. The occupational setting is a logical access point to reach a large percentage of working Americans. Nearly 30% of companies with more than 5 000 employees have onsite or near site clinics offering some variant of primary care; an increase of 24% since 2013 [12]. Onsite medical clinics have demonstrated consistent reductions in healthcare costs and positive returns on investment (ROI) for employers. They have achieved this through convenient and ready access to care, better management of chronic conditions, earlier treatment of injuries and illnesses, reduced visits to the emergency room and urgent care facilities, decreased absenteeism and enhanced workplace productivity. From the confluence of an employer's on-site primary care clinic, with a focus on employee wellness and disease prevention, new telemedicine initiatives are taking root in near-perfect alignment.

The deployment of a well-executed telemedicine initiative as part of a blended health care delivery model, will strengthen the workplace wellness mission, enhance delivery of acute care and intensify employee reach. The synergistic potential has untold possibilities including, but not limited to, tremendous cost savings as well as the imminent change and alteration to the course of primary care delivery.

Summary

Telemedicine has proven to be a tool for optimizing patient utilization of healthcare services whether in the rural or semi-rural areas having few to no physicians or a corporate workplace with numerous satellite locations in need of access to care for remote employees. It is an effective, cost-efficient solution to overcoming the barriers of time, travel and distance for both patient and providers, whether physicians or mid-levels. Telemedicine is rapidly developing as a forceful complementary primary care delivery platform irreversibly changing the structure and fabric of the US healthcare system.

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Using Quality Indicators to Improve Emergency Medical Services Systems Efficiency

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Abstract: **Measuring quality in Emergency Medical Services Systems (EMSS) is challenging because emergency medicine is all about juggling tasks. The complexity of the task is increased by the fact that the EMSS is only one of components of the larger health care delivery system. As such, it is subject to many forces far beyond its direct control. Our paper explores some preliminary results of the starting stage of collaboration project between Medical University of Sofia and Technical University of Sofia, which has the main task to improve the EMSS efficiency and to define requirements of new generation EMSS in Bulgaria.**

Introduction

The Emergency Department (ED) is one of the principal elements of modern healthcare systems. The aim of emergency care medicine is to provide patients with the healthcare that they need, ensuring the quality and safety of care [2]. There is an increasing demand for this resource, which involves high resources (staff, costs, equipment, etc.).

Quality healthcare guarantees safe, appropriate, effective, efficient, accessible, and fair patient-centered care [4]. In last two decades, the care quality has the central healthcare focus, and patient safety has come to represent one of the key quality aspects. In the case of emergency care, this interest in quality is even more evident, not only because of its social and economic impact. Today, two factors are cited as key ones to the continuing push for improving quality of emergency care:

- For many humans the Emergency Department is the only public portal to access medical services;
- Another key factor is the 'life-and-death' nature of emergency care.

Although the final aim of medicine is to answer patients' medical needs, the expectations of the family or of the patient's significant others, of the professionals, of the institutions, and of the society in general should also be taken into consideration [3].

This paper, a result of the starting stage of a collaboration project between Medical University of Sofia and Technical University of Sofia, explores some preliminary results and selected direction to investigate quality indicators to improve emergency medical services systems efficiency.

The Approach

Although emergency medicine is relatively new discipline of medicine (it is separated as an independent discipline towards the middle of the 20th century), but nevertheless, throughout this period the quality enhancement of emergency care has been a major concern and task for healthcare. That's why the main goal of the starting last year joint project between Medical University of Sofia and Technical University of Sofia was to make an analysis of the existing quality of emergency care (activities, devices, environment, staff, etc.) and to determine the requirements for a new framework to the Emergency Departments in Bulgaria.

The creation of a procedure and an instrument that enable quality to be measured has been essential in the transformation of this concern into a way of working. We started project activities based on well-known key axiom of engineering: "*The evaluation of quality is a process of measuring of the difference between the results that should be achieved and those that are achieved.*" In order to accelerate the initial project activities stage we used a hybrid approach between the two classical basic approaches to the evaluation and improvement of the quality of care [3]:

1. The so-called "Room for Improvement" model:
    - It begins with the identification of problems, followed by their analysis and proposals for improvement.
    - The main question: What should we improve?
2. The so-called "Monitoring systems" model:
    - This model is used to detect problems and periodically evaluate performance, the fundamental element of which is the indicators.
    - The main question: Of everything that we do, what is most important and how can we assure that we are doing it well enough?

We chose this hybrid approach, because such a type of studies has been carried out in Bulgaria, but they were not permanent and do not span all aspects of emergency care. This allowed us to prepare two preliminary lists of activities aimed at quality improvement: a list of mandatory ED activities needed to be improved (the "Room for Improvement" model point-of-

view), and a list of activities that necessarily need to be part of the emergency care (the "Monitoring systems" model point-of-view).

Some Preliminary Results

One of the mandatory rules of successful development of a new framework is that the set of requirements to be a complete and a consistent. In our hybrid approach that rule is converted to the need to prove that there is full connectivity and traceability between the activities of the two lists, i.e. for each element from one list to have at least one directly connected element of the second list (an activity giving rise this action or an activity that is a direct consequence of this action). This led to rapid extensions of the both lists with many new activities.

The next stage of activities is the restructuring and merging two lists because we need more general categories of activities (i.e., a smaller number of specific quality indicators). Here are some of these aggregated categories:

- The emergency care is a patient-centered care and this includes good communication, an emphasis on relieving suffering, and the overall experience of patients.
- Patients with emergency care needs should have as early as possible access to specialist to assure appropriate on-going treatment. Additionally, after timely and appropriate care patients need additional care which continues to support them after they have left the ED.
- The ED staff should as early as possible recognize those patients requiring immediate attention and prompt time critical interventions. This improves assessment, investigation and management of patients with emergency conditions.
- The hallways or non-equipped overflow spaces are no place for routinely caring injured or acutely-ill patients.
- The duration of patients' stay in the ED is a compromise between requirement to maximize care and comfort of patients and requirement to optimize hospital outcomes.
- The ED should have adequate space to provide the necessary patient care: the environment should be promoted patient dignity and privacy.
- The ED staff should be specially qualified and trained to deliver emergency care. In cases of injury, life-threatening illness, mental or physical changing illness as early as possible to involve senior physician/-s with specific expertise (It is recommended that these professionals have experience in emergency care). Example: in

many cases diagnoses and treatments need collaboration with physician from intensive care and/or anesthesia departments.

- The ED environment should be provided for appropriate access to diagnostic support services (labs, radiology, ultrasound, etc.) when needed for the immediate diagnosis of life threatening conditions.
- The ED environment should not be a source of new hospital infection. This requires appropriate set of rules, tools, and compliance with infection and hygiene control.
- The ED management should establish mechanisms to monitor compliance and standards, with action taken if a staff short.

Designated categories allow easier to define quality indicators because the indicator's influence is localized only within a specific group. This allows binding the created indicators with the basic three structural units of Emergency Medical Systems [6]:

- 1st emergency medical care: provide treatment for emergency patients with relatively mild illness or injury;
- 2nd emergency medical care: provide treatment for emergency patients with more severe conditions, requiring surgery and/or hospital admissions, in general referred from initial emergency medical facility;
- 3rd emergency medical care: provide 24 hour treatment for emergency patient with serious conditions requiring high level medical care (e.g., head injuries, stroke, myocardial infraction).

Conclusion

The quality of care can be defined as the degree to which the services provided to an individual and to a population increase the probability of obtaining a desirable outcome that is coherent with the current knowledge of the profession [3]. The results of the first stage of our project allowed us to determine the main groups of quality indicator: staff, approach, processes, decision making, results, environment, support, inpatient vs. outpatient services, creation of new services, the starting time and the duration of staying in ED, etc. The first useful conclusion from the analysis of these indicators can be defined so "An important element of good emergency care is the constant development of enhanced and innovative services to support the delivery of safety and quality."

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eHealth Quality: Standards, Interoperability, Legal and Ethical Issues

Constrained Data Transmission with Critical Services in Healthcare

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Introduction and Facts

Transmission of constrained data is a major issue in industrial systems. Today, we find more and more sensitive data in circulation. Regarding the transmission channel, questions of security, confidentiality, but also end-to-end integrity and traceability are hot research topics. It is of course a major concern in healthcare, especially in telemedicine where telecommunications are used to enable tele-expertise or tele-monitoring services. We qualify these types of services as *Critical Services* because they transmit *Constrained Data* with specific needs in QoS such as end-to-end guaranteed transmission time, privacy, etc. In Healthcare, some threats are even more specific [1]. Health data are very sought after by cyber-criminals for blackmailing, spying and monetizing. Nowadays, a social security number is worth more than a credit card number [2].

The world is becoming a connected place. With the IoT coming, Healthcare will not be spared, which is why it is important as of now to understand and anticipate the risks that come along with this transformation.

First we will present a use case in healthcare to illustrate the problem in a concrete way. Then we will introduce the approach that we propose to better understand and define *constrained data* and *critical services* with examples. Finally, we will briefly describe the future work and conclude on some considerations about constrained data transmission through critical services in Healthcare and beyond.

Use Case in Healthcare

The current trend in aging population will result in an increase of chronic diseases (i.e. cardiovascular diseases, diabetes, respiratory diseases and kidney diseases). In this context, telemedicine can improve the management of these illnesses by using information and communication technologies [3].

In the world of tomorrow, hospital services will be decentralized. It will be possible to monitor a patient outside the hospital - at home or in mobility. People leaving in remote location will have a fair access to health services and new kind of decentralized use cases will emerge.

The digital transformation of health will be social – more regular follow-ups, more comfort for the patient, fair access to health service - [4], economic – reduction of the costs, see the report [5] and ecological – fewer unnecessary travels. To support this transformation, telecommunication networks and information systems will have a major role to play, hence our focus on data transmission system.

Here is a simple use case illustrating a tele-monitoring situation. Alice is a patient suffering from a chronic heart disease and she needs very regular follow-ups with her Dr. Bob – see *figure 1*.

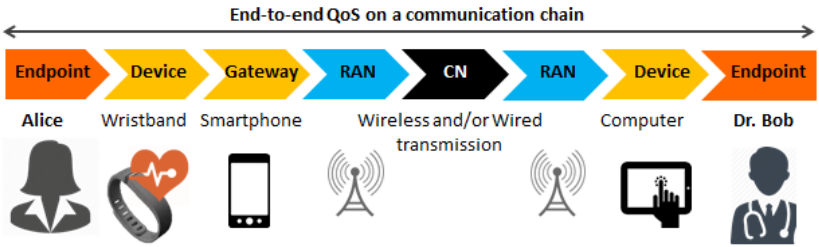

Fig. 1. End-to-end communication chain

If we use this communication chain, we automatically expose very sensitive data about Alice's health and identity to risks (e.g. security breach because of an attacker, transmission delay due to traffic congestion).

Being able to guarantee privacy, integrity, traceability, time and delivery of the data all the way is really challenging. This is why we need critical services to handle in a proper manner the transmission of such constrained data.

Proposed Approach

Our motivation is to be able to guarantee the end-to-end QoS on a communication chain from sender to recipient. We want to help design appropriate critical services for constrained data transmission through a decision support platform.

Constrained data: Type of data that require a critical service for a safe and reliable transmission.

Critical service: Transmission service which provides fine-grained end-to-end QoS with respects to data's constraints. A CS is supported by a communication chain which failures (hardware or software) or lack of QoS could lead to serious consequences for: the end users (Alice & Bob), the service provider (Orange) and the client of the service (Hospital).

Here is a non-exhaustive list of constrained data to provide some concrete examples:

Health Data	Sensor Data	Identification Data
Vital measurement, documents (pictures, MRI scan), personal health record (allergies, disability, blood tests)	GPS position, accelerometer, T°, humidity, pressure	Name, ID card number, social security number

Fig. 2. Constrained data examples

We often find the term "critical data" in industry or technical literature. However our research shows that the criticality is not inherent to the data, it is related to **how the data should be transmitted** by a service, hence the use of the terms *critical service* and *constrained data*.

If we consider this subtlety, we can know define precisely the QoS constraints C_{QoS} of a critical service quantitatively and qualitatively with respect to the need $N_{service}$ that the user expressed which is very useful for modeling.

$$N_{Service} \rightarrow C_{QoS}$$

Indeed, if one wants to design critical services in an automatic way, it is interesting to be able to formalize precisely how the Need expressed by the Client (e.g. a hospital that wants to use Orange Critical Service to deploy a new tele-monitoring service for its patients) impacts the Constraints on the Service in terms of **SLA** (service level agreement). In our work, we consider five main **Constraints criteria** for our QoS model:

$$C_{QoS} = (Privacy, Integrity, Traceability, Delivery, Time)$$

The presence of a cross «X» indicates a specific need that is more than «best effort» or standard QoS level. (X) between brackets means that it is not a priority but it eventually depends on the use case. A bold **X** means that this constraint is crucial for this type of critical service.

Type of Critical service	Privacy	Integrity	Traceability	Delivery	Time
Simple *collection*		X		X	
Active *monitoring*	(X)	X	X	X	X
Passive *monitoring*	X	X	X	X	
Continuous	(X)	X		X	**X**

Discrete	(X)	X		X	(X)
Actuator		**X**	X	X	(X)

Fig. 3. A mapping of critical services

Simple data collection: Messages are transmitted with two strong requirements: being delivered with a notification of success for the sender, and providing a high integrity. Any corruption of the data by a malicious entity or because of a problem in the network is unacceptable because these data might be used for patterns detection or knowledge inference.

Data monitoring: *Collection* means that the transmitted data are stored for a later use, whereas *monitoring* indicates that the data are used as they arrive by the end-user (or the application) for visualization, computation on-the-fly, or decision making in real time.

Active VS Passive*:* In an *active* critical service, the data can trigger an **alert** (e.g. rescue teams are notified) whereas a *passive* critical service has no action directly linked to it, hence no real time requirement

Continuous VS Discrete: A *continuous* transmission refers to a critical service transmitting a data flow with a very high sampling frequency which means that any small delay can directly affect the QoS of the critical service, as opposed to *discrete* transmission (e.g. one measurement per minute).

Actuator: In this type of critical services which is by definition *active*, the data can directly trigger a sensitive action on the endpoint (e.g. change the parameters of a pacemaker from a remote location, inject insulin to the patient). This type of CS requires high QoS because any mistake or security breach can lead to serious damage for the patient.

If we take our previous use case (Alice → Bob), the Need ($N_{Service}$) is to design a critical service that can monitor Alice's heart with an alert system in case of abnormalities detection.

The *reasoner* component of our *Core* system will be able to match the Need of the User with the Constraints and compose a suitable critical service (CS) like this one and infer the proper SLA:

$$CS_{A \rightarrow B} = \{ active \wedge monitoring \wedge discrete \wedge real\ time\ analysis \}$$

Future Work

We will complete the definition of the links between Need, CS and SLA. The next major axis in our research will be the implementation of our ontological model for the decision support platform. Our platform will be domain-agnostic (any domain with constrained data is concerned) while being specific enough to handle heterogeneity and complexity of the need at a fine-grained level. Our solution aims at modularity and evolutivity. For

this reason, adding new types of a *constrained data*, or increasing the *knowledge database* with various models – physical or statistical – and rules is possible, without having to change the *core* algorithms.

Conclusion

A new world of opportunities and challenges is opening up before us. Healthcare is a good illustration of why guaranteeing QoS for constrained data transmission is crucial. However the concepts brought here are cross-cutting for different fields (smart home, smart city, finance, crisis management etc.).

In this short paper we were able to give insights about *constrained data* and *critical service*, and highlight the relevance of such terms. As a quick overview, we also explained our approach which consists in a decision support platform to help design fine-grained critical service.

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Sajida Zouarhi is an engineer and a PhD Student in Computer Science and Network since 2014 with Orange Labs and LIG (computer science laboratory of Grenoble). The work presented here is related to the following thesis subject: "***Quality of service of complex and heterogeneous systems for critical data transmission***".

Do Standards for Telehealth Respond to the Needs of Service Users?

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Abstract: **Telehealth services are developing in different ways (embracing mHealth, medication compliance, telecare, vital signs monitoring and activity monitoring). The need for appropriate service standards, norms or codes has never been greater. This presentation explores a selection of telehealth standards by reference to experience in different European countries, North America and Australasia. Trends in their development are identified that point to their increasing flexibility; and their evolution in a way that should help to foster a move away from 'top-down' prescriptive and towards more integrated approaches.**

Introduction

Telehealth is the means by which technologies and related services concerned with health and well-being are accessed by people or provided for them irrespective of their location [1]. Telehealth services operate in a number of domains including mHealth, medication compliance, telecare, vital signs monitoring and activity monitoring. Such services can be approached from two different directions – from clinical health or social care. Each of these has histories, traditions and professional dogmas that have been re-enforced by a range of standards, norms or codes (henceforth standards). Such standards have given us some of the certainties that frame our personal or professional lives and give us our 'comfort zones'. But telehealth cuts across such certainties and the increasing range of available technologies and services provides an opportunity for greater choice and the real empowerment of service users. It follows that the role of standards as we know them (and which may reflect more traditional top-down health and social care approaches) should be questioned.

Methods

This paper reports on the outcomes of research into telehealth related standards in different European countries, North America and Australasia. It

begins to give shape to what Krupinski and Bernard referred to as 'differences in approaches and norms for conducting telehealth' and responds to what the European Commission lamented as the 'lack of regulation at the EU level' [1, 2].

A key objective in the research was to explore the content of a selection of standards and explore the way in which they:

a. Help or hinder telehealth service development (by reference to their content and the degree to which they prescribe certain ways of operation); and
b. Support particular (changes in) attitudes and the process of integration between health and social care.

From the social care perspective the standards explored extend from the early offerings of the British Standards Institution from 1987 to the Telecare Services Association's 'Integrated Code for Telecare and Telehealth' released in 2012. The United Kingdom, it can be noted, were early pioneers with regard to telehealth – at least in those elements that relate to social alarms and telecare. Other standards that can be seen as emanating from a social care direction (around social alarms and telecare) are noted from Australia, France, the Netherlands, New Zealand and Spain.

From the clinical health direction the focus is on 'home telehealth' where standards have been promulgated from 2002 by the American Telemedicine Association (ATA) through to their 2014 'Core Operational Guidelines for Telehealth Services involving Provider-Patient Interactions'. In addition it is necessary to note the ISO 2014 International Standard on 'Health Informatics. Telehealth Services: Quality Planning Guidelines'.

Results

From the social care side of things it is clear that 'standards thinking' around telehealth has focused on social alarms, telecare and emergency responses. That thinking has been, in large, focused on service 'operation' and a particular way of doing things. A similar 'operational' perspective is evident from the clinical health side of things in 'home telehealth'. But with regard to the latter it is significant that the ATA has maintained awareness of the broader social care agenda – and, with this, has held to a somewhat less prescriptive standards approach.

Overall, the extent to which standards *are* prescriptive is evident from, first, the degree to which operational procedures as opposed to service outcomes are specified; and, second, whether (and the number of) readily quantifiable 'performance indicators' are included. In addition, the extent to which standards reflect attitudes that encourage more integrated service approaches is signalled both in standard content and in language – with

integrated approaches tending to eschew the term 'patient' in favour of, for instance, service user.

Discussion

In examining the range of standards, three trends are indicated.

First is the trend towards standards that are more flexible. There is, therefore, less emphasis on 'how to do it' and *ipso facto* less prescriptive operational approaches. The exceptions are for particular telehealth-related 'tasks' such as virtual visits, or in relation to technical requirements that demand, for example, the continuous availability of communications networks. This means that, at least in part, standards appear, in the range and content of individual clauses, to be increasingly allowing for different telehealth service approaches. This can be argued as important in order to accommodate the way in which new technologies are becoming available and are helping to foster innovations in service development. Within such 'more flexible' standards there is, as a consequence, less emphasis on specific performance 'indicators', albeit that services may be called upon to report openly on their performance (in relation to particular measures).

Second is the trend away from top-down approaches that have reflected views of telehealth that may have been driven more by the interests of professionals (within service provider organisations, manufacturers and suppliers) than service users. This trend relates, in part, to the advent of new and cheaper technologies (including those relating to mHealth) that mean service users are accessing health and related support services in new ways. It also relates, in part, to a consumer-driven agenda where people (all ages) are more and more assertive with regard to their needs and service choices.

Third is the trend towards service integration – something that is particularly strongly championed by the European Union (as, for instance, exemplified in the EIP AHA – the European Innovation Programme in Active and Healthy Ageing) [4]. The EIP AHA sees the need for a break-down in the barriers that are extant in some European countries - not just between health and social care but also between primary and secondary healthcare. Those barriers are seen as thwarting the provision of more user-driven service approaches. Telehealth and related technologies, supported by appropriate standards, are seen as contributing to overcoming them.

Conclusions

The nature of standards for services in telehealth is evolving in a way that, at least in the medium term, holds the promise of more flexible and less prescriptive service approaches. The relevant standards that have been put in place since the 1980s are few in number. Many can be seen as relevant in

some specific service areas but as restrictive in a context where telehealth services are seen as a possible means by which barriers to innovative service development can be overcome. Trends are beginning to be evident, however, that suggest that standards, as they evolve, will increasingly support more flexible telehealth service approaches and that these may help them to fulfil a more meaningful ongoing part in health and social care.

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Estimating the Environmental Impact of e-Health and POCT in sub-Saharan Africa

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Introduction

e-Health is defined by the World Health Organization (WHO) as 'the use of Information and Communication Technologies (ICT) for health'. Other technology related innovations are also impacting health and healthcare, including the performance of clinical laboratory testing at the 'point of care' (Point of Care Testing, POCT). POCT can be defined as medical diagnostic testing performed outside of a clinical laboratory and in close proximity to where the patient is receiving care; it is typically performed by non-laboratory personnel and the results are used for clinical decision making. Extremely innovative approaches are being applied, including paper-based microfluidic solutions [1] as well as more sophisticated e-based tools [2, 3]. In the developed world this embraces private practice, home monitoring for chronic disease, fitness, and remote communities [4, 5, 6]. In the developing world, this is likely to be spearheaded by smartphone use by Community Healthcare Workers (CHW), and nurses or medical attendants at rural or remote clinics [7, 8].

Healthcare systems in developing countries typically follow the Primary Healthcare Model promoted by the WHO, and have a hierarchical structure. Using Uganda as an example insight can be gained about typical hierarchical primary healthcare provision, including numbers of CHW, remote clinics, and hospitals country-wide. Thus, the healthcare system in Uganda is structured into National Referral Hospitals (NRHs) and Regional Referral Hospitals (RRHs) operated at the Ministry of Health level, and General Hospitals (GHs), Health Centres (HCs II, III, and IV), and Village Health Teams (VHTs) at the District Health level. These include Public, Private Not for Profit, and Private (for profit) facilities [9]. Delivery of healthcare at the most remote level is typically provided by CHWs, or their equivalent.

Of importance when considering the growth in technology application in healthcare is any environmental impact. Use of any form of ICT is known to result in environmental impact, therefore both e-Health and POCT have environmental impact. The scale of the potential impact is unknown at this

time. This paper uses specified assumptions (described below) to make projections of the number of smartphone, Point of Care, and Personal Computer (PC) devices used for healthcare delivery for all of sub-Saharan Africa (SSA) over a 10 year period.

Methods

Recent figures available for hospitals, CHWs, and population density in Uganda were collected. In addition estimates of the number of e-Health (PCs and smartphones) and POCT devices that might be used for healthcare in Uganda were devised [10]. These data were then used to make projections of the total number of e-Health and POCT devices used in sub-Saharan African countries over a 10-year period, proportional to Uganda.

Results

Within Uganda in 2010 there were 129 Hospitals, 4,265 Health Centres (3,006 Level II with only ambulatory services; 1,082 Level III with continuous basic preventive, promotive, and curative care, plus laboratory services, maternity care and first referral; and 177 Level IV). A recent report indicated there is a total of 179,175 VHT members in the country [11]. Uganda has about double the 'average' population (32M vs 18M) and ½ the 'average' geographic area (236,000 vs 500,000 km^2) of the 49 sub-Saharan countries. According to the World Bank the population density of SSA (people per sq. km) was about 41 in 2014 compared to 165 for Uganda. In 2010, there were 0.5 hospital beds/1,000 population, or 16,000 beds. A very crude approximation can be made using these values. Assume 49 countries with ¼ the number of health facilities of Uganda to, proportionately, deliver equivalent services. Assume also that each VHT has 5 smartphones / PDAs; each Health Centre has 1 PC, 5 POCT devices, and 3 smartphones; and each hospital has on average 6 wards with 1 PC, no POCT devices, and 20 smartphone users per ward.

Using these assumptions, the following calculations can be made for the SSA region:

A. *Total PCs: ((4,625 / 4) * 1) + ((129 / 4) * 6) = 1,156 + 193 = ((1,349 * 49) * 3) = 198,000 every 10 years*
B. *Total POC**T** devices: ((4,625 / 4) * 5) = 5,781 * 49 = 283,281 * 3 = 850,000 every 10 years*
C. *Total Smartphones: ((179,175 / 4) * 5) + ((4,625 / 4) * 3) + ((129 / 4) * 20) = 224,000 + 3,468 + 645 = (228,113 * 49) * 3) = 33,532,611 every 10 years*

Discussion

This is the first attempt to estimate the potential growth in the use of e-health and POCT in Sub-Saharan Africa, and to concomitantly explore the potential environmental impacts.

The projections indicate that within 10 years, SSA will *utilise and dispose of* about 198,000 PCs, 850,000 POCT devices, and 33,533,000 smartphones. These estimates do not address such factors as the rapidly growing population and expected rise in the adoption and application of e-health and POCT, and shorter than 10-year life-expectancy of devices, all of which will significantly increase the estimates. Conversely, practical issues stand in the way of ubiquitous application of smartphones, including connectivity (cost, geographic coverage, and bandwidth) potentially reducing the estimates.

A published Environmental e-Health Model exists [12]. Impacts begin with resource depletion, manufacture, and distribution (upstream), continue during the use and maintenance period (midstream), and are compounded by poor e-waste management at the end of life (downstream). Use of both e-health and POCT results in these environmental impacts.

For POCT in particular the environmental impact extends beyond just the technology (hardware and software) aspects as described, and into the realm of biological and hazardous waste handling. Working with human blood and other bodily fluids is recognized as hazardous. The health status of any donor is often unknown (e.g., containing Hepatitis B / C, HIV, or even Ebola). For this reason the principle of 'universal precautions' is adopted as the basic standard of practice. Those handling biological specimens must use appropriate Personal Protective Equipment (PPE), adopt appropriate handling procedures, disinfect and decontaminate appropriately, and follow appropriate biohazardous waste disposal practices. Occupational health and safety guidelines exist for the proper collection and disposal of medical waste however, as exemplified by Nigeria, practice in developing countries is known to be poor [13, 14].

Conclusions

The accuracy of the estimates presented above can be challenged, however the intent is not to provide precision of estimates, but to broach the topic of environmental impact of technology related healthcare delivery, raise awareness of this issue, and to begin broad debate on impact and means of mitigation. At this time there is a lack of awareness of the environmental impact of e-Health and POCT device use, inadequate training in proper disposal, and often low priority and an absence of proper disposal facilities. Rapid growth in the use of e-Health and POCT is occurring. This is result-

ing in the transfer of responsibility for awareness and proper handling in relation to environmental impact and biological and hazardous waste handling to CHW and others who are currently unprepared for this responsibility. These issues are of concern and raise the need for action.

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Interoperability in the Healthcare Domain in Context of the European Digital Single Market Strategy

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Introduction

Interoperability is a prerequisite for effective and timely communication among all stakeholders in health care provision. It is also the basis for the transformation of a primarily paper-based to a digital "paperless" world in health care. Interoperability is a core topic of health informatics since decades and despite numerous initiatives and improvements, cross-sectoral and cross-border interoperability is still rare.

The ambition of this paper is to discuss interoperability at the European level in the context of the Digital Single Market (DSM) strategy of the European Commission [1]. The aim is to list possible solutions that contribute to interoperability at a European level and to discuss their potential in the context of the DSM.

It is obvious that there is no one-size-fits-all solution for health IT interoperability. For practical reasons we define three different categories in health IT: 1) National Infrastructures; 2) Professional Health IT and 3) Consumer Health Informatics.

The Digital Single Market Strategy

The Digital Single Market Strategy is one of ten policy areas or priorities set up by the "Juncker Commission" in mid-2014 at the beginning of the legislation for the European commission 2014-2020. In his opening statement in the European Parliament Jean-Claude Juncker claimed: "Every day, Europe is losing out by not unlocking the great potential of our huge Digital Single Market. Jobs that should be there are not being created. Ideas – the DNA of Europe's economy! – do not materialise to the extent they should. Let us change this for the better" [2].

The DSM is one of seven pillars of the Digital Agenda for Europe [3]. The main objective is to break down the barriers that hinder the free flow of online services and entertainment across national borders. The Digital Agenda will update EU Single Market rules for the digital era, establish a single area for online payments, and further protect EU consumers in cyberspace. How does this relate to the domain of health care? Many

experts agree that digital health trends are reshaping healthcare in the decades to come. A report from Accenture Health based on a survey among healthcare professionals reveals five major trends: The Internet of Me, Outcome Economy, Platform (R)evolution, Intelligent Enterprise and Workforce Reimagined [4]. These trends show that digital health is dramatically influencing the health industry today, and it will increasingly do so in the decades to come. For the DSM strategy discussion in this paper we will focus on: The Platform (R)evolution - Defining ecosystems, redefining healthcare. “Healthcare IT platforms capture data from disparate sources (e.g., wearables, phones, glucometers), and connect it to provide patients and caregivers a holistic and real-time view of your health ” [4]. Although technology to realize this scenario already exists, the reality in many European countries and regions is quite different today. One of the main reasons is the missing ecosystem also known as the Digital Single Market in the health IT domain.

National Infrastructures

The high demand in respect to security and privacy makes it obligatory for states to implement a secure national IT infrastructure on top of the Internet. The architecture of such a national infrastructure is highly demanding and complex and there are different solutions. The US for example is using the Nationwide Health Information Network (NwHIN) implemented in the Open Source project CONNECT [5]. Germany is working on a national Health IT infrastructure (Telematikinfrastruktur) [6]. Denmark is well advanced in its national infrastructure for health IT, primarily because it enables communication between primary and secondary health care. All hospitals, pharmacies, municipalities, and 98% of GPs and 85% of specialists are connected and exchange point-to-point structured patient-specific messages in a closed network. People can see their own health data on the Danish e-health portal, Sundhed [7]. Estonia has set up a secure IT-Infrastructure for eServices called x-road [8]. This nationwide infrastructure is used as a basis for the Estonian eHealth infrastructure. Finland cooperates with Estonia to implement x-road in Finland [9].

On the European level there have been a number of projects to address interoperability between National Health Infrastructures. epSOS [10] and the follow-up project EXPAND [11] aim at defining a minimum set of data that should be transferred between member states of the EU. The openNCP project [12] provides open source components to interconnect national health IT infrastructures.

Professional Health IT

There is no common definition for this category. In the context of this paper professional health IT subsumes healthcare specific IT-systems that are used by health professionals in the course of their professional duties.

ISO/EN 13606 is a global EHR communication standard. It is the simplest possible EHR reference model that still meets all of the requirements. It is ideally suited for interoperability between heterogeneous and legacy systems. On the contrary, openEHR is the richest available EHR architecture, and is ideally suited for building a comprehensive EHR system. The specification is open and technically validated. It conforms to ISO/EN 13606 and extends it for maximum completeness. Standards used in this category vary across Europe. Global standards are used like HL7, DICOM, SNOMED CT and many more. Due to the many existing standards, it is often challenging to agree on specific set of standards for defined use cases. Integrating the Healthcare Enterprise (IHE) [13] is one of the most important initiatives in this category that define this sets of standards in so called "profiles" for defined use cases.

Consumer Health Informatics (CHI)

The Consumer Health Informatics Working Group (CHIWG) of the International Medical Informatics Association (IMIA) defines CHI as:" the use of modern computers and telecommunications to support consumers in obtaining information, analyzing unique health care needs and helping them make decisions about their own health"[14]. This includes websites with health and medical content as well as wearables and other gadgets used in the context of health and fitness.

Apple, Google and Samsung are trying to set up the ecosystem on their own platforms. With Apple Health [15], Google Fit [16] and S-Health [17] these global companies try to set up a de-facto standard for health and fitness data. Philips is collaborating with Validic [18], a company specializing in collecting health data from devices and interfacing to professional health IT systems. The main issues here are security, privacy and the ownership of the data. The basis for the Apple ecosystem is HealthKit [19]. Google Fit is an open platform for the Android operating system that makes it easy to store, access, and manage fitness data. It can be considered a direct competitor of Apple's HealthKit. Not only do we have two different hardware environments with Android Wear and Apple Watch, there is also the difference in the underlying platforms powering them: Google Fit vs. Apple Health. These two worlds are not interoperable. With interoperability in mind the non-profit "Open mHealth"[20] was founded to break down the barriers and to bring clinical meaning to digital health data.

Shimmer [21] is the first open source health data aggregator. Shimmer supports a number of best-in-breed apps and devices among them Fitbit, iHealth, Withings, Runkeeper and Misfit and is compatible with the GoogleFit ecosystem. Granola [22] is an open source integration tool from Open mHealth for the Apple HealthKit Ecosystem. These tools allow developers to set up their own environments without being locked-in to one of the big company-specific environments.

Discussion

The analysis above shows that interoperability of health data is manifold and has to be considered on various levels. While national health IT infrastructures are under the governance of the relevant national authorities, consumer health IT is driven mainly by companies, either SMEs or multinational companies like Google and Apple. However, there is an opportunity here for the community to interfere and engage e.g. with initiatives like open mHealth. Professional health IT is mainly driven by Health IT companies, organizations, professional end users and authorities. This is a complex process and involves many stakeholders. IHE is one of the most important international initiatives in this category.

For the Digital Single Market strategy, a focus on consumer health IT is advisable. There are too many legacy requirements for National infrastructures and Professional Health IT to make the vision of a single market in Europe a reality in a short time. For the Consumer Health IT domain there is more potential. To have a competitive European alternative to the global players like Google and Apple, it is necessary to provide an alternative ecosystem embedded in the European privacy and data security framework but also open from the technological point of view without being tied into one of the big player's ecosystems. Since it is unrealistic to "exclude" the existing solutions it is advisable to create an open alternative ecosystem with tools that are provided e.g. by the open mHealth project.

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Secure Group Key Management Protocol in an Open Healthcare Environment

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Introduction

Network-based applications have virtually transformed every industry and healthcare is no exception. Rapid innovation and adaptation to change require a collaborative, interdependent culture and solutions that cut across function, region and profession. Leaders must learn to shift away from the "individual expert" model so common in today's healthcare systems and move towards a model that leverages cross-boundary groups and teams and spans disciplines, levels, functions, generations and professions. These new collaborative groups will be able to integrate knowledge throughout the system and to anticipate and solve unprecedented challenges all while delivering efficient, high-quality, compassionate patient care across the continuum. Teams in health care can therefore be large or small, centralized or dispersed, virtual or face-to-face—while their tasks can be focused and brief or broad and lengthy [1].

Healthcare is progressively becoming a distributed service involving stakeholders and resources who may be physically far from each other. An Open Healthcare Environment (OHE) implies that a stranger may need to join group collaboration where the entities are diverse and autonomous. It is important that OHE provides secure data sharing, access to data (or other resources), storage of data and transmission of data. Therefore, an effective OHE will enable secure collaboration mechanisms that permit (a) on demand formation of collaboration groups, (b) the ability for qualified strangers to join a collaboration group, (c) the ability to operate in a totally distributed setting without a central administration, and (d) guarantees of privacy and security control by the users of the collaboration system.

[2], [3] and [4] did research work related to Open collaboration (OC). A security architecture called NGC (Next Generation Collaboration) was presented by Ellison and Dohrmann, they gave a process requiring human and machine interaction for binding a name to a public key and use Simple

distributed security Infrastructure (SDSI) names for both groups and individuals. However, the challenges of NGC's flexibility are by the fact that new members could only be added by invitation, and that this could only be done by a subset of the current members' pre-authorized to issue invitations. This means that in general only parties known to the core users could participate. [4] presented a framework for role-based access control in group communication systems. They identified the set of all possible group operations that can be controlled and defined the group policy as a mapping between roles and operations using context as constraints. However, theirs is a centralized system, and it does not provide any mechanisms for allowing a stranger to join collaboration. To overcome this challenge, secure group key management in multicast group is applied to the Open Healthcare environment.

New applications domains have pushed novel paradigms and tools for supporting collaboration among (possibly very dynamic) user groups [5]. A vital requirement in collaborative applications is to support operations for user group membership, like join and leave based on the identity of users, today's enterprises and applications are adopting identity management solutions. It is crucial that these solutions be leveraged on for managing groups [6]. A challenging well known problem in GKM is how to efficiently handle group dynamics (a new user joining or an existing group member leaving. [6] state that when the group changes, a new group key must be shared with the existing members, so that a new group member cannot access the data transmitted before he/she joined (forward secrecy) and a user who left the group cannot access the data transmitted after he/she left (backward secrecy).

This paper looks at how to extend the capability of secure group key management in Open Healthcare Environment. This paper is structured as follows: Section 2 Group Key management requirements, Section 3 implementing secure group key management in Open Healthcare Environment and Finally Section 4 conclude the paper.

Group Key Management Requirements

Multicast protocols require an access control mechanisms such as that only authorized members can access group communications. Access control is usually achieved by encrypting the content with an encryption key [7]. The key is known as a session key (SK) which is shared by all the valid group members. Access control typically employs a tree of encryption keys to update and maintain the SK. Group confidentiality requires that only valid users could decrypt the multicast data [8]. [8] indicate that efficient

key management protocols should take into consideration of miscellaneous requirements.

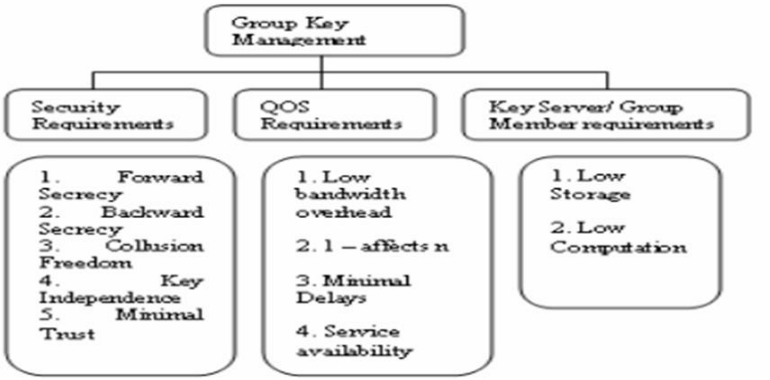

Fig. 1. Group Key Management requirements [8]

Security requirements:

- Forward secrecy: This ensures that a member cannot decrypt data after it leaves the group.
- Backward secrecy: This ensures that a member cannot decrypt data sent before it joins the group.
- Collusion freedom: Requires that any set of fraudulent users should not be able to deduce the current traffic encryption key.
- Key independence: This ensures that any subset of a group keys must not be able to discover any other group key.
- Trust relationship: In mobile ad hoc groups there is no trusted central authority that is actively involved in the computation of group key, that is, all participants have equal rights during the computation process.

Implementing Secure Group Key Management in Open Healthcare Environment

For better understanding how to implement group key management in Open Healthcare Environment the following two use cases are used, the first use case is about the collection and aggregation of patient data and sending out the information required to relevant contacts (e.g., doctors or nurses) [9]. Fig. 2 below indicates multicasting for medical application. In this figure the aggregating unit collects data about the patient's ECG readings and blood pressure. In turn, the processing unit determines the

exact set of participants, who should react according to the data acquired and defines them as a unique multicast.

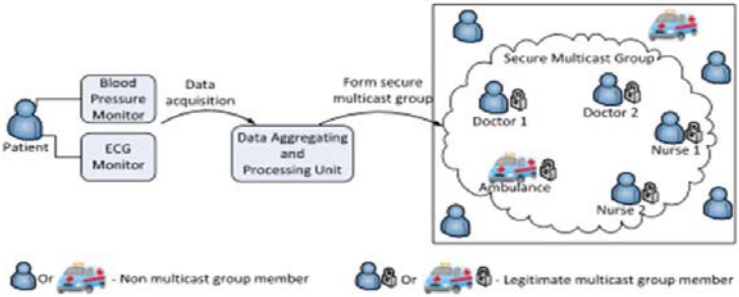

Fig. 2. Tele- Multicasting for medical application [9]

Second use case: a group of AIDS patients intends to share information and resources within their community, so that each member can search and obtain useful content maintained by other members. Due to the sensitivity of the shared content, patients wish to authenticate each other to ensure that only designated community members will have access to this information. Moreover, AIDS patients are concerned about their privacy; they want their personal information and credentials to be revealed as minimally as possible during the authentication process. In this use case the process of secure multicast is divided into two basic steps: key distribution and transmission of encrypted data [7]. Once the AIDS patient group has been securely established among the members of the multicast group, it can be used with any fast symmetric encryption algorithm to encrypt the data to be transmitted. The challenge in developing secure multicast protocols is primarily in designing efficient schemes for the key distribution [10].

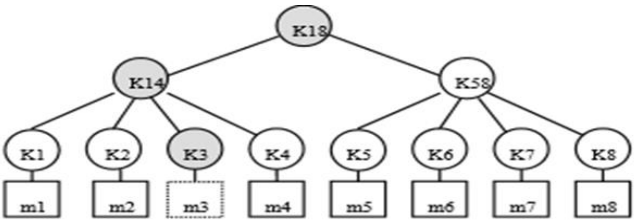

Fig. 3. Tele- Logical Key Hierarchy for each cluster [10]

In this figure 3, we have eight aids members of a sub-cluster, each member of the cluster to hold the leaves from its corresponding to the root node (that is the cluster group key) on the entire key path. m3 is the holder of the key {K3, K14, K18}, the root node of the cluster group key corresponding to K18. Key tree from the point of view, members of m1, m2, m3, m4 intermediate nodes can also be used to complete the cluster key K14 more small-scale secure communications. For each node to apply to join the cluster, it sends the unicasts request message of authentication information to the cluster head node. For new members to receive the request message, the cluster head node needs to check the legality of authentication information, which agreed to decide whether to add it to the group communication cluster. New members to join need to create a logical key tree leaf node, if the auxiliary key in the current tree to find a location free of leaves, on the arrangements for the new adding members to the vacant position, if there is no idle position, could be left from the bottom of the leaf node to start to create a new level, to accommodate more new members apply to join.

When a member leaves the cluster, in order to ensure the security, the cluster head node need to update the leaving member that is holding all the keys, because these keys may be used by other members. In order to ensure that the leaving group members can't decrypt the communication from the group, cluster head nodes need to update some keys on the key path which is from the leaving node to the root node. As shown in Figure 3, if m3 leaves the cluster, the cluster head node must be updated K14, K18. First of all, the cluster node send (K14') K1, (K14') K2, (K14')K4 to the m1, m2, m4 to update the K14, and then send (K18') K14' to the m1, m2, m4, (K18') K58 to m5~ m8 to update the group key K18.

Conclusion

The traditional approach to joining collaboration is to let a system administrator review a registration form and all qualification credentials of that user and then make an account for that user (or reject their application). For dynamic and large-scale application this human-interactive one-way authentication is not suitable. Multicast is an efficient communication technology for provision of group-oriented services over the Internet. These services in multicast could be deployed more comfortably in wireless mobile networks than in wired networks because the entire receiving nodes within the transmission range of the broadcast medium can receive the services in a single transmission. This makes it easier to multicast in Open Healthcare environment.

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Telehealth Standards of Practice: A Nursing Exemplar

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Introduction

Standards of practice are concepts or principles agreed to and used as models to compare quality or performance, organized by specialty or practice level or both. Health care standards use meta-concepts to organize standards.

The purpose of this paper is to describe a framework for telehealth nursing standards development and to discuss how these nursing standards can apply to other telehealth specialties. For telehealth nursing, and most likely for other telehealth care specialties, the conceptual expectations reflect the clinical practice role and the professional performance role.

Telehealth standards and guidelines are considered important for ensuring that clinical care delivery and professional practice roles are focused on quality within specialties. The American Telemedicine Association (ATA) is developing specialty guidelines and notes that practice guidelines for telemedicine are the critical foundation for the deployment of telemedicine services, forming the basis for uniform, quality patient care and safety, grounded in empirical research and clinical experience [1].

The rapid growth of eICU systems, where geographically disbursed critical care units receive centralized consultation, collaboration and expertise, involves many nurses. The American Association of Critical Care Nurses (AACN) has developed standards and practice guidelines for the nurses working in eICUs [2, 3].

The framework described herein comes from the American Academy of Ambulatory Care Nursing (AAACN) [4], a leading organization for healthcare delivery in the ambulatory setting. With a strong tenet of eHealth and telehealth being the outreach to populations that are distant or underserved by medicine and health care in fixed facilities, the ambulatory environment is increasing in importance and range of coverage for health care worldwide.

Standards Development

Prior to developing standards for a specified professional practice context, there must be an understanding of the providers' anticipated capabilities and of the environment in which the work takes place. Ambulatory care nurses,

for example, are expected to have critical reasoning skills and astute clinical judgment in order to expedite appropriate care and treatment. They are expected to be life-long learners. The AAACN has identified 14 of these anticipated capabilities or defining characteristics. The work environment is envisioned as including external factors such as financial and regulatory systems and internal factors such as the care recipient's range of needs from health promotion to disability to end-of-life care. Organizational settings may include tertiary and community hospitals, free-standing medical practices, free-standing clinics, government systems, schools, and telehealth services.

Standards for Telehealth Nurses' Clinical Practice Role

Using the capabilities and telenursing work environments identified for ambulatory care nurses, standards for the telenursing clinical practice role are organized in six areas, representing the process of care delivery [4]. The nursing process is a long-standing concept that has been used for education and practice for more than five decades. Standard 1 (S1) is assessment. Each standard has an explanatory telehealth nurse action. Each standard also has observable and measureable competencies. Competencies are sets of related knowledge and abilities that enable one to act effectively in a situation. Knowledge areas include critical thinking, human caring, knowledge integration and decision-making.

S1, for example, holds that telehealth registered nurses systematically collect comprehensive and focused data relating to health needs and concerns of a patient, group or population. Competencies for S1 include collecting health status data; using evidence-based techniques; prioritizing data collection activities; synthesizing data, information and nursing knowledge and documenting information and data in a retrievable, understandable and readable format.

S2 covers nursing diagnoses; S3: outcomes identification; S4 planning; S5 implementation; S5a coordination of care; S5b health teaching and health promotion; S5c consultation; and S6: evaluation.

S5 has four explanatory telehealth nurse functions: implement the identified plan of care to attain expected outcomes; coordinate the delivery of care within the practice setting and across health care settings; employ strategies that promote individual and community wellness; provide consultation to influence identified plans of care, enhance the ability of other professionals, and effect change.

Standards for Telehealth Nurses' Professional Practice Role

Standards that articulate and shape the professional practice (or performance) role represent 10 areas [4]. The standards include application of the profession's code of ethics; education to competence; research evidence application to practice; performance improvement; effective communication; appropriate leadership behaviors; collaboration with clients, families, and other health care professionals; professional practice evaluation; resource utilization; and assuring a safe practice environment.

The ethics standard states that telehealth registered nurses apply the principles of professional codes of ethics that insure individual rights in all areas of practice. As with the clinical standards, the professional practice standards also have competencies that reflect the nurse's successful actualization of the standard. Competencies for the ethics standard include participating without recrimination in the identification of ethical concern; contribute to the support of patient rights and ethics committees; maintain awareness of ethical trends affecting patient rights; deliver sensitive care and preserve patient autonomy; support patients' informed decision making and voicing of opinions; deliver safe care; use appropriate resources; and promote access to quality health services.

The resource utilization standard has telehealth registered nurses utilizing appropriate resources to plan and provide telehealth services that are safe, effective and financially responsible. Competencies for this standard include using technical resources to determine level of care needed; evaluating dispositions related to safety, effectiveness, efficiency and cost; ensuring appropriate recommendations for care and ethical application of protocols; using clinical decision-support tools as appropriate; and using the nursing process and critical thinking skills to meet unique needs of care recipients.

Multi-disciplinary Applications

The clinical and professional practice standards listed above are clearly applicable across disciplines. Four of the standards were described in more depth, with standards statements and competencies for individual standards. Every care provider is expected to use assessment and to enact or ensure implementation, to include coordination of care, health teaching and promotion, and consultation. Similarly, every person involved in the healthcare enterprise is expected to act in accordance with ethical standards and to use resources wisely and to their best effect. Taking all of the 16 standards together, the meta-concepts are widely applicable across disciplines.

The ATA has, in its work developing standards and guidelines, sought to have multi-disciplinary representation on its panels. More cross-discipline collaboration would be useful for identifying appropriate standards and competencies in the telehealth environment.

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Towards a Telehealth Service Planning and Implementation: A Research about the Requirements, Barriers, Benefits and Risks

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Abstract: **The implementation of telehealth service is a complex task with many requirements and issues to accomplish, however the global opinion is that it can provide many benefits.**

The objective of this paper is to identify the main requirements that must be accomplished to implement a telehealth service in order to increase the healthcare services quality and economic sustainability. The dimensions have different aspects including citizens themselves, social, healthcare providers, policy makers, academic institutions, normalization organizations and industry.

The conclusions are a set of requirements considering healthcare processes and workforce planning, infrastructures facilities, education and training of the professionals, adoption of normalized information architectures, implementation of different processes of quality management and the expected outcomes are improvements of quality and on health economy.

Some potential and possible metrics are also proposed.

Background

According with Ref. [1] there are at least two main issues for tele-health development that point the direction of interoperability of Health data and semantic alignment:

- *Any system must be simple and compatible with existing EMR (Electronic Medical Record) system;*
- *Data flows should be normalized to as closely resemble existing incoming data flows as possible and include a mechanism to feedback information to other care team members.*

The concept of interoperability has many issues that belong to different domains and research areas. The Governance of the Global Health Information Systems includes the interoperability issue.

The IHE (Interoperability Health Enterprise) extends this concept to the level of Management and Governance. According with IHE the environment of Health Information Systems has dimensions of information technology, people, care processes, organization and external environment. The external environment dimension is related with regulations, public behavior and ambient conditions.

The adoption of interoperability models that will promote the Telehealth has some processes that will involve all actors.

The IHE defined the processes of standard adoption in three phases, (Ref. [6]):

- Development process;
- Deployment - Validation process;
- Deployment - Production process.

The development process is formed by a set of tasks that will collect the existent norms, requirements and the known use cases. This information is joined and analyzed. As a result a document with a technical recommendation is produced.

The deployment-validation process is conducted by testing working implementations and validating the results and the impacts. The IT developers are involved as well as de end users.

The Deployment-Production process will consist in using the norms in real products specifications and measure the final impact. Some adjustments can continuously be made to the development requirements.

According with Ref. [6], there are four levels of interoperability:

- Business Use Case Level;
- Interoperability Service Level;
- Integration and Content Profile Level;
- Base Standard Level.

The **Business level** corresponds to business view including services and diseases management.

The **Service Level** is referred to workflows management and definition of level of services.

The **Profile and Base levels** are focused on more granularity aspects like implementation architectures and mainly the Base Standard level is dedicated to specific requirements like ontologies and digital formats.

The Business level domain includes indicators about organizations and about health status. According with Ref. [5], there are the following health dimensions indicators:

- Health Status;
- Determinants of Health;
- Health system Performance;

- Community and health systems characteristics.

These indicators can be built to compare diseases management and health systems across regions, countries and cultures.

Ref. [7] proved in a case study conducted in a clinic that it is possible to define pathways with terms that transcribes most of the medications prescriptions. These pathways can be learned using machine learning tools and the extracted rules can be used to extract information from clinical notes and prescriptions. This method is an automatically process to transform unstructured data like natural language into structured elements.

Ref. [2] proposed a model to summarize clinical free text documents. This model proved that the automation of summarization of clinical notes from free text is possible and can be implemented with a high level of accuracy.

A study conducted by Ref. [9] proved that the usage of Artificial Intelligence to analyze Clinical Pathways can detect *local anomalies that exist in some sub-segments of events or behaviors in inpatient traces.*

Research

A recent study Ref. [8] published by Gulbenkian Foundation highlighted the integrated care and defines the following issues to develop the forthcoming healthcare services:

- Development of new models of healthcare services;
- Reengineering of the National Health Care Services;
- Partnerships to plan and provide healthcare services.

According with Gulbenkian report, a National Healthcare System to the XXI century should accomplish the following issues:

- Must cover a wide social spectrum;
- Be based on ethical values;
- Be inclusive and merge different social segments of the population;
- Be responsible and committed;
- Be open and clear;
- Centered on the citizen;
- Based on local and home facilities but accessible from other sites;
- Based on partnerships;
- Focused on a continuous improvement;
- Be affordable.

To identify the main requirements, barriers, benefits and risks to implement a telehealth service, a workshop and five focus groups were created in UBI on 28th of January 2016. The focus groups were formed by policy makers, health professionals, social assistants and researchers.

The following questions came up to discussion and the related conclusions are bellow:

What will be the main objectives and requirements?

- Reduce the waiting queue for specialized appointments;
- Promote the accuracy of the diagnosis due to the possibility of second opinion;
- Reduce the costs due to patients transportation;
- Reduce the wastes due to patients' absences;
- Include Telehealth as a component of the care process;
- Patient centered care.

What are the principal barriers to implement a telehealth service?

- Some resistance due to lack of information;
- It is necessary to consolidate the ICT infrastructures;
- The new mobile health gadgets collect a lot of data but there isn´t interoperability. So it is difficult to promote an EHR integrated model and keep citizens and professionals involved;
- Telehealth instruments should be user friendly;
- If the health career will be the telehealth recommender he must believe on emergent benefits;
- What is the reimbursement model to the career?
- Some legal issues like privacy, confidentially and data access policies are not quite defined;
- The Governments' policies must be adapted.

How will be the adoption process?

- Knowledge dissemination including education and training;
- Promote pilots, case studies and evaluate the impact.

It was possible with these focus groups to identify three dimensions for the implementation of tele-health, objectives, barriers and adoption processes.

Conclusions and Future Work

Five work groups were created to develop adoption models. The areas of research of each group are:

- Professionals perception and adoption processes;
- Citizen adoption processes;
- Models, architectures and norms of Health Information systems;
- Dissemination and Public Communication;
- Citizen impacts and perceived value.

Each work group has a coordinator and is formed by professionals of related areas, citizens' representatives and researchers.

The expected outcome is a clear understanding of the main issues and challenges that will be considered for the Education and Training courses as well as to create pilot projects.

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eLearning and Health ICT Education

A Systematic Review of E-Learning in Cardiac Rehabilitation

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Abstract: **Cardiac rehabilitation can lower mortality of and reduce risk factors related to cardiovascular disease. More and more these rehabilitation programmes use modern media to aid in educating patients about the importance of rehabilitation and a healthy lifestyle, a concept called e-learning. For this review current literature was assessed and an overview of e-learning possibilities in cardiac rehabilitation is presented.**

Background

Cardiac rehabilitation has proven to be very useful in lowering mortality and avoiding future events by reducing risk factors related to cardiovascular disease (CVD) [1]. Despite proven efficacy, these programmes have low attendance rates and patients often show relapse after termination of the rehabilitation. E-learning may provide solutions for the shortcomings of usual center-based cardiac rehabilitation (CR). E-learning is the use of modern information and communication techniques for the delivery of a learning, training or education programme.

Study Purpose

This review was conducted to determine which aspects of e-learning are proven to be useful for improving compliance of patients to CR programmes. As this review is a precursor for a study on the feasibility of a website-based post-revalidation education programme the focus was laid specifically on studies containing an important educational component.

Methods

For this review the following 6 databases have been searched: LIMO, Pubmed, EMbase, Web of Science and Cochrane (Wiley). The keywords used were: “Cardiac rehabilitation AND (e-learning OR education)”. This general search led to 1714 articles from which 1330 remained after removal of duplicates. On these 1330 articles inclusion and exclusion criteria were applied.

Articles conducted between January 2005 and October 2015 and with the full-text written in English were included. As our interest was on the educational component of CR, articles were excluded when grouped into one of following: 1) articles with a focus other than education e.g. those with a main focus on rehabilitation by exercise and physical activity 2) articles in the paediatric field 3) case-reports 4) obvious irrelevance. The latter is further specified as articles about education of health personnel, improving referral to CR, rehabilitation using alternative treatments such as music therapy or Tai Chi, rehabilitation for other pathologies, and the pharmacologic, cultural and religious approaches of cardiac treatment.

After applying inclusion and exclusion criteria 239 articles were obtained, of which the abstracts were assessed by two independent reviewers. Articles were rejected if their subject matched one of following features: 1) not representative for western hospitals; 2) focus only on in-patient rehabilitation; 3) influence of individual characteristics such as race or education level; 4) no use of modern communication.

Results

After comparing their results, 15 articles were found eligible for the review.

Not many studies have been conducted on the effect of education on adherence and persistence following CR. Most articles used for this review are therefore study protocols. No study was found where the pure effect of education on CR was evaluated. Most trials assessed multi-faceted approaches, which made it difficult to determine the increments of a single component.

It may be useful to divide the studies into different categories according to data traffic between caregivers and patients. Some programmes simply provide information and/or instructions from the health workers to the patients, other focus mainly on telemonitoring and require patients to submit self-monitored data**.** Still other provide two-way traffic of data. On the one hand caregivers provide information and/or instructions to the patient, or try to achieve behavioural changes by interviewing techniques. On the other hand patients are capable of entering self-monitored data in order to maximally individualise their programme [2].

The need for modern media for cardiac rehabilitation

Many reasons can lead to patients not attending a usual CR programme. However, some factors seem to frequently reappear in literature, e.g. employment or family commitments, difficulties with transport or distance to travel, lack of time, and embarrassment related to attending rehabilitation [3-5]

E-learning can overcome the problem of low attendance in conventional CR programmes by making the patients understand the physiopathology of their disease and the need for a healthy lifestyle. It can also be a good asset to an existing programme, where the educational component might lead to more sustainable results in the long term. In order to attain this, patients should have an essential change in their lifestyles. Educating the patients can help accomplish this goal.

E-health provides a cost-efficient way for hospitals to motivate patients to finish their rehabilitation programme and maintain their heart-healthy lifestyle, as well as keep in contact with caregivers and peers. More people can be reached at the same time, compared to face-to-face rehabilitation [6].

Significant for the patient is the ease to use and the convenience of the programme; i.e. the information can be accessed from home, on a proper moment and for a suitable duration [6, 7]. Programmes and the information they contain get perceived as more trustworthy if the general practitioner or own cardiologist approves [1, 8]. Tailoring the feedback and course to the patient's needs might raise the odds of finishing the programme, as well as the satisfaction perceived [6, 9].

Comparison of the available media in cardiac rehabilitation

Media for the purpose of remote CR that have been studied in the past years are the Internet through websites or e-mail, telephone calls, and more recently text-messages and applications (apps) developed for smartphones.

One study developed a second life application in which participants could create an avatar and visit restaurants, a grocery store and attend fitness-sessions in the virtual world. Educational sessions were also provided [10].

Each medium has different applications and strengths. A common disadvantage of all these modern means of communications is the need for a medium. Patients must have access to a computer, Internet, smartphone or telephone. Some e-health programmes use a combination of different media, e.g. text-messaging and a website combined or a website with follow-up by telephone or e-mail [9, 11-13].

Participants of the web-based programmes must have computer and Internet access. Because the target population for CR mainly consists of elderly people, the use of the Internet can be a barrier. In some studies a computer or smartphone was made available for the duration of the trial, but this would not be feasible outside of a clinical trial [2, 10]. Supply of computers and Internet access occurred in 25% of cases in the review of internet-based CR programmes by Frederiks [14]. Allowing access to public Internet services could not sufficiently encourage patients without home Internet access to participate in a study [3].

Websites offer the possibility of a discussion forum for the patients so they can relate with peers, exchange tips and advice and experience social support [9-11, 14]. Comparing progress with fellows gives motivation to keep on going. Some sort of competition can also achieve this. For example, apps with a leader board or with rewards when achieving certain goals have been developed and seem to increase effectiveness [8]. Monitoring his/her own values makes the patient realise the severity of his/her condition and can also support to carry on with the healthier lifestyle [11].

Websites and apps make it possible to process patient input and thus tailor the information offered to the progress of each patient. Both media can use video-messages to clarify the provided information. Compared to apps developed for smartphones, websites can store larger volumes of information and can more easily be updated as new research becomes available [2, 7]. Apps can be used on a cloud to overcome the problem of data storage, but this makes it harder to protect the medical confidentiality. Although websites have a superior protection by use of a username and password, this can also be encountered as a barrier. Passwords can get lost, it takes more time to get to the information when needed, and the more steps it takes, the more chance some patients forget how to work with the programme. Kerr et al. indicated that some participants were too embarrassed to keep asking for help and so they just stopped using the programme [3, 12].

With the web-based interventions patients sometimes forgot to upload their data. They perceived it as bothersome to constantly having to think about uploading them [11]. Text-messages on the other hand can be received passively and function as a reminder to keep up the healthy life [12].

Information can be provided in a pre-determined order by automatised text-messages or fixed screens on a website, but not all patients have the patience and time to go over all the information they might not need at that point. An interactive programme might do a better job at keeping users interested by having them choose what information to access [14]. E-mail has the same advantages of information that can be read at their own pace and time, furthermore an e-mail from a trusted doctor is perceived as more trustworthy than a brochure or random information found on the web [7].

Using e-mail is more ecological and cost saving than letters or booklets. A disadvantage of this medium is the potential for human error, which can lead to unintended content or incorrect recipients. To protect medical secrecy both caregiver and patient would need the same encrypting programme [7].

Content of e-learning programmes

This review focuses on e-health programmes that hold a notable educational component, rather than just physical measurements and activities. To

achieve sustainable results patients must be encouraged to make fundamental changes in their lifestyle. Education plays an important role in this process. There seems to be great diversity in the educational topics covered by the different media. Most attend to improve the best-known risk factors for CVD and thus handle smoking cessation, a heart healthy diet, stress management, weight loss, the importance of medication adherence and improving physical activity. Other subjects frequently taken up are illness perception, self-efficacy, social support and tips on how to recognise symptoms and how to contact emergency medical services.

There are many good examples of how to organise an educational component. Ref. [13] resulted in more people choosing to use the telephone-based programme over the conventional programme. The e-health programme led to better attendance rates. In this study patients received an elaborated rehabilitation package including tools for physical exercise and measuring clinical parameters, but also educational worksheets, books and a DVD on heart health. By using the available media, the patients were encouraged to study one topic a week, which would be discussed in a weekly phone-call. Topics included: understanding heart disease and risk factors, improving communication for better health and preparing for doctor appointments, improving medication adherence, eating well and losing weight, physical activity, reducing stress, coping with feelings and finding support, and smoking cessation.

Tailoring e-learning programmes to patients' needs for long-term results

Physicians and other health professionals play an important role in improving the prevention and management of CVD. Patients usually want to receive as much information as possible from physicians directly, as this information is considered as more valuable and credible. Often they prefer to obtain assistance from physicians in order to change behaviour [1, 8]. Ref. [15] showed that although it was not possible to attribute advantages to an e-health programme based on telephone-calls alone, the satisfaction of the patients increased significantly. Also patients appreciate an individualised approach more than standardised feedback [2]. Adjustment of the CR programme according to the patient's individual progress can help to maintain courage adhering to the CR. In ref. [2] the CR combined text-messaging with access to a website. Text-messages in this programme were tailored to the risk factors applicable for the patient. The website provided graphs for self-monitoring and adjusting physical activity. This way the programme was highly individualised. After both 3 and 6 months the intervention group showed a better adherence and higher increase in adherence to the recommended lifestyle behaviour changes than the control group. Although the difference was significant at 3 months, it did not reach signifi-

cant levels at six months. Medication adherence also seemed significant better in the intervention group than in the control group. Even though less than half of the patients in this study felt using a website was a good way to deliver the programme, nearly all of them would recommend it to other people with a cardiac event. 77% felt the programme had helped them learn about their cardiac event, 84% felt it helped them recover from it. Ref [16] concluded similarly that adherence to CR improved when receiving text-messages.

Many techniques can be used to reach the targeted goals for behaviour change. A key point in long-term behaviour change is moving forward in small consecutive steps [1]. This is initiated by realistic goal-setting, combined with self-monitoring of the progress. Goals should be set in collaboration with the patients, respecting their priorities, concerns, beliefs and values. This will lead to a positive experience for the patients and thus increases their self-efficacy. New goals can be set after reaching a previous goal, ultimately leading to long-term behaviour change [1, 6, 8].

Besides realistic goal setting, motivational conversations and positive reinforcement are useful tools to obtain a positive experience for the patients. They can help accomplish the goals that have been set and maintain adherence to the programme [13].

Discussion

As can be concluded from this overview, there are many media possibilities for the use of e-learning in CR and they seem desired tools.

The e-learning applications described above do not require transport of the patient and are easier to combine with working schemes and other daily activities. In addition there certainly is a demand for alternatives to usual in-patient care in more remote areas.

Each medium has its strengths and weaknesses. Patients readily accept these media, however it seems important to choose the right medium for the right patient, according to his preferences and priorities. The medical knowledge and technological possibilities are rapidly evolving, which implies that developing and adjusting these e-health applications should be possible in a fast and cheap way. The composition of the different studies made it difficult to draw conclusions on the pure educational intervention.

To maintain adherence and a long-term positive influence on healthy behaviour, e-health applications should contain an educational component and be patient-tailored.

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“Heroes of Telemedicine and E-Health” Project: A Tool for the Education Medical Professionals on New Health Infrastructures - Development, Implementation and Further Steps

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Abstract: **Telemedicine / eHealth is a new infrastructure of Health System that is created in order to provide easier access in Health updates, treatments and care by bringing together Technology and Up-to-Date Medicine. Considering its emerging impact on health care, the urgency of “fast” follow up, puts us in front of a defined frame of action towards it. Project “Heroes of Telemedicine and eHealth”(HTeH) aims to provide the “perfect” tool of Continued Education on the implication and involvement of Technology and Medicine together in nets creates to break the barriers outside countries, and thus, involving more of youth into the promotion and education towards this infrastructure.**

The project is implemented through sharing stories on experiences with Telemedicine and eHealth/blogging and sharing articles related to this field. By promoting the work of our members, we do believe on a greater “smooth” education and impact on others who are not yet presented towards the Telehealth.

Introduction

Telemedicine/ eHealth is a new infrastructure of Health System that is created in order to provide easier access in Health updates, treatments and care by bringing together Technology and Up-to-Date Medicine. Considering its emerging impact on health care, the urgency of “fast” follow up, puts us in front of a defined frame of action towards it.

“The perfect combination of the Technology and Medicine to bring forward and to grant an easier access to the Health System and its infrastructure, has set an “urgent” education and action in between health professionals, IT-s and everyone that willingly or imposingly, will be influenced or integrated in this new infrastructure” [1].

“Heroes of Telemedicine and eHealth” project is a project that has started its establishment in July of 2015 as an idea of an educational structure for

the new, developing infrastructure of the Health system-Telemedicine and eHealth among young ones and other who purposely or in an imposing way have been exposed towards the Telehealth concepts.

The transmission, promotion of this mission, as well as defining the frames of the work in general, is based on the experiences, shared in written blogs and more for:

- Educational purposes;
- Promotion purposes;
- Supportive facts of the beneficial of the whole system;
- A pushing of further "urgent" developments.

Considering many societies, groups and associations that have developed a system of blogging of its own in promoting and "getting in touch" with the world, we have developed an eHealth concept of promotion on its own kind.

Thus, the experiences of our members and other people in different zones, areas and regions where they live and work, the challenges that many Health professionals face every day in different zones of "volunteers in field" are shared:

"In 1998 British safari guide Huw Jones was driving through the remote Zambian bush when he suddenly came upon a trail of sticky blood on the dusty road [2]. After following the trail for several miles, Huw caught up with a heavily pregnant woman slumped on a bicycle as her husband pedaled frantically in the relentless heat to get her to the nearest hospital, some 60 km away. Despite Huw's efforts, after such huge loss of blood, the woman and her unborn baby died in the jeep on the way; but the concept for the Virtual Doctor service, which would use the internet to save lives in rural Africa, was born" (Source: http://www.virtualdoctors.org/#aboutus).

Cases like the above have become a strong pushing forward and a strong supporting cause of why we should firstly, start and then develop furthermore the project as well as to widely advertise the main aspect of transmitting what Telemedicine and eHealth really stands for.

People Involved

"Heroes of Telemedicine and eHealth" project aims to involve the youth of the field of Technology and Medicine in its empowerment as well as other collaterals that are the main mechanisms of ISfTeH.

The main core of HTeH are the working group of students of ISfTeH that carry the main responsibility of tracking the main characteristics and with it helping to improve the Telehealth Structure together with the coordinators of the Working groups in ISfTeH, especially in the above mentioned area.

Fig. 1-Coordinators of the Working group of students of ISfTeH

Materials and Methods/Implementation of the Project

The implementation of the project in based in the development of different tools of promotion and education in the Telehealth.

The first step on the project, is the articles posted on the blog, experiences/stories shared from the members on their practices with Telemedicine and eHealth and other relevant articles that do not over cross the frame of Telemedicine and eHealth.

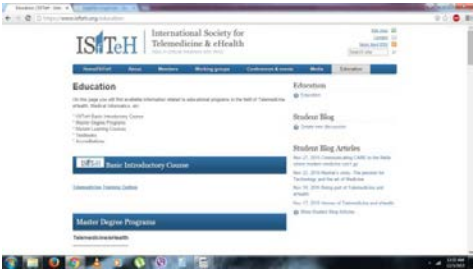


Fig.2-Location of the Students' Blog, under the section of Education

After the development of the Students' Blog under the section of Education, there have been shared stories from the coordinator in duration of approximately 7.6 days per article.

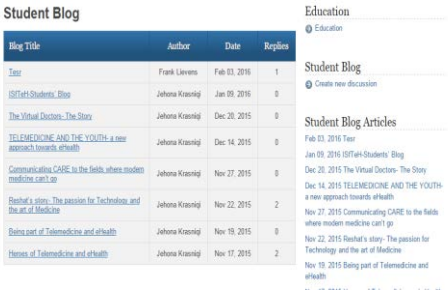
Results

The stories are seven and have almost everything in it: starting from the personal experiences, to the importance of Telemedicine and eHealth and the development of "Telemedicine of the field".

Through the articles, a new concept has been seen necessary to emerge, based in what "the kind" of stories might provide: *Telemedicine Of The Fields,* i.e. a promotion of the work of Health Professionals and others that work in the areas where the "modern medicine can't go":

Telemedicine in the fields [3]

Though, this kind of telemedicine might, in its general overview, be considered as "poor", it has, so far, become quite a generous tool on over-passing the common mistakes that might come up because of the lack of the adequate medical professionalism in related poor areas where the Health system has been constantly under the neglected politics of certain states" [4].



Student Blog

Blog Title	Author	Date	Replies
Test	Frank Lievens	Feb 03, 2016	1
ISITeH-Students' Blog	Jehona Krasniqi	Jan 09, 2016	0
The Virtual Doctors- The Story	Jehona Krasniqi	Dec 20, 2015	0
TELEMEDICINE AND THE YOUTH- a new approach towards eHealth	Jehona Krasniqi	Dec 14, 2015	0
Communicating CARE to the fields where modern medicine can't go	Jehona Krasniqi	Nov 27, 2015	0
Reshat's story- The passion for Technology and the art of Medicine	Jehona Krasniqi	Nov 22, 2015	2
Being part of Telemedicine and eHealth	Jehona Krasniqi	Nov 19, 2015	0
Heroes of Telemedicine and eHealth	Jehona Krasniqi	Nov 17, 2015	2

Education

Education

Student Blog

Create new discussion

Student Blog Articles

Feb 03, 2016 Test

Jan 09, 2016 ISITeH-Students' Blog

Dec 20, 2015 The Virtual Doctors- The Story

Dec 14, 2015 TELEMEDICINE AND THE YOUTH- a new approach towards eHealth

Nov 27, 2015 Communicating CARE to the fields where modern medicine can't go

Nov 22, 2015 Reshat's story- The passion for Technology and the art of Medicine

Nov 19, 2015 Being part of Telemedicine and eHealth

Fig. 3- The main page of Students' Blog with the list of articles posted till now and comments received per article

Virtual Doctors [4]

The story the Virtual Doctors starts back at 1998. The tragedy that happened and that Huw Jones had to face to (see page 2 of this paper), lead him to develop the concept of Virtual Doctors and save lives through the use of internet in the areas where "modern medicine" hasn't touched yet.

The key of what Virtual Doctors stand for are:

- To avoid unnecessary mortality and to avoid motility that might become cause of the unnecessary deaths and to provide the best care for patients;
- To help reduce unnecessary efforts that hospitals deal with every day;
- To help improve the knowledge and skills of the Doctors in the African areas.

Conclusion

Telemedicine and the youth - a new approach towards eHealth [5]

Basically Telemedicine and eHealth in general, have been integrated into its frame of the composition "Technology and Medicine brought together".

Whether it should have stayed in its "solid" form or should cross over its "limits" appropriately, to engage itself in more complex modalities of where it can be used and whom can it be exposed to, is a case of risking its fragile, yet complex form and courageous process we overtake ourselves on more.

We witness every day the situations in which Telemedicine does take over to overcome, crossing border developments so far, actions in the "field" and far more: encouraging new Telemedical centers to open in Nigeria, Qatar, new transformed now centres, integrated into platform of

Health Systems of states in Kosovo and Albania, especially as a grand tool of Continued Medical Education/CME.

And when we come to CME, the education concept itself is taking new dimensions especially towards eHealth. What we attend to educate or to focus into "imposing" this education, is especially to the youth. By attending to develop it in its acceptable form, yet extern-influential or call it "Youth-based Telemedicine education", we are focusing on the questions:

1. Why is it important to educate especially youth towards it?
2. Does this education enter into the evaluation of the success of the whole infrastructure?
3. And what do we tent to put into risk or not?

The answers are outlined as follows:

1. Telemedicine is a concept in " move", thus it needs to spread more into new dimensions and to be integrated in step with the youth, "to stay renewed with new ideas as the World moves forward with technology."

- The development of Technology and the Up-to-dates Medicine is into "the run" and these concepts keep the fresh exposure and dynamism by inter-collaboration of empiric ideas and the new ideas that are being developed.
- The "new" young energy needs to take the channelization into new channels of how Telemedicine should reach even the "forgotten" corners where modern medicine hasn't reached yet.
- Youth can become a great armor of protecting the real concept of Telemedicine, as well as an army of its promotion and right applying, lately becoming the strongest teachers to overpass this tool to others.
- Since youth are the main engine of a state, educating them towards the concept of eHealth and its right implementation, can lead to much better health systems that we have now, by on bringing the concept of "Global Medicine" through computer and online platforms or apps.

2. When we overlook in general of what we can call success and whether the measurement of success of Telemedicine is directly or not related to how much it has found application within new generations of Health Professionals and Engineers of Technology, then we are still in the process of continued evaluation till a X period of time.

3. Though the whole energy and directives tend to be put into a "risky" task of educating young people and especially those young people in areas where Technology and Medicine does not come even closer to each other, yet it is a war worth fighting for.

Discussion

Accessing the Telehealth and developing its further concept, will lead us to the necessary integration of Telemedicine in the curricula of medical studies and to what scale shall it be achieved, is a state of a continued evaluation and researching, thus seeking more facts to support the whole idea.

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Knowledge of Students about Telemedicine and Her Advantages in Healthcare in Kosovo

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Abstract: **Telemedicine is one of most interesting fields to study, in medicine in 21st century. This was the conclusion after the research undertaken in 3 public Universities in Kosovo, with participating of 135 students from different fields of studies. The University of Pristina "Hasan Prishtina", the University of Prizren "Ukshin Hoti" and University of Gjakova "Fehmi Agani" were the universities where this research was done.**

The method that was used for the research was a survey method, where 135 students have to answer a number of open-ended and close-ended questions about Telemedicine and the impact of telemedicine in healthcare system in Kosovo.

From 135 students that participated in the research 62.96 % have listen the term Telemedicine, but only 47.2% were able to write a true concept of the meaning of Telemedicine and what advantages the Telemedicine have in medicine. Most of the students answered the question "What Telemedicine is?" with "A co-operation between medicine and technology". Concerning the advantages of telemedicine, significantly more students from Medicine Faculty (41.17%) and the Computer Science Faculty (21.79%) were aware of this. They said that Telemedicine helps physicians to determine better diagnose of patients because it makes them cooperative with other physician around the world.

The students which had not heard about Telemedicine also answered the survey. They were able to find different concepts about e-Health but none of them were able to say what it is. What is most interesting of this research is that the all students were ready to participate and help to improve the role of Telemedicine in Kosovo, with software, with volunteer work (to inform the population what Telemedicine is), and what amazing things Telemedicine can do.

So the base and the real work to do to have a successful e-Health and Telemedicine in Kosovo is informing people what Telemedicine can do

because with something new people here have trusting issues because many of them do not trust technology more than a real physician.

Key words: telemedicine, e-Health, students, Kosovo

Introduction

Ref. [1] Telemedicine can be broadly defined as the use of telecommunications technologies to provide medical information and services. Although this definition includes medical uses of the telephone, facsimile, and distance education, telemedicine is increasingly being used as shorthand for remote electronic clinical consultation. Interest in the field has increased dramatically in the 1990s.

Telemedicine is one of most interesting fields to study, in medicine in 21st century. This was the conclusion after the research that was undertaken in three randomized Universities in Kosovo, with participating of 135 students from different field of studies, i.e. the University of Pristina "Hasan Prishtina", the University of Prizren "Ukshin Hoti" and the University of Gjakova "Fehmi Agani".

Aim

The purpose of this research was to determine how much students know about Telemedicine and her benefits in the modern health system.

Methods

Study design

This is a survey/questionnaire research. The data were collected in three public universities in Kosovo. Students were selected randomly, yet have or may have relation with medicine and technology.

Data Collection

This study was performed in 2015. A total of 135 students participated in it. Students were studying technology (software design, telecommunication) and medicine (nursery, physiotherapy, general medicine, dentistry, pharmacy). The research took 4 months and all statistical analyses were performed using computer software.

Results

From 135 questionnaires that were distributed, the response rate was 62.96%. Most active were students from the medicine faculty with 41.17 % responses, from the telecommunication - 11.6% and from software design students - 10.3%.

From the total number of responses only 47.2 % were able to write a true concept of Telemedicine. The number has calculated from 100% number of students.

Total students	Response rate	Medicine	Technology
(100%) 135	62.96% (85)	41.17% (56)	21.79% (29)

The majority of students were ready to participante to improve health quality in close cooperation with telemedicine. All the 85 students were ready to attend to conferences and congresses or Telemedicine lectures to learn more for the Telemedicine as a new field of improving life and health quality. This number is a great indicator that the young people who constitute the majority of the population in Kosovo, which more than 70% of population is under age of 35., are ready to learn new topics and technologies.

Discussion

We saw that the Telemedicine is not an unknown term for students in Kosovo. The results also revealed that students are ready to learn about e-Health. They want to be prepared for the future where health will be a great opportunity to help people. What all of them where sure about is that they need more information about Telemedicine and her benefits.

The number of 56 students that know about telemedicine is not a big one but for the quality of learning that they have is a good significant number. The 29 students from technology field that know something about telemedicine are a good indicator too, because the majority of students have never learned in school about Telemedicine. They have all listen about telemedicine from their colleagues or internet surfing.

Conclusion

There were no major concerns among medical students about telemedicine and its applications in medicine [2]. There was a clear need for more information, which suggests that universities should offer special lectures and practical courses in telemedicine. The interest of students in tele-learning was very high. This interest would justify more attempts to introduce tele-learning by the universities.

University of Prishtina and the Faculty of Medicine has on its own campus the Telemedicine Center of Kosovo, which with its projects can help improving knowledge of students for Telemedicine and what telemedicine can do to improve the quality of life.

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Latin American Journal of Telehealth: Challenges to Creating and Maintaining a Regular Telehealth Journal

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Abstract: **The Latin American Journal of Telehealth publishes technical and scientific papers on telehealth by authors from different countries especially, but not exclusively, from Latin America. The Journal accepts submission of articles in Portuguese, Spanish and English and it is published on a quarterly basis. It is difficult to keep frequency and a continuous flow in the theme of telehealth. The first publication occurred in 2009 and until now the journal published seven editions and 59 articles from 23 different countries. Most of the publications (33.8%) are from Brazil. The journal is an important tool for exchanging experiences and for disseminating knowledge on telehealth. However, critical success factors such as access and visibility need to be improved.**

Introduction

The Latin American Journal of Telehealth is a publication of Medical School of the Federal University of Minas Gerais, Belo Horizonte City Health Department and the Laboratory of Excellence and Innovation in Telehealth [1]. The goal of this partnership is to publish technical and scientific papers on telehealth by authors from different countries especially, but not exclusively, from Latin America.

There are many challenges to maintain the frequency and the continuous flow of publications in a relatively new area such as telehealth. Funding and financing, raising articles, quality, access and visibility are some of them. The development of integrated and collaborative action between countries in Latin America coordinated by the Center for Technology in Health (CETES) of UFMG contributes to maintaining the journal's activities.

Methodology

The journal publishes the results of original articles, reviews, short communications and case reports of successful experiences in telehealth, telemedicine and e-learning. The Journal accepts submission of articles in Portuguese, Spanish and English and it is published on a quarterly basis.

Each issue has about 5-6 complete articles, one short communication and one report. The editorial board is composed of experts in telehealth from many Latin American and European countries. The platform used is the OJS – Open Journal Systems, open source software for management and publication of scientific journals on the web.

All articles published undergo a review process by specialist (peer review). Each article submitted for appreciation is sent to editors and then sent to two experts from different institutions. The journal has funding from the Belo Horizonte City Health Department.

Results and Discussion

The first publication occurred in 2009 and until now the journal published seven editions, one of them a special edition for the VII Brazilian Congress on Telehealth and Telemedicine. So far, there were 59 articles from 23 different countries. Table I shows the number of articles published by country since 2009 until now. There was a discontinuity of publications in the period between 2011 and 2014.

Table 1. Number of articles published by country from 2009 to 2015

Country	Number of articles	%
Brazil	20	**33.8**
Spain	6	**11.5**
Ecuador	4	**6.7**
Mexico, Colombia, El Salvador	9	**5.5**
France, Peru , Panamá	6	**3.2**
Other countries	**14**	**23.7**

Brazil is the coordinator of the journal and the place where dissemination and access to the journal are larger. This may explain the majority of the articles originating from Brazil. Each new edition is launched in scientific events which helps and encourages new submissions. Different projects integrating Latin American and Amazon countries are in course and contribute to keep a continuous flow of article submission mainly by Latin American countries. However the journal received articles also from Europe, Africa, Canada and USA.

Access and visibility to the journal in other countries is another major challenge. Table 2 shows the number of access by country with more than 50% of access coming from Brazil.

Table 2. Number of access by country from 2009 to 2015

Country	Number of access	%
Brazil	5.116	63.05
Peru	468	5.77
Ecuador	367	4.52
Spain	318	3.92
Mexico	318	3.92
Colombia	254	3.13
Portugal	188	2.32
U.S.A	168	2.07
Chile	95	1.17
Argentina	84	1.09

Conclusions

After six years of structuring and consolidating, the journal became an important tool for exchanging experiences and for disseminating knowledge on telehealth. However, critical success factors such as access and visibility need to be improved.

Acknowledgment

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New Joint Master's Program in Biomedical Engineering (with Topics on Health ICT) in Armenia Developed through TEMPUS Project BME-ENA

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Introduction

Biomedical engineering (BME) is a modern field at the interface of biomedical specialties and technology. It combines the design and problem solving skills of engineering with medical and biological sciences, to improve diagnosis, monitoring and therapy.

Modern healthcare is highly dependent on the use of technology. There is no area of clinical medicine, medical education and research, which does not require efficient, reliable and affordable devices or technical processes. That makes BME an increasingly needed specialty, and necessitates measures to advance BME education, to match technical developments in the healthcare systems [1].

BME education in Armenia currently undergoes transition. The study programs need to be updated according to modern standards and new demands. The medical device industry is limited, and there is poor link between the demand for the workforce on the one hand, and the educational process on the other. Additionally, public funding of research and development is still low. The equipment available for education and research purposes also needs modernization.

That explains the importance of the educational initiative coordinated by the University of Patras in Greece, aimed at reformation of the BME education in four Eastern European countries: Armenia, Georgia, Moldova and Ukraine, and harmonization of the curricula with the existing BME educational standards in the European Union countries.

The main goal of the TEMPUS IV project titled “Biomedical Engineering Education Tempus Initiative in Eastern Neighboring Area” (BME-ENA) is to advance BME education in the target countries, primarily through establishment of a new joint master degree program in line with the European standards and approaches [2]. That will have major positive effects on both the healthcare technology industrial sector, and the healthcare delivery system through appropriate management and safe use of medical devices.

Materials and Methods

The multinational project consortium involves 17 participant organizations from 11 countries, including the following three institutions from Armenia [3]:

- National Polytechnic University of Armenia (NPUA);
- Russian-Armenian (Slavonic) University (RAU);
- Armenian Association of Telemedicine (AATM).

The three project partners have been selected and invited to participate to the project consortium, based on their experience in BME and medical technology, available capacity, and specific interests in the project’s objectives.

Biomedical Engineering specialization at NPUA exists since 1996 [3]. During the last 20 years the Department of Microelectronic and Biomedical Devices has given 3097 graduates, among them more than 30 PhDs. The educational program at NPUA provides courses in engineering, physical and biomedical sciences and mathematics, and advanced courses that apply these concepts to various biomedical problems. Many of the courses have a laboratory component.

RAU is a higher education institution offering undergraduate and postgraduate programs, different courses and training programs in various specialties [3]. The most distinctive feature of the university is availability of Bioengineering subspecialties, such as: genetic engineering; bioengineering of microorganisms, plants and animals; cloning and transplantation of cells; protein engineering; and biochemical engineering. The university has a laboratory of plant cell cultures, cell engineering, and analytical chromatography.

Armenian Association of Telemedicine (AATM) is a non-governmental, non-profit professional organization with a mission to assist in development of Healthcare ICT in Armenia, via: coordination and support of Health ICT initiatives, programs, applications, services; organization of collaboration between stakeholders in the field; cooperation with major international players; development of educational programs and assistance in staff

management; cooperation with governmental authorities and assistance in the legislative area [3]. AATM has been involved in most organizational and curriculum development activities of the project, and coordinated the project activities at the country level.

Results

During the project lifetime (since December 2013) the project team from Armenia, together with the staff of the coordinating institution (University of Patras, Greece) and other European partners (Technical University of Varna, Bulgaria), developed a unified curriculum for a joint NPUA-RAU master's program in BME, based on the recommendations and templates provided by the European partners on the consortium [4]. The master's program includes four semesters and delivers 120 European credits (ECTS). Each semester's program covers several core topics, and also includes a number of elective subjects that the students are able to select from a predefined list (Table 1). The first semester includes several basic topics such as biotechnology, biomaterials, the basics of anatomy, physiology and biochemistry (for enrollees coming from technical fields), and the basics of mathematics and computer science (for enrollees from the medico-biological field). The second semester is mostly focusing on data and signal processing, biomedical instrumentation, sensors, and imaging technologies, while the third semester – on Healthcare Information and Communication Technologies. The fourth semester is mostly devoted to the master's thesis.

The curriculum was finalized, and the syllabi of the courses developed. The teaching staff of the program then prepared the course content and materials. The program launched in October 2015 with 7 students enrolled. It is also expected that in the academic year 2016-17 several students and teaching staff will participate in mobility programs organized through the Erasmus Plus framework.

Discussion and Conclusions

Proper development of the desired joint master's program in Biomedical Engineering would not be possible without significant input from professionals from other European programs that have been running for a number of years now. An essential element of the study program will be acquisition of practical skills in research laboratories, implementation of these laboratories, as well as of the master theses. Another attractive component of the tuition is an opportunity of training at the leading centers of Biomedical Engineering education in EU countries.

The Tempus BME-ENA project is expected to enhance the possibilities of preparation of qualified specialists in the field of Biomedical Engineering in

Armenia. This innovative teaching program is targeted at engineers, physicians, biologists and graduates from other related fields. During the course of the two-year 120 ECTS program, the students will acquire a set of theoretical knowledge and practical skills necessary for subsequent employment in the healthcare systems or medical industry.

Table I

Term	Lectures (**Core Topics** and Elective Topics)	**N**	**R**	**A**	**E**	ECTS (Hours)
1	**Biology & Biochemistry**		**X**			**3 (90)**
	Human Anatomy & Physiology		**X**			**4 (120)**
	Biophysics incl. Biomechanics	**X**				**2 (60)**
	Mathematics in Engineering	**X**				**4 (120)**
	Computer Science - Software & Programming	**X**				**4 (120)**
	Basics of Electronics	**X**				**4 (120)**
	Language (EN, FR, DE)	**X**				**2 (60)**
	Bioethics, Humanities		X			2 (60)
	Diagnostic & Therapeutic Methods			X		2 (60)
	History & Fundamentals of Modern Science & Technology	X				2 (60)
	Biomedical Informatics		X			5 (150)
	Elaboration of a Master's Thesis	X				**5 (150)**
	Subtotal					**30 (900)**
2	**Biomedical Data & Signal Processing**	**X**				**6 (180)**
	Medical Imaging & Image Processing	**X**				**4 (120)**
	Biomaterials, Artificial Organs, Prostheses	**X**				**4 (120)**
	Biomedical Instrumentation & Sensors	X				4 (120)
	Computer Science - Software & Programming	X				4 (120)
	Language (EN, FR, DE)	X				2 (60)
	Modeling & Simulation	X				4 (120)
	Health Technology Assessment, Regulation & Standards				X	2 (60)
	Cell & Tissue Engineering		X			6 (180)
	Research Methodology	X				2 (60)
	Elaboration of a Master's Thesis	X				**10 (300)**
	Subtotal					**30 (900)**
3	**Information and Communication Technologies in Medicine and Healthcare**			**X**		**4 (120)**
	Telemedicine & Telehealth			X		2 (60)
	Health Care Organization & Management			X		2 (60)
	Patient Safety & Hospital Environment				X	2 (60)
	Biomedical Statistics & Data Analysis	X				2 (60)

Engineering Track – NPUA	ECTS (hours)	*Bioengineering Track – RAU*	ECTS (hours)
Clinical Engineering	**8 (240)**	**Gene Molecular Engineer.**	**6 (180)**
Biomed. Instrum. & Sensors	**4 (120)**	**Artif. Intel. & Neural Netws**	**4 (120)**
Research Methodology	2 (60)	Radiation Biology	4 (120)
Medical Physics, Radiotherapy,	4 (120)	Bionics, Biocybernetics,	4 (120)

	Radiation Protection		Robotics	
	Health Technology Assessment	2 (60)	Nanotechnologies	4 (120)
	Biomedical Research Methods	2 (60)		
	Master's Thesis	**5 (150)**		
	Subtotal	**31 (930)**		**30 (900)**
4	*Engineering Track – NPUA*	ECTS (hours)	*Bioengineering Track – RAU*	ECTS (hours)
	Diagnostic Radiology	**3 (90)**	**Master's Thesis**	30
	Bionics, Biocybernetics, Robotics	4 (120)		
	Modeling & Simulation	4 (120)		
	Nanotechnologies in Medicine	4 (120)		
	Biomedical Acoustic & Optical Electronics	4 (120)		
	Master's Thesis	**14**		
	Subtotal	**29 (870)**	**Subtotal**	**30 (900)**
	TOTAL			**120 (3600)**

N = courses taught by NPUA; R = courses taught by RAU; A = courses taught by AATM; E = courses taught by European partner institutions. ECTS = European Credit Transfer and Accumulation System.

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New Master's Program in Medical Informatics, eHealth and Telemedicine at the European Campus of Deggendorf Institute of Technology (DIT) in Germany

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With recent advances in Healthcare Information and Communication Technologies, including rapid development of telecommunications, videoconferencing equipment and solutions, special software, and web-based applications, eHealth services in industrialized countries are rapidly moving from sporadic reports and isolated pilot projects to sustainable programs with significant input from and coordination by both governmental (national ministries of health, communication, economy and others) and non-governmental (professional associations and societies) structures [1]. Global regulatory bodies, such as the World Health Organization (WHO), and the International Telecommunication Union (ITU), have formally prioritized development and wider use of eHealth applications and services [2, 3]. The European Commission, having recognized the potential of ICT applications for Health, has adopted a series of Communications to support development and wide implementation of eHealth applications and services both within the member states and in the entire European Union area [4, 5].

Such expansion of usage of eHealth applications and services will require a significant pool of Health ICT specialists to support them. These professionals are traditionally trained in a variety of degree and certificate study programs, either in the formal discipline of Medical or Health Informatics, or in applied fields such as eHealth or telemedicine. There are currently a number of master's programs in medical informatics and several masters' programs in eHealth and/or telemedicine in Europe.

We describe a novel master degree (MSc – Master of Science) program in medical informatics launched in 2015 in Germany, in the federal state of Bavaria, at the European Campus of Deggendorf Institute of Technology.

The Deggendorf Institute of Technology (DIT) is a university of applied sciences (German: Technische Hochschule Deggendorf) founded in 1994. DIT has six Faculties: Applied Economics, Applied Health Sciences, Civil and Construction Engineering, Electrical Engineering and Media Technology, Mechanical Engineering and Mechatronics, and Natural Sciences and Industrial Engineering. Eight technology and two healthcare campuses have been established across the state of Bavaria, where experts work closely with companies for developing business oriented and special technological solutions. The healthcare campuses are involved in current topics like demographic change, nursing, prevention, and health promotion, with special consideration of digitization in the healthcare. DIT has more than 5 500 students (among them more than 500 international students), and 500 staff including 120 professors. The European Campus Rottal-Inn, one of the newer satellites of DIT established in 2015 in South-Eastern Bavaria, is a unique modern teaching facility specializing in undergraduate and postgraduate studies in Applied Health Sciences in cooperation with partners from Armenia, Austria, Czech Republic, Finland, Poland and Spain, among others. All courses have unlimited entries and no tuition fees, and are partially or completely taught in English. Modern collaboration systems and e-learning are fundamental concepts in the study programs.

DIT has for a number of years featured a 210 ECTS bachelor program "Informatik in der Gesundheitswirtschaft" (Informatics in Healthcare Management), with German as a language of tuition. Since October 2015 a new master's program in medical informatics taught in English (MMI – Master's in Medical Informatics) was launched at the European Campus.

The program will run for three semesters to a total of 90 ECTS. It includes the following course modules, grouped into four module groups: Module Group eHealth (Introduction to Medical Informatics with Case Study; eHealth and Telemedicine with Case Study; Standards, Terminology and Classifications in Medicine with Case study; Medical Documentation Systems with Case Study in Hospital Information Systems; eHealth Application Systems with Case Study; Collaborative Systems in Medicine with Case Study International Project Management; and Data Security and Data Protection with Case Study); Module Group Healthcare (International Healthcare Management; and International Healthcare Law); Module Group Research and Methodology (Evidence Based Medicine with Case Study; Health Economics; Medical Statistics and Data Analysis) as well as Soft Skills (Intercultural and Interdisciplinary Communication and other general skills). Table 1 gives an overview of the program curriculum, including distribution of the modules and courses, and their duration and credit weight.

Table I

Master of Medical Informatics (MMI)							
Modules and Courses			Semester-week-hours (SWS) and credits (ECTS*)				
Module Nr.	**Module Group**	**Module** / Course	Module	1st Sem.	2nd Sem.	3rd Sem	**ECTS**
1	**Health Care**	**International Health Care**	**6**				**7**
		International Health Care Management		4			5
		International Health Care Law		2			2
2	**eHealth**	**Medical Informatics**	**4**				**5**
		Introduction Medical Informatics		2			3
		Case Study Medical Informatics		2			2
3	**eHealth**	**eHealth and Telemedicine**	**4**				**6**
		eHealth and Telemedicine		2			4
		Case Study Telemedicine		2			2
4	**eHealth**	**Standards, Terminology and Classification in Medicine**	**4**				**5**
		Standards, Terminology and Classification in Medicine		2			3
		Case Study Standards, Terminology and Classification in Medicine		2			2
5	**Research Methodol.**	**Evidence-Based Medicine**	**6**				**7**
		Evidence-Based Medicine		4			5
		Case Study Evidence-Based Medicine		2			2
6	**eHealth**	**Medical Documentation Systems**	**6**				**7**
		Medical Documentation Systems			4		5
		Case Study Hospital Information System			2		2
7	**eHealth**	**eHealth Application Systems**	**4**				**5**
		eHealth Application Systems			2		3
		Case Study eHealth Application			2		2
8	**Research Methodol.**	**Health Economics and Health Research**	**6**				**7**
		Healthcare Economics			4		5
		Medical Statistics and Data Analysis			2		2

Table I (continued)

Master Medical Informatics (MMI)							
Modules and Courses			Semester-week-hours (SWS) and credits (ECTS*)				
Module Nr.	**Module Group**	**Module** / Course	Module	1st Sem.	2nd Sem.	3rd Sem	**ECTS**
9	**eHealth**	**Collaborative Systems in Medicine**	**4**				**6**
		Collaborative Systems			2		4
		Case Study International Project Management			2		2
10	**eHealth**	**Data Security and Data Protection**	**4**				**5**
		Data Security and Data Protection			2		3
		Case Study Data Security			2		2
11	**Soft Skills**	**Soft Skills**	**6**				**6**
		Intercultural and Interdisciplinary Communication				4	4
		Seminar				2	2
12		**Master Module**					**24**
		Master Thesis and Presentation					24
		Sum SWS	**54**	24	24	6	
		Sum ECTS*		30	30	30	**90**

** ECTS stands for European Credit Transfer and Accumulation System.*

The students will also elaborate and present a master's thesis in the last, third semester.

The MMI program envisages opportunities for distance learning and e-learning, with significant input from academia and industry partners of DIT. For example, we are currently working on developing a schedule of distance lectures on several subjects, to be delivered by specialists from various external higher education and research institutions. Field training and case studies are also the basic concepts of the curriculum.

The MMI program at the European Campus Rottal-Inn of Deggendorf Institute of Technology is expected to become an important contribution to international Healthcare ICT education in Europe.

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Synchronous Seminars Telephysiotherapy Rio de Janeiro: Education Instrument for Physiotherapists

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Introduction

The telehealth is a management tool and strategy on health and education [1]. This mode enables the reduction in area of professional isolation by teleconference and videoconferencing [2]. The use of technology enhances the creation of new knowledge and opening strategic, regional and social development at various educational fields [1, 2]. The use of information and communication technology amplifies the learning spaces and educational transformation [1]. The telehealth comes as a device for mediation and transformation of these work processes in the health field, allowing results and multidisciplinary support [1].

Physical therapy is a science that seeks to develop new learning tools and the emergence of these strategic lifelong learning [1, 2, 3].

The objective of this study is to analyse the application of the synchronous Telephysiotherapy seminars by users of the Center for Telehealth-Rio de Janeiro.

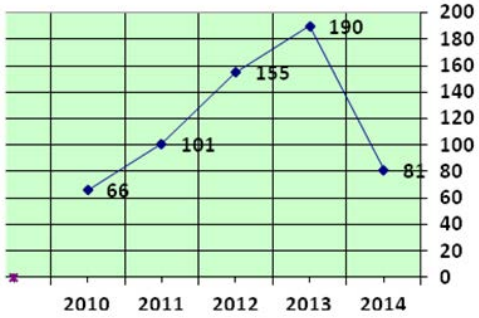
Methods

A retrospective study to assess the inclusion of physiotherapy practices by the Center for Telehealth Rio de Janeiro-based programs in the Pedro Ernesto University Hospital, State University of Rio de Janeiro was performed. Records coming from telehealth database of Rio de Janeiro Nucleus for the years 2010 to 2014. The data collected resulted in analyzes that were divided into workshop mode, number of participants and the access points for this were used.

Data Analysis and Results

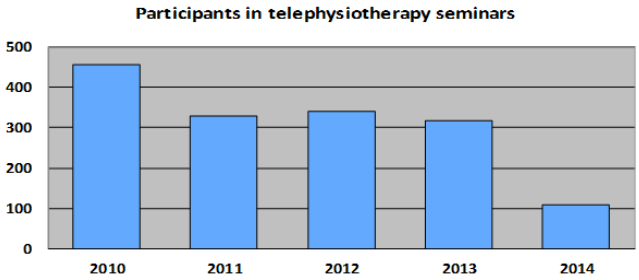
The Telephysiotherapy presented of 1 551 participants of web conferences over the years. 40 seminars were held in real time (synchronous). The access points were 593. The results are summarize in 3 graphics.

Graphic 1 reveals the number of access points throughout Brazil telephysiotherapy seminars in the period 2010-2014.



Graphic 1. Number of hits to telephysiotherapy seminars. The greatest impact observed was in 2013

Graphic 2 shows the share of telephysiotherapy users on a year basis. The total number of

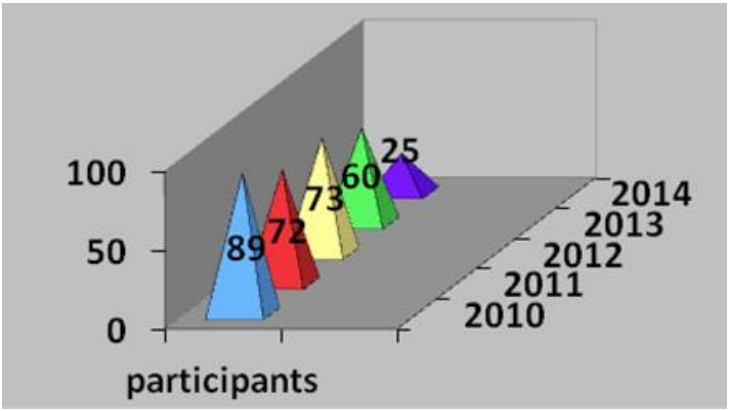


Graphic 2. The share of telephysiotherapy: 1 551 hits in total; 2010 - the most accessible, worst result revealed for 2014

hits is 1 551. 2010 was the most "accessible". A decline in the following years is observed and 2014 exposed the worst result.

Graphic 3 demonstrates the seminars that were mostly attended. In 2010 the seminar on *Kinesiotherapy in hypertension in primary care* was attended by 89 participants. In 2011 the seminar on *Pulmonary*

rehabilitation had 72 participants, while in 2012 the seminar on *Breast cancer: functional recovery - physical therapy and nutritional aspects* had 73 participants. The seminars on *Physiotherapy cardiology: always rehabilitate* in 2013 was attended by 60 participants and *Physiotherapy and SUS principles* (2014) gathered 25 participants.



Graphic 3

Conclusion

The analysis presented shows the impact of using the telephysiotherapy by users of telehealth in Rio de Janeiro, featuring a continuous learning unit for students and physiotherapy professionals.

This study showed that there are still many limitations and challenges in the face of stratified education ideology, generating behaviour modification, action and concepts and attitudes about new means of learning for both students and for their teachers.

The telephysiotherapy seminars proved to be a tool for education, but require improvement and dissemination to obtain greater results from their use in the future.

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Tele-Education as a Support Tool in Combating Abuse of Psychoactive Drugs: A Literature Review

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Introduction

Since the emergence of the Internet, the speed of information flow has increased considerably on a global scale, and both economic and interpersonal relations have been constantly undergoing reformulations and changes, no longer being seen only as a face-to-face relationship. Thus, social networks over the internet have become the largest vehicle of communication between individuals, since the beginning of the XXI century [1]. Social networks can also be seen as a means of non-formal education, as they contribute to teaching and learning. This is the context in which distance education in health operates, contributing to building a collaborative network of communication and establishing links between participants and exchanges of experience based on the reality of each individual.

Concurrent with the increased use of social networking over the internet, the number of people using psychoactive drugs has also increased throughout society and in all social classes. This increase in consumption can be evidenced by the frequency with which we can observe the large number of users on the streets of Brazil. In 2010, the Census conducted by the Brazilian Institute of Geography and Statistics (IBGE) pointed out that 1.2% (2.3 million) of Brazil's population uses or may have already used crack cocaine.

Dependence on psychoactive substances is considered a chronic disease because it often stays with these individuals for life. Faced with these facts, this study aimed to evaluate the use of distance education as a support tool in combating the use of psychoactive drugs.

Methods

This is a descriptive literature survey, in which it was decided to search for articles in national and international journals from 2000 to 2014,

available in the PubMed® database. The following MeSH terms were used: "Telehealth;" "Drug addiction;" "Social Networks." We selected all articles published in Portuguese and English involving the drug user population, and data collection was carried out through social networks over the internet or by phone [2-8]. Literature review articles were excluded.

Data Analysis

The analysis was performed according to year of publication, type of research, data collection instrument used and expected results. Eight articles on the use of social networks as a support tool in combating the abuse of psychoactive drugs were found. Of these, six were selected which fit the criteria.

Results

The results showed that the first publications on the subject occurred in the United States starting in 2006. It was observed that none of the articles used data collection based on social networks over the internet, such as through Facebook®. No research performed on the topic in Brazil was found. Regarding the type of drug, three articles (50%) talked about alcohol abuse, two (33.3%) about tobacco use, and one (16.7%) about opioid use (Fig. 1).

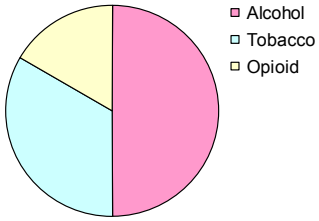

Fig. 1. Type of drugs used by the subjects in the researched articles

In 83.3% of the articles surveyed, five articles used the phone as a data collection mechanism and only one (16.7%) was based on data collection via internet (e-mail). In the studies analyzed, we can see that in none of the items surveyed were online social networks used as a data collection mechanism, and intervention by phone brought improved treatment for most patients with alcohol dependence. Only in one of the articles was there no specific positive effect identified from intervention via social networks. In articles related to tobacco use, the intervention was successful for a 24-week period on average. Meanwhile, the intervention with opioid users showed positive results when followed by medication.

Conclusion

Our findings suggest that distance education can be a powerful mechanism to support reduction or cessation of use of psychoactive drugs, especially if used in conjunction with conventional therapy. Due to the internet becoming the biggest vehicle currently available for information dissemination, this favours social networks (via the internet) establishing themselves as a powerful means of dissemination, and being used as mechanisms of distance education in health, to contribute to reducing psychoactive drug abuse and enhancing individual well-being.

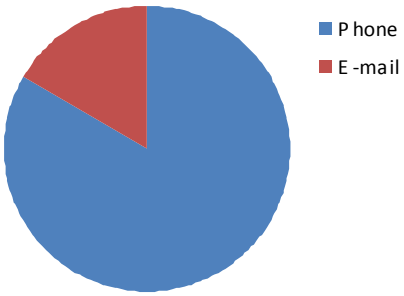

Fig. 2. Data collection mechanism used by researchers in the articles analysed

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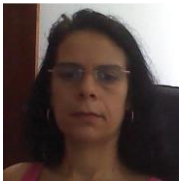

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The Applicability of Yang Content Analysis Model for Assessing Teaching-Learning of Bioethics Process in Asynchronous Online Discussions

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Introduction

Education mediated by technology is a reality, offered at the international level and in every field of knowledge. This network medium promotes student-centered teaching strategies in the process of learning. It is necessary, however, to develop educational pedagogies that are effective, using this medium [1] and not just adapting or simple transferring existing ones.

The development of education mediated by technology happened, roughly, at the same time that several factors culminated in the emergence of a new science: Bioethics, a bridge between the scientific-experimental and the humanistic cultures [2]. Currently we see an increasing number of structures and supply of Bioethics courses, presenting the digital medium as a vehicle of the teaching-learning process.

Specifically, teaching of bioethics intends to lead to the development of cognition and cognitive skills to skilfully consider, foundation and assertiveness [3]. The acquisition of these skills is, therefore, complementary to each other. It is not enough to have a solid theoretical base if we do not have the ability to apply this knowledge to deliberate on an issue, and vice versa [4]: we cannot build an ethical attitude without a theoretical basis, as well as without a previous critical evaluation of the situation. The assessment of the learning process must therefore cover not only the specific cognition but also the necessary skills and competences [5].

The Yang analysis model [6] includes cognitive learning indicators acquired through online asynchronous discussion groups, covering content and skills competencies. The analysis is done by bringing the content argued by the students to the categories and subcategories structured as cognitive learning indicators and cognitive skills, both in scope and in depth learning.

According to Yang, an idea can be classified into different categories [7]. The content of knowledge group **K** (**K**nowledge) assesses learning for the

knowledge of the subject and covers three categories, in ascending order: **FK** (**F**actual **K**nowledge), **CK** (**C**onceptual **K**nowledge), and **PK** (**P**rocedural **K**nowledge). According to the respective subcategories, such indicators correspond to the learning of definitions, guidelines or principles and the method referring to a field of knowledge. The **CS** group (**C**ognitive **S**kills), of the intellectual abilities or skills, encompasses five categories, from the most superficial level to the deepest: **CS-SDS** (**S**haring / **D**escribing / **S**eeking), **CS-ECIC** (**E**xplaining / **C**omparing / **I**nterpreting / **C**larifying), **CS-AC** (**A**nalyzing / **C**oncluding), **CS-A** (**A**pplying) and **CS-C** (**C**reating).

These categories are subdivided, in turn, to one or more subcategories: **FK**: **FK-DT** (**D**efinitions **T**erminologies) and **FK-ON** (**O**ther basic disciplinary details, **N**ew knowledge or information). **CK**: **CK-TM/GPR/CC** (**T**heories, **M**odels, **G**uidelines, **P**rinciples, **R**esearch findings, **C**lassifications, **C**ategories). **PK**: **PK-EC** (**E**valuation processes or methods, **C**riteria or techniques). **CS-SDS**: **CS-SDS-RD** (**R**eferring to, **D**escribing experiences), **CS-SDS-DCS** (**D**escribing assumptions, **C**ommunicating, **S**ummarizing or reporting) and **CS-SDS-OA** (**O**bserving, **A**sking questions). **CS-ECIC**: **CS-ECIC-PSPR** (**P**roviding info or answering questions when asked or prompted, **S**uggesting or providing personal solutions or answers, and etc., **P**roviding or describing opinions or perspectives with explanations or examples, **R**eorganizing knowledge elements in the learning process). **CS-AC**: **CS-AC-CDI/CB/AER** (**C**larifying misconception or misunderstandings of a concept or principle, **D**efining or redefining terms and terminologies, **I**dentifying the linkages or relationships between problems and ideas, **C**omparing, contrasting, or distinguish two or more ideas, opinions, or perspectives, **B**reaking down a complex whole into its elements or parts, **A**ppraising, **E**valuating or assessing ideas, points, or perspectives, **R**eaching or forming a decision or consensus). **CS-A**: **CS-A-DIS** (**D**emonstrating or illustrating the use of a theory, principle, or tool, etc., **I**ntegrating the theories, principles, tools, or research findings into practice, **S**olving problems or suggesting solutions according to a learned theory or principle). **CS-C**: **CS-C-RCD** (**R**aising new ideas for discussion, study, research, etc., **C**reating, constructing, or assembling a new object, concept, perspective, etc. not previously illustrated, **D**esigning or developing an object or project).

Proposition and Methodology

This study proposes the Yang's content analysis model [6] as a methodology to identify the competences of the specific learning of

Bioethics in online courses. We chose to evaluate posts of students in asynchronous discussion groups.

We work with the results of forums of an experimental online course of Bioethics, covering basics notions, developed from October to December 2011. The course was offered to professionals from various fields, interested in deepening the theme of the beginning of human life. The duration was 8 weeks, with themes distributed in 4 modules, during 2 weeks each one. In each module, one or more discussion forums on the theme were opened.

Analysis of Results and Discussion

Considering the usually presented skills as goal of bioethics learning in continuing education courses [5], one can trace it to the Yang's model subcategories. A few examples, are giving below, from student 2A posts, relating skills to subcategories:

Employ basics notions of bioethics and apply in individual cases:

Creating, constructing, or assembling a new object, concept, perspective, etc. not previously illustrated, **CS-C-RCD** - ***About genetic selection, it goes against all principles of Personalist Bioethics. First principle about the defense of life: even if parents want to fight to save the life of the eldest daughter, other children (embryos) were sacrificed to achieve this chance; Second principle of freedom and responsibility: the act of the parents and the doctor give precedents for new techniques of manipulation of embryos to be carried out, although the parents were not completely enlightened about the consequences of this act; Third therapeutic principle: on one hand, they are seeking solution to the illness of the eldest daughter, but on the other, the removal of a cell from the healthy embryo can be missed.***

Identify and analyze cases / ethical issues that occur frequently (in their ambience professional):

Reaching, **CS-AC-CDI/CB/AER** - ***The fact is that the embryo already is a being of the human species with a genetic code that allows him to form a physical body by the end of the 10th week of pregnancy (from then his body is already formed, only grow). And therefore, stop this pregnancy is an act that is against the principle of defense of life.***

Identify possible solutions to ethical dilemmas providing reasons as justification:

Reaching or forming a decision or consensus, **A**ppraising, **CS-AC-CDI/CB/AER** - ***Indeed, it is a complex and controversial issue. Once life begins at the moment of fertilization, its discontinuation in any period***

over time, whether in prenatal, postnatal or late can be considered murder.

Collaborate with colleagues from other areas to address ethical issues:

(Post of another student, 4A – ***Another (ethic) issue about freedom and responsibility, we see in scientific publications, even science has become dangerous. The "scientifically proven" in many cases is not as proven as it seems***…)

Referring to, **CS-SDS-RD** - ***I agree with 4A, there is a certain danger in scientific evidence.***

Providing information or answering questions, CS-ECIC-PSPR - ***Most of the population does not have critical sense about the results of certain studies that are often exposed in the media.***

Reaching or forming a decision or consensus, **A**ppraising, **CS-AC-CDI/CB/AER** – ***In this sense that was "scientifically proven" becomes an absolute truth.***

Predict and take into account issues that could arise in the future:

Evaluating or assessing ideas, points, or perspectives, **CS-AC-CDI/CB/AER** - ***These women certainly do not believe they are "killing" a person. On the other hand, they must carry this tragic memory, even if unconsciously.***

R*aising new ideas for discussion, study, research, etc.*

CS-C-RCD - ***What will happen to this second daughter, considering their physical, psychological and spiritual dimensions?***

Conclusions

The Yang's model cover more fully the competences related to the content but also the cognitive skills, that allows assessing learning in the field of bioethics, in order to point the capacity and depth of personal reflections, when actually manifest in asynchronous discussion groups.

We expressed the thanks to CAPES for research assistance in the form of the support, to the stage developed at the Faculty of Medicine, University of Zaragoza, as well as the attention provided by Professor Dr. Rogelio Altisent.

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Using Online Social Networks as a Support Tool to Reduce Psychoactive Drug Abuse

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Introduction

In Brazil, the use of psychoactive drugs is growing, in particular, the use of crack cocaine. The Brazilian Association for Studies of Alcohol and Other Drugs (ABEAD) [1] states that the psychoactive drugs most widely and frequently used are: marijuana, hashish, cocaine, crack, ecstasy, amphetamines, alcohol, tobacco, benzodiazepines and other tranquilizers. At the same time, a large increase can be noted in the number of people using the internet worldwide, increasing the flow of information on a global scale. Economic and interpersonal relations, which in the past required personal contact, have continually undergone reformulations and changes, and may often occur today in the virtual environment. Currently, many drug users in Brazil have difficulty in accessing units of the Psycho-Social Services Center – Drugs & Alcohol (CAPS-ad) [*Centro de Atenção Psicossocial – Álcool e Drogas*] of Brazil's Unified Health System (SUS) to initiate treatment and get free from addiction [2-5].

The objectives of this study were: to create a group called "Getting Free from Drugs" (FLD) [*Ficar Livre das Drogas*] on an online social network where users of psychoactive drugs could sign up for treatment, and to evaluate the efficiency of drug users signing up via online social networks.

Methods

This is a qualitative and descriptive study approved by the Research Ethics Committee, where the sample consisted of psychoactive drug users in the city of Rio de Janeiro, who have Internet access, and who voluntarily seek help by accessing the FLD group. The setting for the study was a group created on Facebook, with data collected via an online form.

Data Analysis and Results

From July to September 2015, there were 25 visits to the group, of which 16 later visited the CAPS-ad to initiate treatment after receiving information from the group. Most visits (13) occurred in the evening and during August 2015 (Fig.1).

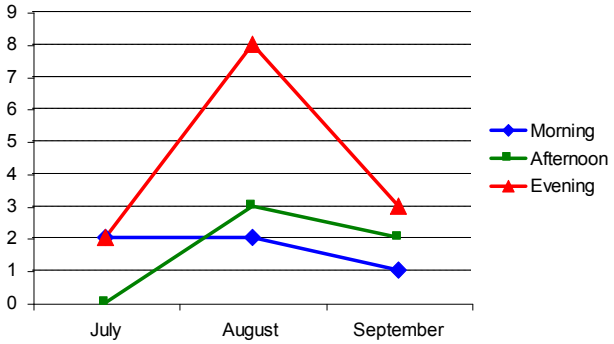

Fig. 1. Time of access to the "Getting Free from Drugs" group

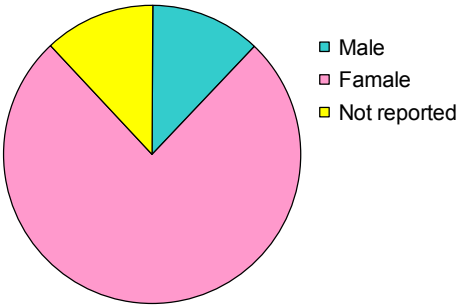

Fig. 2. Classification of subjects by sex

The patients took a minimum of one day and a maximum of 40 days from the first contact with the researcher until their first visit to the CAPS-ad, with an average of 8.4 days.

Regarding the sex of all participants in the "Getting Free from Drugs" group, the majority were female (Fig. 2). Among the three male users, one-third did not visit the CAPS-ad, while among the 19 female users, five did

not visit the CAPS-ad. There were also 3 subjects who visited the page but who did not report their name or sex on the form.

Three types of drugs were prevalent: alcohol, tobacco and other drugs not specified. The highest incidence was exclusive use of alcohol, followed by other drugs. There was also an association between alcohol and tobacco and between alcohol, tobacco and other drugs (Table 1).

Table 1. Type of drug used

Type of drugs	Percentage
Alcohol	62.5%
Other Drugs	12.5%
Tabacco	6.25%
Alcohol + Tabacco	6.25%
Alcohol + Tabacco + Other Drugs	12.5%

All subjects who used tobacco reported having already used nicotine patches and gum to try to cease smoking, but had been unsuccessful. Some alcohol-using patients reported having used religious support groups as a joint treatment. The other patients reported not having used any type of prior treatment (Table 2).

Table 2 Joint or previous therapies

No of subjects	Type of drugs	Therapy used
3	Alcohol + Tobacco Alcohol + Tobacco + Other Drugs	Nicotine patches or gum
1	Alcohol	Religious support group therapy
12	Tobacco + Alcohol Alcohol + Tobacco + Other Drugs Alcohol + Tobacco + Other Drugs	No previous therapy or joint therapy

Asked about the treatment they wished to receive, 18.75% (3 subjects) reported that hospitalization would be a good choice, given that they find themselves every day in places which favour their addiction, with friends, family and other users; 75% (12 subjects) did not express a preference for a

specific treatment; 18.75% (3 subjects) believed that a treatment using medications would the ideal for their problem; and 6.25% (1 subject) believed that psychological counselling would be the solution to their problems.

Conclusion

Our results indicate that online social networks constitute an important tool to support combating the abuse of psychoactive drugs and can thus be used as an educational mechanism in patient health care and outreach.

The CAPS-ad is the leading public institution for treating people with disorders resulting from abuse of psychoactive drugs. However, this institution still has problems regarding dissemination of information about the services which it provides.

Our findings suggest that strengthening the dissemination of information about drug treatments and about the CAPS-ad through diverse means of communication, including online social networks, can be a way to improve patient health care and outreach, since patients in Rio de Janeiro are unaware of the availability of these free psychosocial care services at the CAPS-ad.

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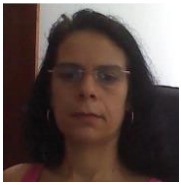

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WhatsApp Telemedicine a Growing Field: A Literature Review

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Introduction

The smartphone is playing a growing role in telemedicine. Healthcare professionals are finding ways of using their phones and applications (apps) to develop their own telemedicine services. Several spontaneous telemedicine services using WhatsApp Messenger have started in our province in South Africa, most notably in burn wound triage and management, and dermatology [1]. These services were unplanned and started because junior staff initially saw the benefit of taking photographs with their smartphones and sending them to their seniors or other specialists using WhatsApp.

Initial analysis of these services noted potential legal and regulatory problems related to confidentiality of patient information, data security during transmission, data storage, record keeping and evidence of consent. As WhatsApp has over one billion users it may well become a convenient, low cost means of implementing telemedicine services, particularly in rural areas of the developing world.

The aim of this paper was to undertake a descriptive scoping review of the literature on the use of WhatsApp in clinical medicine.

Methods

The following databases were searched, PubMed, Science Direct, IEE Expert and Google Scholar. The search terms were "WhatsApp [All Fields]" for Pubmed, "WhatsApp" for Science Direct and IEE Expert, and WhatsApp AND telemedicine, and WhatsApp AND mHealth for Google Scholar. The first 100 hits were reviewed for each of the two Google Scholar searches. Inclusion criteria were that the paper described the use of WhatsApp in a telemedicine context. Papers describing the use of WhatsApp for teaching or social support in weight loss, exercise or similar programmes were excluded. Abstracts were reviewed for relevance, duplicates removed, and the remaining full text papers read.

Results

After initial abstract review 58 papers were retrieved and 32 met the inclusion criteria. They originated from ten countries: India (12), UK (5), Italy

(4), Saudi Arabia (3), Spain (2), Turkey (2), Brazil (1), Netherlands (1), Philippines (1), USA (1). They were made up of 13 papers, eight letters (three of which were responses to a paper), seven case reports and four abstracts. Disciplines reported were orthopaedic surgery (7), surgery (5) (three of which were letters in response to a paper), maxilla-facial surgery (3), plastic surgery (2), urology (2), dermatology (2), cardiology (1), critical care (1), cardiac surgery (1), stroke (1), palliative home care (1), paediatric surgery (1), neurosurgery (1), diabetic retinopathy screening (1), oral medicine (1), allergy (1), and laboratory services (1).

The use of WhatsApp groups were reported in 17 papers three of which were letters in response to a paper and one service was reported twice. Of the thirteen remaining reports all were in surgical disciplines, except for a survey of dermatologists involved in several groups. All of the services are confined to intradepartmental communication across a range of aspects, from second opinion, updates of patient admission and changes in treatment, theatre scheduling, sharing of X-rays and photographs (on admission and pre and postoperative), scheduling of academic meetings, and sharing of educational materials such as papers. Five were from India, two from the UK, two from Italy, two from Saudi Arabia and one each from Spain and the Philippines. Seven of the services reported routine use of WhatsApp for communication (three in India, two in Italy, and one each in Spain and Saudi Arabia).

There were seven case reports, six of which were from India and one from Saudi Arabia. Six clinical services, other than intradepartmental groups, included: a diabetic retinopathy service in India that used a fundal camera attached to a smartphone, a triage service for oral and dental pathology in Italy, an after-hours second opinion service for emergency maxillofacial injuries in Turkey, an emergency cardiology programme in Turkey, and patients in Spain using WhatsApp to contact their allergist. An overview of use of surgical apps in clinical practice mentions the use of WhatsApp by a paediatric surgeon in South Africa.

Five papers dealt with consent. Four were group services and in only three was consent actually obtained for clinical photography and sharing of information within the group [2, 3, 4]. A survey of dermatologists involved in one or more groups noted that ideally consent should be obtained. Two of the papers reported plastic surgery groups, with one dermatology and one orthopaedic group, specialties that commonly take clinical photographs. Patients should not only consent to their photographs being taken but also to their information being sent by WhatsApp [5]. Confidentiality was addressed in 18 papers, seven of which identified it as a challenge or proposed ways of maintaining confidentiality. In the 11 services that discussed confi-

dentiality, 10 were in WhatsApp groups. Actions taken were to: de-identify patients; minimise patient identifiers; identify patients by ward, bed number, procedure and specialist or by date of surgery and place on the operating list; password protecting the phone or phone and WhatsApp; and keeping communication only within the group.

Nine papers mentioned data security in terms of using secure wireless networks, end to end encryption, deleting messages from the phones, and password use. One paper from India felt that the steps taken in their service made them HIPAA compliant [6]. The security issues around WhatsApp were addressed in two papers [7, 8].

Governance issues were raised in four papers.

Discussion

Social media has exposed many people to sharing comments and photographs using their smartphones. WhatsApp is a free communication application with more than one billion users. Its ubiquity and ease of use has enabled healthcare professionals to find ways in which it can facilitate their everyday practice, from replacing pagers, to rapid store and forward telemedicine within groups, to sharing administrative information.

Users have been enthusiastic about the benefits of WhatsApp, such as improved communication [9], no longer having to be at a computer for store and forward telemedicine either at home or at work, rapid advice from a number of more senior colleagues [10], flattening of the hierarchy within clinical services [8], faster daily handover meetings, and improved team function. One of the unstated advantages of WhatsApp is the ability to enlarge images without loss of resolution. Negative comments include, government opposition [8], having to be online all the time, inability to print a record of the interaction [2], problems identifying which patient is being discussed after identifiers have been reduced or removed, frequent disturbance, a disparity between what is considered urgent by doctors and nurses [6], and potential loss of autonomy of registrars because of direct intervention of senior specialists [8].

What is apparent is that few clinicians understand how WhatsApp works and what has to be done to maintain confidentiality and data security. A WhatsApp message is sent to a server, which may or may not be in the same country. The server then attempts to send the message to the recipient. If and when the recipient is available the message is forwarded and deleted from the server. If the message has not been forwarded it is deleted from the server after one month. Data are encrypted during transmission to the server and recipient on Android phones. It is not clear whether end to end encryp-

tion has been activated for phones using iOS or Windows operating systems.

Security is linked to confidentiality and vice versa. Within chat groups doctors have experienced difficulty in identifying which patient is being discussed after de-identification or reduction of identifiers. Strategies like using the ward and bed numbers are not valid means of maintaining confidentiality. When WhatsApp is used for store and forward telemedicine with a doctor to doctor interaction this is less of a problem. In both situations keeping adequate records of the consultation or advice given is required but not described.

The inability to print records of the chat was noted as a disadvantage of using WhatsApp [2], but it is possible to email the chat group messages so that a paper record can be kept. It has been argued that the chats are a form of electronic medical record and that "…lost x-rays are a thing of the past" [9].

Ideally, however, there should be no patient data stored on a phone. Some have advocated deleting messages after a given period [8, 5] while others have noted the benefits of having patient data permanently stored [9]. Drake maintains that the data remains stored on distant servers and could be retrieved using specialist techniques [7]. Approaches to security that involve passwords, use of hospital wireless networks or sending messages only to members of the group are also inappropriate as they fail to appreciate the data transmission process.

That WhatsApp has been mostly reported from the developing world is probably an indication of the more stringent regulation of confidentiality and data storage in the developed world. As Senthoo Pandian noted, " There are no clear guidelines for patient confidentiality from both the Dental Council and Medical Council of India currently and as such is less of an issue in India as compared to the developed countries" [9].

The WhatsApp services noted in South Africa did not involve WhatsApp groups, but direct doctor to doctor communication about a patient. The only similar reports were on emergency triage following cardiac events in Turkey [11], and emergency triage of maxillofacial trauma in Turkey [10]. These made no mention of confidentiality, consent or data storage.

Conclusions

WhatsApp is being used, both for group chats within departments and doctor to doctor telemedicine. The literature shows a general lack of understanding of how data are transmitted and stored when using WhatsApp and the effect that this may have on attempts to maintain confidentiality and data security. That so few papers report valid means of maintaining confi-

dentiality and data security is indicative of this. WhatsApp holds great promise for the developing world because it is freely available and commonly used outside of medicine as are other similar apps. Guidelines need to be developed to assist users in addressing medico-legal and ethical concerns when using WhatsApp or similar communication apps.

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Home Healthcare & Remote Patient Monitoring

A Diabetic Patients Remote Monitoring System in a Rural Community of Brazil: A Report of the Technological Implementation

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Abstract: **A Rural Hospital is being restructured in Southern Brazil. With the dissemination of new technologies in favor of the health sector, an innovative Tele-Diabetes project is being implemented in the Centro de Saúde São João da Reserva Hospital - CSR, delivering to the patients a real-time monitoring of their blood glucose level, in a Pilot phase.**

Introduction

Around 347 million inhabitants around the world have Diabetes, with an estimate 1.5 million deaths in 2012 [1]. The World Health Organization (WHO) estimates that deaths due to Diabetes will double between 2005 and 2030 and its frequency is rising drastically all over the world [2].

Besides, diabetes is a major cause of premature illness and death in most countries, mainly through the increased risk of heart disease and is a leading cause of blindness, amputation, kidney failure, as well as, endothelial dysfunction and oxidative stress. Apart of the average blood glucose concentration, blood glucose variability can be a major factor in the development of chronic diabetes complications [2 - 3].

Considering this negative information, the CSR, a rural hospital located in southern Brazil, in the city of Sao Lourenço do Sul, RS [Fig.1], is implementing a new model of health assistance among the inhabitants. A Tele-Diabetes monitoring method is part of this initiative.

Fig. 1. Map of RS State and City of Sao Lourenço do Sul

Objectives

The project´s aims are: 1. To implement the technical infrastructure of the Tele-Diabetes network in the CSR, 2. To ensure that health care professionals of the Institution can analyze the clinical data of patients in the CSR server database.

Method

The method includes the acquisition and implementation of a software license for the management of diabetic patients, developed by Mediinspect©, from the Czech Republic.

The project offers immediate analysis of patients' glucose level, through homecare Tele-Diabetes strategy. For this study, during 6 months (October 2015 – March 2016), 10 diabetic patients, living in the rural region, were selected after some technical evaluation, such as: 1. Internet coverage, 2. Basic skills for managing new technologies.

Each patient received 2 devices: A digital glucose meter with strips and lancets, and a smartphone. Twice a day, the patient sends the glucose data to the Tele-Diabetes Center in the CSR, where a nurse is receiving and analyzing, in real time, the patients' data. A Medical Doctor and a Nutritionist are also available for providing counseling to patients that have severe hyperglycemia and/or hypoglycemia.

The technical implementation of this project, as well as the ongoing technical support, is provided by the author Robert Timm, IT expert, in a cooperation with Mediinspect© professionals.

The CSR Tele-Diabetes Center is equipped with the following items: Server, Desktop, 5 MB Internet Connection, a 60" LCD TV, Printer [Fig. 2].

Fig. 2. The Tele-Diabetes Center

Fig. 3. The Server

The Server consists of the following configuration: Linux, MySQL, Apache, PHP, Mediinspect software [Fig. 3].

Results

After 6 months of this Pilot Project, the clinical data about the follow-up of the current 10 diabetic patients, as well as comorbidities, will be available to the nursing and medical staff of the CSR [Fig. 4].

In this way, the technical infrastructure of the CSR will allow the expansion of this project, moving it to a new level, with a higher amount of patients monitored in the CSR.

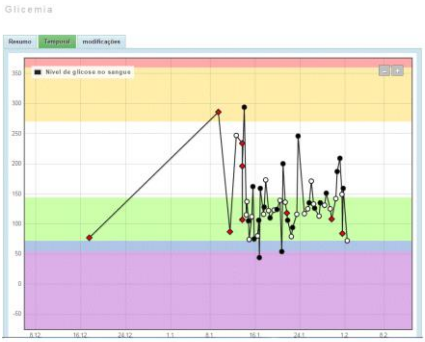

Fig. 4. Graphic View of Blood Glucose Levels

Also, the Pilot Project has been a unique opportunity for the professionals of the CSR for the acquisition of knowledge and evaluation of new concepts, both in the technological and health sectors.

Conclusions

With almost half a billion smartphones sold around the world, mobile health applications - mHealth - are becoming ease-of-use tools for different populations, offering self-management of chronic diseases and also allowing to improve communication between the health institution and the patient [4-5].

Telemedicine strategies can highly contribute to the achievement of remote specialized medical advice in order to improve patients' care. The contribution of qualified multicentre professionals, including advice from IT professionals towards the implementation of Telemedicine projects, can play a major role for the success of the CSR rural eHealth project.

This innovative project is a starting point with a premise of a new concept of health prevention and assistance, which includes Tele-Diabetes as a key component of some new eHealth strategies.

Acknowledgments

The authors greatly acknowledge the CSR Hospital and Mediinspect© professionals for their cooperation and support during this pilot project.

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Reducing Hb1Ac Marker by Providing Telemedicine Support to Patients with Diabetes Type 2 at Home

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Introduction

Careful control of blood glucose levels in patients with type 2 diabetes (DM2) can significantly decrease the risk of developing complications. They are strongly correlated with elevated glycated haemoglobin (HbA1c) marker. A drop of 1% in HbA1c can result in reduction of risk of diabetic complications [1], i.e.:

- 21% for deaths;
- 14% for myocardial infarction;
- 37% for microvascular complications.

Thus, any reduction in HbA1c is likely to reduce the risk of complications.

With adequate blood glucose control we tend to keep HbA1c values in the normal range (<6.0%) [2]. A target HbA1c should be negotiated individually, but a level close to 7% (53 mmol/mol) seems to be an acceptable compromise for the majority of people with DM2 [2-3].

Very intensive glycaemic control is associated with increased risks e.g. hypoglycaemia, weight gain and possibly increased risk of mortality. Early intervention is beneficial, so the glycaemic control system in place should make data available. Long-term use of the home glucose telemonitoring (telehealth) system has proven to be superior to conventional diabetes care systems based on office visits for controlling blood glucose and achieving glucose stability [4].

A TM service network to support DM2 patients was set-up in Slovenia within the United4Health European project (www.united4health.eu) [5]. Within the project there were eight other centres (Scotland, Wales, Northwest Moravia, Campania, Italy, Cosenza, Calabria, Thessaly (Central

Greece) and Berlin) offering TM support to DM2 patients for their self-management at home. In this study only partial results for Slovenia are presented. Results of the other 8 TM centres participating in the United4Health will be published elsewhere.

Objective

The objective of this study was to investigate the effectiveness of using the telemedicine support on HbA1c level control in patients with DM2.

Methods

The telemedicine support service for DM2 patients consisted of blood glucose measurement taken by the enrolled patients at home using a glucometer (Cignus Profiline TM-TD4279 BT) with a built-in Bluetooth interface. One day per week the whole daily blood glucose profile was performed.

The measured values were sent to a gateway (a smartphone with app) and from there over the Internet to a server in the General Hospital Slovenj Gradec. The server software checked the incoming data for validity and proper time sequence. In a case of exceeding predefined (personalised) interval of glucose values medical staff was informed.

Regular and timely data allowed a diabetologist on duty to intervene when needed. The patient received an advice or a change in therapy based on blood glucose measurements.

Two groups of patients were formed. The intervention group consisted of 321 DM2 patients used the TM service for 360 days in average (17 patients less than 180 days). The control group (401 patients) was combined by the patients in the intervention group in the period of one year prior to inclusion into the service, and additional 80 patients who were not supported by TM.

The intervention and the control groups were compared against the level of HbA1c marker. It was measured in a clinical laboratory at the beginning of the control period (all patients), at the end of the control period (all) and at the end of the observation period (intervention group only). Beside the TM service, the patients in both groups received equal standard diabetic treatment.

Results

In the control group the level of HbA1c marker changed from 7.8% at the beginning to 7.9% at the end of the observed control period. This change was statistically not significant.

In the intervention group the level of HbA1c marker was reduced from 7.9% at the beginning to 7.4% at the end of the observed intervention period.

Encouraged by the above results a subgroup of 140 patients from intervention group having HbA1c >8% was further investigated. In this subgroup the HbA1c changed from 9.2% at the beginning to 8.0% at the end of the observed intervention period.

Frequency distribution of patients against HbA1c level was calculated. Previously homogenous group (HbA1c >8%) divided into three groups:

48% of the patients migrated to the group 7-8% and 12% to the group with HbA1c less than 7%.

Discussion

The above described telemedicine support to DM2 patients has considerable influence on reduction of HbA1c level. Lower HbA1c values directly reduce risks of developing complications.

The DM2 patients in the intervention group were empowered as they received a feedback support from the medical staff at the TM centre thus being aware of their blood glucose results and eventually the needs for change in medication. Empowered patient is an equal partner in relationship with his/her doctor at self-management of diabetes at home. Providing the telemedicine service the patient and his relatives receive additional support during the treatment to improve his health condition.

Conclusion

The results in the intervention group demonstrate a substantial reduction in the HbA1c level which was attributed to the efficient TM support service model. Patients with poorly controlled diabetes (HbA1c >8%) gained most from TM support service.

The results obtained are encouraging for further investigations of glycaemic control by targeting glucose variability and associated effects on HbA1c.

Acknowledgements

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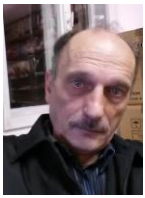

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Reducing Hospitalisation by Providing Telemedicine Support to CHF Patients at Home in Slovenia

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Introduction

In several scientific publications authors suggest that telemonitoring provides a potentially useful tool for disease and case management in those patients who are likely to benefit from frequent and regular monitoring by health care providers. Almost all studies state that telemedicine provided as telemonitoring can be an effective add-on tool for managing elderly patients with heart failure. Researchers tend besides measuring clinical outcomes also assess economic impacts in terms of hospital admission rate, readmission rates, and total cost of care [1]. Comín-Colet and co-authors [2] report that a telemedicine group of 178 chronic heart failure patients experienced a significant mean net reduction in direct hospital costs of €3.546 per patient per six months of follow-up. Number of hospital admissions and number of hospital days per year are often considered a direct indicator that could potentially demonstrate economic benefits of telemedicine services.

A telemedicine support service (TM) to patients with Congestive Heart Failure (CHF) living at home was set-up in 2014 in Slovenia [3] within the United4Health European project (www.united4health.eu) [4].

The service is provided by a regional General Hospital of Slovenj Gradec since April 2014 within Carinthia region, Slovenia. Within the United4Health project there were three other centres (NHS24 in Scotland, Kronikgune in Basque Country and GH Olomouc in Northwest Moravia) offering TM support to CHF patients for their self-management at home. Number of admissions (readmissions) to the hospital related to decompensated heart failure and duration of hospitalisation (hospital days) were the primary clinical outcomes observed in United4Health.

This paper deals only with the outcome in Slovenia, while results on the project level will be published elsewhere.

Methods

A retrospective analysis of hospitalisations in the last 2 years was done for a group of 134 CHF patients using the newly established TM support (intervention group) where the primary diagnose at hospitalisation was CHF. The comparator group was the observed group itself, but in the period of one year prior to inclusion into the TM service. Data on date of hospitalisation and its duration were exported from the hospital information system (HIS). The intervention group was using the TM support service in average 402 days (16 patients less than 280 days). In the observed period patients in both groups received equal standard support through the existing long-term care programme. That involved self-care management measures involving daily measurements of weight, blood pressure and heart rate.

After enrolment in the TM programme all the patients continued doing their daily measurements at home. Changes for the patients introduced in the intervention period were:

- Their standard devices were replaced by their modern equivalents containing a Blue-tooth interface;
- They were provided blood oxygen saturation meters for additional measurement and
- They received additional support from the TM centre in case of deterioration of their health condition.

This was assessed by the TM centre staff using telemetrically collected data that were after each measurement automatically (within a minute) sent to a hospital server without any patient's intervention.

The received data values were compared by the server telemedicine application against set thresholds and trends. If the received data exceeded the individually set threshold limits (set by the medical specialist), a telemedicine centre coordinator (a nurse) received a warning email. The coordinator called the patient by phone to get more information on the background of the out-of-range data values. The measurements were repeated if there is any doubt on data reliability. If the measurements confirmed a deteriorated condition, or they are indicated by the patient him/herself, the coordinator consulted a specialist on duty and informed him/her on the findings. The specialist decided on action to be taken by the patient itself. This could be: advice, change in medication / treatment, a visit to his/her GP, a visit to the hospital clinic during regular working hours, or an emergency visit to the hospital. The information was conveyed to the patient by the coordinator over a phone, and later as a written report by a

surface mail. Every phone call, advice, change in therapy, home visit or other action were registered in the patient's electronic record.

Results

In the period of two years (one year prior to enrolment into TM support service and one year of using TM service) the cohort was hospitalised for 390.5 days with CHF as the primary diagnose. Of those hospitalisations 316.7 days were in the control period and only 73.8 days in the intervention period. Number of admissions (readmissions) was 46 in the control and 13 in the intervention period.

The results demonstrate a substantial reduction in duration of hospitalisation for the patients in the intervention period (from 2.36 days/year/patient to 0.55 days ($p<0.001$)) and a reduction in number of admissions (readmissions) to the hospital (from 0.34 times per year per patient to 0.1 ($p<0.001$)).

Discussion

Many publications report reduced mortality and hospitalisation due to home telemonitoring of CHF patients [5]. But telemonitoring itself is only one part of delivering telemedicine to support CHF patients at their self-management at home. The other, even more important part is a strong response system established to reacts to health deteriorations sensed by the telemonitoring system. Firstly, there is a consultation in place that is initiated by the medical staff at the TM centre. Secondly, the above described telemedicine service inherently includes a process of therapy adjustment according to the patient's needs or an invitation to enter the traditional clinical pathway if health conditions deteriorate. The response happens within one to two days in case of drastic changes or in four to five days when there was only a worsening trend indicated. A decision for an action is taken by the medical staff and not by the patient. It is known that many patients (not TM supported) wait too long before deciding to make any step towards potential health improvements. Consequently many are hospitalised because any other intervention comes too late.

Many experts including the pioneers in the area of TM in Slovenia believe that the observed reductions in number of hospitalisations and number of hospital days in the intervention group is a result of effective performance of the established response system and an adequate patient support. Carefully planned "above-standard" support to CHF patients potentially combined with nurse home visiting offer a good prevention that brings benefit to CHF patients and consequently to all other stakeholders

involved, namely their cares, healthcare professionals and healthcare service payers (health insurance system).

The reported reductions have also economic consequences for the hospital and also for healthcare service payers. These economic consequences should be studied separately.

Conclusions

Telemonitoring of CHF patients as a part of a self-management scheme is effective in reduction of number of admissions (readmissions) and number of hospital days, if having an immediate response system from healthcare workers integrated into the TM service that reacts to the health deterioration events revealed by the telemonitoring system. The reported reductions have economic consequences for a hospital that covers the living area of CHF patients and also for healthcare service payers (health insurance system). These economic consequences should be studied separately.

Acknowledgements

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Tele Monitoring Home Program in Patients with Cystic Fibrosis: Results after 15 Years

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Introduction

Cystic Fibrosis (CF) is a genetic, hereditary and chronic disease, widespread among the Caucasian population, resulting in fatal outcome. It affects about one child every 1 500 births. The defect consists in production of an abnormal protein, Cystic Fibrosis Transmembrane Regulator (CFTR) that regulates the amount of salts secreted in body fluids. The effect is thickening of mucus with impaired activity of many systems (digestive, respiratory, endocrine, reproductive organs etc.).

The Natural history of CF is characterized by recurrent episodes of respiratory infection, with progressive pulmonary damage and decay of long-term lung function leading to death. Goal of home follow-up is (short-term) prevention and control of lung infections and (long-term) slow down the decline of pulmonary function.

To follow the course of lung function in CF, spirometry is commonly used. The trend is a 2% /year decrease of FEV1 (forced expiratory volume) and a long-term decrease of FVC (current Volume) [1].

In case of infectious relapse, modifications of pulmonary function often precede the clinical symptoms [2].

An early antibiotic treatment can prevent more serious complications, limits the pulmonary damage in the long term and allows less invasive (oral) antibiotic therapies [3].

Since 2001, in CF Centre of the Pediatric Hospital Bambino Gesù in Rome, the possibility of using telemedicine in order to facilitate the home follow-up of patients with CF was tested.

Methods

A clinical diagnosis of CF was given in all subjects, confirmed by study of CFTR (Cystic Fibrosis Transmembrane Conductance Regulator) gene and by sweat test.

We improved the procedure through our daily experience in tele homecare. We described the way we daily act in remote tracking of CF outpatients [4].

At Home, in the morning, after chest FKT and answering a questionnaire about pulmonary subjective symptoms, patients perform a data transmission. The recommended frequency is twice a week. Patient may autonomously decide to send data.

In Hospital, healthcare professionals daily download the data in a protected way, interpret the data through the application software, print and store every transmission in a paper archive. Application Software provides spirometry curves and main parameters (FEV1, FVC, PEF, and FEF25-75) as well as a graph of the night SaO2 (mean, minimum and maximum SaO2, T90 and T89).

As intervention parameters, we consider significant an acute shortfalls of FEV1 (>10% compared to previous values recorded in stable clinical conditions) and reductions below 90% of the maximum value of oxygen haemoglobin saturation and of mean SaO2 so as an increase of T90.

The decisional flow is as follows: patients with significant decrease of SaO2 and/or FEV1 are invited to transmit soon further test. In some cases antibiotic home therapy is prescribed on the basis of the last sputum culture collected in hospital. In other cases patients are invited for a clinical evaluation, to perform further testing, or to be admitted. In any case the next data transmission is scheduled.

We followed and treated patients included in THC program with the usual protocols, similar to those who do not practice [5].

Results

The study has involved totally 55 patients (35 female, 20 male) affected by CF, followed at our Unit with THC, for a total period of 15 years.

The balance of enrolment showed a 44, 23% drop-out, whose main cause was poor adherence (60, 87%).

We used various equipment in this period, also following the progress of technology in this field. The evolution of technology in respiratory telemedicine is described in Figure 1.

The Oxytel experience is described in Tab.1.

The Spirotel experience from 2010 is described in Table 2 and 3

The Intel experience is showed in Table 4.

Fig. 1

Oxytel – OBG experience (2001-2005)

n. of treated patients	17
Male/Female	6/11
Age at the beginning Years (mean ± sd)	15.74 ± 5.8
FEV1 at the beginning % of exp. value (mean±sd)	67.48 ± 21.28
Follow-up duration Months (mean±sd)	29.30 ± 13.32

Table 1

Spirotel-Summary to	13/07/2015							
period	2010	2011	2012	2013	2014	2015		Total
patients n.	30	29,7	26,5	24,6	25,1	29		27,5
days	226	257	243	235	249	132		1342
transmissions	466	669	831	868	1029	1789		5652
spyrometry	554	985	1060	957	952	856		5364
pulse oximetry	162	211	292	168	62	138		1033
symptoms		255	709	755	794	201		2714
adherence	23,19	23,00	32,34	37,41	41,19	61,26		
phone calls	420	592	745	672	669	655		3753
answers			618	564	573	528		2283
answers/calls			82,95%	83,93%	85,65%	80,61%		83,29%
inpatients n.	8	15	49	38	35	27		172

Table 2

The ADIPED experience is showed in Table 5.

Discussion

In Oxitel study, the results in THC treated subjects compared to controls showed a statistically significant decrease of outpatient accesses, an increase of therapy cycles and a trend of higher stability of the respiratory function. We concluded that tele homecare seemed to increase in general the rate of access to health care without any clear effect of pulmonary function.

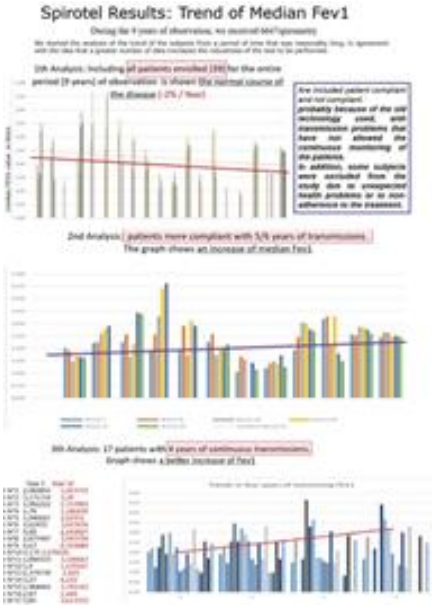


Table 3

Patients followed in telemedicine showed in general a lower decay of respiratory function compared to those in follow-up only with the traditional method.

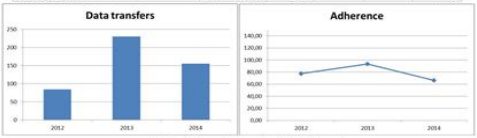
The data show an increase of examinations sent although the number of patients in remote monitoring has remained virtually constant.

One of the critical aspects in the follow-up of chronic patients is poor adherence to therapy.

We observed over time a considerable percent increase of adherence to telemonitoring.

The tele monitoring has been accepted in most cases positively by patients. The percentage of telephone responses (≈ 80%) is to be considered high (as if the patient waiting for the contact with the center) but insufficient to consider the phone a completely reliable means of communication.

Intel - 2012 - 2014 Summary						
Period	**2012**	**2013**	**2014**			**Total**
Patients n.	4	4	4			4,0
Days	84	230	155			469
Data transfers	103	347	165			615
Adherence %	77,51	93,24	66,53			79,10



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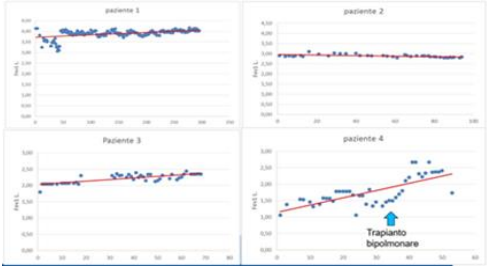

Table 4

ADIPED: trasmissioni

Values Row Labels	Count of SaO2 (%)	Count of FEV1 (litri)	Count of P.A. minima (mmHg)	Count of F.C. (BpM)	Count of Glucosio (mg/dL)	Count of Peso (Kg)	TOTALE
Paziente 1	26	133	152	151	4	130	596
Paziente 2	15	35	10	10	35	10	115
Paziente 3	2	11	6	6	13		38
Paziente 4	5	16			11	5	37
Paziente 5	1	11	5	5		2	24
Paziente 6	1	14					15
Grand Total	**50**	**220**	**173**	**172**	**63**	**147**	**825**

ADIPED: trend del Fev1

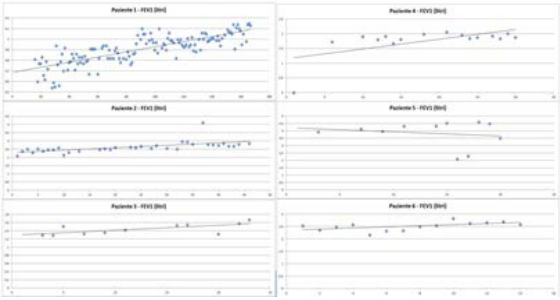

Table 5

Conclusions

The trend of both quantitative and qualitative parameters of our work has been positive for all the equipment. The data are encouraging with regard to the possible role of Telemedicine in the organization of homecare of chronic diseases. In the current state, however, reliable data on the long-term direct effectiveness of the use of Telehomecare in CF are lacking. The major benefits of using telemedicine would seem to be indirect effects as a stronger and better doctor-patient relationship and an increase in the quality of life for the patient, which could ultimately contribute to an increase in life expectancy.

In our experience, however, telemedicine is certainly a useful method in the follow-up of chronic conditions because it allows:

- A minor deterioration of lung function, resulting in less need to use invasive therapies;
- A radical change of the motivations of the accesses to the hospital, which have become more rational and less demanding both for the patient and for the staff that follows it;
- Overall a better quality of life.

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Telemedical Monitoring of People with Sleep Apnea by High Signal Resolution Pulse Wave Method

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Introduction

Pulse oximeter is a small device which placed on the finger measures heart rate and blood saturation. However a lot of information is included in a pulse wave itself but this information is unfortunately neglected in a standard practice. In High Signal Resolution Pulse Wave Method (HSR-PW) the pulse wave as a bio-signal is analyzed. It is possible thanks to a special software based on linear transformation method which allows to enhance the resolution of a standard signal and obtain more information about the circulatory system status [1-2]. The application of this method has been previously described in the diagnosis of cardiovascular diseases [2], in monitoring people subjected to lung surgeries [3] and people being on a fruit and vegetable diet [4].

The aim of this paper is to check out how this method can be applied and useful for monitoring people with a sleep apnea, which is a sleep disorder characterized by pauses in breathing during sleep. Each pause can last for several seconds to several minutes. The qualification for diagnosis of this disease is the occurrence at least 5 apnea and/or hypopnea in an hour. Sleep apnea is often diagnosed with an overnight sleep test called a polysomnogram. The value of characteristic parameter, called apnea/hypopnea index (AHI), determines disease rate:

- Mild form – AHI ≥ 5 and < 15;
- Moderate form – AHI 15-30;
- Severe form – AHI > 30.

Methods

In this study 10 people during a sleep have been monitored using a standard wireless electronic pulsoximeter NONIN Wrist Ox_2, which allows measurement of oxygen saturation and pulse rate.

Measurements were performed on the index finger of the left hand. The input data from standard pulse oximeter were collected from the patients staying at hospital through a system of telemedicine network MONTE. System MONTE enables the transmission of pulse waves' records to servers that calculate parameters of a pulse wave. In recorded pulse waves the number of incidents related to arrhythmia, the oxygenation deteriorated and pathological changes of HSR–PW were observed. To interpret the obtained results they were compared to results obtained from standard test method which is the polysomnography.

HSR–PW method 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: parameter describing ventricle/aorta volume ratio, aorta valve, pulsatility index, k1/k2 index ventricle/aorta and arteries dynamics. They all can be determined. These parameters are sensitive indicators of cardiovascular abnormalities such as increased vascular resistance, atherosclerosis, arrhythmia, heart valve defects, etc. [2, 4].

Results

During the monitoring of sleeping patients the changes are observed not only in the heart rate and blood saturation but also in a shape of pulse wave and determined parameters. The exemplary results of 52 years old patient monitored during a sleep are shown in figures 1, 2 and 3. In this case the severe form of sleep apnea was diagnosed (AHI=54.2).

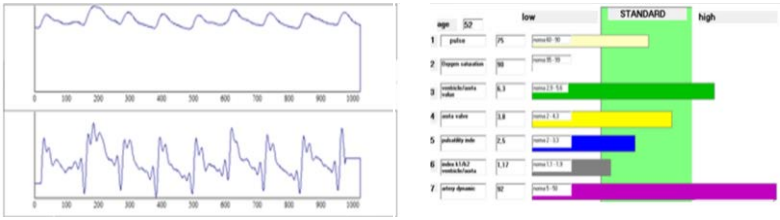

Fig.1. Standard (top) and high signal resolution (bottom) pulse wave recorded at 11:25:48 pm during the beginning of sleep apnea, heart rate 75, blood saturation 90% and parameters determined for HSR-PW.

At 11:26:42 pm the heart rate decreases to 61 and the saturation to 69%. Also ventricle/aorta parameter decreases indicates a reduced stroke volume of the left ventricle (Fig. 2).

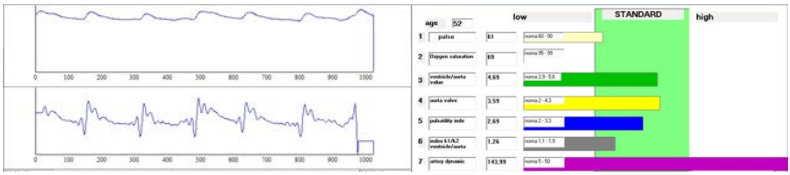

Fig. 2. Standard (top) and high signal resolution (bottom) pulse wave recorded at 11:26:42 pm and parameters determined for HSR-PW.

After 14 seconds appears irregular heart rhythm. After 27 seconds the pulse increases to the value of 87 and blood saturation rises to 86% while increasing ventricle/aorta parameter.

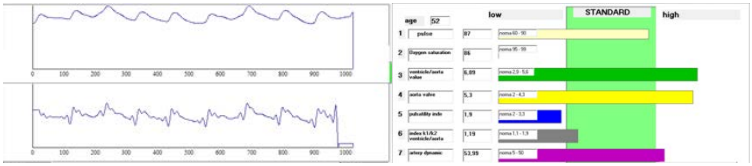

Fig. 3. Standard (top) and high signal resolution (bottom) pulse wave recorded at 11:27:23 pm and parameters determined for HSR-PW.

After less than 2 minutes remains high pulse 88 and blood saturation is relatively high 81% with a simultaneous normalization of most parameters, including ventricle/aorta parameter.

Conclusions

In all the cases examined in the situation of sleep apnea after several tens of seconds occurred increased heart rate, increased oxygenation and increased vascular resistance.

HSR-PW method is a good tool to monitor the sleep apnea.

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Bernadeta Dobosz – received Ph.D in physics in June 2007 from Adam Mickiewicz University in Poznań, Poland. The main field of her research is a medical physics, an application of Electron Paramagnetic Resonance to investigate physical properties of nanoparticles and free radicals in biologically active compounds and also numerical processing of electrophysiological signals. She also educates medical physicists.

The Design and Implementation of an Online Home Exercise Program that Fits the Needs of Patients with Mild Cognitive Impairment

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Introduction

The support of independent living in the older adult population is important to preserve quality of life for as long as possible. Due to the socioeconomic challenges to the healthcare system, new technologies are expected to contribute to providing this support.

As such, we developed a home-based exercise program for pre-frail older adults to promote physical well-being (www.perssilaa.eu). This is a self-management program of 3 months of home based exercising for 30 minutes each time and consists of two modules:

1. A home based personalized training module which enables older adults to train independently in their home environment in three different categories: strength, balance and flexibility; and
2. A communication module which gives older adults the possibility to indicate how the exercises were performed and whether they have any questions to a physiotherapist about the exercises.

As the population ages, especially risks for cognitive decline threaten the independence and quality of life for older adults. As a result, many eHealth applications have been developed to support people with cognitive problems and their family and formal caregivers [1, 2]. Unfortunately, many eHealth applications are not used by them, because they do not match their needs and capacities [3]. Therefore, we aim to adapt the home based exercise program to the needs of older adults with mild cognitive impairment (MCI). Involving informal and formal caregivers and inclusion of older adults with MCI in the development and design process are key features.

In this paper, we present the development and the design process of the home based exercise program for older adults with MCI.

Methods

A user centred design approach, which involves all the end-users in the design process, is crucial to ensure adoption by these users and the chance of successful implementation in daily care [4]. As such, two focus groups were organized at Trivium Meulenbelt Zorg in the Netherlands. Older adults with MCI and (in)formal caregivers who attend 'day activity/care' were asked to participate.

In the second workshop, only formal caregivers were invited to further discuss the design and implementation of the program. All participants had to fill in an informed consent.

The aim of these workshops was to gain insight in

1. Adaptations needed for the exercise program and
2. Ideas about the implementation strategy in daily care.

The focus group sessions were audiotaped. The focus group results were analyzed according to the PACT framework [6] to elicit the MCI related requirements of the home based exercise program. The PACT stands for People (the primary end-users of the system), Activities (the activities between the end-users and the system), Context of use (the environment of the system) and Technology (applications and components of the system).

The AD8 Dementia Screening Interview questionnaire (AD8) was filled out to gain insight in the user group with regard to their memory problems [5]. The following cut points are provided: 0-1: normal cognition; 2 or greater: cognitive impairment is likely to be present.

Results

In the first focus group, 38 persons participated with a mean age of 80.3 +/- 8.1 years (range 54-92) and the group consisted of 14 males and 24 females. Seventeen persons were living alone and 8 persons were caring for an older adult. Twenty-two participants scored a 2 or higher on the AD8 and 10 persons scored a 0 or 1. Six persons didn't fill out the questionnaire correctly.

In the second workshop, 10 formal caregivers participated, who were all female.

Main adaptations needed following the PACT framework

People: Patients using the program have mild cognitive impairment and co-morbid condition with age-related cognitive and physical problems and low attention/concentration possibilities. Twenty-two of the 30 older adults with MCI that were present in the focus group had never used a computer or internet before and only three of the participants used a computer on a daily basis. So patients that are envisioned to use the program are expected to

have low literacy levels. However, the older adult with MCI needs to be able to use the program independently (without a caregiver being present). This means that the program:

- Should have high user friendliness
- Should contain as little information as possible;
- Should consist of a program of max 20 minutes;
- Should have minimal communication possibilities and questions.

Activities: (in) Formal caregivers will be the first person to introduce the program to the older adult with MCI. They will support the person when using the program which is difficult and takes time. Both patient and (in) formal caregivers log in with a username and password to make sure the data of the patients are safe.

This means that:

- Instruction should be simple and quick, relying on the intuitiveness of the system and its accessibility features;
- Password and username should be easy to remember.

Context: The users live independently in their home environment or day care facility as well as residential care. Support will depend on the person with cognitive impairment and their existing knowledge of ICT. When the disease progresses, they might need more and more functional support and supervision.

This means that the program should provide a clear overview to the (in) formal caregiver in case action is needed

Technology: The program will be used in different settings such as the home environment and the day care facility. As such, the program will be accessed by different means being smartphones, tablet or computer.

This means that the program should work on different operating systems (e.g. Windows 95, 98, XP) and different browsers (e.g. Internet Explorer 5 or 6, Chrome).

Ideas about the implementation strategy in daily care

The program will at first be implemented in the care setting where patients can start using the program under supervision of a formal caregiver and train in groups when needed. After a while, the patient can decide to continue using it in their home environment when they feel familiar enough with the program.

Discussion

We aimed at developing a program which will have high chance of adoption by the end-users. As such, this paper presents the requirement elicitation and development of an innovative eHealth program for older

adults with MCI following the PACT framework. This methodology seems to be an effective and easy way to adapt an existing program to the needs of patients with MCI. We found that adaptations are mainly on the level of usability and implementation compared to older adults without MCI and not specifically on the content of the program.

The next step would be to validate the requirements in the care organization with patients and (in) formal caregivers, which will be done mid 2016.

Acknowledgment

The authors would like to thank Trivium Meulenbelt Zorg in the Netherlands for their participation in and help with the two focus groups.

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Miriam Vollenbroek-Hutten is a human movement scientist and got her Ph.D. at RRD in 1999 in the area the development of a new assessment instrument for patient with clbp. She is currently working as cluster manager Telemedicine at RRD and she is a professor in technology supported cognitive training at the University of Twente, Institute for Biomedical Technology. Her interest is in research on how to develop telemedicine applications that enable patients to train in their own daily environment in an effective manner as well as into the evaluation of these applications.

Young Population in Megacity: Self-Monitoring of Health Risks and Wellness Education.

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Introduction

Living in megacities creates additional load that may be considered as separate and independent risk factors for dis-adaptation. We also know that many diseases are precipitously become “younger”.

In the Russian space medicine, alongside the clinical diagnostic procedures at the selection and medical monitoring of cosmonauts, health is considered as the ability to adapt. This concept is successfully used in different fields of Earth medicine.

Telemedicine is one of the branches of both space and Earth medicine. The possibility of remote control and self-control of cosmonaut’s health status is most relevant for space medicine. It is not only more effective from the financial point, but also allows the make examinations more often. Self-monitoring is a periodic and scheduled use of different devices by the patient to obtain clinical data that is used by the patient to measure their own health status [1]. One of the benefits of remote self-monitoring is the greater patient motivation and satisfaction when passing examinations. In the Russian space medicine this concept is successfully used in different fields [2]. Adaptation level can be assessed by a simple non-invasive method, i.e. the analysis of heart rate variability (HRV) [3].

Materials and Methods

Within the project "Mars-500", that took place in 2010-2011 in IBMP (Institute for Biomedical Problems, Russian Academy of Science), a number of satellite studies have been conducted. Within 1,5 year period 64 healthy individuals aged 19-49 years has been surveyed on a monthly basis, and 776 investigations with "Ecosan- 2007" device were performed. Based on the results of this research a new telemedicine system "Ecosan-TM2" was developed, which passed approbation in the survey of some groups in Moscow and one of the small cities of Russia (215 persons, age 17-80 years).

As already underlined, the level of adaptation can be assessed using a simple non-invasive method - the heart rate variability analysis. In our

studies, HRV method has been complemented by a questionnaire, measuring of blood pressure, height and weight. It has been done to assess the individual risk factors, which are calculated taking into account gender, age, objective data (HRV, blood pressure, height and weight) and the results of a survey about the life style and somatic complaints. General (life style, physical health, mental health) and more specific (for groups of diseases) risk factors are evaluated. After investigation the user receives an automated conclusion, "Health passport", which in clear and simple terms explain results and provide their graphical representation.

Results

The results of our study revealed some alarming trends.

First: It is logical that, according to the HRV analysis, with ageing, the function of autonomous regulation is reduced and the balance shifts toward the sympathetic regulation, the representation of prenosological and premorbid conditions are increasing. It is alarming, that in Moscow more than half of people younger than 20 years were in the conditions associated with stress of adaptation mechanisms (Figure 1).

The results of interviews revealed, that young people combine their education with work in the evening and night time, constantly experiencing overloads, including emotional stress, irregular eating, insufficient sleeping.

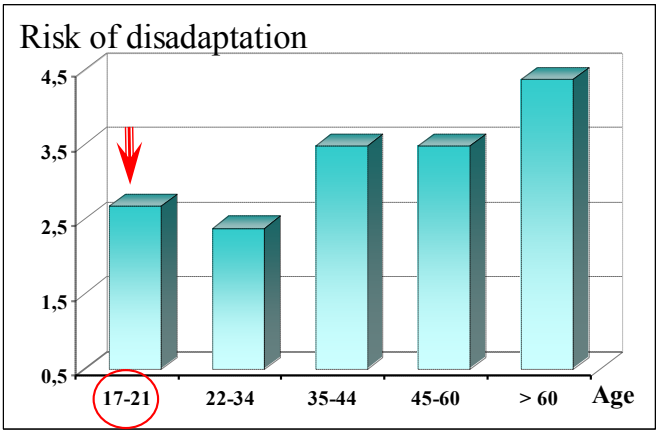

Fig. 1. Risk of dis-adaptation in age groups (Moscow)

Second: Values of main functional parameters in all examined groups are the same, despite of the fact that one of the teams consisted of younger people (28-40 years) (Figure 2).

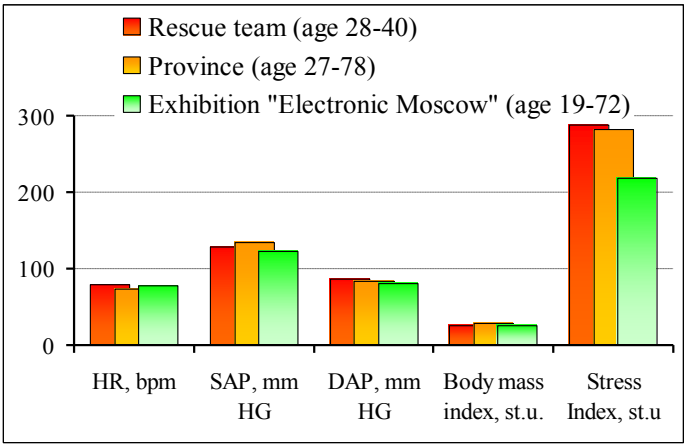

Fig. 2. Main parameters of functional status in surveyed groups (Moscow and province)

The main risk factors identified in this group were physical inactivity, diet, stress and unhealthy habits.

As in all surveyed groups, the risks of diseases have become the highest when related to the cardiovascular system, gastrointestinal tract, and musculoskeletal system.

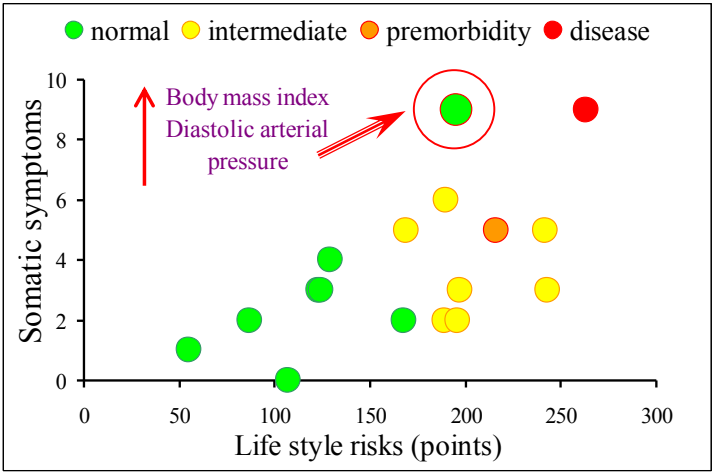

Fig. 3. Functional status, life style risks and somatic symptoms in rescue team (Moscow)

Third: Comparison of the data from the questionnaire and objective assessment of functional conditions, according to HRV analysis showed, that in the group of rescue team the objective functional status and the number of identified somatic symptoms correlate with lifestyle related risk factors (Figure 3).

Conclusion

Most often, telemedical monitoring, as well as the obligatory initial medical examination, aimed at obtaining sufficient information on a limited number of vital parameters: heart rate, body temperature, blood glucose level, blood pressure and levels of blood oxygen saturation. Some researchers and experts have also referred functional status to "vital" signs [4].

We have seen, from the results of our study, that it is extremely important not only to identify promptly the deviations of physiological indicators from clinical standards, but also to predict the risk of reducing the adaptive capacity and assess the individual risk factors. Individuals of young age in a metropolis are, from this point of view, at risk. They require regular health monitoring and creation of special education programs aimed at their health improvement.

Each person must find its way to health. Unfortunately, most people don't do this, because they don't have information about their health and how they can manage it. Telemedicine technologies can essentially expand possibilities of wellness education in different populations, especially of young people, providing a self-monitoring, access to information and adequate feedback.

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International Telemedicine & eHealth Initiatives

A Pan European Rapid Benchmark on the Stage of Development of Telemedicine in EU Member Countries

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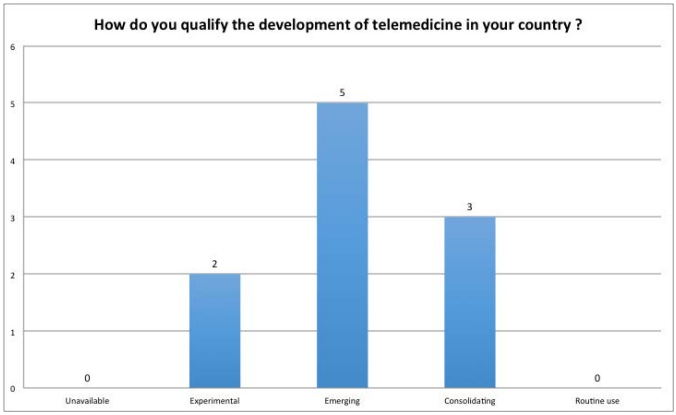
Introduction

We sent a short questionnaire on the stage of development of telemedicine to 17 eHealth experts of the International Society for Telemedicine and eHealth (ISfTeH). We received complete or partial answers from 10 experts located in the following countries: Belgium, Bulgaria, Denmark, France, Italia, Ireland, Poland, Portugal, Slovenia and Spain.

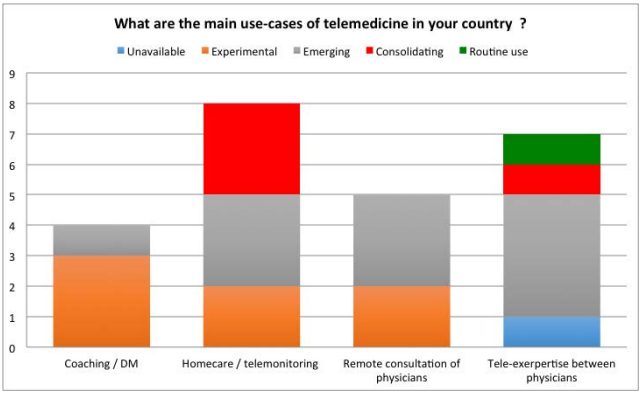
The questionnaire raised several global questions regarding the overall level of development of telemedicine, as well as specific questions regarding legal, technical and specialty issues.

Global Issues

There is a significant gap between the level of available technology, which is now fully mature, and the stage of development of telemedicine among the EU countries.



Numerous use-cases have been developed among the 10 countries, but the vast majority of these use-cases remain experimental or emerging.

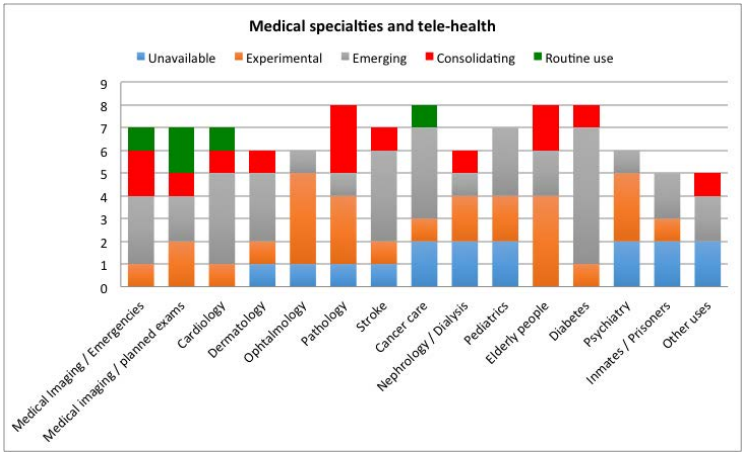


Specialties and Telemedicine

The various specialties experience a very different level of implementation. Thanks to the Dicom / IHE interoperability features and the relative facility to distinguish technical and medical factors and fees, medical imaging appears to be the most advanced specialty in telemedicine.

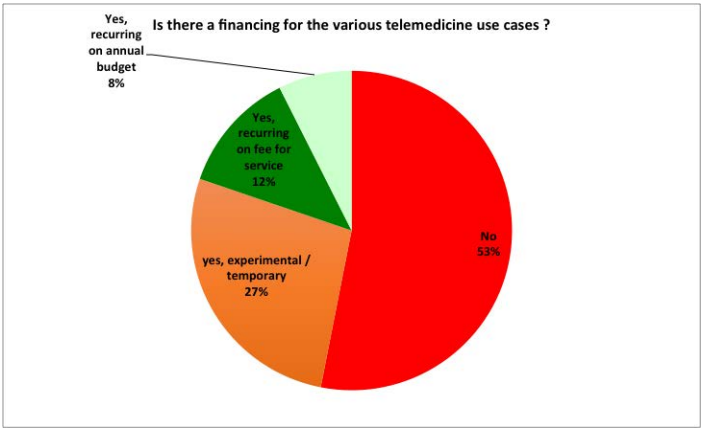
Some other specialties (pathology, nephrology…) should find rapidly the proper economic and organizational model.

On the contrary, some clinical specialties have still a long way to go before reaching an appropriate model for telehealth.

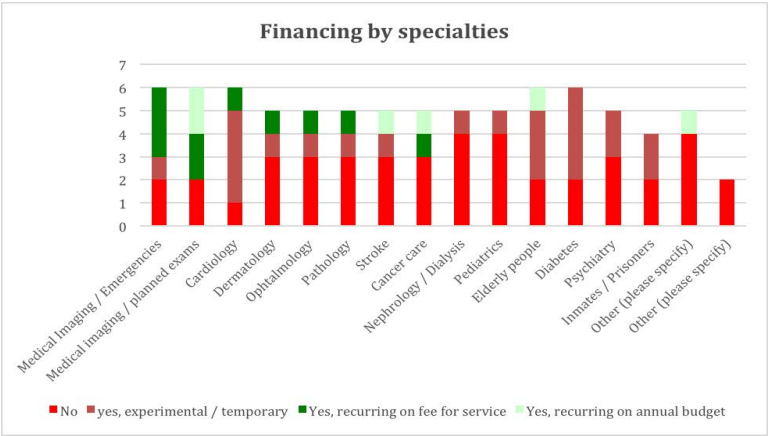


Financial, Legal and Technical Issues

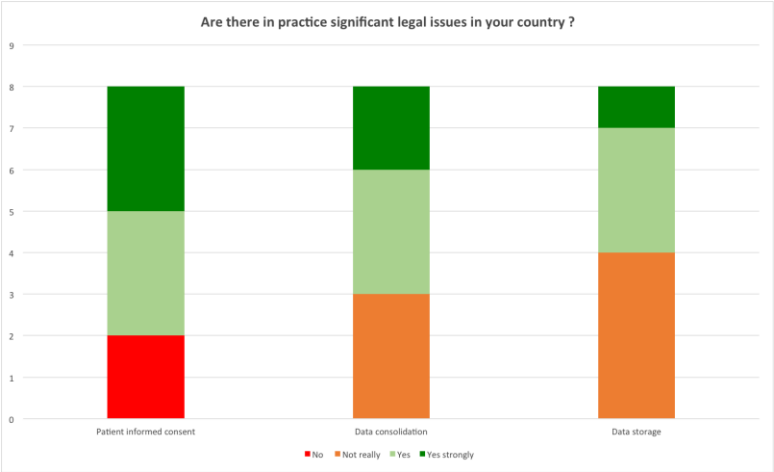
Without any surprise, the lack of financing of telemedicine activities seems to be one of the crucial factors for this delay in development of telehealth.



The availability of financing and its nature is strongly correlated to the level of development of telehealth within the various specialties. Without any surprise, Medical Imaging activities beneficiate from a frequent fee-for-service model of payment.



Legal and technical issues need also to be taken into account. Regulations regarding informed consent of patients, data storage and data consolidation are very present, in accordance with EU recommendations.



Noteworthy, 7 countries have a national unique patient ID, which is a clear facilitator for telemedicine.

Conclusions

Although there are numerous pilot projects all over the EU, telemedicine is a "work-in-progress". The legal and technical backgrounds are now in place in Europe, but Telemedicine still need to demonstrate cost-efficiency in order the wave the financing constraint.

There is no national or European comprehensive database on telemedicine projects. It is thus difficult, if not impossible, to gather reliable quantitative information on these projects.

As such, experts' opinions are currently probably the most valuable source of information. We will continue in 2016 to complete the questionnaire under the ISfTeH umbrella, hopefully with more respondents in order to have a comprehensive view of telemedicine within EU.

Aïssa KHELIFA is a member of Isfteh WG of E-Health economics. He has been a healthcare consultant for 16 years, with a special interest in HIT and Economics. He has managed over 150 missions for public and private entities. Over the recent years, most of his activities dealt with telemedicine.

Improving Cross-border European ePrescription and Patient Summary Services through e-SENS Cross-sectorial Building Blocks

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Introduction

The cross-border healthcare services are now largely regulated by the Directive 2011/ 24/ EU [1] on the application of patients' rights. ePrescription and Patient Summary (eP/ PS) services are expected to be the first cross-border healthcare services to become operational in real life by some European Union (EU) countries, starting 2017, with the support of the Connecting Europe Facility (CEF) [2]. The Electronic Simple European Networked Services (e-SENS) project (2013-2016) provides solutions for seamless public service delivery across borders by developing infrastructure for interoperability, adaptable to different domains (like e-Justice, e-Procurement, and Business Lifecycle), using the results of previous Large Scale Pilot (LSP) projects, and more specifically those of e-CODEX [3], SPOCS [4], STORK [5], PEPPOL [6], and the more specific to eHealth epSOS [7].

Method

During the first year of the e-SENS project, each domain listed their business requirements for priority use cases, together with technical solutions adopted in the past to meet these requirements. e-SENS consolidated and analyzed the maturity of each technology and packed the most relevant ones into generic components, called Building Blocks (BBs), that can be used across different domains. The Building Block (BB) continuum is guaranteed by the e-SENS architectural approach, strictly based on TOGAF [8]. Each BB has an *architectural* view (ABB), and a *solution* view (SBB) to guarantee both the architectural as well as the operational continuum.

As far as eP/ PS is concerned, e-SENS has tried to mitigate issues related to missing evidence, patient identification, central configuration services refactoring, and end-2-end security (which are linked to several BBs). Patient identification was considered to be of the highest priority for EU

Member States as well as patient access to audit trails. Central configuration services are considered to be background infrastructure and a priority when looking at infrastructure redundancy with view to CEF adoption.

Based on the elicited business requirements for eP/ PS, the e-SENS eHealth domain took benefits of three cross-sectorial BBs among the ones identified by the project to be part of the e-SENS reference architecture [9]: *Evidence Emitter*, *Electronic Identification (eID), Service Location,* and *Capability Lookup*. Each BB has been implemented in the OpenNCP reference implementation framework for a National Contact Point for eHealth (NCPeH) [10]. The participating Member States – Austria, Greece, Italy, Luxembourg, Portugal and Spain – installed and localized this reference-implementation in their NCPeH. IHE [11] provided the conformance testing procedure to perform these tests in IHE Connectathon (April 2015) and later in EXPANDATHON (December 2015).

Building Blocks and Benefits for the eHealth Domain

The *Evidence Emitter* BB provides a layer enabling actors to generate and emit electronic evidence used for non-repudiation purposes, in a cross-domain scenario. Non-repudiation services are mandate to generate, collect, maintain, make available, and validate evidence concerning a claimed event or action in order to resolve disputes about the occurrence or non-occurrence of an event or action. Several definitions and corresponding frameworks have been proposed to achieve the four fundamentals non-repudiation evidence, namely the *Non Repudiation of Origin*, *Submission*, *Delivery*, and *Receipt*. The Evidence Emitter fits in a per-hop non-repudiation mechanism where the tokens have the format defined by ISO 13888 [12] and are using the ETSI REM [13] standard. Its peculiarity relies on the abstract model implemented: each incoming/outgoing message is evaluated against a XACML policy [14] in a specific evaluation context (e.g. domain of application, data classification) and the resulting evaluated XACML policy obligations trigger the emitting of a domain-specific non-repudiation evidence, following domain-specific non-repudiation policies.

To ease the piloting operations, epSOS had relaxed the need for non-repudiation tokens. In fact, non-repudiation of origin and receipt had been implemented by using Audit Trails [15]. Although interoperability had been achieved, it did not fit into the definition of non-repudiation [12]. For these reasons, the e-SENS evidence emitter BB enables the epSOS NCPeH with non-repudiation tokens based on the standard ETSI REM, while preserving compliance with the Audit Trails: when a message reaches the NCPeH, or leave the NCPeH, the Evidence Emitter policy is evaluated and, based on

the type of the message, the specific REM and Audit Trail are emitted and stored.

The *eHealth eID* components primarily address the problem of the last mile on how to effectively and efficiently operate a multitude of eID token carriers, like smart cards, and their specific complex cryptographic material in a highly regulated but technically limited environment. The core tool deals with identifying, transforming, and mapping available token services and data onto a singular virtual ISO 24727-3 compliant middleware [16] to decouple a specific eID technology from its after-use as well as avoiding the need to install several middleware or drivers for each token type. Paired with Java Web Start technology, the tools are available to the health professional when needed, install and configure automatically, and are removed afterwards. Currently, international smart card-based services for authentication, authorization, and the patient-centric application of electronic signatures are operated with a planned extension for the inclusion of the European Authentication Scheme eIDAS [17] as well as smart phone-based mobile eID. A systemic integration into the epSOS-inspired OpenNCP eHealth gateways has been done in order to test-drive its functionality in real medical environments.

The *Service Location* BB provides a DNS-based query mechanism to locate capabilities of remote services. Once located, capabilities can be retrieved, and consumed using the definitions of the *Capability and Location Lookup* BB. The underlying standard is the OASIS SMP [18]. Such BB is widely used in production in the eProcurement domain, where a single-PKI trust model is in place. Authorities push their SMP-based metadata into servers that apply a signature (note that the processing model can be either centralized or distributed). The receiving party verifies the authenticity of the data by checking the signature of the server. The epSOS LSP provided an ad-hoc model based on ETSI TL files [19] for the definition of remote NCPeH configurations. This was a manual procedure: operators had to create the TL-like file, sign it, and submit into central configuration services, using the Secure File Transfer Protocol (SFTP). Daily a cron-job was on duty to fetch new TL files and configure the local NCPeH. This manual task has been proven to be inefficient and error prone, thus adopting the Capability and Location Lookup BB has been considered relevant. However, the integration presented several challenges. A different trust model (single public key infrastructure and direct brokered trust), a set of mandatory (mainly procurement-specific) elements, and a lack of extensibility of the SMP model are examples. The adoption of SMP firstly enables the NCPeH with a flexible method to retrieve dynamically remote configuration (that can be cached) improving the overall system performance, and secondly

improve the SMP specifications to open for cross-domain transactions. For this latter point, a change proposal has been submitted to the OASIS SMP.

Conclusion

The proposed solution improves on the technical solutions supporting the data protection, privacy and security process initiated in epSOS, through the use of technologies enabling stronger identification and authentication of the patient and improving on the usability of the technical solutions. The objective has been to facilitate cross-border access to EU eP/ PS services and to enhance the technology used with cross-domain technical BBs.

Cross-sectorial BB usage is expected to reduce cost of maintenance and allow the IT industry to be provided with open source solutions to be adopted in their own business services in order to improve efficiency, cost-effectiveness, and safety.

e-SENS results will be handed over to CEF in order to increase the value of the cross-border health services offer to citizens, health professionals, and public administration with fast, secure and seamless electronic access to medical information in the appropriate language.

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Teleconsultation in VPH: Fighting Zoonoses and Maintaining Public Health through Veterinary Care on São Vicente, Cape Verde

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Introduction

SIMABÔ - *Associação para a Protecção dos Animais e do Ambiente* is the only non-profit animal welfare organization based on the island of São Vicente, Cape Verde. As such, they are the only provider of veterinary services for animals living on the streets or with owners on low income. To increase the health status of Cape Verdean dog population, SIMABÔ has been implementing the project "*Fighting stray dogs on Sao Vicente: A pilot project for the Capeverdean Islands*" from February 2012 to January 2016. SIMABO's project is the first, and to date, the only action of this kind co-funded by the European Union [under EuropeAid/130817/L/ ACT/CV (DCI-NSAPVD)] due to its combined value for public health.

The working hypothesis of the project is that surgical sterilization of the dogs is an effective way to control population density. This may improve animal health and subsequently public health.

Background

As most cats and dogs, both owned and stray, roam freely around the streets throughout the day and night, the Municipalities of the nine Cape Verde Islands have implemented different systems to control the canine population. Amongst these, strychnine poisoning is the most commonly used. Focusing on "elimination", this method is opposed by the WHO because it is ineffective and it is opposed also by the local population because it is dangerous and doesn't allow to discriminate between owned and stray animals. SIMABO's aim is to provide a more humane and more effective alternative to decrease the dog population: surgical sterilization to reduce the overall reproductive index.

In 2013 SIMABÔ was recognized as an Organization of Public Utility by the Cape Verdean Government and in October 2014 the organisation was

included in the list of the beneficiaries of Law no. 45/VI/2004 of 12.7.2004. This states that a limited number of eligible organizations can receive a percentage of the tax paid by Cape Verdean companies. Back in 2010, the local Delegation of the Ministry of Health had authorized the purchase of medications by SIMABÔ from the only Cape Verdean vendor that supplies hospitals, private clinics, and pharmacies.

Rationale

The lack of local veterinarians to help with treatment and care of neutered dogs and cats has meant that SIMABÔ must employ lay staff for these purposes. One nurse and two more lay staff (all with no formal training) take care of the neutered animals with the support of protocols prepared by the veterinarians of Centro Veterinario Monviso (CVM), Italy. The vets from CVM make also themselves available 24/7 via Skype or email when their assistance is needed for more challenging cases. The feedback obtained is used to continuously update existing protocols (Fig. 1 and 2).

In conjunction, Drs. Tizzani and Peano from the University of Turin, Department of Veterinary Sciences, Parasitology Sector, are collecting samples with the aim of preparing specific protocols for treating and preventing *Microsporum canis* infection in dogs. *Microsporum canis* is a dermatophyte fungus, and causes dermatophytosis - commonly known as ringworm or *tinea*. Preferential hosts are cats and dogs, and as the infection is zoonotic it is also of significant public health importance. This disease has been investigated and documented in several countries within Europe, but documentation of the disease and public awareness are lacking within Cape Verde.

Finally evaluation of the long term consequences of surgical sterilization on population dynamic and health conditions was investigated by means of specific census activities carried out at the beginning (year 2012) and at the end (year 2016) of the project.

Objective

The objective of using telemedicine in this veterinary capacity is to support remote lay staff in four main areas:

1. Post-operative care,
2. Anti-parasitic regimes,
3. Appropriate emergency care and
4. Evaluation of population dynamics.

This project "*Fighting stray dogs on São Vicente – A pilot project for the Capeverdean Islands*" co-financed by the European Union provides funding

for the castration, microchipping, anti-parasitic treatment and post-operative care of 10 000 dogs.

The overarching aim is control of the canine population of the island, to make abandoned animals more adoptable and to make stray dogs better companions.

One of the problems with canine overpopulation is the resulting opinion of the general public, often being that the animals carry zoonotic diseases and have little or no value. The animals castrated under the project are thus exposed to numerous risks when put back on the streets, from poisoning to road accidents, from neglect to torture. SIMABÔ is working to improve public-animal relations through awareness and create a more harmonious human-animal bond by bettering the health of street dogs, and educating local communities, for example through educational school visits. To evaluate the impact of the sterilization on the canine population, two census campaigns were carried out at the beginning and at the end of the project, applying direct and indirect census techniques.

Fig. 1. Taking a sample from a puppy with a very severe skin lesions

Fig. 2. A neurological consultation of a paralyzed cat via Skype

Materials and Methods

The lay staff relies on the following limited resources:

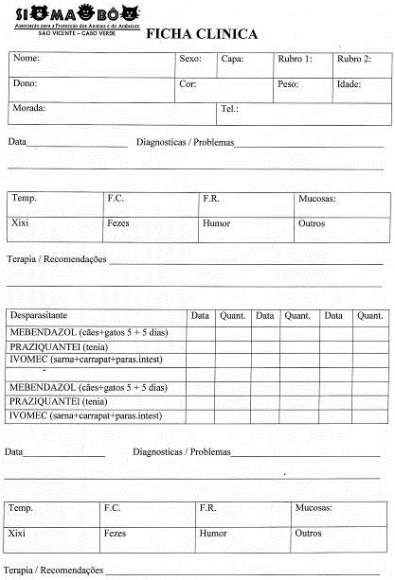
1. A very limited list of pharmaceuticals that allow treatment of the most common conditions, such as internal and external parasite infestations (mainly round worms, tapeworms, fleas and ticks), ehrlichiosis, pyoderma, mycosis, scabies, other infections, trauma and tumors, especially Transmissible Venereal Tumour (TVT).
2. A protocol for the treatment of common conditions based on the principle “primum non nocere” (first, do no harm), that excludes for instance the use of steroids, cardio drugs, diuretics, antipyretics, if not explicitly recommended for the treatment of very specific conditions or after the web-consultation with CVM;

3. Tele-consultations with Dr. Raineri or her staff for difficult cases – (Fig. 3) a standard form containing all the animal information and clinical parameters is completed by lay staff and sent by email to the clinic in Italy, with pictures if required. On average, two cases per week are handled in this manner including eye conditions, skin problems, systemic diseases and trauma.

During the two census campaigns carried out in 2012 (beginning of the project) and 2016 (ending of the project) the monitoring was done using direct and indirect techniques, to provide an accurate and precise estimation of the canine population (an accurate evaluation using narrow confidence intervals of the estimates). The population estimates were done in almost real time with a first team collecting field information in Cape Verde and a second team, based in Europe that received, analyzed and elaborated the data to provide rapid evaluation of population trend.

Results

Since the beginning of the project, there has been a remarkable improvement in the health of the canine population of São Vicente, together with an appreciable increase in public awareness of the importance of animal health. Due to the very low mortality rate of the neutered animals and high recovery rate of these patients, most of whom arrive at the clinic in a very bad condition, the treatment offered by the project in conjunction with the neutering is high in demand. The rapport generated with the local owners during the process of neutering and post-operative care now, more often than not, means that SIMABO's assistance is sought as soon as any further concerns about their animal arise. This conveys that not only is the canine population being managed, but awareness of animal health and welfare is being raised and the remaining population of dogs are better cared for. This in turn generates benefits in public health.



SIMABO
Associação para a Protecção dos Animais e do Ambiente
SÃO VICENTE – CABO VERDE

FICHA CLINICA

Nome:	Sexo:	Capa:	Rubro 1:	Rubro 2:
Dono:	Cor:		Peso:	Idade:
Morada:		Tel.:		

Data_____ Diagnosticas / Problemas_____

Temp.	F.C.	F.R.	Mucosas:
Xixi	Fezes	Humor	Outros

Terapia / Recomendações _____

Desparasitante	Data	Quant.	Data	Quant.	Data	Quant.
MEBENDAZOL (cães+gatos 5 ÷ 5 dias)						
PRAZIQUANTEI (tenia)						
IVOMEC (sarna+carrapat+paras.intest)						
MEBENDAZOL (cães+gatos 5 ÷ 5 dias)						
PRAZIQUANTEI (tenia)						
IVOMEC (sarna+carrapat+paras.intest)						

Data_____ Diagnosticas / Problemas_____

Temp.	F.C.	F.R.	Mucosas:
Xixi	Fezes	Humor	Outros

Terapia / Recomendações _____

Fig. 3 Clinical notes

The most important effect of the project was the reduction in the total canine population from 11,838 animals estimated in 2012 to 8,821 in 2016 - a 25% reduction in population density within 4 years. Additionally the incidence of parasitic diseases amongst remaining animals was investigated and showed a reduction over these years.

Considering the above, the project implemented by SIMABO achieved its aims of control over canine/feline population density and net improvement in animal health and welfare, with secondary improvements at the human/animal interface. In short, the concept of Veterinary Public Health, being "the sum of all contributions to the physical, mental and social well-being of humans through an understanding and application of veterinary science", was well and successfully applied.

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Telehealth Really is here to Stay: New Care Pathways, Lessons Learned, and Policy Messages

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Introduction

United4Health is a recently-ended European large-scale telehealth deployment project. Fourteen regions in 10 European countries were involved in its activities: they deployed 19 different service models. The initiative successfully implemented innovative healthcare services for remote monitoring of patients with chronic conditions, and assessed their impact. Its patients comprised those with chronic heart failure, chronic obstructive pulmonary disease, and Type 2 diabetes.

This is a short overview of United4Health's achievements:

- Selects from United4Health's wide variety of experiences to describe how four specific deployment sites, working on improvement of heart failure experiences, embedded telehealth technology solutions into their care pathways;
- Examines how United4Health itself learned lessons from its experiences;
- Summarises the policy messages that United4Health announced at both a Science and Technology Options Assessment (STOA) session, held with policy-makers, in the European Parliament buildings and at its final conference.

Care Pathway Experiences on Four Deployment Sites

United4Health delivers a set of messages about care pathways.

United4Health was a European large-scale telehealth deployment project that ended in January 2016. The countries involved in the initiative included a large number from inside the European Union and others associated with it: the Czech Republic, Finland, Germany, Greece, Italy, Norway, Scotland, Slovenia, Spain, and Wales (Scotland and Wales are, of course, two of the United Kingdom's four home countries) [1].

United4Health successfully implemented innovative healthcare services for remote monitoring of patients with chronic conditions. Among its tasks were to demonstrate that telehealth services, that have already been

validated in previous randomised controlled trials and initiatives such as the Renewing Health project www.renewinghealth.eu, could be successfully transferred to other regions and deployed at scale. Its patients were people with some of Europe's most common diseases: chronic heart failure, chronic obstructive pulmonary disease and Type 2 diabetes. More than 10000 patients with these three chronic conditions were recruited from 2013 to 2015. A comprehensive evaluation was based largely on the Model for Assessment of Telemedicine (MAST) methodology.

The brief findings reported here focus on chronic heart failure. Despite progress in the management of heart failure, heart failure remains a major healthcare problem because of its high prevalence, mortality and increased cost [2]. A number of randomised controlled trials have identified a potential role for telemonitoring in selected patients with heart failure. There has over time, however, been little evidence of the real-life effectiveness of these services.

To rectify this lack, in United4Health therefore, a total of 1 106 patients with heart failure were enrolled in four European countries (the Czech Republic, Slovenia, Spain, and the United Kingdom): 611 patients were followed for at least six months and included in the evaluation [2]. The various sites involved in implementing telehealth support for chronic heart failure were the Czech Republic, Scotland (involving regions such as Ayrshire and Arran, Lanarkshire, Greater Glasgow and Clyde), Slovenia, and Spain (specifically, the Basque country) [2]. The general approach was to shift three forms of self-management (patient self-management, supported self-management, and specialist supported self-management) overall towards greater patient self-management. Techniques used involved alarm management, alert response, health coaching, monitoring and the use of such technologies as email, telephone and particularly text messaging.

Regression analyses after adjustment for all possible confounders show that the patients in the intervention group were 4.622 times ($p<0.001$) less likely to be hospitalised due to heart failure; they have also been hospitalised for fewer days (OR 5.222, 95% CI 2.943 – 9.267, $p<0.001$). The total mortality and use of hospital services were significantly reduced in the intervention group while, nevertheless, the use of primary care services increased [2].

The United4Health project results suggest that best practices already validated in randomised controlled trials and other projects can successfully be transferred and deployed at scale in other locations. Further analysis of these results and those of the economic evaluation and assessment of patients' perspectives are, however, necessary, in order to reach final conclusions.

Lessons Learned from Experiences

Lessons learned also feature among the chief findings of the United4Health initiative.

Among the chief lessons learned by United4Health are those relating to identifying and applying the main strategic issues; focusing on stakeholders' engagement; identifying the procurement and technology challenges; creating knowledge; and managing the whole process well [3]. These critical success factors have much in common with the findings of the MOMENTUM thematic network http://telemedicine-momentum.eu/, 18 factors uncovered during 2012-2015 by a group of telemedicine doers (i.e., implementers) [4]. This observation of similarity comes about since the profile of the stakeholders and actors involved in these real-life situations, although not identical, are very similar also in terms of their experiences.

The United4Health lessons learned emerged from real-life experiences shared by the more than 10 deployment sites. These sites now possess much practical, applied experience on subjects as diverse as health/information technology infrastructure, electronic health records, organisational transformation, patient acceptance, stakeholder engagement, and workforce adoption that they are able to share with other regions and localities. They were evaluated in addition using a qualitative, formative assessment method that used an observational study design [3]. By focusing on lessons learned, this evaluation helped to assess a wide variety of deployment aspects related not only to chronic heart failure but also to chronic obstructive pulmonary disease and Type 2 diabetes.

It is particularly important to emphasise that, in expanding the use of telehealth services, collecting data through home monitoring alone does not by itself drive benefits either to the patients or to the system. Home monitoring appears to have real benefits in terms of improving quality of care and reducing the burden on formal services, when it is combined with self care. This absolutely requires patients and carers alike to be informed, and to be supported in taking responsibility for managing patients' conditions.

United4Health Policy Messages

Another set of messages – policy messages – emerge strongly from United4Health. These messages were chiefly designed by the project's management team, derived from the real-life experiences and their evaluations undertaken. To assist with this goal, the United4Health user policy advisory board members met repeatedly – in actuality, on five occasions – throughout the final 18 months of the project to offer feedback

on the project's developing results, and to assist in formulating its policy messages.

The messages emerging from the United4Health user policy advisory board meetings were used to define the initial scope of the project policy messages. These are described in an official project document first publically released on 1st December 2015 [5]. The report introduces United4Health and its work, and describes the policy context underpinning the project. It gives information on the three telehealth solution types explored by United4Health, and highlights the three main learnings of the project in relation to the diverse and changing environment, people, and technology.

The report delivers United4Health's three main policy messages on the need to:

- Secure a policy environment that promotes and supports telehealth deployment.
- Seek national consistency with local adaptation.
- Empower patients, carers, and healthcare professionals to take full advantage of telehealth.

Six specific policy recommendations were also by United4Health to indicate changes that should take place at European level. These relate to regulatory environments, programme funding, cross-fertilisation of telehealth, promotion of appropriate evaluation methodologies, assessment of programme priorities, and the insertion of policy messages into the relevant policy fora e.g., the eHealth Network.

As Ms Agneta Granström, chair of the Assembly of European Regions' (AER) eHealth group emphasised additionally at the United4Health final conference, held in Brussels in January 2016 [6]: "*We need infrastructure. We need broadband, and we need mobile connectivity.*" To leverage the benefits from constructive initiatives like United4Health, it was proposed that: "*In Europe, we should take the opportunity to be the frontrunner for eHealth services, outside of hospitals too.*" Continuing linkage of the work of such associations as AER, with the continuing post-project work of the United4Health deployment sites and other regional telehealth activities, is warmly encouraged.

Conclusions

In summary, when telehealth is integrated into mainstream service provision, it can offer more accessible, equitable and sustainable services for the benefit of people in Europe. Telehealth will increasingly become a critical component of the transformation of Europe's healthcare.

Looking ahead, the convergence in technologies and initiatives that has

been experienced in recent years is likely to gather pace. Healthcare systems will probably tend towards embracing 'bring your own device' solutions, particularly focused around mobile telephony/mHealth.

United4Health's deploying regions are currently committed to continue scaling-up and expanding the use of telehealth in Europe: they believe that this is a journey worthwhile – and worth it – for other European, and international, service providers to explore too. Finally, it now appears that "*Telehealth is here. It is happening!*"

Acknowledgments

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The Use of Twitter and the Hashtags in the WONCA Conferences

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Introduction

Twitter [1] is a free social network, which is becoming increasingly popular at medical conferences, being used for both storytelling and online discussions. With the default settings, the accounts and posts on Twitter are public; anybody can follow them, thus offering the possibility to use it as a tool for an online discussion [2]. In many Conferences and meetings, speakers and participants have found tweeting very interesting and beneficial and it has the potential to change the health communications space associated with conferences [3].

A tweet is a short message limited to 140 characters and may include hyperlinks. They are posted in real time, but are permanent, public (unlike others) and searchable; everyone can search tweets and follow conversations whether they are members of the network or not.

Furthermore, users can also follow hashtags, represented by the symbol "#". Used to tag tweets, hashtags are widely used on social networking and microblogging services as a way to search and find messages with a specific theme or content. It is therefore easy to collate the tweets that have been posted under a certain topic by searching for the respective hashtag - like a "backchannel" that constitutes a multidirectional complex space, where users make notes, share resources, ask questions, hold discussions and establish their own presence online [4].

The objective of this study was to analyse the use of the hashtags for the Conferences of the World Organization of Family Doctors' Europe Region

(WONCA Europe) in the last 3 years and report on its potential as a networking and educational tool.

Methods

Through Symplur, a pioneer social media analytics tool that promotes a deep understanding of the healthcare conversations with real-time access to insights, we analysed the use of conference hashtags during the last three years - since it was registered for the very first time in Symplur's Healthcare Hashtag Project.

The latter Project aims to connect anybody in healthcare in a more efficient way or in the words of Symplur [5]: "*empowering decision-making with real-time access to insights from over a billion healthcare social media data points. Symplur Signals is a web-based platform that invites an unparalleled voyage deep into the analytics of global (Twitter) conversations swirling around the topic of healthcare.*"

We searched Symplur's Healthcare Hashtag Project for hashtags pertaining to WONCA Conferences. We found three hashtags which were eligible of the last three years: #WONCA2013, #WONCA2014, #WONCA2015. Using Symplur's social media analytics tool, we obtained the freely available data for each of the three hashtags.

The period of time when each hashtag was active was analysed to determine its use and impact on the community.

The timeframe selected ranged between a week before the start of each Conference and a week after its end:

- #WONCA2013 (25-29 June 2013): from 18th June until 6th July 2013 (Figure 1).
- #WONCA2014 (2-5 July 2014): from 25th June until 12th July 2014 (Figure 2).
- #WONCA2015 (21-25 October): from 14th October until 1st November 2015 (Figure 3).

We obtained the tweets' transcripts and performed an exploratory analysis on its contents.

Discussion

In 2013 the number of impressions was higher than in following years and taking into account that Symplur computes total impressions by taking the number of tweets per participant and multiplying it with the number of followers that participant currently has, doing this with all participants in this time period, the final numbers are added up.

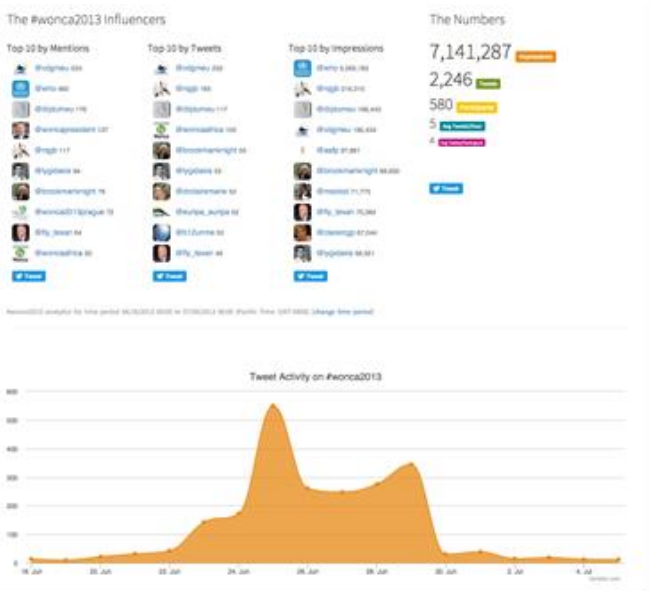

Fig. 1. Analysis of the #WONCA2013 hashtag on Symplur's Healthcare Hashtags Project

As we found that 2013 had equal/lower number of tweets compared to 2014/2015, the reason why impressions are higher in 2013 might be one of two:

1. Probably because the regional WONCA Europe Conference was co-organized alongside WONCA World (Table 1), so there were more Twitter participants in 2013, while in 2014/2015 were only regional events.
2. We could hypothesize that Twitter participants in 2014 had more followers or top figures (with more followers) were attending, offline and online.

The number of tweets was similar in the first two years, but a steep increase was observed in 2015, when the average of tweets per hour and participant was also doubled. For each conference, the peak of the posted tweets was observed during the days in which the event took place (Table 1).

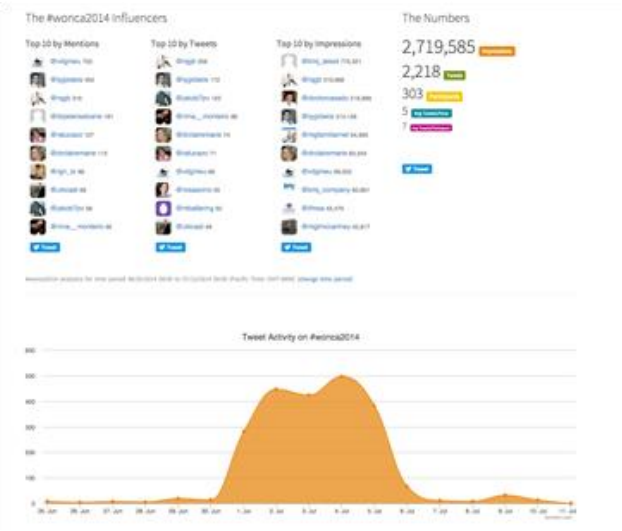

Fig. 2. Analysis of the #WONCA2014 hashtag on Symplur's Healthcare Hashtags Project

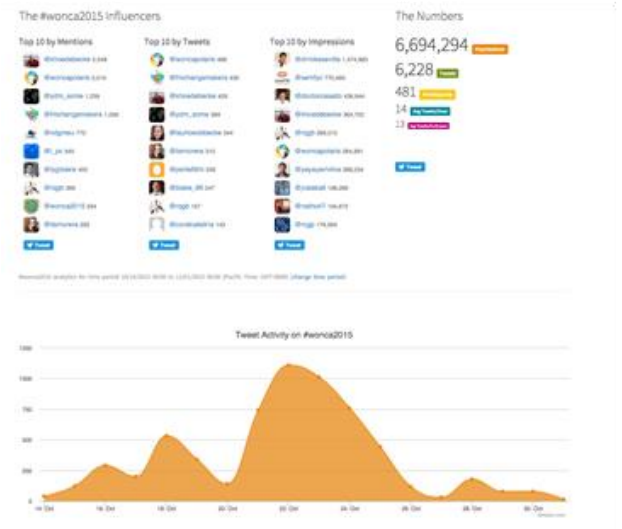

Fig. 3. Analysis of the #WONCA2015 hashtag on Symplur's Healthcare Hashtags Project

Table 1

	2013	2014	2015
Impressions	7,141,287	2,719,585	6,694,294
Number of tweets	2,246	2,218	6,228
Participants	580	303	481
Peak of posted tweets	21st – 28th June	30th June – 7th July	18th – 25th October

Delegates tweeted to disseminate the knowledge and the discussions that were taking place inside the rooms of the conferences. They also used the medium to raise questions to the Twitter audience and the colleagues around the world who may have been interested in a topic.

In the most recent conference (2015), Twitter was used even more meaningfully with the inclusion of tweet conversations in three panels. During these sessions, the speakers answered the questions that were asked directly on Twitter, thus enriching the discussion by adding a remarkably simple way for the audience to interact. A moderator relayed the most important and relevant questions to the panel speakers, while all tweets were being projected on the wall.

Conclusions

The use of the hashtags during the Conferences has become prevalent during the last years, not only as a method of amplifying the messages of the events to a wider audience including those not physically present, but as a novel way of interacting with of those interested in the same topic. The overall results demonstrate that the use of Twitter in Conferences is feasible, acceptable and even desirable, as it provided with an easy way of sharing views in real-time and of networking with other healthcare professionals.

As this assessment was conducted only retrospectively and was exploratory in nature, it is recommended that a proper mix-method research study is set up with the aim to measure the interactions and contents more thoroughly. By employing a rigorous methodology, it will be possible to demonstrate the impact and return of investment from the Twitter use, thus encouraging the organizers of more Conferences to include them in their scientific and communication strategic planning.

Acknowledgment

The authors would like to thank the World Organization of Family Doctors, namely its European section, for the adoption and promotion of the WONCA hashtags during the Conferences, as proposed by the Young Doctor Movements.

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Mobile Solutions (mHealth)

A Mobile Application for Individual Health Monitoring within the Home Medicine

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Introduction

Recently there has been a trend to develop and sell medical devices, adapted for use by patients at home. Many personal telemedicine systems, based on the heart rate variability analysis, and, in fact, on the stress assessment, are becoming more and more popular [2, 4]. Such devices make recommendations about preventive measures or consultation with doctor.

This report is devoted to simple and convenient for home use system for individual prenosological control, based on smartphone - the "Health Traffic Lights".

Materials and Methods

The main method of assessing the personal functional state in the system is the heart rate variability (HRV) analysis.

The signals of the heart are obtained from the finger photoplethysmogram by using the smartphone camera. The smartphone microcomputer recognizes and measures the duration of cardio intervals and calculates a number of statistical HRV indices.

The survey consists of the registration of cardio intervals and completing the questionnaire about the well-being. As a result the application creates a report and sends it to the analytical center (Fig. 1).

Our report includes the results of studies on personal monitoring with the use of this system in 5 volunteers (men - 2, women - 3, age 25-52 years), about 120 records for each.

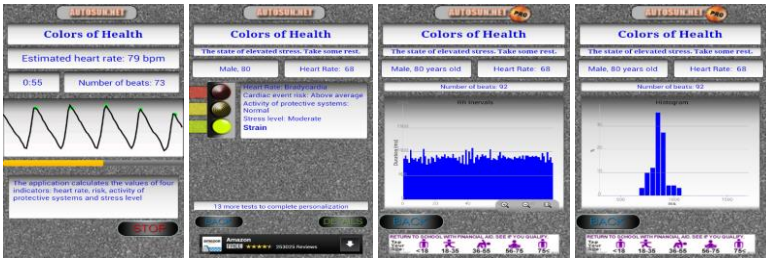

Fig. 1. Screenshots of the smartphone during the survey using a mobile app "Health Traffic Lights"

Results

The correction of HRV analysis algorithms for a mobile application «Light Health» was performed in cooperation with the company Autosun Health Technologies Inc., Canada.

We have checked the accuracy of cardio intervals by simultaneous registration of heart rate with a smartphone and the use of the electrocardiograph (Fig. 2). The studies were conducted at different times of day, before, during and after work [1].

Special attention was paid to the adequacy of the dynamic studies. A series of studies, including three consecutive records in the provisions of "sitting", "standing", when deep breathing and again "sitting", was conducted.

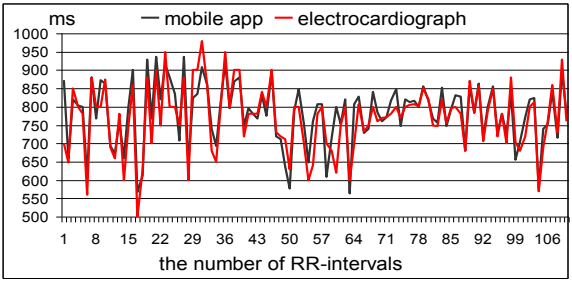

Fig. 2. Simultaneous recording of cardiac rhythm through the mobile and further details of ECG machine

Comparison of the dynamics of individual values of HRV, AMO, HR and SDNN (Fig. 3) simultaneous studied, using a "Health light" and electrocardiography, showed adequacy of the results obtained with the mobile app. These HRV indicators were selected and used for conclusion about functional status [1, 3].

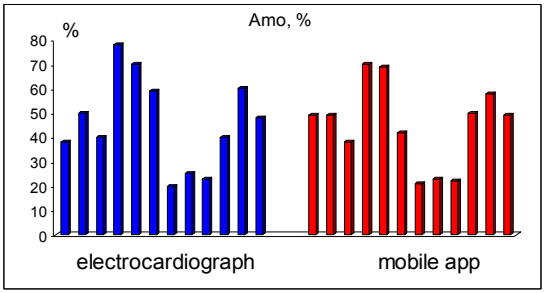

Fig. 3. A comparison of the AMo values from "Health Lights" (left) and ECG (right).

We have developed a unique system for data personalization, allowing to consider about specific features of autonomic regulation for each individual user. The vector of the functional state changes is determined in the course of dynamic observation on the basis of stress assessment and data personalization. The application makes recommendations about necessary preventive measures or immediate consultation with doctor. The results of the test can be sent to the specified e-mail address or in a special analytical center.

Table 1. An example of constructing a database for personalization

	HR	SDNN	RMSSD	pNN50	SI	%
1	53,76	192,21	248,64	84,85	10,55	5
2	55	176,48	246,91	84,54	11,99	10
3	55	154,07	213,03	83,16	12,27	15
4	56	147,57	194,43	82,69	12,99	20
5	57	131,54	183,99	80,65	17,6	25
6	58	101,45	132,5	72	26,06	30
7	58	95,35	104,95	66,1	26,8	35
8	60	86,17	94,1	65,42	34,38	40
9	61	75,53	88,14	53,1	38,65	45
10	61	75,32	87,34	52,54	40,01	50
11	62	72,25	86,25	51,69	40,2	55
12	62	71,28	80,16	50	40,82	60
13	64	67,91	79,36	46,43	42,88	65
14	67	63,71	78,38	37,29	55,14	70
15	67	62,65	63,8	33,04	57,66	75
16	67	60,33	62,75	32,48	70,24	80
17	67	53,98	60,22	31,09	93,51	85
18	71	48,61	54,74	30,91	93,97	90
19	76	33,83	48,77	29,91	123,81	95
20	80	31,78	44,82	26,89	134,15	100

The personalization function became active after accumulating the first 20 results in personal database (Tab. 1). The database is constantly updated.

This provides the individual dynamics of change in the health status of the patient.

For example, if the HRV parameters of the person do not exceed standard values, the traditional approach based on comparing the functional condition of patient with different standards, doesn't show significant dynamics. Application of the developed personalization system has helped more clearly identify the dynamics of the functional state.

Conclusion

Systems of an operating control of a state of health allow to constantly monitor the functional state of the organism, that gives the chance to detect the signs of strain of the organism with subsequent correction of lifestyle. This is especially important in modern intensive pace of life.

Compared with statistical approach, the personalization system allows you to identify and to interpret even small changes in the functional state.

The use of mobile communication for rapid assessment of functional status can be an important part of a unified system of telemedicine monitoring health at home.

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A Mobile Ultrasound E-Learning System

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Abstract: **Ultrasound diagnosis is an important skill for gynecologists. However, there is no routing ultrasound course for medical students during pre-clinical stage, and no enough chances to practice ultrasound diagnosis during clinical stage for interns at the department of gynecology in Taiwan. The objective of this study is to develop an ultrasound diagnosis e-learning system for medical students and interns to enhance the skills of ultrasound diagnosis. When an experienced gynecologist performs an ultrasound examination, the synchronized videos, including ultrasound images and operational procedures of ultrasound, are shown on mobile phones of medical students with less delay. This real time e-learning system provides interns with comprehensive learning scenes, including continuous operational procedures of ultrasound, and corresponding changes of images. This system provides interns with more chances and more flexible ways to practice ultrasound diagnosis while patients refuse to allow the interns to be present in the ultrasound examination room.**

Introduction

Medical ultrasound is widely used in clinical medicine since 1940s. As a noninvasive, cost-effective tool, it provides multi-disciplinary and multi-system applications. In obstetrics and gynecology, physicians use real-time ultrasound imaging to enhance the assessment and treatment. Experienced clinical physicians and sonographers act important roles on correct ultrasound examination for diagnosis and treatment. However, there is no routing ultrasound learning course for medical students during pre-clinical stage, and no enough chances to practice during clinical stage for interns at the department of gynecology in Taiwan. How to promote the education of ultrasound has become an important issue [1]. Based on the evolution of ultrasound and information technology, tele-ultrasound will act as a more and more important role in telemedicine services for remote areas. Additionally, videoconference technology develops successfully and works efficacy for experts' consultations and surgical intervention supports. According to the study results, store-and-forward images have been proved its better quality and improved diagnostic accuracy than hard-copy images.

A real time video-conference system which can provide feedback simultaneously has competitive advantages on diagnosis, education and training [2]. Some studies focused on expert visual guidance (EVG) systems, and which demonstrated that an inexperienced sonographer can be significantly assisted by EVG as compared to verbal instruction alone [3].

Generally, medical students can learn the skills of ultrasound examination in clinical environment. However, most of patients refuse medical students to be involved in their medical ultrasound examination procedures, especially in the department of gynecology. Therefore, it is difficult to learn the skills of ultrasound examination from practices for medical students. It is on great demands to setup a real time tele-ultrasound videoconference system for the mobile learning of ultrasound examination.

Methods

The medical images of an ultrasound device were captured in real time with refreshed rate 25 pictures/sec and the images were synchronized with a real-time ultrasound manipulation video recorded by a mobile phone when

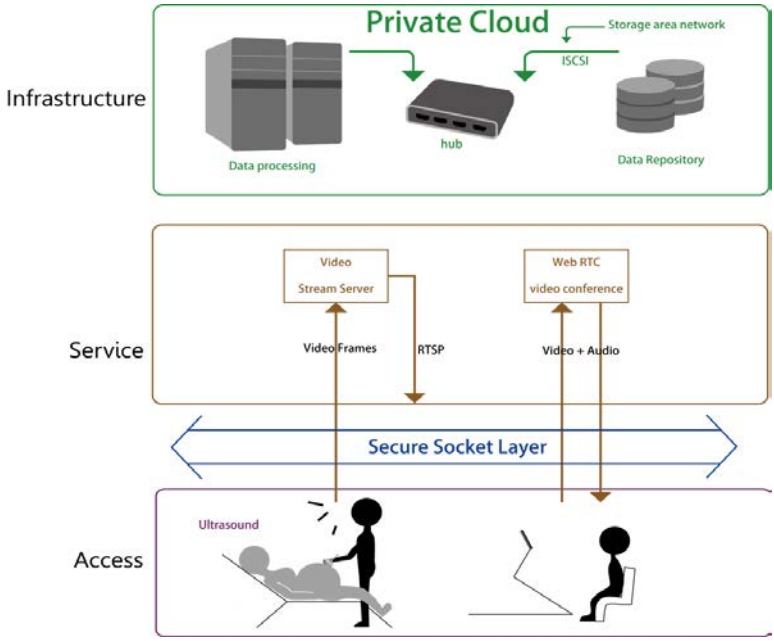

Fig. 1. The mobile ultrasound e-learning system

an experienced gynecologist was performing an ultrasound examination. The two videos were then streamed into a video stream server and delivered to the mobile phones of interns or medical students. This real time e-learning system provides comprehensive learning scenes, including continuous operational procedures of ultrasound, and corresponding changes of images. As shown in Figure 1, this mobile e-learning system is composed of three-layered infrastructure based on private cloud computing. The top layer is the hardware for video storage and processing. The middle layer is the virtual machines for video streaming and display services. The bottom layer is the setup for video capturing and transferring.

Results

As shown in Figure 2, a practical ultrasound examination workflow can be recorded as real-time teaching materials. The medical students can ubiquitously learn the skills of ultrasound examination prior to clinical practice. When an experienced gynecologist is performing an ultrasound

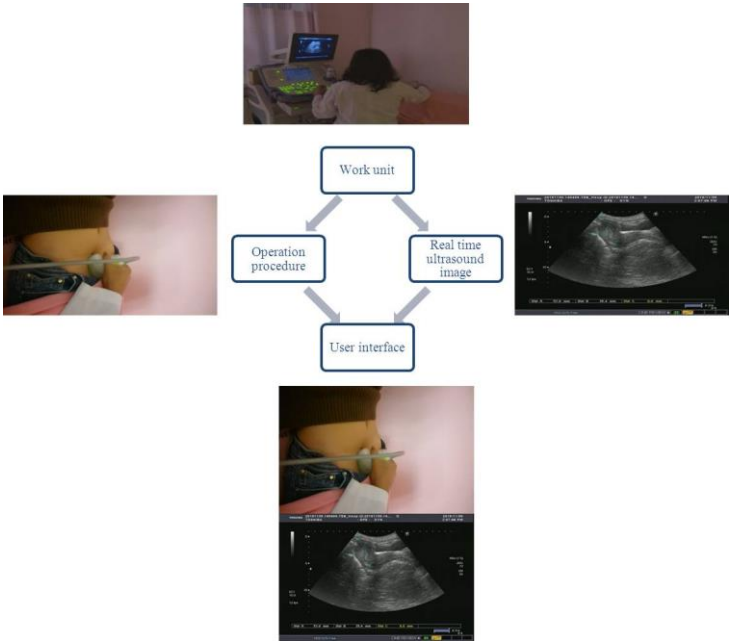

Fig.2. Mobile learning of ultrasound examination via real-time video streaming

examination, two videos, including: (1) ultrasound manipulation, and (2) corresponding changes of images are streamed into a video stream server and delivered to the mobile devices. Interns or medical students can learn the ultrasound skill via mobile devices apart from ultrasound examination unit. It can also leave a private space for patients. This mobile e-learning system provides medical students with a new learning way to practice ultrasound examination. Additionally, two synchronized videos with physician's comments can make the learning easier as compared to lecturing on class.

Conclusions

When a physician is performing the ultrasound examination, the final diagnosis making is strongly dependent on combination the information of examination position and image. This system provides learner with more chances and more flexible ways to learning ultrasound skills and leave the patients with a more comfortable environment in the ultrasound examination room. There are many factors that can influence implementations of this e-learning system, such as curriculum design, technology awareness, motivation, and changing learners' behavior [4]. With the advance of modern communication technology and popular mobile devices, it is possible for us to set up a high quality real-time mobile videoconference system to promote medical education. These are no barrier for medical students using this system. Although this system is mainly designed for medical students, it also could serve as a medical consultation system to improve tele-ultrasound services on clinical practice.

Acknowledgment

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Inpatient's Medical Records Installed on Mobile Interfaces: A Natural Evolution of the Mongolian Tele-Assistance Medical Network

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Background

Delivery of quality cardiovascular services to the people of Mongolia over thousands of kilometers through numerous constraints including the harsh climate presented a big challenge for the country. However, the telemedicine network that was established thanks to the telemedicine project in Mongolia, implemented under the grant from Luxembourg Government, answered the demand to connect the country altogether and proved to be an ideal tool for delivery of timely professional advice and tele-consultation to the cardiologists practicing in those remote provinces, thus contributing to the delivery of quality medical services to local residents. The cornerstone of this network is a web-based software named "MnCardio". An outpatients module enables the cardiologists throughout the country to create an individual electronic medical record that keeps track of the patients' medical history, clinical examinations, angiographic, and echocardiography procedures, thus ensuring continuity of care. It also includes a forum-like function to seek advice from colleagues, and guidance from the reference center. In this paper we present the prescription and treatment functions that constitute the first steps of the in-patients module.

Objective

The specific objective of the development of the prescription/treatment section is to record the treatment received during hospitalization, and to automate the time-consuming and error-prone manual works of the staff. Several challenges/demands were presented requiring appropriate addressing. These include:

- To appropriately convert the traditional practice of writing prescriptions into electronic format, and to apply up-to-date practices and international standards, if need be;

- To systematically encode/input detailed information of medications including international and commercial names, descriptions, ingredients, packaging, daily dosage into the software database;
- To develop user-friendly interface compatible with mobile devices in consideration of the needs of doctors to use the program during their daily examination of patients in bed;
- To study the information/input flow of the inpatient department and to automate works which can be computerized;

Material dnd Method

A series of workshops was held with the staff including the doctors, nurses and pharmacists. As a result, architecture and design of the program were identified and the development work is ongoing under the constant feedback from the users. Those challenges/demands were compared to international standards and domestic forms in use. The following issues were identified:

Traditional Practice of Writing Prescriptions

Currently there are 2 types of practice in use by doctors:

- Prescription using brand name. For instance: Augmentin 625 mg, 1 tablet per day for duration of 5 days;
- Prescription using generic name. For instance: Amoxicillin 500mg + Clavulanic acid 125 mg, 1 tablet per day for duration of 5 days.

First option may be more appropriate for use in outpatient examinations and/or primary level health care providers (family and soum level doctors).

Second option is more suitable for use in inpatient department of hospitals. As the treatment will be completely handled by professional nurses and pharmacists, there is no need for doctors to waste time on administrative work by searching for commercial names and packing quantities of medications. Therefore, it was considered wise to directly apply the second option of prescription into the first ever inpatient module.

Drug Modeling

Drugs were modeled as a dictionary with a simple table of main columns such as drug ID, Name, Form, Concentration, Value, Unit in the raw version of the inpatient module and tested by doctors. List of the dictionary was found too long due to the combination of columns. As a result, doctors tended to waste time searching for a single drug in the long list. Therefore, modeling of drugs was restructured for more optimal way to make the search of drugs quick and easy. In specific, the tree structure shown below was adopted for drug remodeling (Image 1).

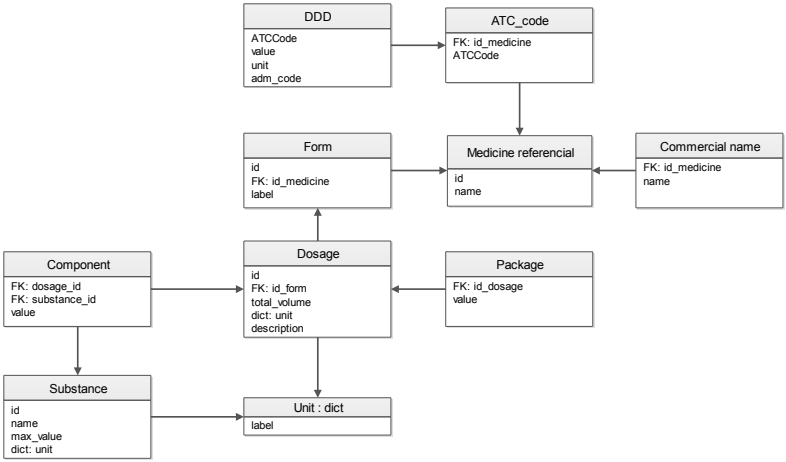

Image 1. Drug structure in database

With the use of the tree structure, search for drugs was made more systematic. Moreover, possibilities to input additional information of the drugs including International Coding (ATC, DDD), maximum daily dosage of the ingredients and to detect any exceeding of the maximum daily dosage of the ingredients in the prescriptions were enabled. Coding of all drugs into the database under this model requires tremendous amount of work and this task is under execution by a team of hospital pharmacists. ATC coding and appropriate daily dosage information (DDD) is advantageous in a way that it will allow doctors to improve their drug knowledge during their daily practice.

Mobile Interface

First requirement for development of inpatient module was to create a possibility for doctors to easily enter treatment prescriptions into the program without having to write prescriptions on paper and later input to the program. For inpatient department, the best solution is to create a mobile interface that allows doctors to input the treatment prescriptions directly into the program from their mobile devices while examining patients in bed.

From the technical point of view, ReactJS library, the product of Facebook, was used in the development of this mobile interface. ReactJS library breaks interface into self-managing small components. Therefore, this technology is appropriate for programming sophisticated/complex tasks such as inputting of medical prescriptions, looking up into the treatment schedule etc.

Automatization of Manual Works in Inpatient Department

Data flow made at the hospital level during a patient's hospitalization period (from admission through discharge) has been studied and manual activities which could be automated were identified and automated. These activities include:

1. Management of patient hospitalization wait list: Patient waitlist was made possible to be managed simultaneously by doctors from outpatient and inpatient departments to save time and to manage availability of beds in emergency situations.
2. Calculation of quantities of all medications to be used for medical treatment of patients in inpatient department; Work load of nurses was substantially decreased.
3. Analysis into the inpatient department activities and its treatment management: With the input of patient's pre and post hospitalization diagnosis and their physical condition into the program, a possibility to automatically obtain statistical data on inpatient department's activities, treatment management and services was created.

Results

MnCardio, the telemedicine and e-medical record program, has been used by Mongolian doctors since 2009. As of January 2016, a total of 133 844 patients have been recorded in the program and 747 severe cases were consulted receiving 5 607 advices/suggestions from doctors. Moreover, a total of 166 883 outpatient examinations and 429 interventional procedures have been recorded in the electronic medical files in the program. Further development of the program is ongoing with development of new modules/features for recording of treatments received by patients during their hospitalization, and for simplifying administrative activities of the inpatient department. Currently, inputting of drug information into the program is ongoing with simultaneous testing of this new module.

Prescription section of the inpatient module is dedicated as a whole for mobile devices. The developed interface (Image 2) is an "easy-to-use" and "time-saving" one that enables doctors to search for drugs, to combine several drugs to create a solution and to input a prescription for patient's daily treatment in "continue, stop, pause, edit" modes. The program calculates the amount of drug that a patient will consume within 24 hours and shows to the doctor the recommended daily dosage of the drugs (DDD) as additional information.

Main factor that simplified the prescribing process in the program was the use of tree structure for drug modeling.

Image 2. Doctor is inputting treatment prescription into the program from a mobile device next to the patient's bed

Currently, management of patient hospitalization waitlist and calculation of quantities of all medications to be used in the inpatient department have been fully automated.

1. The inpatient module automatically prioritizes patients in the waitlist according to their health condition and the number of waiting days. As of today, hospitalization queue of 821 patients have been managed by the program.
2. After the input of prescriptions into the program by doctors, it is possible to calculate total quantity of medications to be used for all patients in the inpatient department and print out the required inventory from the program. However, as mentioned earlier, not all medications have been coded into the program. Therefore, this module is currently in use for testing and practice purposes only.

Discussion

Advantages and benefits

Two main specific objectives of the new module are:

1. To enable recording of the treatment received during hospitalization;

2. To automate the time-consuming and error-prone manual works of the inpatient department staff;

In addition to these, development of the new module presents following benefits and advantages:

- Reliable exchange of data from doctor to doctor and from nurse to doctor, leading to improved quality in medical treatment and services;
- Preparation of medical staff towards the utilization of the Future Hospital Information System (HIS).

Challenges/solutions:

- It is always a challenge to dismiss traditional practice of specialists and replace it with the new;
- To interoperate with the future HIS as its fundamental data collection component.

There are certain needs to further develop the program and create additional new features under the inpatient module:

- Inputting of a patient's treatment into the program on daily basis is fundamental. In this sense, the program was developed accordingly to input treatment prescriptions into the program on daily basis. However, in practice of Mongolia, on public holidays and weekends doctors on duty are allotted with big number of patients. This results in substantial increase of workload for duty doctors. Therefore, doctors on duty do not examine every patient, but only those in critical health condition. For this reason, doctors are suggesting to add a new feature for planning of treatments.
- Nurse performance section is another necessity. Upon recording treatments, medical cares provided to the patient and the materials used, some administrative tasks will be significantly eased.
- Development of a new feature for calculation of costs of drugs will be extremely beneficial for activities of the hospital pharmacy and the medical insurance.

Conclusion

As this telemedicine platform perfectly meets the uniqueness of the country and satisfies the real conditions of its users, it has been a great asset for the medical sector of Mongolia, providing invaluable contribution to the introduction of ICT technology to the cardiovascular health service of Mongolia, which is one of the key fields of the medical sector of the country. Hence, this platform serves as excellent experience, lesson and foundation to the future national HIS.

The telemedicine program “MnCardio” can be concluded by following points in brief:

1. The program answers the current real needs of doctors and nurses and significantly alleviates their workload.

2. The program clearly demonstrated in practice how health service can be provided efficiently under the introduction of ICT technology and it is serving as the foundation/basis to the introduction of future HIS. Moreover, the program not only realized the benefits of e-health into the real practice, but also prepared the users for utilization of e-health tools, and elevated its utilization to the next level.

3. As MnCardio is a web-based program with one concentrated server, the deployment process is cost free. The new module is available at the same time in hospitals across big distances of the country. These together make the program appropriate for the country’s specificity.

4. Introduction of new required modules/features to the familiar program, which is already under confident utilization by the doctors, is more efficient compared to the introduction of a completely new program.

5. As MnCardio is based upon free and open technology, the local team keeps a full control over it and can make it evolve as the needs change.

Tele-Operated System or Vocal Guidance for Remote-Echography through Internet on 340 Isolated Patients

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Introduction

Previous studies have confirm the strong need to provide access to remote echography to isolated person because echography is the first imaging modality which can be setup without huge and costly installation. Moreover it's the only imaging method that can identify very quickly emergency situation to be treated immediately and other that can be treated on place. Access to remote echography will facilitate and make safer the medical diagnosis, which may result in a better medical assessment and a quicker decision making. Several method were designed and validated for providing remote ultrasound examination to isolated subjects and patient. These methods were based on tele-operated systems [1, 2, 5, 9, 11], remote analysis or remote guidance through videoconferencing [4, 6, 9, 10] or volume capture with 3D reconstruction [3, 7, 8].

It was hypothesized that not a single method could answer all the medical and ergonomic issues related to tele echography practice. We had the opportunity to use in the same medical center on the same population of patient 3 different methods and try to determine the method the most appropriate for each organ/pathology.

Methods

Study procedures and population

Three methods were used to perform remote echographic examinations. The method used was dependent on the organs to be investigate. For deep organs (abdomen, pelvis, fetus organs) the movement (orientation) of the probe was controlled from the expert center (a) using a robotic arm holding an echographic probe [1, 5] (Figure 1) or (b), an echograph with a 3-7MHz

motorized probe [2] (Figure 2). The motorized probe (7-15MHz) was also used for peripheral vascular targets (Thyroid, Arm leg muscle, superficial vessels...) with additional examinations being conducted using (c) remote guidance (Carotid Femoral Arteries and Leg vein) where the operator at the side of the patient held a 2D probe and oriented it manually according to verbal direction provided by an expert sonographer [6, 9].

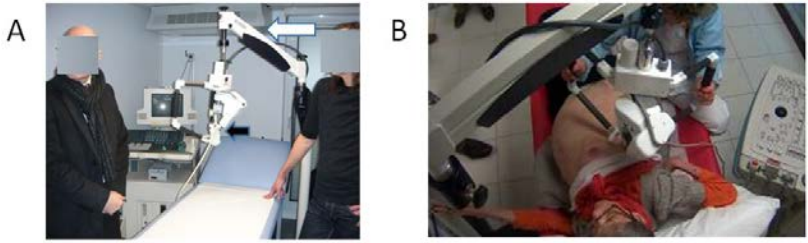


Fig. 1. Robotic arm (black arrow) used for teleoperated echographic examinations pictured (A) hanged to the ground support (white arrow) and (B) over the patient for the examination.

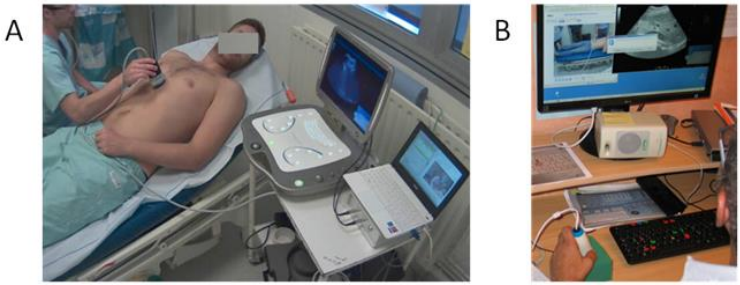


Fig. 2. Examination set up for teleoperated echography showing (A) the patient site with the non-sonographer operator holding the motorized probe on the patient and (B) the expert site where the expert sonographer used the dummy probe, ambient video from the patient site, and echographic video to perform the examination.

The three methods were used for performing remote echographic examinations on isolated patients in a single medical center located 60 km away from our expert center. Similar patient populations were investigated for all the examinations which allowed the methods to be compared to determine the most appropriate for each organ of interest and pathology. Because of technical constraint (weight, size, ergonomy) only the second method (motorized probe) could be used for remote echography on pregnancies located 1800 km (Ceuta Spain city north of Morocco) and 7000 km (Apatou dispensary French Guyana) away from our expert center.

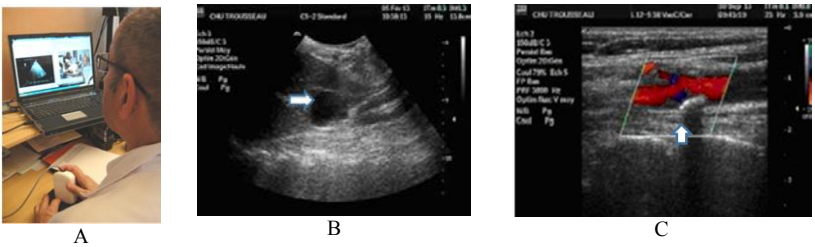
Tele-echography assessments

The three methods of tele-echography were used to conduct standard echographic examinations. Images were acquired in B mode for morphological evaluations of diseases (ex: lithiasis, cysts, gall bladder wall thickness, tumor, hematoma, and renal cavity dilation), organ or lesion size, thrombus imaging, and collapsing veins. Color and PW Doppler were used to assess things such as blood flow velocity, atheromatous disease, the degree of stenosis, vascular resistance, vein reflux, and parenchyma arterial color cartography.

Results

During the first run of the study (2014), 160 patients were investigated by tele-echography using the robotic arm (n=47) or by remote guidance (linear probe 7MHz; n= 113) (Figure 1, 3). During the second run of the study (2015), 180 patients were investigated by tele-echography using the echograph with the motorized probes (n=92) or by remote guidance (linear probe 17MHz; n=88) (Figure 2, 4). Fifteen pregnancies were investigated in the 2 long distance patient site (Figure 5) using the motorized probe.

Both the robotic arm and the echograph with motorized probe provided enough views to deliver a diagnosis for deep organs in 97% of the cases. The full control of the orientation of the probe via teleoperation was necessary for getting correct views of the deep organs (including fetus) as the operator at the patient site was not a sonographer. For the superficial targets the tele-operated motorized probe (for superficial organ) or the remote guidance (for superficial vessels) provided the right view of the organ necessary for the diagnosis in 98% of the cases.



A B C

Fig. 3. Results of the first phase of the study showing (A) the expert performing the examination, (B) an image of a renal cyst visualized using the robotic arm, and (C) an image of the carotid bifurcation with atheromatous plaque obtained using remote guidance.

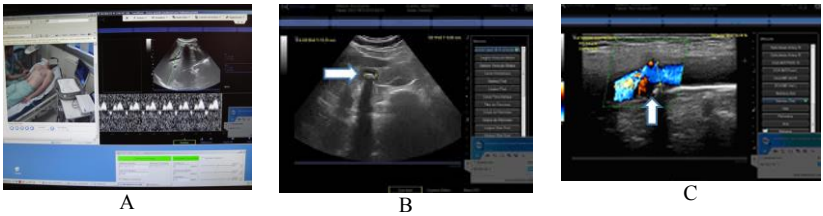


Fig. 4. Results from the second phase of the study showing (A) the expert center computer screen during an examination with the motorized probe showing the patient video (left), hepatic vein Doppler trace (right), and the probe interface (bottom), (B) a lithiasis (arrow) in a Gall Bladder obtained with the motorized probe, (C) image of carotid atheromatous plaque (arrow) with blood stream in color Doppler by remote guidance

Figure 5: (Left) Fetal remote echography on a pregnant in Ceuta (Right: Expert, bottom: patient site, left: Fetal Abdomen, Femur, umbilical cord). (Right) Remote fetal echo in French Guyana (Embryo at 10 week and fetal head at 23 week of gestation).

Discussion

For the deep organs investigation the robotic arm or the echograph with motorized probe, provided similar diagnostic performance. However, the motorized probe (430 gr; 400 cm3) was found much more ergonomic, and easy to move along the abdomen or the lateral side of the patient than the robotic arm (3,5 kg; 40x35x35 cm3) which made the tele-echography quicker and of better quality.

For the assessment of superficial blood vessels, remote guidance using a high frequency 2D probe was the best method, while the superficial motorized probe was more appropriate for assessing superficial volume structures (ex. thyroid or muscle). For superficial organs, the robotic arm was found to be too difficult to locate accurately on the organ acoustic window and to maintain motionless during the examination due to the size and weight.

The remote guidance method with a conventional 2D high frequency probe provided vessel echographic images of better resolution and contrast than the motorized probe of lower frequency. Thus it was agreed that for superficial vessels (carotid artery, leg artery, and veins) the priority should be put on the echographic performance of the probe (high frequency) rather than on teleoperation control. Despite the fact that the operator at the patient site was not a sonographer, the operator was able to consistently obtain a transverse view of the vessel and get the long axis view of the vessel simply by turning the probe 90° while keeping the image of the vessel in the field. Conversely for non-vascular superficial structures (muscle, thyroid) the tele-operated superficial motorized probe was preferred as it allowed the expert to fully investigate the organ by tele-operating the transducer orientation or to entirely scan the structure and reconstruct it in 3D for later analysis. As the visualization was done by the expert sonographer, the motorized probe allowed for a faster and more accurate examination of these structures.

The tele-echography performed in this study utilized a standard Internet connection. The results confirm that 1Mbit/s bandwidth with 10/s frame rate was sufficient for getting echographic images and Doppler data of good quality for diagnosis with a transmission delay of less than 2s. The use of the tele-echography methods in this study required minimal training of the non-sonographer operator at the patient site as the final movements of the robotic arm or motorized probe (to optimize the view of the organ including the fetal ones) and the echograph functions activation were tele-operated by the expert sonographer. Conversely the remote guidance method required the most training as the operator was required to properly locate and move the ultrasound probe. However, with several weeks of training, the operator had acquired a sufficient level of skill to perform superficial vessel examinations using remote guidance.

Conclusion

Presently, the medical reliability and usefulness of tele-echography for isolated patients has been demonstrated. However, results indicate that a single method of tele-echography is not appropriate for all examinations routinely used in clinical practice. The control of the echograph setting and functions with the use of the motorized probe improved both the time required for the examination and the quality of the echographic and Doppler data. The motorized probe and tele-operated echograph also provides a method of tele-echography that can quickly generate diagnoses and requires minimal training of the operator at the patient site (including for the fetal tele echography). At last the remote guidance is suitable for some specific

targets like the Carotid and leg arteries in case of suspicion of atheromatous disease and the leg vein searching for vein thrombosis. Future work is required to refine this system to provide a method of tele-echography that can generate the same quality of echographic images and with the same ease as traditional echographic examinations.

Acknowledgement

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National Telemedicine & eHealth Initiatives

An Update on eHealth in China

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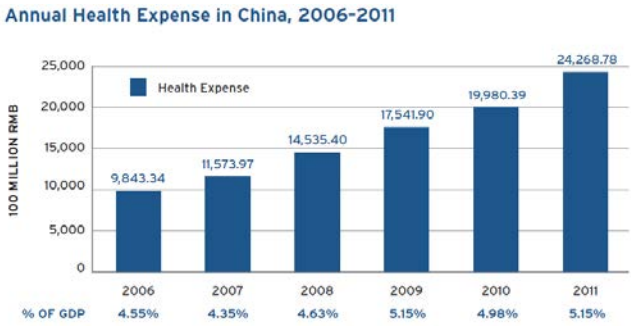
The Economic Foundations of e-Health Development in China

Swings in financing healthcare

Modern China has experienced 3 major stages regarding the financing of healthcare [1]. Until the late 70's, the care delivery and its financing were public, alike in most communist countries. After 1984, the political swing to market economy led to public disinvestment in healthcare and to a rapid development of a private sector. In 1999, less than 50 % of urban Chinese were covered by a health insurance and the rate of cover fell to 7 % in rural areas [1]. In 2003, Chinese authorities decided to launch a plan to expand dramatically social coverage. This was followed in 2008 and 2012 by important steps to provide to 95 % of the population a comprehensive healthcare coverage and to develop primary care.



Source: [2]

Although health still represents only a small share of China GDP, the rate of growth of the Chinese economy over the last 20 years has been so important that the average per capita spending on health has been multiplied more than 10 times between 1995 and 2015.

These swings in the financing of health care prompted a significant increase in out-of-pocket health expenses. "*Out of pocket spending as a share of total health spending increased from 20.43 % in 1978 to a peak of 59.97 % in 2001 and then declined to 35.52 % in 2010*" [3]. This out-of-

pocket spending represents the major part of non-public health care expenditure.

At the time when telemedicine technologies were becoming mature, in the early 2000's, healthcare demand was thus mostly private, which resulted in a strong incentive for the development of private-based teleservices.

Demographics

Over 200 million Chinese are over the age of 60. The impact of an ageing Chinese population is reinforced by the significant increase of chronic illnesses in the Chinese population, partly linked to the deep changes in the way of life and the increase in life expectancy.

Approximately 630 million rural Chinese experience lower income per capita (1700 €) than urban ones (4740 €) and a limited access to healthcare services. The number of hospital beds per inhabitants in rural areas is less than 50 % of urban areas (3.11 for 1000 vs. 6.88). "*Urban hospitals attract most of the health professionals with serious shortages in rural areas (...) In consequence, rural residents were less likely to have access to healthcare than their urban counterparts*" [4].

As a result of the increase of healthcare demand, the activity of Chinese hospitals has surged. Outpatient visits have increased by 50 % and inpatients stays by 150 % between 2005 and 2012. However, local hospitals have a low level of credibility among patients, which tend to travel to large "level 3" hospitals located in urban areas which are facing occupancy rates over 100 % and can hardly accept more patients. Telemedicine conventions between those "level 3" hospitals and local "level 1 and 2" hospitals thus appear as appropriate solutions to maintain patients in level 2 or level 1 hospitals, while guaranteeing an adequate quality of care.

Current Status of E-Health

Public initiatives

In 1999, the Chinese government launched a first plan to improve the Health system through IT. Ten years later, in 2009, the "Opinions of the Communist Party of China Central Committee" emphasized IT through 4 major objectives: build a practical, medical information sharing system, push forward the healthcare information standardization, establish a public healthcare service platform and finally construct telemedicine network in rural and remote areas [5]. 3 Billion € have been spent between 2009 and 2012 on Health IT to achieve these targets [6]. In 2012, another 9,1 billion € have been voted. The efforts made on HIT provided good results, but one major problem remained unsolved: healthcare resources are limited and mainly located in urban areas.

In August 2014, the NHFPC (Ministry of Health) issued the "Opinions (…) Regarding the Promotion of Medical Institutions' Telemedicine Services" [7], which provide a very comprehensive canvas for telemedicine. Three main ideas can be outlined: the need to promote the coordinated development of telemedicine as an appropriate tool to manage the shortage of medical resources. Telemedicine is a medical activity, which needs to be defined and regulated as such to guarantee quality and safety. This requires performing cooperation agreement between institutions, providing informed consent to patients, etc.

These "Opinions" have been followed by the Technical Guidance [8], which describes the infrastructure, the functional and technical requirements, the interoperability framework and the safety standards targeted for the deployment of nationwide telemedicine solutions.

The need for interoperability arouses from the development of hospitals "hub and spoke" networks. At first, level 3 hospitals extended their own private networks. Then, the government tried to develop regional platforms. Chinese authorities and numerous districts favoured this approach and regions started building their own RHIP. However, if RHIPs tend to structure the Health Information Exchange processes, they do not solve the crucial problem of remote rural population with limited access to high quality of care.

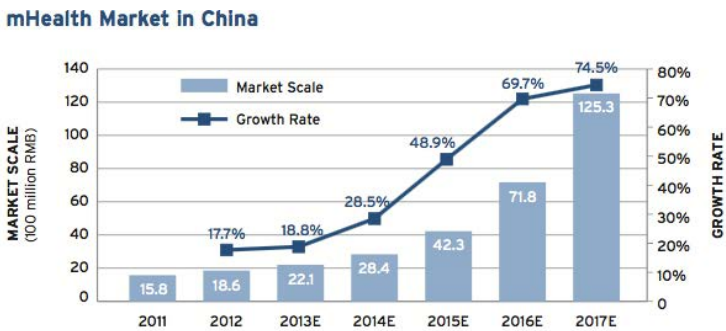
Private initiatives

According to various estimates, the Chinese market for private would amount to 2,5 to 3 billion €. This amount can appear as overestimated (and probably is) compared with worldwide telemedicine market estimated around 12 to 15 B€. However, this amount represents only 20 RMB per patient, i.e. only 1,25 % of total healthcare spending. Unlike Europe or the USA, where telemedicine started from hospital-based procedures, China's main driver for telemedicine has been the mobile phone with the supply by private sector of low cost m-health teleconsultations.

More than one billion Chinese have a mobile phone, out of which 368 million accessed the Internet via their smartphone in 2013. According to Li [9], one-third of mobile users will use an m-health application in 2015.

Corpman documented in 2013 numerous m-health apps [10] by performing a comprehensive review of the applications that had been documented by a scientific publication.

Mobile health can also be a tool for public health campaigns. One campaign "*in Mianyang City specifically highlighted text messaging as a "low cost, high return method"*, whereas two other ones cited *"text messaging as "achieving effects that traditional forms of announcements cannot"* [10].



Source: [2]

Issues Facing China

Regulatory challenges

This very rapid private-based expansion might however be constrained by recent public decisions. "Circular 51" issued by NHFPC in August 2014 requires physicians to obtain prior approval from their employers in order to provide telemedicine services. This requirement comes in addition to the strict definition of teleconsultation within the "Opinions" and might result in an increased difficulty for private operators to hire on a part-time basis public physicians to provide "health consulting services".

China is also facing an increasing concern for patient data protection that leads to progressively introduce regulatory constraints on telemedicine. This generates a significant political risk linked with increased regulations on the mobile health market.

Technical challenges

The optimistic view on mobile health should be balanced by practical considerations. «*Considering existing domestic truth, E-health spring has not yet arrived. It faces with so many practical difficulties*" [11]. Among technical challenges, on can note a poor functional response, due to a lack of medical resources, expensive solution, or to a weak technical solution, a lack of openness, standardization and interoperability in most public hospitals. The road towards interoperability is still complicated in China.

Economic challenges

The unit value of telemedicine / e-health in China remains very low when measured per inhabitant, in the range of RMB 10 (1.5 €) per capita, but it amounts to approx. 1 % of the annual healthcare expense per capita.

Several business models (BtoC, BtoBtoC, public vs. private) are currently competing on the E-health market and their future may strongly depend upon actual enforcement of current political orientations. The economic model of private-based telemedicine based on fee-for-service might be constrained as cost of production of services increase due to scarcity of human resources.

As far as the public sector is concerned, telemedicine will progressively require assessment of cost-effectiveness and interregional increased interoperability. In a general context of semi-recession, it is not sure that the pace of investment of Chinese government in E-health infrastructure can be maintained. There is no doubt that Telemedicine will continue to grow at a rapid pace in China, where political orientations following the issuance of the "Opinions" and the "Technical Guidance" will however lead to some arbitrations between the public and private sectors.

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Asynchronous Teleconsultations Applied to Reduce Patient Waiting-List to Specialized Care in Minas Gerais, Brazil

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Abstract: **The Telehealth Network of Minas Gerais (TNMG) provides telehealth services to around 1000 sites in the state of Minas Gerais, Brazil, mainly in primary care. Telediagnosis (electrocardiogram, Holter, retinography and ambulatory blood pressure monitoring) is very well incorporated in public health system, but teleconsultation is still under-used. From March to October/2015 it was implemented a project in Montes Claros (a city in the north region of the state) with the aim to reduce the waiting-list for face-to-face specialist consultation in endocrinology, dermatology and gynecology. All Family Health Teams (FHT) were trained during four workshops. A new workflow was proposed to support the attendance of these patients: (i) preparation of a waiting-list for each FHT and specialty; (ii) patient home visit by the Community Health Agent (CHA) for program participation invitation; (iii) a new face-to-face consultation with FHT's doctor, and (iv) teleconsultation when necessary. Some forms were created to collect information about project's activities. One of the negative aspects was the difficulties to obtain the information. As preliminary result, the waiting-list was reduced in 79%. Individually, the three steps efficiency in reducing the waiting-list was 34% by CHA activities, 31% by the doctors and 82% by teleconsultations. These preliminary results showed the potential of the new workflow, incorporating teleconsultation use, to reduce waiting-lists.**

Introduction

The Telehealth Network of Minas Gerais (TNMG), a partnership of six public universities since 2005, provides telehealth services to more than 700 cities from a total of 853 cities in the state of Minas Gerais, Brazil, which

correspond to around 1 000 sites, mainly in primary care. The services include telediagnosis and asynchronous teleconsultation. Telediagnosis (electrocardiogram, Holter, ambulatory blood pressure monitoring and retinography), is very well incorporated in public health system, proven by more than 2.5 Million exams performed by distance, mainly electrocardiograms [1]. However, asynchronous teleconsultation, in operation since 2007, is still under-used, with 73 000 teleconsultations performed. In opposition to telediagnostic, with more than 90% of utilization, teleconsultation is used, in average, by 40% of the cities. Written clinical queries to TNMG specialists can be sent by primary care practitioners to better conducting their clinical cases and thereby, reduce the number of patient referral to specialized care. From 2007 to 2015, the system was used in a spontaneous form, that is, when the primary care practitioner felt it was necessary [2].

With the objective to reduce the waiting-list for specialized consultation, incorporating the teleconsultation as a routine activity, a project was implemented in Montes Claros specifically in endocrinology, dermatology and gynecology. The objective of this paper is to describe this project and its preliminary results.

Methodology

Montes Claros is the largest city of the north region of the State of Minas Gerais, with 400 000 inhabitants, HDI 0.770 and 130 Family Health Teams (FHT). The project consisted on establishment of a new workflow in the primary care units to support the attendance of patients that already had a consultation with FHT's doctors and were waiting at home for a consultation with specialists. Waiting could be more than one year. The project, called Telehealth & Regulation (TeleReg), was discussed, defined and implemented in a partnership between TNMG and the Municipal Health Department of Montes Claros.

Based on a general patient waiting list compiled in December/2014, it was defined the first specialties to initiate the project as endocrinology, dermatology and gynecology, specialties with more than 2 000 waiting patients. Besides, TNMG had recognized specialists in these fields that accepted to begin working immediately.

The project was implemented from March to October/2015 through two types of workshops: Introductory Workshop and Follow-up Workshops. To cover 130 FHTs, four Introductory Workshops were done including presentation and discussion of the project, its benefits and difficulties and training section about the use of the system. One physician, one nurse and

one community health agent (CHA) of each FHT were invited. Difficulties and results were then discussed in the Follow-up Workshops.

The new workflow, with five main steps and applied to each FHT was:

1. Preparation of a new waiting-list divided by the three specialties;
2. Presentation and discussion meeting with the whole team;
3. Patient home visit by the Community Health Agent (CHA) to explain the project and invite them to participate;
4. New face-to-face consultation with FHT's doctor to re-evaluate the previous referral, and
5. When necessary, it was performed an asynchronous teleconsultation between the FHT's doctor and the TNMG specialist.

Possibilities of waiting-list reduction occur in three occasions along the new workflow:

1. Reduction by CHAs: During the CHA visits they were able to identify several causes for waiting-list reduction: patients that had already attended another consultation, or had their disease healed, or have moved out, etc.
2. Reduction by the FHT's doctor: Since FHT's doctor rotation is high and waiting time long, in many situations the new consultation was made with a different doctor who decided to conduct the clinical cases, cancelling the referral.
3. Reduction by teleconsultation: If during the consultation the FHT's doctor was not able to conduct the case, a teleconsultation was performed with the possibility to solve it.

To identify weak and strong points in the new workflow, a monitoring system was implemented since the beginning of the project. For each FHT, a nurse was responsible for the project implementation and follow-up. A TNMG researcher assistant contacted all these nurses each fifteen days (and after monthly) to follow-up the project implementation.

Manual or electronic forms were created to control the CHA and doctors activities. Monthly reports were sent by each FHT to TNMG project coordinator.

Results and Discussion

Initial project's participation was high, since only 4% of 130 invited FHTs missed the workshops. During the four workshops 347 primary care professionals (99 doctors, 124 nurses and 124 CHAs) were trained. Acceptance of the project by doctors and CHA were high. However, nurses responsible to implement the new workflow, fill and send the forms, have complained about lack of time and work overload, lack of computers and

low bandwidth internet. As a consequence, the monitoring had some troubles contacting nurses and receiving forms. As consequence, the preliminary analysis was impaired by the quality and quantity of forms received until January/2016 (27% of the FHTs have sent the CHA form and 16% the doctors form). High primary care practitioner turnover was another difficulty for project continuity and highlighted the need of continuous training.

Until January/2016, 1 065 patients were listed in the CHA forms. However, only 551 patients were listed in the doctor forms and have completed the process. That was the universe used for this preliminary analysis. Figure 1 show these patients flow along the workflow according initial data collected.

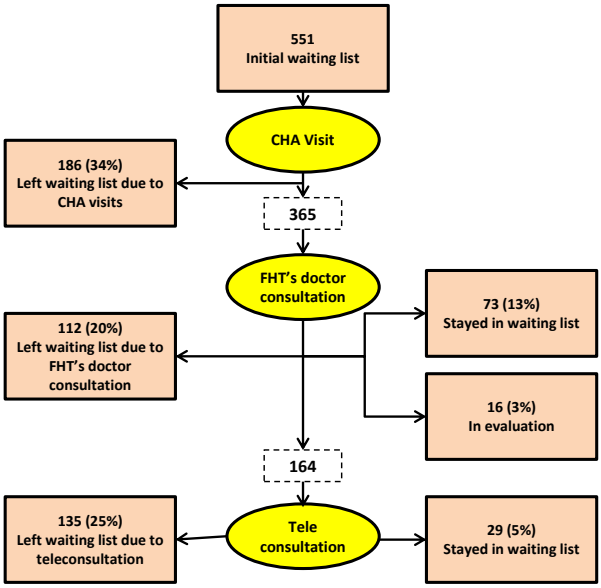

Fig. 1. Patient flow along the new workflow according initial data collected until January 2016

According to this figure, 79% of patients in waiting-list were removed due to the new workflow: 34% after CHA visits, 20% after FHT's doctor consultations and 25% after teleconsultation. Considering each step individually, CHA visit has an efficiency to remove patients from the waiting list of 34% (186/551), FHT's doctor consultation has an efficiency of 31% (112/365) and teleconsultation of 82% (135/164).

Conclusion

Besides the difficulties pointed out, the first results are promising and showed an important reduction on patient waiting-list for specialized consultations in endocrinology, dermatology and gynecology.

The partnership between TNMG and Municipal Health Department of Montes Claros was an important factor for the success of the implementation, as teleconsultations actually were incorporated in the public primary care unit workflow. Based on the benefits of the project, FHT's doctors and the municipal management asked for other specialties to be incorporated in the project.

Acknowledgment

TNMG thanks the Municipal Health Department of Montes Claros, the State Health Department of Minas Gerais and the Ministry of Health of Brazil for the support received.

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Bridging the Gap towards Efficient Collaborative Digital Pathology: A Pioneer Initiative of the FlexMIm Project

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Introduction

This paper presents the main results of the FlexMIm cooperative project launched in January 2013 by a consortium of six partners in the area of Digital Pathology. The project architecture is relying on secure cloud hosting of medical data (whole slide images being uploaded on to an ad-hoc secure image server). The original target was to develop and provide, within a cloud, a complete set of innovative digital algorithms for Whole Slide Image analysis, annotation and retrieval, as to develop Semantics algorithms for high-content image management. We describe these smart

algorithms enabling and supporting an extensive collaborative telepathology initiative intended to address a large community of pathologists, mainly coming from 27 pathology laboratories in the Paris region (coordinated by the public hospital system of the city of Paris and its suburbs – APHP: Assistance Publique - Hôpitaux de Paris). A first glance of the assessment by the pathologists is given.

Project Organization and Consortium

At the very early stage of the project, one major event occurred which slightly modified the initial goals. ARSIDF, a second project launched by APHP with the involvement of a subset of FlexMIm consortium, was labeled and funded in the field of Telepathology, for a collaborative pathologists' work on common medical cases. This gave the opportunity to specialize both projects on complementary goals. Therefore, ARSIDF focused on pathologists' collaborative work including web conferences sessions, secure hosting of digital medical images in the case of image sharing and remote diagnosis for 2nd opinion in difficult cases. Accordingly, the FlexMIm project became a pure research project, aiming at improving the global workflow of digital pathology and targeting development and use of the necessary smart digital algorithms facilitating pathologists' work.

Orange led the project management (WP0) and the associated communication (WP7). WP1, led by APHP, was dedicated to the constitution and coordination of the cluster of pathologists' working groups, and to the preparation of a full information document that would tailor the platform specifications in accordance with the pathologists' requirements. WP2, led by Orange, consisted in administration of a hosting platform in cloud mode, and the development of an innovative algorithm for image best transport in situations where network conditions could be subcritical. WP3, led by the UPMC University Paris 6, was dealing with semantics and images and involved Pertimm, a company specialized in data indexing and retrieval. WP4 was driven by TRIBVN (a medical software company with large expertise in whole slide imaging), which developed dedicated image analysis algorithms, and integrated on the hosting platform all of the algorithms developed by the partners, including (but not limited to) the blur detection algorithm developed by Paris 7 University. WP5, dealing with co-working activities, was actually transferred in the ARSIDF project, as previously explained. WP6, led by APHP, consisted in permanent advice during the algorithms development phase, by including the current (six month - started in December 2015) phase of full assessment of all the algorithms produced by partners (and the potential upgrade requests by the partners after this evaluation) during the project.

Algorithms and Achievements

This section gives an overview of the algorithms developed by FlexMIm partners and integrated in the Teleslide-FlexMIm platforms since the beginning of this project. The details, goals and the operation modes are listed in accordance with a possible query in the medical process workflow.

In order to avoid uploading unusable slides, the platform is able to filter potential flare or scanning defects in the slides. During the FlexMIm initiative, this was achieved by the development of a robust **blur detection** algorithm by University Paris 7 [5]. The algorithm was first tested in standalone mode and found successful with nearly any slide file format (JPEG, PNG, TIFF, SVS, NDPI and MRXS) prior to its integration in the project platform. Once integrated, optimizations were made in order to remain compatible with most of the existing slide file format.

The optimization of the pathologists' access to WSI using their terminals, by providing this access as a natural function of their actual environment (defined by pathologist localization on the network, the network bandwidth, the type of terminal used, the medical use of the image e.g. diagnosis or training), is insured by a "**smart transport" algorithm**, developed by Orange. Tested first in standalone mode and then integrated on the FlexMIm platform, it allows the pathologist to define a quality and a time thresholds, for an efficient image access, in accordance with these thresholds. An important improvement of displaying speed has been shown, as much as 10 to 50 times faster in poor bandwidth context, while the displaying speed was almost identical with or without this smart transport algorithm in good bandwidth context.

In order to deal with possible staining variations (mainly due to inter-hospitals variations in the dye chemicals used for slide preparation), a powerful **coloration correction algorithm** was developed by TRIBVN.

In the field of automatic detection for some specific cases, an analysis algorithm allowing help for identification of possibly critical (dysplastic) / uncritical areas was developed for Inflammatory Bowel Diseases (IBD) by TRIBVN and tested. It was further integrated to CaloPix Server and then made available on the collaborative platform.

Virtual slides can be annotated on line due to several value-added functions developed by TRIBVN on the CaloPix server. Besides, Ki 67 index marker being essential in Breast cancers or in neuroendocrine tumors, a specific algorithm allows counting stained and unstained nuclei. Indeed, the ratio of stained/stained+unstained cells (Ki67 index) represents an important criterion for assessing the prognosis in tumors.

For both IBD cases and prostate cancer cases, a **contextual graph** method has been elaborated and implemented with the support of UPMC

Univ. Paris 06, and the derived vocabulary put online on the project platform. Besides, **mitosis detection** algorithm has been built and tested. This H&E-WSI based algorithm can be launched off-line for specific localized second opinion requests.

In the same spirit of the above described tools - designed to provide quantification support to pathologists, on line semantics service / vocabulary has been produced **to annotate IBD slides**, with the **ontology repository** built by UPMC Univ. Paris 6 and an external **search engine** developed by Pertimm. The whole platform is linked through APIs used by the Pertimm's search engine to communicate with this ontology, and to grab and index annotations. The ontology has an editing interface designed to allow pathologists feeding it with data, that will enrich it and improve the annotation, indexing and retrieval tools, as making possible converging towards a strong semantics tools open to everyone. Moreover, a moderating mechanism is being implemented to improve the overall acceptability of the ontology updates by all pathologists of the project.

Algorithms Assessment and Methodological Approach

In order to assess the performance of the above-described algorithms, a complete system of on-line forms has been implemented by TRIBVN, upon recommendations of project pathologists in the "build" phase. During the evaluation pathologists "users" can thus provide quantitative and qualitative answers to specific questions without interruption of their tests and no risk to lose their written answers. A statistical treatment of these answers can then be derived, provided that enough pathologists are enrolled in the evaluation. All algorithms evaluations are performed on usual PC but pathologists were also provided with some touchscreen tablets to assess its ease of use in Digital Pathology.

For efficiency reasons, in order to reach a minimal consistent cohort from the 27 pathology laboratories in the Paris region involved in the project, a focused number of laboratories were equipped with a new-dedicated slide scanner. For these services, an engineer is fully assigned to the support of the pathologists of these laboratories during the "build" and "run" phases of the assessment.

First Results, Conclusions and Follow-Up

In view of the very first results coming out from the beginning of the evaluation phase, we can conclude that most algorithms, which have been tested by the "FlexMIm" cohort of pathologists, have great potential for the development of Digital-Pathology and Telepathology. However, the most interesting resides in the fact that the complete combination of digital tools,

methods, and algorithms creates a genuine arsenal of added value functions, which will support the pathologists in their medical practice, in a very near future.

Acknowledgment

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Antoine Veillard is a researcher in artificial intelligence. His current topic of interest is deep learning. Antoine graduated form Ecole Polytechnique and obtained a Ph.D. in computer sciences from the National University of Singapore. He was attached to Université Pierre et Marie Curie for the duration of the FLexMIm project.

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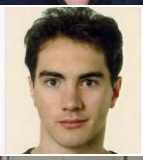

Nicolas Phan is an engineer specialized in health science, especially biophysics. He's working at Saint-Louis Hospital as a research engineer for the FlexMIm project. His role has been to test the various algorithms, as well as supporting the pathologists in the platform's use and algorithms' evaluation.

Prof. M. D. Frédérique Capron, head of the Pathology Dpt. - Pathology Imaging & Modeling Unit UIMAcP of the Hospital Pitié-Salpêtrière Paris, has been opening the way to the digital pathology protocols in France. She is the president of ADICAP (Association for the Development of Informatics in Cytology and Pathology).

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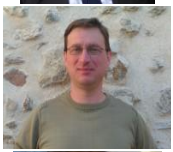

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Jacques Klossa is the President and Founder of TRIBVN. He is in charge of R & D programs, of their implementation and of the coordination of research consortiums and academic partnerships. With an academic training, graduated in Industrial Marketing from "Arts et Metiers" engineer school, he spent most of his career in multimedia and image business. He is co-founder of IHE Europe Pathology and has been the Co-Chair of Working Group 26 of the DICOM Committee (digital pathology), from its creation in 2005 to 2012.

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Challenges and Opportunities for Telemedicine in Morocco

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Introduction

Telemedicine refers to health and medical services performed using Information and Communication Technologies (ICT). Telemedicine in Morocco presents opportunities for the health systems but faces and poses numerous technical, legal, societal and cultural obstacles. If telemedicine is not well developed, the awareness of health professionals and policy makers is growing. Numbers of telemedicine initiatives have been launched and they concern various areas such as elearning, teleoncology, teleradiology, telecardiology, or teleechography. The current status of eHealth Morocco will be described and examples of telemedicine initiatives will be examined. The positioning of the government will be investigated and the factors of success and challenges toward deploying sustainable e-health services will be discussed and the potential benefits of eHealth for Morocco will be highlighted.

National Perspective of eHealth in Morocco

The Moroccan health system is organized with a predominance of the public sector, characterized by the free health care services and the centralized management. The State is positioned at the center of the health system. The Ministry of Health runs the Basic Care Health Network, Hospital network and the National Institutes and Laboratories. Local governments have Municipality health services. However, over the years, the private sector developed progressively. Most health providers and health care centers are located in urban areas. There is lack of adequate medical resources particularly in the rural settings. In quite large areas, there is only one doctor for each 40 000 people or only one hospital bed for every 3 000 people. Presently, the Basic Health Care network comprises of about 2500 Health Facilities. The health system is organized according to a pyramidal hierarchy. Primary healthcare Structures (clinics, health centers, local hospitals; medical offices and infirmaries) represent the first access resort for the patients; the second recourse being the provincial and prefectural hospitals. The third one includes regional hospital centers. The Fourth level

corresponds to the university hospital centers, where secondary healthcare requiring advanced logistics and equipment is being provided.

The World Health Organization (WHO) has recently urged the member countries to formulate their own e-health strategies as one means towards better health care system. However, Morocco didn't yet define any roadmap. eHealth promises to be a practical way to handle health and prevention issues in the country. mHealth, a section of eHealth, strategies have been used in various problems. Recently, a mHealth toolkit has been launched by WHO to help innovators scale up projects.

Information and Communications Technology (ICT) Infrastructure

Infrastructure enabling eHealth includes Networks, Data Centres, Servers, and end user devices. Morocco possesses one of the most advanced ICT infrastructure and telecom markets in Africa [1]. Morocco have been working to increase broadband access nationwide by extending fiber-optic networks into more isolated regions of the country and to roll out a 4G network. The number of mobile phone subscribers grew by 7.93% year-on-year (y-o-y) to reach 41.32m at end-September 2013, representing a penetration rate of 133%, one of the highest in Africa. The number of subscribers accessing the internet through ADSL also increased, rising by 21.7% y-o-y. A high level of internet access exists in Morocco with 51% of the population had access in 2012. However the country will need to inject more trained staff into its workforce if it is to fully realize the benefits of an expansion in digital services. A National Broadband Plan was launched in 2012, with the purpose of providing fixed or mobile broadband access to the whole population by 2022 [2].

Telemedicine and eHealth initiatives in Morocco

Telemedicine in Morocco presents opportunities, yet it is not well developed. However the awareness of health professionals and policy makers is growing. Numbers of telemedicine initiatives have been launched and they concern various areas. While Health Information Management Systems are being introduced in a growing number of hospitals throughout the country, however, Electronic Medical Records are not yet an essential cornerstone for supporting health care services. Following some examples for telemedicine and eHealth initiatives are presented.

Information system for newborn screening program

One of the field where the necessity and the opportunity of setting up a national eHealth program would be The Newborn Screening (NBS) programs. Establishing a sustainable NBS program requires building an

information system that allows rapid and effective communication between the NBS numerous actors [3].

mHealth for maternal and child health

In maternal, newborn and child health, we are witnessing the game-changing effects that mobile technology has to offer through services such as pregnancy and birth registries, immunization and nutrition tracking. A *Mobile Ultrasound Patrol* project was one of the most concluding experiences by the company Qualcomm. Results indicated that the technology cut the time for diagnostic review or second opinion time from two weeks to fewer than 24 hours and reducing the cost from $80 to $2 per patient; cut the time for transportation of the medical data for review from four days to two seconds and increased the medical practitioners' skills to deliver ultrasounds; including midwives, nurses and general practitioners, from 20% to 92% sufficient for diagnostic purposes [4].

Mobile health for tuberculosis

Another telemedicine initiative concern mobile health Tuberculosis pilot project in the city of Sala (Rabat area) by the Korean Cooperation. The partnership agreement between the Moroccan League Fight Against Tuberculosis and South Korea Cooperation Agency was signed on March 2014 to deploy the 'Mobile Health Tuberculosis'. This innovative concept in the treatment of tuberculosis equips patients with a smart box that detects patients who leave treatment. The Mobile Health Tuberculosis is a simple and inexpensive way to careful monitoring of the patient and better coordination among stakeholders [5].

Regional initiatives in telepathology

The French company RESINTEL was providing telepathology services for hospitals in Morocco since 1994. Unfortunately, circa 1998 the TRANSPATH network was stopped due to lack of funding for continued operation [6]. iPath platform for telepathology gained significant traction during 2001, being extensively used by the Réseau Afrique Francophone de Télémédecine (RAFT) project [7, 8, 9]. In 2004 in Casablanca, a telemedicine unit equipped with a satellite connection and four ISDN lines was deployed [10]. In 2005, the Euro-Mediterranean Internet-Satellite Platform EMISPHER provided real-time online telemedicine services to Mediterranean countries, including Morocco [7].

Belgian Moroccan cooperation in telemammography project

The ability to provide early diagnosis has a strong impact on the cancer survival. In 2007, a partnership agreement between the Lalla Salma Foundation against Cancer and the Brussels Center Coordination for breast

cancer screening helped to set up a breast cancer screening program by telemammography. The digitized mammograms performed at the Oncology Center of Rabat INO and interpreted locally by Moroccan radiologists, are then sent to Brussels for a second reading. This method reduced the risk of errors of interpretation and diagnosis [11].

US Morocco partnership for telecardiology

In 2005, Children's National Telemedicine program supported the establishment of a pediatric teleeducation network with Morocco. This project resulted in the installation of a telemedicine station in Rabat and training of 40 physicians and staff. A second donation was made in 2009 to fund cardiac surgical trips to Marrakech. The goal was to augment the skill level of the pediatric cardiovascular team through telemedicine and onsite visits. Considerable improvement in echocardiography skills was observed. Focus on barriers including technology, satellite availability, language, and time difference has contributed to the success of the project [12].

Hospitals Rendez vous Online

Recently, at the government world summit in Dubai 2016, *Rendezvous* apps from Morocco bagged the award in the one-stop app category, on the regional level in the health sector. The app manages hospital rendez-vous, appointment schedules, etc. This service has been generalized since January 2016 to all hospitals in the kingdom.

Medigraf platform for teleconsultation

In October 2013, a teleconsultation has been achieved with the help of a telemedicine's platform, Medigraf, designed and deployed by a Portuguese company. This solution is deployed in two hospitals and three clinics in Casablanca and in the region of El Jadida. This project is a partnership between Meditel Foundation, Open Idea and the Ministry of Health.

Events in Telemedicine in Morocco

Numbers of international telemedicine events have been organized in the country. The Moroccan society for Telemedicine and eHealth (MsfTeH) has been founded after the 2010 Casablanca international conference on eHealth thanks to the support from the International Society for Telemedicine and eHealth (ISfTeH) and WHO directorate of knowledge management and sharing. The MSfTeH is promoting eHealth and telemedicine in the country and as such organized number of meetings including the 9th Euro Mediterranean conference for Telemedicine and Medical Informatics in 2013.

The MSfTeH have also been participating in the annual visioconference by the French Telemedicine Network, Catel.

More recently, Morocco hosted the first EU exploratory seminar where initial conclusions confirmed that there is significant interest in, and potential for, cooperation in the area of eHealth policy and its implementation between EU and Southern Mediterranean countries. On the other hand, although number of researcher and academicians are conducting research and teaching in Medical informatics and eHealth in some universities, The Casablanca Medical Informatics Laboratory (CMIL) is unique in Morocco [13].

Challenges for Telemedicine Implementation in Morocco

Most of the initiative cited above did not move beyond the pilot phase. The recent award at the world summit government for the Rendez-vous application will boost further the growing interest by officials. In term of infrastructure, Morocco retains one of the most advanced ICT infrastructure in Africa and the highest mobile penetration rates in the region.

However, number of challenges remain to be overcome including the lack of a national eHealth strategy and legal framework; privacy concerns; weakness of information infrastructure in the hospitals; and lack of skilled personnel. Further ethical issues include patient rights, quality standards, data ownership, providing information and collecting patient consent. Technical issues include interoperability and standardization. The challenge of availability of powerful infrastructure concerns the ability for the providers to enable full connectivity across all the country, security of the network, reliability and accuracy of telemedicine applications. Many clinics exist in places where there is little reliable electricity, making it difficult to deploy ICT technology solutions. These many issues require immediate intervention by the ministries of health and digital economy.

The mission of IT departments in ministries of health also needs to be defined.

The strategic introduction of e-Health initiatives in Morocco can be a key driver in helping realize Morocco objectives of its National Health Strategy.

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Modelling the Implementation of Teledentistry for Rural and Remote Paediatric Patients in Victoria, Australia

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Introduction

In the Australian state of Victoria, whilst publicly funded dental services are available, there are strict eligibility criteria and considerable waiting lists, especially for dental specialist services. Teledentistry (TD) has the potential to improve access to quality services that patients previously deemed inaccessible, in addition to reducing travel time and costs for those currently accessing distant services.

Victorians in rural and regionals centres travel further for dental visits and are less likely to have seen a dentist than those in metropolitan centres [1]. A substantial portion of Victorians (25%) travel long distances to attend these appointments.

The implementation of TD can potentially remove barriers to access to specialist dental care which exist in the current service delivery model, where geographical distance and limited local resources result in a lack of dental specialist services to these areas [2, 3].

The Royal Children's Hospital Melbourne (RCH) Dentistry Department provides the majority of specialist dental services for children and adolescents in the management of Cleft Lip and Palate (CL&P). The CL&P Scheme is a Federal Government initiative that compensates registered patients with specified treatment costs associated with this condition. These services include paediatric dental examination and limited treatment, including orthodontic and surgical treatment deemed necessary for the management of CL&P.

For rural and regional patients management may involve multiple trips to RCH, which are time consuming and costly, and can be a source of frustration for the patient and parents. A significant proportion of these appointments are to monitor and review the patient's oro-dental

development, which may not require hands-on examination by the specialist. TD may provide an alternative method to a traditional consultation. Patients could be monitored and reviewed remotely rather than the current practice of face-to-face consultation at the RCH.

A field study demonstrated that TD can improve access to specialist dental care, and can bring savings in terms of time, stress and money from avoiding travel to the RCH for consultation [2]. This would mean that RCH could increase its capacity to provide dental services for minimal extra infrastructure costs.

As part of a larger study to model the cost effectiveness of teledentistry for remote specialist paediatric dental consultation, this study aims to determine the potential clinic time saved of implementing TD at the RCH for rural and regional patients.

Methods

A model-based analysis was conducted to determine the potential clinic time saved of implementing TD at the Dentistry Department at the RCH. The model was developed by outlining the hypothetical implementation and operation of TD to provide teleconsultation for certain appointments that are appropriate for TD in this population group.

Under the TD model, eligible patients would present to their closest TD enabled Community Dental Clinic (CDC) for a TD consultation instead of a face-to-face consultation at the RCH. The hypothetical TD model was constructed by choosing the TD enabled CDC's. This was chosen based on regional classifications used by Dental Health Services Victoria (DHSV), whereby dental services are provided in CDC's throughout metropolitan Melbourne and rural Victoria. Two centres in each rural region were chosen based on population centres and centrality within that zone (i.e., Belmont; Warrnambool; Ballarat; Horsham; Rosebud; Morwell; Bendigo; Mildura; Shepparton; Wodonga), and two additional centres (i.e., Craigieburn and Pakenham), as a large number of patients were located close to these areas.

Population

The population chosen to be analysed in this model were Victorian rural and regionally-based patients who attended the RCH from the 1st January to 31st December 2014 for specialist paediatric or orthodontic consultation and assessment under the Medicare CL&P scheme. From dental records at the RCH, eligible patients include those patients registered under the Medicare CL&P Scheme [4], who lived in rural and regional areas as defined using the Australia Post criteria [5].

Timely appointments were chosen as the outcome. Data regarding the timeliness of each appointment was collected from assessing each record of

those who, under this model, would receive a TD consultation. The date of the consultation was noted and the record was retrospectively assessed to determine when the patient's last consultation was, if there was a suggested recall noted and if the patient had presented back to the RCH within an appropriate time of this schedule. If the patient was seen within two months of this suggested recall, then the patient was deemed to have received a timely consultation. If the patient did not present within two months, it was recorded as a late appointment. If there was no suggested recall, a one-year recall period was assumed.

The potential clinic time (days) saved at the RCH by introducing TD was calculated using the assumption that each consultation is 45 minutes long and the chair is operational for 7.5 hours a day.

The RCH and University of Melbourne human research ethics committee granted ethics approval for this project.

Results

Of the 1439 consultations at the RCH under the CL&P Scheme in 2014, there were 673 consultations for the rural and regional population. Of those, 367 (54.5%) TD appropriate appointments were conducted at the RCH. 267 patients presented for a specialist paediatric dental consultation only, 32 for an orthodontic consultation only, and 68 for both specialist paediatric and orthodontic consultation.

After calculating average distances based on postcodes, 275.3 clinic hours (i.e., 5.3 hours a week x 52) or 36.7 clinic days, would be saved under the TD model (Table 1). This time represents the potential clinic time freed up at the RCH that could be used to increase the current capacity of the RCH Dental Department. This amounts potentially to an extra half-day clinic per week being available, effectively increasing the capacity for service provision at the RCH dental clinic.

Table 1. Saved time in Clinic

	Total TD consults
Saved time in Clinic (hrs)	**275.25 hrs**
Time in Clinic Saved (days – 7.5hrs/day)	**36.7 days**

Regarding responsiveness of the consultations in this dataset, 65.7% of appointments were considered timely. Those who did not attend on time lived further away from the RCH than those who did attend their appointment on schedule (137.5 km vs 124.1 km). This finding indicates that those who tend to find it more difficult to visit the RCH for their scheduled consultation tend to live further away.

Discussion

The present findings are important in establishing evidence supporting the use of TD as a viable option for the delivery of oral health services. A conservative approach was taken, and some assumptions made may underestimate the true time saving for RCH consultations.

One of the notable benefits of TD is that it can increase the capacity of the RCH Dental Department without adding additional dental chairs. An extra 5.3 hours a week of clinic time available to see patients is noteworthy especially when demand for services are increasing and government resources are limited. This outcome strengthens the case for TD to be implemented at the RCH.

A pragmatic design was taken in modeling this study, which was based on a pilot study, providing a more realistic scenario and more credible results. Despite this, we may have underestimated the use of TD. The population that the RCH Dental Department services extends beyond those eligible on the CL&P scheme to patients who are eligible under the public dentistry schedule. According to the RCH Dentistry Department, approximately 25% of patients are seen through the CL&P scheme, with the remainder subsidized under DHSV public eligibility guidelines. This underestimation only strengthens the case for TD. Further research of the entire RCH patient database is needed to estimate the number of appointments that could be TD appropriate.

The outcome measurement used in this study gives an indication of health service utilization to determine if access to care can be improved with the provision of TD. No clinical outcome was used in this study. Previous studies have also included inappropriate referral rates and failed appointments as an outcome measurement [6]. TD could be used to improve clinical outcomes such as rate of inappropriate referrals to the RCH and hence, extending the use of this technology beyond teleconsultation. Investigation into how TD could be used in the current referral system to improve inappropriate referral rates could help strengthen the case for TD to be used in at the RCH.

There are a number of limitations of the present study. Firstly, this study was based on a hypothetical model for implementation of TD. Whilst these results are robust, there may be unknown factors that may influence the real life operation of TD and thus the rate of timely appointments.

The model assumes that patients would prefer a TD consult, but the reason for acceptance of TD by patients is unknown with some potentially preferring a face-to-face consultation instead, despite the possible transport costs and time saved. Some patients or parents may prefer to have a face-to-face consultation and are willing to take the time and pay the extra costs for

the opportunity to travel to the city. Whilst there were criteria used to indicate suitability based on the pilot study and expert opinion, there may be some cases that may be deemed unsuitable for TD that were not considered. Further investigation regarding both the reason for patient acceptance of TD and clinician preference regarding what is appropriate for TD would be beneficial to assist in determining a more accurate number of possible TD consultations.

Further analysis could help policy makers and researchers to better understand TD and make more informed decisions regarding health service delivery. Specific areas of further research include determining an approximate monetary value for a TD item code for health service reimbursement and performing probabilistic sensitivity analysis to better test the robustness of our model.

Conclusion

There is potential for the RCH Dentistry Department to increase productivity with the implementation of TD without needing to build additional dental surgeries. Whilst there are some study limitations that should be considered, there is credible evidence that this is a conservative model and it is likely that the TD could free more time for patients living remotely requiring consultations at the RCH. This study provides evidence supporting the use of TD for appropriate specialist dental consultations.

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Provider Independent Upgrade to IHE e-Prescription by Using Existing Paper Printing Features

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Introduction

E-prescribing, e-prescription, and e-dispensation are topics of high relevance. In most countries, e-prescribing (selection of appropriate medication) is a well-known feature of practice and hospital information systems. Contrary, e-prescription, as a structured document and its e-transmission, is not widely supported and may require software adaptations of hundreds of systems. Instead printing the receipt on paper, information of the receipt needs to be encoded, for example into an XML (Extensible Markup Language) structure defined by IHE (Integrating the Healthcare Enterprise), called PRE(scription) [2]. One reason for still missing support of e-prescription might be that each software system, which prints paper receipts today, has to be adapted accordingly.

In this paper we show how to create e-prescriptions fulfilling IHE PRE by complementing a system independent adaptation. Our prototype runs as process in background and catches paper prints of receipts before they are printed onto paper templates. The process extracts every necessary information independent of, and without any modification of the original systems. The obtained data is used to create an e-prescription according to IHE PRE. We have tested our prototype successfully with three different systems of various software providers.

Intercepting the Data

The background process hooks in just after prescribing, when the data should be printed onto a paper form. Instead, the receipt is redirected into a XPS (XML Paper Specification) file, which contains textual information as well as meta information (e.g. coordinates) for rendering. Because prescriptions in Germany are compliant with a specific paper form, we can combine the coordinates of the extracted textual information in the XPS file with the coordinates of the paper form and assign the extracted data to its meaning. Fig. 1 is an example of a prescription printed onto the paper form.

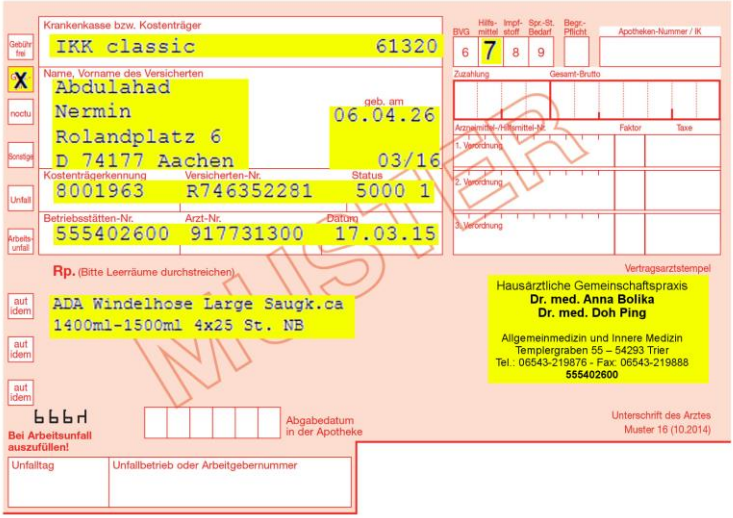

Fig. 1 Prescription compliant with the German paper form. Note that only the yellow marked text passages are contained in the XPS and printed onto the paper form.

Unifying the XPS File

The XPS file has one ‘FixedPage’ element, which may contain several ‘Glyphs’ elements as shown in Table 1. It is an excerpt of the prescription above and already limited to the attributes that are actually needed for processing. The attributes ‘OriginX’ and ‘OriginY’ are the coordinates where the string in ‘UnicodeString’ is placed in the rendered XPS file [1]. Comparing XML codes of several XPS files shows, that the ‘Glyphs’ elements appear in arbitrary order. The goal of this step is to extract the textual information and arrange it the same way for all prescriptions. This is necessary in order to assign the data to their meaning automatically.

Sorting

The first step to rearrange the data is sorting the ‘Glyphs’ elements by their attribute ‘OriginY’. This results in a line wise order of the elements, as they appear in the rendered file.

Extracting the textual information

In most cases, the textual information could be extracted by reading the ‘UnicodeString’ attribute.

Table 1. XML snippet of the XPS file from Fig. 1.

```
1  <FixedPage>
2  <Glyphs OriginX="248" OriginY="158.08"
3  Indices="24;19;19;19;3;20" UnicodeString="5000 1" />
4  <Glyphs OriginX="42.08" OriginY="158.24"
5  Indices="27;19;19;20;28;25;22,135;53;26;23;25;22;24;21;21;27;20"
6  UnicodeString="8001963R746352281" />
7  </FixedPage>
```

However, in some cases information is not clearly separated and thus must be detached before. In Table 1 the ‘UnicodeString’ in line 6 holds the insurance number (‘8001963’) and the insurant's number (‘R746352281’). Although the data are not separated in the ‘UnicodeString’, the partition is visible in the rendered XPS file (see Fig. 1). This information is given by the ‘Indices’ attribute. Such an attribute is a sequence of numbers representing the index of a symbol from the following ‘UnicodeString’. The indices are separated with semicolons. Blank space is encoded as ‘AdvancedWidth’, which follows an index and is separated with a comma (e.g. in line 5 at position ‘22,135;53’ the value ‘135’ is the ‘AdvanceWidth’). It states where the following symbol has to be placed relative to the current symbol [1]. Whenever an ‘AdvanceWidth’ occurs and exceeds a defined threshold, a blank is indicated for the corresponding position in the ‘UnicodeString’.

Further, some data appear in one row in the rendered file, but are split into different ‘Glyphs’ elements (see line 3 and 6 of Table 1). Those elements differ slightly with respect to their ‘OriginY’ values. If the difference between two values undercuts another defined threshold, the ‘OriginX’ values must be compared to decide, which element is first in the row. Accordingly, both elements can be merged. Please consider the composition of the strings of line 3 and 6 as well as the inserted blanks in the result: ‘8001963 R746352281 5000 1’.

Segmentation

We divided the paper form into four different segments (see Fig. 2 with I, II, III, and IV as segment numbers). The first segment contains information about the patient and insurance. Segment II is the “physician stamp”. Segment III may have additional information encoded in form of numbers six to nine. The fourth segment holds the prescribed medicine. Again we make use of the coordinates and thresholds to determine the segment for each element. The result of the unifying step delivers the textual information of the XPS file. It is arranged similar to the rendered file and

divided into four segments. An example is given in Table 2, which shows the result for the first segment of the prescription example.

Tokenizing

In this step, every gained information from the unifying is assigned to its meaning. Segment I is tokenized by scanning the segment for single 'X' at the beginning of a row (see line 2 Table 2). Such an 'X' equates to a cross for a checkbox (compare Fig. 1). Dependent on the row number, where an 'X' occurred, it is mapped to its meaning. Because of the unifying step, every prescription is arranged the same way and it is known where the data are placed. This makes it possible to assign the semantic of each information for every line. Segment IV is tokenized by assigning one row within the segment to one prescribed medicine. Segment III (supplements) tells us which digits occur. For segment II we found that each management system produces different kinds of stamps. So, we initially register the required data of segment II (the current physician stamp) manually during a configuration step, since the stamp does not change for a dedicated physician.

Creating the e-Prescription

As format for the e-prescription we use the CDA (Clinical Document Architecture) profile 'Pharmacy Prescription' as provided by IHE, which defines the content of a prescription document [2]. CDA is based on XML and is used as an independent format for storing and exchanging medical data. The profile specifies how the extracted data should be stored in the given CDA document.

Some data of the German paper form are not covered by the general IHE PRE. Currently there is no localised version of the profile matching the specific (i.e. additional) fields of the German paper form.

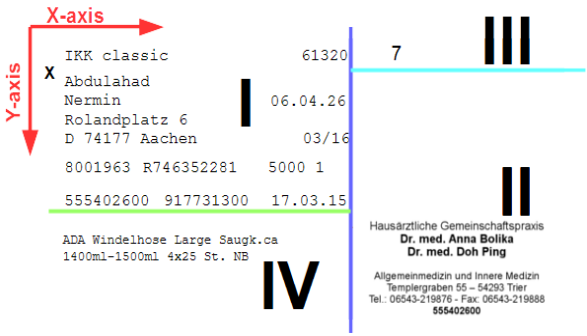

Fig. 2 The elements of the paper with its four segments.

Table 2 Result of the unifying step for segment I of the example.

1	IKK classic 61320
2	X
3	Abdulahad
4	Nermin 06.04.26
5	Rolandplatz 6
6	D 74177 Aachen 03/16
7	8001963 R746352281 5000 1
8	555402600 917731300 17.03.15

Hence we temporarily append some additional fields to IHE PRE until a localized version will be available.

Conclusion

With this approach, we shift implementation work from many system providers to one single, post-processing interface, which enhances current systems with the ability to create IHE e-prescriptions. The generic approach allows adaptions for other countries' paper forms. In general, any system with a template-printing feature (not only prescriptions) can serve to generate structured electronic documents by combining the extracted text-coordinate pairs with the known positional semantics of a paper template.

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Telehealth for 60 000 eVillages in India: The Beginning of the CSC Story

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Introduction

The Government of India (GoI) promoted, Common Service Centres (CSC) [1] project, that is an entrepreneur driven model, for empowering rural India. A key pillar of the National e-Governance Plan (NeGP), 135000 ICT enabled Information Centers on a Public Private Partnership (PPP) mode, are now providing insurance, education, veterinary, agriculture and financial sciences. NeGP envisions "web-enabled anytime, anywhere access" to information and services in rural India, through three infrastructure pillars. These are the State Data Centre, the State Wide Area Network (SWAN) and the internet through which citizens can access services. CSC is the front-end delivery point for Government, private and social sector services to citizens of rural India. The objective of the CSC is to progressively migrate all government services to an e governance platform.

CSC Structure

The essence of the CSC system is its equitable geographical rural spread, throughout all the states in India. While planning is centralized, implementation is decentralized. Private entities have been identified in all the states ensuring value at the bottom of the pyramid. The local franchisee is from the community, ensuring motivation for social entrepreneurship and acceptance within the users, in the community. Soft loans and essential training are provided to the franchisee called the Village Level Entrepreneur (VLE), by the Government of India, through the CSC SPV (Special Purpose Vehicle), an organization dedicated for this truly innovative project. Government and business services (G2C and B2C) can be accessed at the doorstep, in tens of thousands of villages, increasing effectiveness and efficiency through the VLE. Table 1 illustrates some of the services rendered.

Setting up a CSC

Minimum space required to set up a CSC is 150 sq. ft. One Personal Computer with a UPS, one printer, a digital camera / webcam, a generator or an Inverter or access to solar power, storage Devices (CD/DVD/Pen

Drive), mobile recharge units, a functioning TV and Data Cards which can be recharged, approved Operating Systems, application software, broadband connectivity and trained incentivized manpower complete the requirements. The VLE has generally studied up to 10th grade in school and is computer literate. Many can read English, though less than 5% would be graduates. The initial capital expenditure to set up a CSC would be about €3400 and the monthly operational expenses would be about €240. Most VLEs would make a net monthly income of about €340 after paying a nominal interest on bank loans etc.

Table 1: Demonstration of some of the CSC services

Government to Citizen (G2C) Services	Business to Customer (B2C) Services
Election Commission of India (EC) Services	Internet Data Card Recharge
Unique identification Authority of India (UIDAI) Services	
Passport Services	DTH Digital TV Recharge
Banking Correspondent (27 banks)	
National Institute of Open Schooling (NIOS) Services	CSC Bazaar e-Commerce / Shopping Services
PAN Card Services	
Pension Fund Regulatory Development Authority (PFRDA) services	
NIELIT Services	Mobile Phone Bill Payments
Agricultural Services	
Healthcare Services	Prepaid Mobile Recharge
e-District	
SSDG	Entertainment
Mission Mode Projects	e-Learning

Conceptualization of Adding Tele Health Services to Existing CSC Services

Though operational since 2008 it was only in 2013 that a chance meeting between the first author and the CEO of the CSC SPV Dr Dinesh Tyagi at a conference, led to the Apollo Telehealth Services team having detailed discussions. The Apollo Hospital Group globally renowned [2] as a tertiary and quaternary care centre took a major policy decision to provide primary health care to the villages of India using Information and Communication Technology. Contact was established with a small number of CSC's and an attempt was made to understand what was currently available and what was needed. The challenges were, to say the least astronomical. ATHS signed an MoU with the CSC-SPV on 14th November 2013 [3] to enable "Primary, Preventive, Specialty and Promotive Healthcare Services through telemedicine platform". ATHS took the responsibility of customizing a Turnkey Solution, end to end, on a Program Management approach. After providing

a few hundred teleconsults and testing the waters ATHS agreed to scale up its efforts. On August 25th 2015, GoI announced the launch of SEHAT (Social Endeavour for Health and Telemedicine) the world's largest PPP programme in Telehealth (Fig.1) [4]. Apollo Tele Health Services (ATHS) had been entrusted the difficult task of providing health care through 60 000 CSC's in a socially relevant, self-sustaining manner. It was decided to initially provide primary and preventive health care and specialist opinion when required. Later it was planned to provide patient empowerment through Social Health Education (SHE) programmes. The massive urban rural health divide is explained by the 80:20 rule. 80% of health care providers cater to 20% of India's population. Hence out of the box thinking and deploying every single innovation, is essential to provide health care to rural India. Utilizing the already functioning internet enabled CSC's appeared an option. A dedicated think tank was established and following several rounds of discussions and inputs from a diversified group of extremely motivated and passionate individuals, it was decided to launch a Proof of Concept Validation and critically analyze the findings. As this was a first of a kind initiative with no precedent whatsoever it was opined that training of all stakeholders was critical.


Access to telemedicine throughout the country with the launch of 'SEHAT'

This venture with the Apollo Hospitals was the first of its kind in India to connect 60,000 Common Service Centers across the country to a common network and provide healthcare access to millions of citizens irrespective of geographical location or connectivity.

25 August 2015, 6:06 PM IST

Newsletter

SHRI RAVI SHANK

New Delhi, 25th August 2015 : Shri Ravi Shankar Prasad, Honorable Minister of Communications and Information Technology, and Minister of Law and Justice launched the government's latest health and IT initiative called SEHAT (

SEHAT

Telemedicine Now for the Aam Aadmi

Move part of Digital India drive to allow people to consult doctors of Apollo Hospitals via video

At Your Doorstep

DeiTy, Apollo Join Hands for Telemed

Fig. 1. Press Cuttings on Inauguration of SEHAT

Training Programme for Introducing Telehealth Services

Considerable effort time and funds were deployed to train VLEs to facilitate teleconsults [5]. As of 31st January 2016 about 8125 VLEs have been trained virtually and about 500 VLEs physically. A help desk Phone + 91-11-49754975 and Email: *health@csc.gov.in* ensures that all queries are addressed. Workshops are being conducted periodically virtually and physically to familiarize the VLE about key issues in rural health care and how they could effectively help bridge the gap. VLEs are given a specially designed training manual to understand how to use the ATHS service. This can be downloaded by clicking on the download button http://csc.gov.in/images/CSC_Healthcare_Booklet.pdf

CSC Clinical Training and CSC Technical Training

As most of the VLEs are more comfortable with *Hindi* language, the virtual training manual is available both in Hindi and English. To ensure quality control, all teleconsults are recorded. 10% are randomly audited. The Quality-in-charge Auditor listens to a sample set of different paramedics on a weekly basis and measures the professionalism / courtesy and the ability to be easily understood. Using this Audit, the supervisor will use a scale of 100 and rate the paramedic. An escalation matrix ensures that any issue is attended within a reasonable turnaround time. In view of the huge number a Training of Trainers scheme (ToT) ensures that all are trained. VLEs are taught to get the consent form signed and electronically fill the case record as a physician assistant would do in western countries. Fig 2 summarizes the process followed from beginning to end when a teleconsultation is pro-

Fig. 2. Illustration of the process flow of Teleconsultations at CSC

vided at a CSC. All teleconsults are scheduled electronically with an ePersonal Health Record. The trained VLE connects the patient to the Apollo Medical Response Centers. The experienced trained doctors who provide the initial teleconsult use an approved Decision Support System to ensure quality health care. If necessary, the consultation is escalated even to a super specialist. Drugs are prescribed in generic form, from a list of drugs which are known to be available in the vicinity. Dosages are described in user friendly language along with relevant home remedies. Identification of worsening signs, action to be taken and when to get back are also highlighted.. The CSC operator takes a print out of the prescription emailed and hands it over to the patient. It is hoped that soon the government sponsored

Jan Aushadhi Medical Store [6] will be part of at least selected CSC's Clinical quality processes and protocols are being put in place. The possibility of a proper certification of "Rural Health Care Facilitators" is being looked into with a plan for scalability of the front end and backend.

The Business Model

A detailed need assessment study was initially carried out. The team interacted with all stakeholders including administrators, local health care providers, doctors (including non allopathic), patients and the community at the village, district and state level. For this project to truly succeed it has to be financially self sustaining and revenue generating. While the ultimate large number (300 million covered in 60 000 villages at 5 000 per village) make the eventual RoI theoretically viable, the challenges are humungous. Theoretically even if 0.1% of the total population that would eventually be catered to, used telehealth services once a month, there would be 10000 teleconsults a day. Financial break even presupposes at least 1 000 teleconsults daily. The VLE retains 45% of the 1.4 Euro currently charged, 15% is for the CSC organization and only €0.56 per consult to ATHS. To create the much needed awareness free teleconsults were offered for limited periods (Fig. 3, 4). This was widely publicized.

Fig. 3. Creating Awareness for Teleconsults

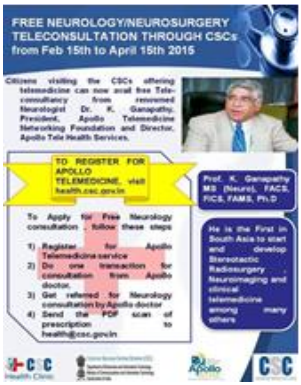

Fig. 4. Free Super Specialty Teleconsults

Challenges

A major cultural transformation had to be achieved to convince the residents in far away villages that virtual remote health care was indeed possible. Technical challenges included power outages and low bandwidth. While training and operational issues could somehow be addressed in the absence of research grants or philanthropy, funding was the single major problem. However to deliver quality, affordable accessible remote care presupposes a dedicated infrastructure consisting of trained nurses, medical doctors, a robust software and hardware and most important a passionate team which will not take "No" for an answer. Urban teleconsultants need to be sensitized to rural requirements. When functional the GoI *Jan Aushadhi* Scheme will make available quality affordable generic medicines at CSCs. A customized insurance plan exclusively for CSC beneficiaries would of course go a long way in providing the essential cross subsidy.

The Story so far

Table 2. CSC Activities as on 31st January 2016

CSC Activities & Milestones	Qty.
Centers activated on ATHS services	5 602
Number of States in which CSC's have been activated	29
Training completed	8 625
Consultation done – new patients	2 562
Review cases	267

As on 31st January 2016 (Table 2), 5602 centers have been activated, and 8 625 have been trained online. 2562 consults have been given so far. Health Literacy programmes delivered through Multi Point VC have just commenced (Fig. 5) [7]. Villagers assemble at CSCs. This knowledge / patient empowerment will hopefully promote the concept

Fig. 5. Promoting Health Literacy at CSC through Multi Point VC

of wellness and improve healthcare outcomes. *Community Connect* activities will include telehealth screening camps. Tele Laboratory Services will also be introduced in selected CSCs. Training with *Control H* [8] an indigenously made POCD has commenced. Even though delivering health care through CSCs is just starting and we have a long, long way to go Columbia University thought it fit to include ATHS CSC activities as part of a study on eDoctors to illustrate Global Best Practices [9].

Acknowledgement

Our thanks to *Dr. Dinesh Tyagi* CEO CSC SPV and *Ms. Sangita Reddy* Joint Managing Director Apollo Hospital Group for the leadership provided and to *Mr. S. Srinivasan* for secretarial support in preparing this manuscript.

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S. Prem Anand, MBA with over 20 years of experience in implementing Information & Communication Technology programmes for Rural Development in India. Leads the Programme Development group for Public Private Partnership Programmes in Health care at Apollo Tele Health Services.

Ayesha Nazneen, MBBS has over 15 years of clinical experience, feathered by 5 years of being in the core team of telemedicine services/remote heath care of Apollo group. Has demonstrated leadership roles in developing and establishing virtual clinical consultation modalities. A Self-motivated, pro-active and decision maker, aims to reach to greater heights in field of virtual medicine.

Joshita Majumdar, M.Sc. has industry experience that includes stints at Philips Innovation Centre, Bangalore and Covidien Healthcare. Since February 2015 she has been working with Apollo Tele Health Services on developing cost-effective technology enabled solutions to provide access to healthcare to remote parts of the country.

Vikram Thaploo, MBA is result oriented, enthusiastic and decisive management professional with proven success in effective strategizing and implementing projects. Been in a P&L responsible position for more than 8+ years. Has logical approach to challenges, performing effectively within highly competitive work environments. Having over Seventeen years experience with over 10 years in leadership positions.

Telehealth in the Himalayas: Operational and Clinical Challenges: A Preliminary Report

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Introduction

This innovative Public Private Partnership is providing 24/7, quality, affordable, remote health care, to 34 000 citizens of Lahaul and Spiti (height of 14 000 feet in the Himalayas) in Himachal Pradesh.

People were commuting 20 to 50 kms for primary and 250 kms for secondary health care services in this mountainous isolated, sparsely populated region. Following a need assessment study a MoU was signed with the National Health Mission. Government paid for CAPEX and OPEX. Apollo Telehealth Services took the responsibility of customizing a Turnkey Solution, on a Program Management approach and monthly reports.

Nothing was available. Everything was a challenge. Landslides were common [1]. Staff from the local government and recruited from the community were trained in Chennai. An online appointment booking system facilitated patient friendly interaction. A Comprehensive Patient Health Information System (CPHIS) was updated in real time. Personal interaction

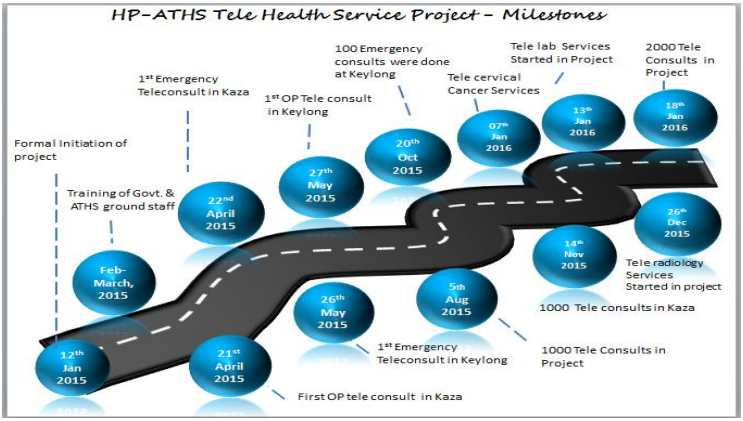

Fig. 1. Milestones in providing telehealth in Himalayas

by telemedicine coordinators on both sides ensured that traditional human

touch continued. In addition scheduled tele camps (virtual OP's) were organized in 15 different specialties and super specialties Case records were audited. Feedback was obtained and audio recordings made available. Tele Laboratory services, Tele Health Education [2] and tele cervical cancer screening programmes have been added (Fig 1).

Conceptualization of Introducing Tele Health Services in the Himalayas

With 90% of the 6.8 million population living in rural isolated areas, the Department of Health & Family Welfare, Government of Himachal Pradesh realized that providing affordable quality tertiary, secondary and even primary health care to the community would be impossible. Government measures to motivate, train and incentivize local doctors and external doctors had been unsuccessful. A Telemedicine programme could create a conducive environment in areas isolated for six months due to heavy snowfall, and temperature of minus 30 C. Patients requiring emergency care would be stabilized before moving them to secondary or tertiary health care facilities. Previous attempts to introduce telemedicine had been unsuccessful [3-4].

ATHS submitted a detailed proposal where they would be totally responsible for the entire project providing technology solutions, tele consultants and creating awareness. A detailed need assessment study was carried out interacting with all stakeholders at the state, district and village level. Reviewing the proposal, ATHS was asked to provide Tele-Emergency and Tele-Specialty & Super Specialty services on a PPP mode. Govt. Health facilities at Kaza and Keylong were chosen for the initial pilot.

Programme Management Approach

The Planning component included need assessment, budgeting, defined Service Level Agreements (SLA) for all major activities and a project implementation action plan. The Implementation component included training, capacity building, CME programmes, weekly and monthly project reporting, efficient community engagement and optimized capacity utilization providing access to quality, multi-specialty health services virtually through the existing Government health system.

Implementation Process

A radical cultural transformation was the basis for the implementation. After an intensive 3 month training at Chennai (Fig 2), a Tele-Health Coordinator/Facilitator and two Tele-Health Community Linkage Coordinators were posted at Kaza and Keylong. ATHS initiated a well-integrated teleconsultation unit with remote diagnostic devices (digital 12 lead ECG, Spirometer3 and Stethoscope (Fig 3-5) and seamless Internet connectivity of

512 Kbps. X-ray films were scanned and sent to Chennai. The Telemedicine system blended seamlessly with existing OPDs. With support of a well-trained Telemedicine facilitator, patients were able to get tele-consultation with Apollo specialty doctors at Chennai [5-6]. An online appointment booking system facilitated patient friendly interaction. The patient CPHIS was updated in real time. Scheduled tele camps (virtual OP's) were organized in 15 different specialties and super specialties. Tele consults for 'walk in OP patients' were also provided.

Fig. 2. Hands-on training at Chennai for staff in Himalayas

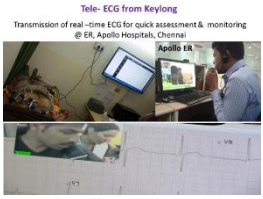

Fig. 3. Tele ECG

Fig. 4. Tele Spirometry

Fig. 5. Tele Auscultation

Tele Emergency Support Services

An experienced ER specialist from Apollo Main Hospital Chennai tele-mentored the CMO / duty nurse at Kaza and Keylong to provide initial medical support to stabilize patients (Fig 6). 133 out of 2108 teleconsults were emergencies. Making available prescribed emergency medicines, ER medical disposables, hardware /software, emergency mobile cart and VC systems for direct real time interactions between the casualty at HP and ER specialists at Chennai, though a herculean task, was implemented.

Tele Laboratory Services

Using an FDA approved POCD (Point of Care Diagnostic Kit) blood biochemistry (lipid profile, LFT, RFT, HbA1C, Hb, PCV), were made available at the remote telemedicine location itself. The local staff were virtually trained (Fig. 7) and soon became adept at using the kit. In 4 weeks 100 patients had a random blood sugar, 65 had Hb and PCV 23 had TSH and 3 had a Troponin I besides urine routine for 23 patients resulting in better clinical management.

Fig. 6. Tele Emergency Consult

Fig. 7. Tele Laboratory Services

Tele Cervical Cancer Screening

In a first of a kind pilot initiative tele cervical cancer screening has commenced (Fig 8). A nurse semi trained virtually does a cervical speculum examination and takes a smear after coating with acetic acid. These images are captured and sent to a senior consultant gynecologist in Chennai who reviews the images and counsels the patient. Smears are couriered to Chennai where the slides are evaluated by a trained cyto pathologist. Out of the first six patients for whom this was done, clinically 4 were normal and 2 were diagnosed to have cervical erosion.

Fig. 8. Tele Cervical Cancer Screening

Challenges and Difficulties Encountered during Implementation

Mobilizing equipment in time, facing melting snow and landslides was the first obstacle ref 1. Dedicated customized VSAT's (Very Small Aper-

ture Terminal) were provided by BSNL [7] (India's largest government network provider). Major change management issues were faced with the local staff, who initially perceived telehealth as a threat. In an isolated community, long standing mind sets and a sense of complacence had to be radically changed. Technology provided virtual specialists on a screen – but making available drugs prescribed and tests was difficult. Creating awareness within the community, was done with trained coordinators making house to house visits (Fig 9).

Fig. 9. Obtaining Patient Feedback

Benefits of the Project to Various Stakeholders

Besides the 34 000 citizens of the district, the stakeholders included the National Health Mission (NHM) of the Govt. of India and the Government of HP as large scale escalation of this PPP model depended on this Proof of Concept Validation Health Education Programs to provide knowledge empowerment and health literacy have been started. Even in this short period of time a major potential epidemic of fungal scalp infection in monasteries was avoided

Cost Effectiveness

The Govt. of HP had been willing to spend 375 000 US$ per year as compensation to make available 10 specialists for the district. These salaries were almost triple of what is normally paid. In spite of these inducements there were no takers. Money was being spent on helicopter evacuations for seriously ill patients. The total cost of the telehealth project with its major societal impact was less. A detailed survey of 105 users of the telehealth services indicated that in addition to saving considerable effort, time, physical discomfort and emotional stress US$ 13 040 would have been spent for obtaining perhaps sub optimum health care. If extrapolated to all users, the community would have saved more than the cost of the project. Benefits to the environment include reducing carbon print, as about 100 ambulance trips of 150 km and probably 5 helicopter evacuations have already been avoided.

Achieving Clinical and Services Excellence

A critical self-review presented in the interim report pointed out the challenges, difficulties, limitations and offered doable suggestions resulting in tele-laboratory services, increasing availability of drugs, providing additional backup power etc. Table 1 shows the specialty distribution and Table

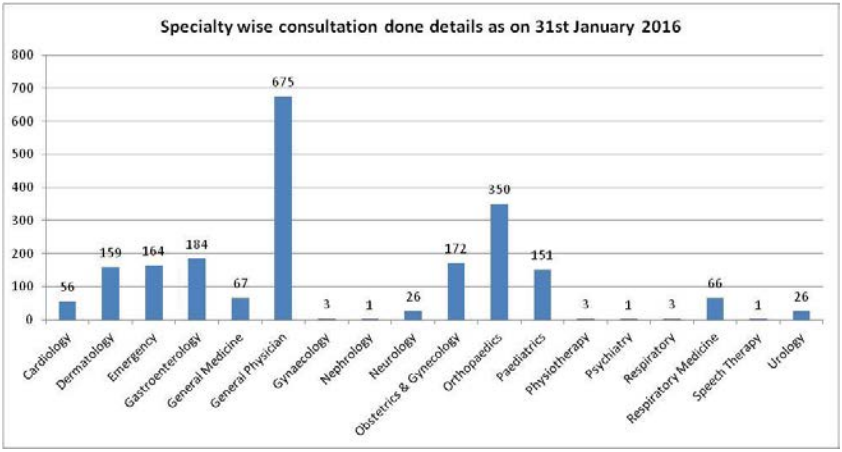

Table 1. Specialty Teleconsultation

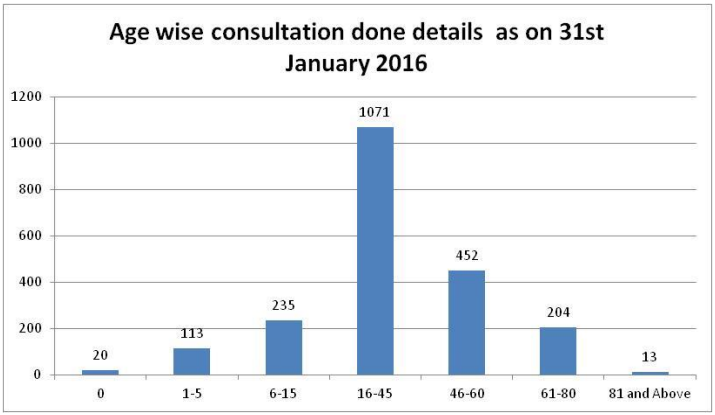

Table 2. Age Distribution Among Teleconsults

2 the age distribution. 69% of all teleconsults (specialist and super specialist) were given from Chennai, and the remaining 31% from the Medical Response Center at Hyderabad manned by family physicians..

Patient Satisfaction

Objective assessment of user satisfaction is under way. An interim interview of 659 patients [8] revealed that 75% were delighted and only 9% dissatisfied with the telehealth services provided.

Discussion

Successful PPP in Healthcare in India are being reported including Apollo hospitals operating a dialysis unit for the state government of Uttarakhand with tele nephrology consults being added shortly. Though an administrative decision, for PPP's to be successful, political and community support is essential [9-10]. Formulating mechanisms, legal and regulatory framework would ensure confidence of both players to invest in such partnerships. PPP will help mobilize resources for specialist healthcare.

The Story so far

In the first 38 weeks 2075 patients have utilized telehealth services constituting 6.15% of the district's population. 7 overseas tourists also utilized these services. It also means, that every 85 minutes, a new patient is treated in the telehealth centres in Lahaul and Spiti (lowest population density 2 persons per square km). On an average, every 4th day, a patient is being stabilized thru Tele-Emergency services. Reviewing the interim report, the National Health Systems Resource Centre, WHO – the Collaborating Centre for Priority Medical Devices and Health Technology, Government of India has recognized this particular PPP delivering remote healthcare as "a good, replicable and innovative practice for 2015".

The HP-THS programme has made a sustainable health care impact, unequivocally demonstrating that remote health care delivery in a Public Private Partnership mode is socially relevant, financially sustainable and scalable.

This preliminary analysis indicates that, given the right partners, with mutual respect, conviction, dedication, complete belief and passion, it is possible to surmount the insurmountable, innovate, customize and scale up remote healthcare in inhospitable terrains in a PPP mode anywhere in India.

Acknowledgement

Our thanks to *Mr. Vineet Chaudhary* Additional Chief Secretary (Health) Govt. of Himachal Pradesh and *Ms. Sangita Reddy* Joint Managing Director Apollo Hospitals Group for authorizing this innovative project.

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Chandralekha, MBBS, MBA has extensive experience in public health, handling medical camps and medical administration. She is actively involved in the Himachal Pradesh Telemedicine project since its inception and has a meticulous and untiring approach towards challenges.

S. Prem Anand, MBA with over 20 years of experience in implementing Information & Communication Technology programmes for Rural Development in India. Leads Programme Development group for Public Private Partnership Programmes in Health care at Apollo Tele Health Services.

Arunabh Sharma, B.Sc. has substantial field experience in implementing telemedicine activities in difficult terrains. He has been actively involved in the Himachal Pradesh project from its inception.

Yogesh Kumar, M.Sc. in Physics, has vast experience in the field of Research and IT. Has experience in software testing, tech support and handling day to day telemedicine operations. Having 6 years of total experience of total experience, with the last 2 years in the field of Telemedicine.

Vikram Thaploo, MBA is result oriented, enthusiastic and decisive management professional with proven success in effective strategizing and implementing projects. Been in a P&L responsible position for more than 8+ years. Has logical approach to challenges, performing effectively within highly competitive work environments. Having over Seventeen years experience with over 10 years in leadership positions.

Telemedicine: A Tool for Investigation, Research and Treatment of Eczema at Remote Beneficiary in Punjab

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Introduction

Among the specialties practiced through the telemedicine system, dermatology is the most suited for modern telemedicine techniques and practices [1]. For teledermatology, dermatologists use telemedicine techniques to diagnose and treat patients from a distance. This involves clinical evaluation of skin lesions and review of laboratory findings [2]. Physicians use the patient data collected and transmitted through teledermatological systems to diagnose the disease and suggest necessary therapeutic measures [3]. Store and forward communication refers to forwarding of digital images and associated patient data to the specialist for storage and consultation. On scheduled dates and times, patients are consulted with the help of still Pictures, live video conferencing and sophisticated zooming derma scopes. The goal is to deliver specialized dermatological care more efficiently by reducing commute, expense, and patient flow at urban care centers [4].

Background

Pakistan is an economically struggling and densely populated country with health resources unevenly distributed across its regions. Advanced technical medical services are only available in urban centers. The lack of healthcare access in rural and semi-urban areas has caused patients to rely on paramedics, faith healers, and scam artists to treat chronic conditions for which they are not properly trained. Some patients revert to using herbal remedies passed down generations by word of mouth that actually damage existing dermatological problems beyond repair [5].

The Department of Dermatology at King Edwards Medical University has collaborated with the Telemedicine Department at Mayo Hospital Lahore since 2009. By 2014, they had seen the highest rate of consultations for teledermatology than any other specialty care. According to the data compiled in December 2014, 17 000 dermatology patients have been

consulted from Attock, Khushab, Gujrat, Jhang, Rajanpur, Dera Ghazi Khan and Sahiwal. The district headquarter hospitals are equipped with video conferencing equipment supported by high resolution cameras and other advanced medical equipments. Dermatology comprises more than 59% of total consultations made.

Consultancy Plan for Dermatology Patients

Patients at remote areas can visit their local telemedicine centers during operational hours instead of commuting to urban centers at great distances. Providers and patients interact via live video conferencing [6]. Patient's pictures and data are recorded and saved on dermatology software for referrals and advance research purpose. A receipt is provided to the patient indicating the time and date of consultation. Patients with severe conditions are referred to Mayo Hospital for further treatment. More than 2050 eczema patients from seven remote hospitals were treated through telemedicine from seven districts of Punjab (Table 1).

Table1: Percentage of Eczema patients consulted during teleconsultations.

TOTAL NUMBER OF PATIENTS DERMATOLOGY			
	Eczema	**Others**	**Total**
Total Number of patients treated from Year 2009 to 2014	**2,061**	**15,363**	**17,424**
Percentage %	**11.83%**	**88.17%**	**100%**

Types of Eczema Consulted During Teleconsultations

When someone asks a doctor what is eczema, the answer generally points towards any intensively itchy problem with oozing of fluid from that skin and propensity of patient to itch more and more. Eczema is a term which describes a wide range of non contagious conditions of skin, involving inflammation. In most of the patients eczema appears as dry, red itchy patch or series of patches which occur when body's immune system overreacts to an irritant. That is the reason physicians often refer to eczema as "the itch that rashes [7]. Eczema is a general but broad term which clinically encompasses a variety of different Endogenous and Exogenous types. Endogenous ones are mostly caused by genetic background, aggravated by environmental factors importantly infections, drug allergies and hypersensitivity to environmental allergens, where as Exogenous ones are mostly environment related amongst which there may be person to person

variation in having genetically increased sensitivity towards environmental allergens [8].

During consultations, 91 males and 28 females were treated for Atopic dermatitis over a period of six years. Atopic dermatitis is a long term skin disease. Word atopic refers to a tendency to develop allergy conditions and dermatitis means swelling of the skin. Dry and itchy skin, rashes on the face, inside the elbows, behind the knees and on the hands and feet are observed [9]. Most patients belonged to the Gujrat and Rajanpur districts where cousin marriage is a common practice. Seborrheic dermatitis (also called dandruff, seborrheic eczema or seborrheic psoriasis) was observed in 87 males and 0 females belonging to low socio-economic status from Attock, Rajanpur and Gujrat districts. Asteatotic eczema was diagnosed in 51 males and 27 females from poor and lower middle class populations of Attock, Jhang and Khushab districts. Discoid eczema is a common type treated in 304 males and 0 females from poor and lower middle class districts of Rajanpur and Jhang. Pityriasis Alba is a type of eczema that primarily affects children and was treated in 54 males and 36 females. Patients of all socio-economic groups were observed to be similarly affected. Pompholyx eczema is a form of hand and foot eczema observed in 114 females and 16 males from middle and lower middle classes of Jhang and Rajanpur. Gravitational dermatitis or venous eczema affects legs with venous insufficiency. Only one male case was recorded and 78 women belonging to rich and middle classes from Gujrat, Attock and Dera Ghazi Khan. Lichen simplex chronicus is the thickening of skin with variable scaling and was treated in 238 males and 165 females from poor, lower middle class and middle class patients from Khushab, Gujrat and Rajanpur.

Fig 1: Eczema Patients Consulted Through Teledermatology

Contact dermatitis was the most prevalent type among all the eczema patients treated of which 235 were females and 397 were males. Every socio-economic status was almost equally affected. Infective eczema is caused by microorganisms which must be eradicated to clear the infection. Most of the 47 males and 92 females treated belonged to poor and middle

class status from the districts of Jhang, Khushab, Dera Ghazi Khan and Rajanpur (Table 2 and 3).

Table 2: Eczema cases collected by type and year for female patients

Eczema Type	Female												Total	%
	Year 2009		Year 2010		Year 2011		Year 2012		Year 2013		Year 2014			
	No	%	No	%	No	%	No	%	No	%	No	%		
Asteatotic	5	50%	6	50%	2	50%	2	40%	8	25%	4	27%	27	34.62%
Atopic	6	33%	5	31%	5	33%	2	13%	6	16%	4	24%	28	23.53%
CD	34	29%	54	66%	22	58%	27	28%	76	35%	22	28%	235	37.18%
Discoid		0%		0%		0%		0%		0%		0%	0	0.00%
Gravitational	21	100%	9	90%	7	100%	7	100%	25	100%	9	100%	78	98.73%
Infective	10	34%	10	91%	5	71%	19	76%	35	71%	13	72%	92	66.19%
LSC	18	24%	38	62%	19	58%	20	26%	48	44%	22	44%	165	40.94%
P. Alba	11	50%	3	27%	5	50%	1	14%	9	38%	7	44%	36	40.00%
Pompholyx	17	85%	35	88%	12	92%	18	90%	22	85%	10	91%	114	87.69%
Seborrheic		0%		0%		0%		0%		0%		0%	0	0.00%
Grand Total	122	33%	160	52%	77	48%	96	29%	229	36%	91	35%	775	37.60%

Table 3: Eczema cases collected by type and year for male patients

Eczema Type	Male												Total	%
	Year 2009		Year 2010		Year 2011		Year 2012		Year 2013		Year 2014			
	No	%	No	%	No	%	No	%	No	%	No	%		
Asteatotic	5	50%	6	50%	2	50%	3	60%	24	75%	11	73%	51	65.38%
Atopic	12	67%	11	69%	10	67%	13	87%	32	84%	13	76%	91	76.47%
CD	83	71%	28	34%	16	42%	71	72%	141	65%	58	73%	397	62.82%
Discoid	40	100%	46	100%	27	100%	59	100%	95	100%	37	100%	304	100.00%
Gravitational		0%	1	10%		0%		0%		0%		0%	1	1.27%
Infective	19	66%	1	9%	2	29%	6	24%	14	29%	5	28%	47	33.81%
LSC	56	76%	23	38%	14	42%	56	74%	61	56%	28	56%	238	59.06%
P. Alba	11	50%	8	73%	5	50%	6	86%	15	63%	9	56%	54	60.00%
Pompholyx	3	15%	5	13%	1	8%	2	10%	4	15%	1	9%	16	12.31%
Seborrheic	16	100%	18	100%	8	100%	18	100%	20	100%	7	100%	87	100.00%
Grand Total	245	67%	147	48%	85	52%	234	71%	406	64%	169	65%	1286	62.40%

Conclusion

Telemedicine is a tool that has proven effective in Punjab at improving access to available healthcare and medical services for populations living in

remote villages with inadequate transportation and low income resources. The high rate of consultations provided thus far have demonstrated the extent of need there is in remote places for services currently only available in urban regions.

The Mayo Hospital in Lahore is able to fulfill this need for the people of Punjab due to telemedicine.This has resulted in generating increased interest by both doctors and patients from other regions of the country towards the adoption of Telemedicine system. The data produced from this initiative is used for academic and research purposes at King Edwards Medical University Lahore. This data enables students to study the demographic distribution of Dermal Diseases across the Province and the diversified proliferation of diseases in regions and social groups. The data generated through the system is also helpful to the health department of the province of Punjab in the formulation of future health policies for filling gaps in the existing structure of health services in remote areas.

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Open Source Software in Healthcare - Benefits and Issues

An Update on Free/Libre and Open Source Software (FLOSS) in Healthcare

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Introduction

The uptake of FLOSS in health care on a global scale has been slow but steady in the last 15 years. From a global viewpoint the adoption and use of FLOSS principles in healthcare is very different in the different regions of the world. However, there have been remarkable developments in the last couple of years on almost all continents and in various different contexts.

One of the very promising developments is the emergence of FLOSS ecosystems in a technical sense but also in an organizational/economic sense. In this brief review, the authors will highlight some selected projects, tools, platforms and ecosystem in the domain of FLOSS in health care from different parts of the world. It is evident, that this selection is subjective but attention has been given to form a cross sectional overview spanning different application domains, different regions as well as low-, middle- and high-income countries.

One impressive topic is the ASEAN countries proactive trial to adopt FLOSS, in order to achieve universal health care. Another important topic is open data. In the age of cloud software and Software as a service (SaaS), this is becoming increasingly important.

The listed projects were identified through web-searches during the process of manually curating the MedFLOSS [1] database during the year 2015. MEDLINE was parsed with a keyword list and specialized blogs and websites dedicated to FLOSS in healthcare were regularly inspected.

Besides an increase in publications reporting about FLOSS in health care systems there is especially an increase in platforms and ecosystems that have been developed over the last couple of years. There has also been an increased adoption by authorities on a national or regional level.

Table I: MedFLOSS statistics

Type	Number
Projects	323
Professional service provider	106
Publications	341
Links to other resources	50

Open Infrastructure Projects

One of the main challenges of health care IT is the fragmented landscape of tools, technologies, platforms, architecture and even standards. There are actually too many standards available. Integrating the healthcare enterprise (IHE) [2] is a global initiative to define profiles and create agreement on sets of available standards in the context of specific user driven use cases. There are several open source implementation tools and reference implementations for several IHE profiles. Some of them can be found under the following references [3–6].

Another challenge is the extremely fast development of new technologies. While the healthcare domain has relatively slow development cycles, health IT is changing faster and faster.

On a national level the challenge is to exchange patient data among many different systems. Even standards have not completely solved the problem so far. A valuable contribution towards interoperability is an open infrastructure that helps to build health information exchanges. In the US the project CONNECT [7] provides modules to access the National Health Information Network.

On the European level the project OpenNCP [8] provides components for national contact points. As of January 2016, the OpenNCP governance model changes. The OpenNCP project shifts under the direct responsibility of the European Commission, Directorate General for Health and Food Safety, DG SANTE. “The project is dedicated to remain open-source and the governance is designated to be driven or influenced by the OpenNCP community and health care professionals, in cooperation with the European Commission” [9].

Digital Health is one of the new mega trends combining personalized medicine and mHealth. This domain is driven by consumer health and fitness products, so called wearables and health apps. The global players like Google, Apple and others are creating their own ecosystems and provide open source tools to link devices and sensors to their ecosystem. E.g. ResearchKit from Apple is open source. For the Google ecosystem

there are many open source bits and pieces available since the basis is Android. However, your health data ends up in the Google or Apple system with serious questions about privacy. An alternative is to set up an own ecosystem. Open mHealth [10] provides tools to set up an ecosystem and to integrate devices from the Apple or Google environment [11, 12].

Organizational ecosystems and communities have been strengthened and extended over the last couple of years. The Open Source Electronic Health Record Alliance (OSEHRA) [13] has been founded with the mission to develop a community of software experts, clinicians, and implementers as well as a robust ecosystem of complementary products, capabilities and services. In 2016 the 5th OSEHRA Open Source Summit will be held with several hundred participants from the free and open source in healthcare community.

The UK has seen very fruitful developments as well. A very agile FLOSS community has grown over the last couple of years with the NHS hack days [14] as a core element and driver. IMS MAXIMS [15] has open sourced their electronic health record and clinical software under the product OpenMAXIMS [16] which is life now at the Blackpool Teaching Hospital [17].

Japan has been cultivated open source software community in medicine, and they held the 11th medical open source software seminar in Kyoto at January with Dr Mun, CEO of OSEHRA from USA.

GNU Health has been chosen as National Health IT infrastructure for Jamaica and is implemented in Laos and the Philippines besides various other sites. DHIS2 is a well-known health information management system with geographical information, and widely adopted in many countries especially in low-mid income countries. MFS (Medicos Sin Fronteras) adopted DHIS2 for their works officially to manage communicable diseases with geographical information. OpenMRS has been also developed and adopted in low-mid income countries to manage HIV and tuberculosis.

Open ecosystems are also under development for specific indications. Glucosio [18] offers user centered free and open source apps for diabetes management and research and Tidepool [19] offers an open and secure platform that serves as a home for diabetes data. The Tidepool Platform is secure and HIPAA-compliant.

Open Source for Biomedical Research

The bioinformatics community has a long and excellent tradition of open source software tools. “The Open Bioinformatics Foundation (OBF) is a non-profit, volunteer-run group dedicated to promoting the practice and philosophy of open source software development and Open Science within

the biological research community" [20]. OBF runs and supports the Bioinformatics Open Source Conference (BOSC) [21]. Reviewing the open source bioinformatics domain is out of scope for this paper. We will only mention two projects that overlap with the medical domain due to its interference with clinical research. The first is the OpenClinica software [22], an electronic data capture tool for clinical research. Since its foundation in 2009, OpenClinica has seen a rocket-like development and has currently over 76 000 downloads.

The CTMM Translational Research IT (TraIT) project [23] is the second that we would like to mention. TraiT is developing and implementing a long-lasting IT infrastructure for translational research projects in the Netherlands that will facilitate the collection, storage, analysis, and archiving of data generated in the biomedical research projects. The tranSMART platform [24] has grown out of this project and is now governed by the tranSMART foundation [25].

Related Domains

Several related domains interfere with health or health data. We have already mentioned the fitness domain. Another domain is the home automation and "Smart home" domain. It is obvious that health data can be measured in the home and that smart home middleware may serve for vital sign and activity monitoring. Google and Apple count on this and have integrated home automation into their ecosystems. An open alternative is provided by the open source platforms openHAB [26] and openRemote [27]. The Internet of Things (IoT) may also serve to collect data that can be used in the context of health. Kaa [28] is a 100% open source IoT middleware platform.

Discussion

The projects presented above are only a short list and a subjective selection of the free and open source in health care domain. Many excellent projects are not mentioned here due to lack of space. One of the most comprehensive collection of FLOSS in health projects is MedFLOSS [1].

Acknowledgment

The authors like to thank the anonymous free and open source software developers contributing their time and brains to the development of free and open health IT ecosystems.

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First Experience in Implementing an Open Source Health Information System for a City Hospital in a Developing Country

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Abstract: **The challenges in implementing Information Technology Systems for a Health Organization are many and are not limited only to technical challenges. There are even more challenges that need to be faced when the Health Organization is a Local Government Unit (City) in a Developing Country such as the Philippines. These challenges can be generalized into the following categories: Organization (People), Process, Technology and Sustainability. This paper will present the experiences of a small I.T. consulting company in engaging with a Local City Government to implement the whole I.T. infrastructure using Free and Open Source Software (FOSS) for a newly built 50 bed hospital to serve the healthcare needs of the local population of 250 thousand inhabitants.**

Introduction

In the last five years, there have been several implementations of Electronic Medical Record Systems in the public health clinic setting in the Philippines using Open Source software [1]. On the other hand, there have been little available published reports of the use and deployment of Free and Open Source Software (FOSS) to operate public government hospitals.

Three years ago, the City Government of Navotas [2] decided to use GNU Health [3], to run the operations of the first, new, public hospital that was still under construction. The hospital was being built to serve the healthcare needs of the city's 250 thousand inhabitants [4].

The Navotas City Hospital (NCH) was inaugurated on November 21, 2014 [5], and officially began operations in June of 2015 [6]. The vision of the Hospital Director and the City Mayor was for the hospital to have "paperless" operations for increased efficiency, transparency, quality of service, and accountability.

It was with these requirements that the City Government engaged Integrated Open Source Solutions (iOSS) [7], in order to make the vision become a reality. Being a brand new hospital, the whole I.T. infrastructure had to be designed and implemented from the ground up.

The author, who is the founder and president of iOSS, was given the opportunity to design and implement the whole Information Technology infrastructure of NCH using Free and Open Source Software. The details of the project will be explained in the succeeding paragraphs.

System Outline

Successful implementations of Information Technology within an organization require a combination of People, Process and Technology [8] moving together to achieve defined goals. A fourth element, Sustainability, was added by the author in order to relate how the project was pursued despite a long duration from initial talks to contract signing and first payment received for the project.

People: Navotas City Hospital Stakeholders

Stakeholder Title	Stakeholder Position
Project Funder	The City of Navotas Mayor's Office
Project Owner	Hospital Director
Project Manager	Hospital Administrative Assistant / Consultant
System Admin (Functional)	Hospital Administrator
System Admin (Technical)	Hospital I.T. Analyst
System Users	Hospital Section Heads (16 sections)
Consultant - Medical Informatics	External Consultant (National Institute of Health)
Consultant - Information Technology	External Consultant (iOSS)

Success of the project hinges on the acceptance and buy-in of each of the stakeholders listed above. With regards to the Navotas City Hospital I.T. project, the project funder and the project owner were on-board and committed from the start of the project. Since this was a new hospital, the hospital required on-site computer proficiency tests to all new applicants. Thus the hospital staff already had some level of computer proficiency upon being hired by the hospital.

The Medical Informatics consultant had recommended the Free/Libre GNU Health software to the hospital, and was part of the team engaged by the hospital to implement the software, and to map the current hospital workflows to GNU Health.

The main challenge on the People perspective was in getting the section heads and hospital administration to commit to meeting regularly, and to allocate a separate time, aside from their current duties, to study and work with the consultants to customize and map the workflows into GNU Health.

Process

The Cobit 5 framework [9] was recommended by the author to be used for the I.T. project implementation for NCH. The Project Team applied the Scrum Methodology [10] to iteratively define and deploy customizations to GNU Health for the hospital.

Technology

Free/Libre and Open Source Software was used for the I.T. Infrastructure

Server Infrastructure

Server Function	Software deployed
Firewall	**PFSense [11]**
	- VLAN - For separation of machines by section/department - Controlled Internet Access based on VLAN membership - Internal Domain Name Server
Server Virtualization	**Proxmox [12]**
	- Implemented Proxmox with software RAID 10 in order to easily create and deploy virtual machines, and to maximize the use of the physical server.
Internal Communication and Collaboration (ICC) Tools	- **Nethserver [13]** - Services: Email, Calendar and Event Scheduling, Instant Messaging, Shared folders, Open LDAP for single sign-on. - **Moodle[14]** - Open Source Learning Platform that the hospital will use as a document repository and as collaboration and learning resource.
Reporting Tool	**Jasper Reports Server [15]:** - For generating custom reports needed by the hospital management
GNU Health Servers	- **GNU Health Test Server**: This environment is for individual users/sections to study/explore/learn GNU Health. - **GNU Health Data Preparation**: This environment is to be used for importing/entering/preparing initial data needed for production use. - **GNU Health Integration/Training Environment**: This environment is to be used for integrating process flows across sections, and for testing the system with production ready data - **GNU Health Production Environment**: This environment is to be used for production/live use by the hospital.

Sustainability

Timeframe of engagement of iOSS with the City of Navotas:

2013 July	**First exploratory talks with the client were initiated.**
2014 March	Navotas City hired a new Hospital Director/City Health Officer
2014 August	iOSS unofficially was engaged by the City of Navotas to customize

	and implement GNU Health for the new hospital that was under construction
2014 November	The Navotas City Hospital was inaugurated and blessed
2015 June	The Navotas City Hospital officially began accepting patients
2015 June	The agreement between iOSS and the City of Navotas for the GNU Health customization and implementation was finally signed and approved.
2015 September	The first payment on the contract was released

From the timeline listed above, it took 2 years and 2 months from the first meeting up to the first payment by Navotas City to iOSS. From a sustainability point of view, iOSS could not maintain a team and pay for their salaries for two years, while waiting for the contract to be awarded, signed and the first payment to be released.

iOSS engaged with the City of Navotas with a team of one person, the author of this paper. The author also retained his current work as I.T. professor at Asia Pacific College throughout his engagement with the City of Navotas. The author was the local developer, implementer, system administrator, project manager, and technical requirements analyst for the project. The Navotas City Hospital engaged a medical informatics consultant, a project manager, and hired one full time I.T. Staff. The core team was composed of the four roles just mentioned.

Additional technical expertise for GNU Health was provided by Dr. Luis Falcon, creator and maintainer of GNU Health. A Jasper Reports developer was also sourced through Upwork [16] and engaged through a deliverables based arrangement.

The author initiated and cultivated close personal ties with Dr. Luis Falcon, and with the GNU Health development community [17]. Because of the relationship that was cultivated, the author could make requests to the community and get replies regarding technical issues of the software.

This relationship was the key in allowing the author to do his own customization development on GNU Health, thus not requiring iOSS to source and hire a separate developer for the project.

Results and Discussion

The Navotas City Hospital I.T. project is still on-going at this time. The internal collaboration and communication tools have been implemented and are now in use by the hospital staff. Current mapping of workflows into GNU Health and testing by the users is on-going. The method for implementing the systems is a phased approach, beginning with the patient

admission and administrative modules, and then continuing on with the clinical aspect (electronic medical records) of the patients.

Conclusion

The Navotas City Hospital I.T. project has provided the author with a unique opportunity to apply a complete range of Free/Libre and Open Source Software for all of the I.T. requirements of the hospital. Keys to success of the project hinges on: commitment and buy-in of all stakeholders involved, a phased, incremental deployment, and a sustainable, long term engagement of the I.T. consultant implementing the project.

Acknowledgment

The author would like to thank the various Open Source communities from which all the Free and Open Source Software was created and maintained.

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ScatterWeb Tele-Health Platform Acting As a Proposed Solution for e-Health Strategy Implementation in South Africa: Work in Progress

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Introduction and Background

E-Health is the application of ICTs, particularly internet, for improving the healthcare services [1]. Many developed nations have invested huge amounts of money on these systems and the developing states are also making efforts to adopt these technologies. However, there are several difficulties to be addressed before taking full advantage of these technologies [2]. According to [1], several factors have been discovered as the important variables in defining the successful implementation of e-Health. The research indicates that 'infrastructural arrangements' play central role and it becomes extremely important in the context of the developing states like South Africa. So availability and effective use of ICT Infrastructure is indispensable for successful adoption of e-health systems. In response to such challenges, Wireless sensor networks (WSNs) have become the most recent exciting and pervasive technology in telecommunications. Rapid improvement and recent advances in wireless communications, digital electronic technologies like ASIC design, micro-electro-mechanical system (MEMS) and mobile computing enabled sensor nodes to be deployed with the target to access information and measurements of physical phenomena anywhere and anytime. A WSN is defined as a network, which consists of individual nodes that are able to interact with the environment by sensing or controlling physical parameters [3]. These nodes have to collaborate to fulfil their task using wireless communication to enable this collaboration. Wired networks need to be maintained, which is convoy by higher costs of ownership. Wiring prevents entities from being mobile and is not suitable for a range of environmental, health, home, commercial and military applications. WSNs suffer from

some limitations such as energy consumption, its optimization, the accuracy of the delivered measured data, size and cost of a node as well as the capacity of its onboard energy supply.

The purpose of this article paper is to discuss and review some existing research on the role of ICT-infrastructural components on e-health implementation in South Africa. It then proposes a ScatterWeb Tele-Health platform that can act as one of infrastructure deployment for e-health system deployments in South Africa.

The State of the Art of e-Health Strategy Implementation in South Africa

South Africa (SA) government have strong commitments to promote improved health services and the quality of life of its citizens. The government have proposed the National Health Insurance System (NHIS) aiming in providing all South African citizens with essential health care. The challenges currently SA is facing in the health sector are the shortage of health professionals, inefficient health record management, infrastructure barriers, poor communication between the various health entities and poor disease control and surveillance [4]. SA, like most African countries has limited health information systems infrastructure; some health information system components are implemented on an ad-hoc, piecemeal basis and are designed to solve specific problems. Little attention is paid to how these components can be integrated into a national health information system. In a survey of e-Health readiness of hospitals in the North West province of SA, [5] concluded that urban hospitals in SA have more Information and Communication Technology (ICT) equipment than rural hospitals. Internet connection is more reliable in terms of connectivity and speed in urban hospitals. In rural hospitals however, the connectivity and speed of Internet services are affected by poor telephone lines and interruption of electricity power supply.

The ICT systems are not integrated to work together within and across hospitals to allow healthcare professionals to gain benefits of e-Health solutions and applications. This means that the e-Health maturity curve is at zero level and this is a picture that is repeated all over SA. Historically, health information systems in SA have been characterized by fragmentation and a lack of coordination, prevalence of manual systems and a lack of automation, and where automation has existed, a lack of interoperability between different systems. Following are the ten strategic priorities for e-Health that are identified and the key activities required for each of these priorities to be outlined: *Strategy and Leadership, Stakeholder Engagement, Standards and interoperability, Governance and Regulation, Benefits realisation, E-Health foundations, Applications and Tools to support*

healthcare delivery, Monitoring and Evaluation of the e-Health Strategy. This strategy is a product of a concerted effort by a team of officials from the National Department of Health (DoH) and the Medical Research Council (MRC) who worked tirelessly to develop it, in constant consultation with the NHIS of South Africa (NHIS/SA).

Research Methods and Proposed Tools

The content of this study follows a simplified strategic planning process. It was conducted as a literature review which starts by introducing the current state of e-Health strategy implementation in SA and continues to research the existing literature in order to discover the current key challenges in relation to e-Health strategy implementation. The information was gathered through the use of case studies like white papers, conference papers, documented Telemedicine organization information websites, journals and peer-reviewed articles with the aim of investigating and accepting various Tele-Health Open-Source tools that are currently available. For easy integration of wireless networks into different environments like, health sectors, higher education institutions, industrial sectors and etc, this study is focused on implementing a ScatterWeb Tele-Health solution that can offer Ethernet gateways with the aim of addressing some of the ten strategic priorities of e-Health strategy implementation in South Africa. This platform will integrates to a distributed, heterogeneous platform for ad-hoc deployment of self-configuring wireless sensor network and it will offer all typical Internet protocols for data transmission. Tele-Health Living Lab will be applied in this study for experimentation environments, for designing assistive Tele-Health tools and validating them in a real life environment.

Therefore, there is a need for an assistive environment to be developed as a living laboratory for experimentation and validation of assistive living techniques at Tshwane University of Technology/F'SATI facilities. An experimental scientific research approach with ScatterWeb supporting tools will be conducted and applied in this study in order to address the main research objectives. In order to ease development and for simulation purposes, we will utilise NS-2 and WNS simulator in order to integrate the ScatterWeb software and this will allow for different applications written against the ScatterWeb API to be run without changes on both the simulator and the real-world network sensor node. Evaluation and validation of the developed platform will be conducted from the lab environment by following further tests and reviews.

ScatterWeb Tele-Health Platform

ScatterWeb is a heterogeneous embedded platform collection, consisting of simple nodes, called Embedded Sensor Board (ESB), and more powerful data sinks, called Embedded Web Server (EWS) [3]. The proposed ScatterWeb Tele-Health Platform (Fig. 1) will be tested and deployed with the aim of providing a flexible system based on enhanced sensor wireless technology that combines robustness and high reliability with low-cost hardware. For easy integration of wireless networks into different environments like, health sectors, higher education institutions, industrial sectors and etc, the study is focused on implementing a ScatterWeb Tele-Health solution that can offer Ethernet gateways with the aim of addressing some of the ten strategic priorities of e-Health strategy implementation in South Africa. EWSs can act as gateways between the sensor field and external infrastructure (Ethernet, GPRS, Internet and etc). The ESB board will integrate luminosity sensor, noise detection, vibration sensor, IR movement detection, microphone/ speaker, and IR sender/receiver [3].

Typical application scenarios can be environmental monitoring, smart buildings, tracking, health patient monitoring and etc. The flexibility and ease of deployment of wireless sensor networks (WSNs) can enable such infrastructures to be used in various locations. The mobility in WSNs provides several new challenges in techniques, protocols and energy support [3]. According to [6], the mobility in WSNs can be categorized in three types:

Node mobility: The wireless sensor node can change its position during operation time. Specifically when the network is used to monitor a moving object (e.g. a sensor node attached to cattle). Requirements in such networks are auto configurability and acceptable energy consumption to maintain a good level of functionality.

Sink mobility: The sink is considered as an external part of the network.

Event mobility: In a typical application the source of the event is mobile (e.g. in tracking applications). This type of WSN's mobility needs a sufficient number of sensor nodes. Sensor nodes that are currently not used to detect any appropriate event can be sent to sleep state.

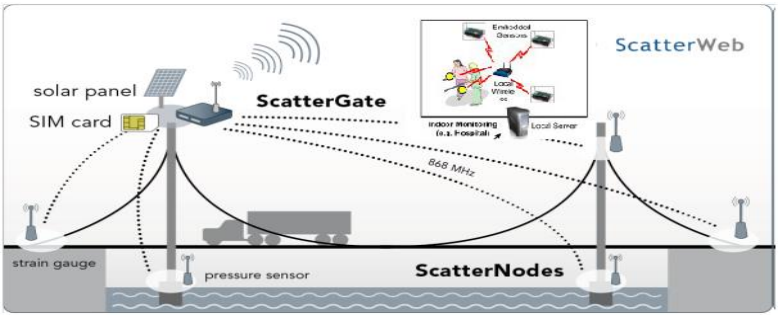

Fig. 1: ScatterWeb Tele-Health Platform

Single-Hop versus Multi-Hop Networks

Single-Hop networks use a direct communication between the source and the sink. Due to the limited distance using radio transmission, a simple direct communication between the sources and the sinks is not always possible. Hence, communication relays in Multi-hop networks. A hop represents one portion of the path between source and its destination. According to [8], in wireless networks, data will passes from the source to the sink through a number of intermediate devices like routers. Such devices will cause each data to hop between one point-to-point network connections. The main benefit of Multi-hop networks will be an increase of wireless coverage areas, performance enhancement, energy consumption reductions and enabled automated reorganization of access point distribution [7]. According to [8], in Multi-Hop WSNs the sensor nodes can act like relay nodes without need of intermediate devices. Commonly WSN applications have multiple sources and sinks and following figures (Fig. 2, 3, 4 and 5) exemplifies various WSN Multi-Hop networks [3].

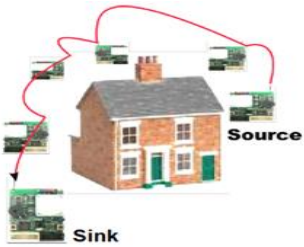

Fig. 2. Multi-Hope Network with 1 Source & Sink

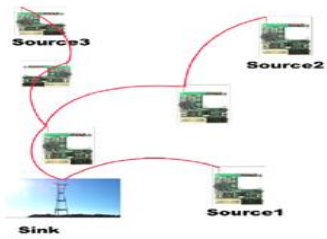

Fig. 3. Multi-Hope Network with 3 Sources & Sink

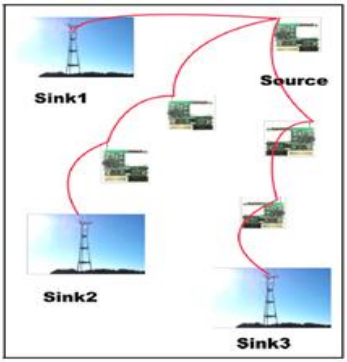

Fig.4. Multi-Hope Network with 1 Source & 3 Sinks

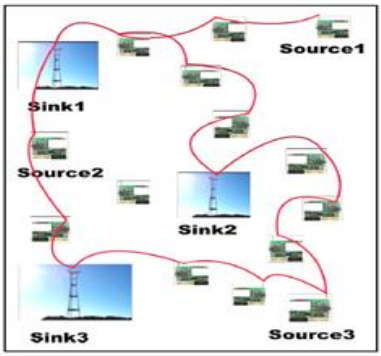

Fig. 5. Multi-Hop Network with 3 Sources & 3 Sinks

Acknowledgement

Thanks to Professor JS Van Der Walt and Thierry Simonnet for their dedication and contribution.

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Smart and Assistive Technologies for Independent Living and Wellbeing

A Driving Assistant to Help People with Mild Cognitive Impairment or Early Stages of Dementia

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Abstract: **Sudden or gradual loss of ability to drive a car -such as with sight loss and/or cognitive decline- can have significant impact on people's wellbeing and mental health. In the InLife project there is a desire to provide an integrated suite of assistive technologies to particularly support people with dementia or mild cognitive impairment. This paper presents a possible wearable technology to facilitate driving and monitor decline in driving capacity. The way we perform common daily activities is influenced by our cognitive abilities. Driving is one example of significant importance since the way we drive may have a potential impact in our safety. This paper proposes a framework to monitor and track the driving efficiency of a particular user in terms of energy consumption and perceived stress as a way to assess the user's cognitive abilities. A smartphone based personal recommender system is proposed to help the driver to drive better in high cognitive demanding situations as measured by the perceived stress by providing in advance information to help the driver better manage those situations. The perceived stress is estimated from the heart rate variability (HRV) signal from a wearable device. In the long term, the evolution in detected patterns in personal time series of perceived stress, when driving in similar conditions ,could be used as an indicator of the severity and progress in mild cognitive impairment or early stages of dementia for particular patients.**

Introduction

Driving, as many other common human tasks, requires the application of our cognitive capabilities to deal with the perceived mental processing workload in order to assess the best action to perform to deal with our sensory data. This mental workload (in the way it is perceived by a particular user) has an impact on the driver's physiological data (such as an increase in the heart rate (HR) or decrease in heart rate inter-beat variation HRV). At the same time, the way we drive has an impact on the associated workload that it is required to provide an on-time response to each driving event. Assessing the correlations between stressors and their impact both on

physiological sensed data and user driving behaviour could give us very valuable information about the cognitive capabilities of a particular user. A part from the particular perception that a certain mental workload may have on a particular user in the presence of a particular stressor in a particular case, assessing over time how similar cognition-demanding stressors influence the perceived mental workload (as translated into the HR or HRV signals) could be a mechanism of assessing early stages of cognition deficits.

To assist drivers with cognitive deficits, it is necessary to investigate, measure, and quantify the drivers' perceived mental workload. The term "load" in this context indicates the portion of capacity that is needed to drive. This capacity is limited. Therefore, if the task is perceived as requiring a significant cognitive ability it will have an impact on his or her physiological response (such as the increase in HR) and it is likely that the driver makes mistakes in the actions performed as a result. The level of the perceived workload is not only affected by the stressor per se but also by several factors such as the road type, traffic conditions, driving experience, gender and the way in which the driver has driven in his or her approach to the stressor.

In this paper I will present preliminary results about how driving stressors have an impact on the HR and HRV and the correlation that a particular stressor may have on the perceived cognitive load depending on how the driver has driven when approaching the stressor. Further analysis of measured behavioural consequences that a particular stressor has on related driving actions and the evaluation of variations over time are left for future studies. The technological implementation of the developed system is also briefly described. Apart from performing measurements, the implemented system provides feedback to the driver to help mitigating the perceived cognitive load.

There are many works on measuring and quantifying the driver's workload. In [1], Wu and Liu described a queuing network modelling approach to model the subjective mental workload and the multitask performance. They propose to use this model to automatically adapt the interface of driving assistant according to the workload. In [2], Itoh et al. measured electrocardiogram (ECG) signals as well as head rotational angles, pupil diameters, and eye blinking with a faceLAB device installed in a driving simulator to estimate the driving workload. In [3], the driver workload associated to lane changing was measured through simulation test driving. In [4], a multiple linear regression equation to estimate the driving workload was proposed. The model employs variables such as: speed, steering angle, turn signal, and acceleration.

On the other hand, the impact of the cognitive load on the driver's behaviour has been studied on many papers. In [5], Kim et al. analysed the relationship between drivers' distraction and the cognitive load. It was discovered that heart rate, skin conductance, and left-pupil size were effective measurement variables for observing a driver's distraction. The authors in [6] showed that the increase in visual demand when driving tends to cause a reduction in the speed and an increase in the variation in lane maintenance. However, the authors showed that the increase in the perceived cognitive load does not necessarily affect speed as a resulting action. In [7], the authors propose to use a set of variables (vehicle speed, steering angle, acceleration, and gaze information) to predict the workload driver. The authors achieved an accuracy of 81% with this method. Other studies [8] propose to use the movement of the steering wheel as an indicator of driver workload.

There are, however, only a limited number of works where the workload is analysed in a real environment when driving. Furthermore, there is a lack in available applications. This paper presents a driving assistant that employs the information of the driver stress response to particular stressors (points of significant likelihood of causing stress to drivers such as street crossings) as measured from the HR and HRV physiological signals and the driver's way of driving when approaching the stressor to assess high cognition demanding situations and provide early warning messages to the users to reduce the speed before approaching the stressor.

Developed System

The modular architecture of the implemented driving assistant is captured in figure 1. The assistant is deployed on Android mobile devices and is able to get telemetry data from the car's CAN bus from an OBD2 connector. In the cases in which the OBD2 connector is not available, telemetry data is estimated from the GPS in the Android device. The drive wears either a smart watch or a fitness band with a HR sensor which sends the physiological data to the Android device through a Bluetooth Low Energy connection. A database of stressors is built from previous recordings of stress data. If the assistant detects that the driver is approaching a stressor and the driving style of the driver in approaching this point makes the prediction of the likelihood of confronting a high expected cognitive load above a predefined threshold, the assistant recommends the user to reduce the speed.

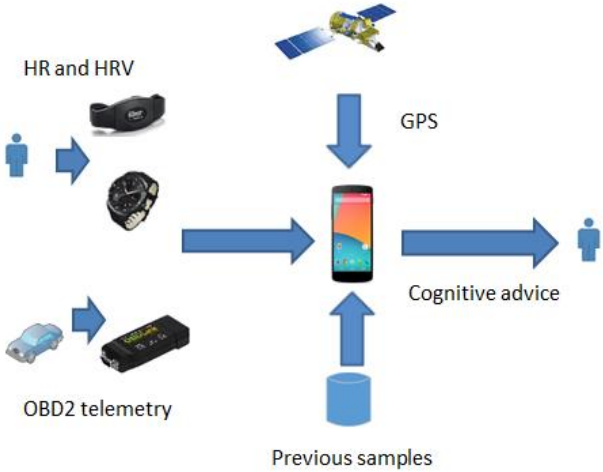

Fig. 1. Developed system

Early Results

The implemented system has been used to monitor different drivers in their normal daily journeys to work (since they tend to confront similar stressors, in the same locations and with similar traffic conditions). A particular setting is shown in figure 2.

Fig. 2. Deployed system

To show the impact that a particular stressor has on the HR and HRV signals, some recordings are captured in figure 3. The "y" axis represents the beats per minute in the case of HR and the inter-beat time interval in ms

in the HRV. We can see that the same stressor does not always have the same impact on the measured physiological data.

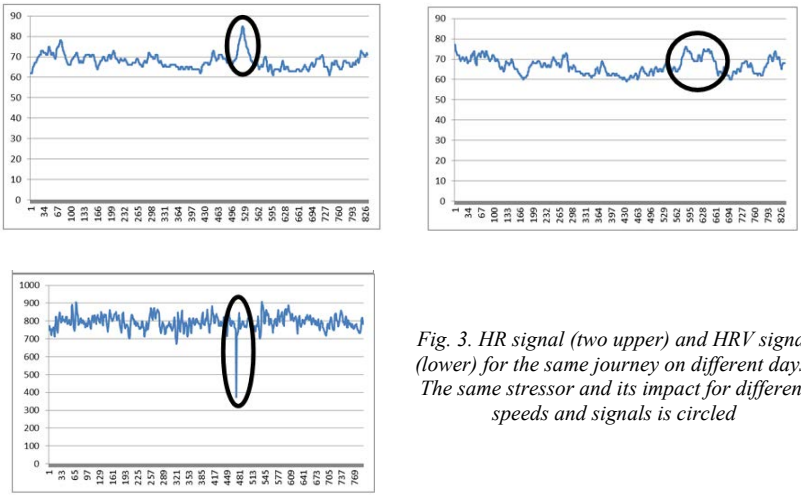

Fig. 3. HR signal (two upper) and HRV signal (lower) for the same journey on different days. The same stressor and its impact for different speeds and signals is circled

In order to present early results about how the driving style when approaching a stressor impacts the physiological data recorded after the stressor, the duration of the stressful events related to the speed variability when approaching a particular type of high cognitive demanding point (street crossing) for a particular user in similar traffic conditions (9 am in the morning on a working day) is presented in figures 4 and 5. The "x" axis captures the division of the standard deviation of the speed and the average speed for the 20 seconds before the stressor (figure 4) and for 40 seconds before the stressor (figure 5). A positive correlation may be intuited.

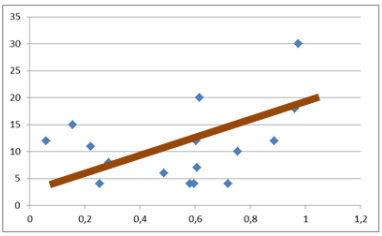

Fig. 4. 20 seconds anticipation

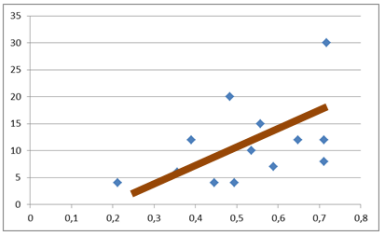

Fig. 5. 40 seconds anticipation

Conclusions

The presented results are just a preliminary assessment of the potential of the use of driving assistants to help drivers to mitigate high cognitive demanding driving situations. The physiological measurements as well as the assessment of the driving style show promising potential correlations with the driver's ability to handle cognitive load and therefore open the door for assessing and helping drivers with cognitive deficits.

Acknowledgment

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Assistive Technologies in Integrated Care

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Introduction

During 2015 we performed (as members of an expert team) a detailed study on possibilities of utilization of assistive technologies in the systems of social, health and informal care. The motivation for the study was the fact that no proper survey of assistive technologies existed in the Czech Republic. The Ministry of Labor and Social Affairs realized a long-term project "Process Support in Social Services". It is an important system project that focuses on social services and their financing. The main aim is to support availability of social services to their users. As a special activity of the project the sub-project "Support of Assistive Technologies" was initiated in November 2014.

Assistive technologies (AT) cover a very broad area, which is not yet fully mapped out in the Czech Republic. AT are technologies that help to provide so-called "inclusive services". The ATIS concept (Assistive technologies and inclusion services) is used in modern states for improving provided services to clients of social and health care system. The whole concept can be utilized in social and health care services and also in the environment of home and informal care.

The output is supposed to serve as one of the supporting documents for legislative, methodological and economical adjustments of the social care system in the Czech Republic. The goal is to stabilize the whole system, simplify and ensure the best targeted distribution of required services to their users.

Study "Support of Assistive Technologies"

The aim of the activity was to evaluate current situation in the area of development and use of AT and to set mechanisms for their utilization in favor of persons with health or social impairment and their neighborhood. The study comprises of following eight reports: introductory report, four reports focused on various types of services, and three reports formulating requirements and conditions for future successful implementation of AT.

The introductory report defines the area of assistive technologies, classification of AT tools and devices, standards and norms concerned, target user groups, types of care and services, current legal regulations and state of art in the area in the Czech Republic. Further, examples of existing solutions and criteria for AT evaluation are presented. Last part of the report focuses on international context, describing state of art in technology and utilization, related EU research programmes, international organizations and initiatives.

The successive four reports focus in more detail on identified types of service and related issues as education, research and development, care organization and financing, legal framework. In particular, the reports cover: utilization of AT at providing social services; utilization of AT at selected health services; utilization of AT at informal and home care; and utilization of specific AT for handicap compensation at persons with health impairment. Although distinction between different types of care was used throughout the study, we showed finally that the criteria, conditions and processes are very similar. Thus we can speak about integrated care as more general term.

The report on utilization of AT in social care is focused on key aspects that nowadays play a role in introduction of technologies in care. The most important aspects are: shorter time of new technology acceptance; technologies as enablers of higher independence, and AT significance for support of security and increase of quality of life. Evaluation of technical parameters of AT is not the most significant activity (satisfaction of defined requirements is basic condition). It is more beneficial and important to evaluate their influence and impact in connection with a given situation and way of use. One of the main criteria is quality of life. Physical health, level of self-sufficiency, mental health and social relations are set as key parameters. The report provides detailed analysis of various impairments, suitable technologies and evaluation with respect to the key parameters.

The report on utilization of AT in health care aims at analysis of situation in all types of health care services, including prevention, acute and urgent care, chronic diseases, and rehabilitation. It discusses relation between AT and medical devices, their utilization in telemedicine, issues of electronic health record. This report also contains overview of related educational programs and recommendations for future changes of curricula.

The report on AT in home and informal care brings an overview of current state of AT related to their utilization in home and informal care and analysis of regulatory framework. It discusses effectivity of AT utilization with the aim to show how to modify the relations in AT area, which legislative and economic changes have to be introduced and finally how to

modify offer of products and services in such a way that AT become more accessible both from financial point of view and from the point of view of practical usability.

The report on specific AT for handicap compensation at persons with health impairment focuses on overview of technologies for compensation and inclusion. The key issues discussed are user perception, increase of quality of life, standard devices, assessment of suitability, economic demands in relation to benefits and increase of quality of life.

All four reports confirmed positive impact of AT in all considered areas. However, they also identified issues that are not yet solved. Potential users are willing to use AT but in many cases these technologies are not properly classified and thus not included on the list of financially supported aids from social benefit system or health care insurance. Conclusions of these reports represented starting point for the final set of reports whose aim was to present recommendations and tasks to be performed as preconditions of successful implementation of AT in integrated care.

Final three reports formulate requirements and conditions for future successful implementation and sustainability of AT. Economic analysis in the first report estimates costs and benefits in several areas of applications, e.g. home care, senior homes, hospitals. Methods of health technology assessment are used and for evaluation of extra-financial value relative to resources invested the so-called social return on investment is applied. This value represents environmental and social value which is not reflected in conventional financial accounts. Second report focuses on common principles for setting regulatory and process framework for utilization of AT in the Czech Republic. Third report defines areas of further development of AT in the Czech Republic, both from the technological point of view, and potential application areas.

The first report shows one of the problems of current financing of AT in the Czech Republic. Since AT utilization is on the border between social and health care, two ministries, namely Ministry of Health and Ministry of Labor and Social Affairs are involved. Moreover, two different insurance systems are involved as well: health insurance and social insurance. There is no defined guideline for simple calculation of costs of health and social services, which frequently leads to inefficient exploitation of resources.

In the second report focused on regulatory framework, the conclusions are similar. If we want to aim at efficient solutions and collaborative environment, it is necessary to coordinate effort in both social and health areas. There were identified legal regulations that must be modified or completely changed to reflect current situation and future needs better. Another important issue identified during the preparation of the study was

lack of information on all sides. Many clients do not know about existence of AT and where and how to get them. The social service organizations are not informed about existence of potential clients and many health care institutions are not aware of the offers of social services in the client neighborhood. The concept of community care existing in some countries is one of the possible solutions that can be introduced. However, it needs legal and organizational support at least on the community and regional level.

The third report shows the technological potential in the field of AT. However, it states also that there is no systemic approach to financial and institutional support of research and development in AT. It evaluates qualitative and quantitative contributions of AT. Although it is difficult to calculate value of qualitative benefits we consider them more important for involved actors, in particular support of independence, self-sufficiency, social inclusion, communication, security, prevention of risk health states, quality of life, possibility of continuous care without necessity of increased number of carers. Contribution of AT is also obvious at the side of informal carers, in particular family members.

Conclusions

The study provided a systematic and detailed overview of existing technologies, including their classification, namely to compensation aids, medical devices and other technologies. The work was also focused on analysis of existing legal framework. We identified several tens of legal regulations that are in certain relation with development, use and financing assistive technologies. The crucial issue is that there is no single and unified legal framework for assistive technologies both in the Czech Republic, and in European Union. There are also unclear relations between health and social care and services although these services are frequently provided to the same clients. Thus the processes should be described in standard and transparent way. Clear definitions of duties, such as service and maintenance of AT, responsibilities of producers, care providers and other actors must be introduced.

In the Czech Republic, this problem area is fragmented and is being solved only marginally as part of various legal regulations. We see as problems the non-existence of any legal or procedural link between used technologies and services provided using such technologies. There is no clear legal framework for support of development, utilization and forms of state participation on reimbursement for needful clients. The problem that there is not much information about AT and their utilization at target groups (clients, service providers) is of the same significance as the above mentioned issues.

Acknowledgment

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Challenges in Design of Digital Care Systems That Support People with Dementia

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Abstract: **The paper argues there is a need to ensure that effective health and social care technologies and associated services are innovated to meet the requirements of people living with dementia or other cognitive impairment. It lists factors that should be considered in designing such solutions. It highlights the need for intelligent and much more adaptable universal/ubiquitous solutions to address inhomogeneity of the population.**

Introduction

Dementia is a major global health challenge particularly prevalent in older age populations in developed and, increasingly, developing countries as well [1]. The need for affordable treatments is well recognised [2], but attention is also being paid to the role of services and technologies in addressing the independence of people living with dementia, allowing them to live at home for longer [3] and reducing the financial impact on health and social care services [4]. In trying to develop any digital technology and associated services – anything from infrastructure systems to personal portable products – that are intended to serve the public, the needs of those with cognitive impairment should be an important consideration [5, 6]. In general people with cognitive impairments have similar prevalence of co-morbidities to that of their peers who do not have cognitive impairments [7]. There are many examples of digital technology being used to address the safety and security of individuals [8, 9], often where the person with dementia is not the intended user [10]. However, this should not be the primary focus as technology can be used to facilitate autonomy, activity and living well [11]. Further, there is a growing body of evidence demonstrating that some people with dementia are able to use existing and unfamiliar digital technologies [5, 12, 13].

This paper reports some of the many challenges that are faced when designing inclusive digital services to address the care (health or social) needs of people living with dementia.

Challenges

Any software or digital system developed for the population of people living with dementia need to address the syndrome specific issues:

- Ability/ inability to use/comprehend some text/language;
- Impact of cognitive deficits, memory problems;
- Sensory deficits; for example in seeing/perceiving colours and depths;
- Reduced capacity to reason/abstract/learn;
- Motivations across individuals with dementia;
- And, carers expectations, capacities and motivations.

This is on top of those reported for many older people:

- Expectation of what the 'technology' or 'service' will do for them [14];
- Physical, hearing and sight functional capacities [15];
- Need for support from others with greater ICT competencies [16] and
- Fear of technology's impact on them and their impact on technology [16, 17].

Practically this has the potential to causes many issues, including:

- Losing devices;
- Inability to use passwords or PINs;
- Difficulty with computer generated menu choices;
- Impaired control of capacitive touchscreen technology;
- Accessing Wi-Fi Internet;
- Need for repeated training on how to do things;
- In advanced stages of dementia, inability to initiate own activities;
- And, knowing how much support is needed for set up and maintenance of use (e.g. charging devices).

To make a fundamental point not made explicit above, these issues/factors are individual, and, can be expected to vary with progression of the dementia, which in turn follows an individual timeline.

Discussion

The above design considerations may lead the reader to conclude that commodity technology and software is unusable by people with degenerative cognitive impairment. Rather it illustrates the need to acknowledge that most technologies and associated services will only work for or benefit **some** people with cognitive impairment. This can make identifying the benefiting population and its size very difficult for entrepreneurs and innovators when seeking funding or adoption by potential

service suppliers. This is where the role of an intelligent agent – whether that is a human being or an artificial intelligent technology – providing facilitation, support and engaging in use/operation can broaden the population of beneficiaries. However the inclusion of an agent is not straightforward in delivering an affordable or effective solution. When it is a human being then this can bring high staff care costs, a need for training and ongoing technical support. For technological agents, research of solutions – such as domestic assistive robots – is largely still at a very early stage and raise in many cases ethical and safety issues; while also having training and support costs (although presumably for fewer people).

Conclusion

It is important that all health and social care digital system and services innovators rise to the challenges outlined above. Technological developments should enable solutions to be created/ identified. In the immediately foreseeable future most devices supporting life, health and wellbeing will require some form of interaction with the user. For example ubiquitous devices could offer the flexibility to have the currently individually appropriate interaction with the end user, including offering intelligent initiation of interaction and activities, and even for some, appropriate services that do not require the person to interact directly with them. The challenge, now and in the future, is to ensure that such technologies and services are acceptable, accessible and useable by people with cognitive impairment.

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Context Understanding for Medico-Social Assistance with an Interactive Robot

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Introduction

The aging population and the increase in chronic diseases stretch to increase care and health spending needs. According to INSEE [1], the medical population will decrease by 10% until 2019 before returning to its current level in 2030. New solutions must therefore be found to optimize resources and health expenditures, and improve prevention, care and monitoring of patients and vulnerable people throughout their course of social and professional life. Most current IT medical monitoring systems are based on technological platforms consisting of information systems (e.g. patient record management information systems) and connected objects (e.g. communicating medical devices). They aim to provide better professionals' coordination and prevent the degradation of patients' health condition.

However they lack of intelligence and interactivity to personalize the relationship with the patient.

The scope of this article hence generally addresses the technical feasibility of using an interactive "human-friendly" robot to perform intelligent medical monitoring of people. More precisely, we got interested here on the feasibility of making the robot able to find the appropriate situation for patient's completion of a symptoms' questionnaire. Indeed this is a common function for a number of cases where there is a need to monitor patients' symptoms at a distance (for example in the case of home chemotherapy).

In this paper we will first present our analysis of the existing robots that are tested or used with the elderly and/or sick people. Afterwards, we will describe our system of context understanding that aims to find the right time for completing a symptoms' questionnaire. Finally, the implementation of this system on the NAO robot and the main results will be exposed.

Robotic Systems for Medical Monitoring

Service robotics is one of the most growing businesses. It aims to help people in their daily lives and to provide basic services such as transport, cleanliness, safety, care and support. Indeed, the development of assistive

robotics is an emerging field that could help to bring this interactive dimension, smart and easy to access. These robots are designed to provide support services to daily life at home (reminder for taking medication, making meals, porterage, security ...) and / or have a role of companions to preserve the autonomy and quality of life at home. They may have humanoid or animal varied forms and are designed to interact with humans via various interfaces: touch, kinesthetic, sensory, emotional, cognitive and socio-behavioral. Some are even called emotional robots because they are likely to trigger positive emotions. These emotional or social robots, animaloid-form like the Paro robot [2], are opening interesting perspectives of multimodal management of people with cognitive dementias such as Alzheimer's disease. Indeed many studies indicate that the use of these robots as a means of communication can promote social interaction and soothe some behavioral disorders in these patients [3]. Other home care robots are more focused on social telepresence like the BEAM robot. (Note: Home health care robots, i.e. making clinical information available at the right time and the right place to reduce the risks of error, increase the safety and quality of care.)

However the detection of emotions includes universal emotions (happiness, surprise, anger, sadness and doubt) but not anxiety / stress, and generally do not combine physiological approaches. Moreover, robots are usually bulky and their visual appearance is sometimes a bit scary, and so no "human-friendly", even if left to the subjectivity of each observer. Moreover, the home deployment of these robots with human size such as Kompaï, poses major technical problems far from being solved [8]. Indeed, despite the promises offered by home care robots, over 40% of developments are stopped for lack of understanding of socio-technical factors. These factors are determining in the adoption of such robots. In [4] the authors find that intends of use depend on social

Fig. 1. Examples of assistive robots and virtual agents (left to right): NAO, Care-O-Bot, SAM, PR2, Twendy one, Giraff, Kompai, Asimo, Paro

influence, expected performance, confidence issues, privacy, and ethical concerns. Among the determinants, social influence is the strongest predictor. In addition, monitoring of vital signs, easy communication with family, and recall of medication are the most requested applications by respondent people (recruited in health service companies).

This state of the art shows that tele-monitoring robots on the market and under development have varying features and different aspects. Few of them are now connected to a sensors' environment.

Home monitoring features that help observance does not cover the understanding of several context dimensions to ask symptoms' questionnaires, which is one of the main preoccupation of professionals when patients are at home, and which is likely to allow better anticipating emergency situations.

Context Understanding

We then designed, developed and tested a system to understand the context in order to allow the robot to ask a questionnaire of symptoms to the patient every day. This task is most of the time annoying for the patient. Indeed, if the robot asks questions to the patient at any time of the day, it can quickly be perceived as intrusive and disturbing instead of motivating and entertaining the patient. To make it less painful and more fun, the robot should determine when the patient is willing to answer the questionnaire and send it to his doctor. In addition, each patient is different; the robot

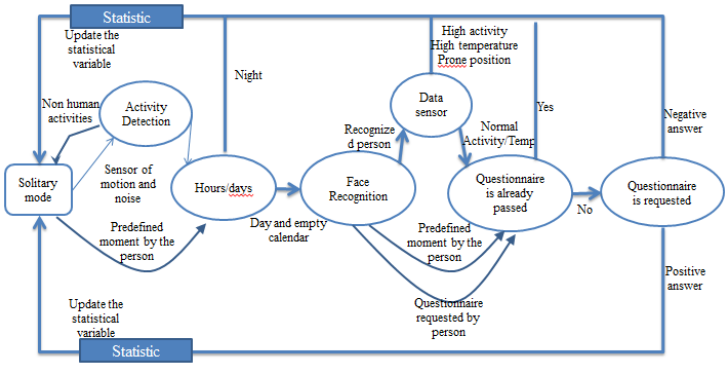

Fig. 2. State machine for context understanding

must be able to adapt its decision based on his experience with a particular patient, and to several parameters.

Here we have considered a context taking into account the data of an activity/temperature sensor (MOVISENS [5]) worn by a patient undergoing chemotherapy at home [6], but also parameters such as the presence of the patient near the robot, facial recognition, and time (calendar concept). The system was designed as a state machine as shown in Figure 2.

Each state of this machine is a robot feature that will be implemented in the comprehension of the context to ask the questionnaire.

The "Solitary mode" is the robot baseline mode. The robot is not in active listening but can detect movement activity to consume less battery. This is the initial state of our system.

Our system calls different features depending on the transitions described in Figure 2. Hence, the response time and the effectiveness of our system depends on the response times and efficiency of the different features.

Main Results

We have established an implementation choice on the robot NAO because it presents a "human-friendly" interface. To do so, we have improved the performance of various features used in the state machine designed to be able to be integrated into the robotic system. The implementation of our system was made within the robotics software of Aldebaran, called Choregraphe [7]. In this software we have designed and integrated the blocks corresponding to different features related to each other as described in the application's design of context understanding. An improvement of the effectiveness of each feature has been performed beforehand. The improvement was realized independently on each feature [9]. As an example of improvement, we have significantly increased the accuracy of facial recognition:

- Adding check of the variable representing the confidence level;
- Empowering of the learning repeated facial;
- Renewing the identifier of face.

In order to compare the system developed with the algorithms realizing the original features of the robotic system (first result) and our system implementing enhanced features for efficacy in the treatment (2), we calculated the average precision with two implementations (1) and (2). We observed a global average of system's precision (according to the equation below) of 76.8%, giving an improvement of 18.2%.

$$Precision = \frac{\sum_{i=1}^{i=N} Precision\ of\ feature\ (i)}{N}$$

Of course this system has allowed us to increase the efficiency of our system but we must elaborate further research to increase this ratio as our context requires a response time closer to the real-time with effectiveness convergent to 100%.

Conclusion

The subject of this article discusses a rich scientific research topic because it addresses several axes starting from IT to health through robotics. Given the promising results we have obtained in this article, we focus our future research on understanding the context while building on what happens in the semantic web.

Acknowledgment

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Empowering Seniors' Self Care at Home through Advanced Technology Apps: The Senior-TV Project

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Introduction

In the context of population aging, keeping as long as possible the seniors in their own family is highly beneficial for them if they are benefiting from a safe home environment and prompt help for their medical or daily living needs [1]. As documented by the American Association of Retired Persons – AARP [www.aarp.org], about 90% of seniors want to remain in their own homes as they age, even if 82% of them need day-to-day assistance. Delaying seniors' institutionalization is equally important for reducing the social burden in terms of health systems' efforts and costs [2]. However, these two goals are facing several critical challenges. Currently, the eldercare workforce is not large enough to meet older patients' needs, and it is estimated that by 2030, 3.5 million will be additionally needed [3]. Moreover, there is a change of the traditional informal care models. Women are more and more involved into the labor field and thus lesser available for accomplishing informal care giving tasks for the older members of the family. The same effect will have the current decrease in the birth rate in the context of the growth of elder segment in the overall population. Affordability matters, especially for seniors living alone, are another challenge for getting informal homecare services. Advanced technology-based apps evolve as an enabler for aging in place. They are able to equally empower seniors' self care at home, helping them to fulfill their daily living tasks, and keeping them in contact with needed stakeholders and socially

inserted. Moreover, advanced technology-based apps may support the development of the second, non-human, cost-saving ICT-based component of health-care systems [4].

The Senior-TV Project

The recently started EU-AAL funded Senior TV Project (November, 2015) is dealing with the empowerment of seniors to live as much as possible independent in their own homes. It aims at developing a widespread access, adaptable platform, installed on TV, STB, smartphones or tablets as main interfaces, able to provide seniors living in their own homes with a set of social and health services that may facilitate their self care, prevent physical and cognitive deterioration, improve their access to formal and informal caregiving services, and enhance their family and community insertion.

From a technical point of view, Linux based platforms (running on TV, STB, etc) with support for open standards like HTML5, JavaScript, CSS and XML will be the preferred operating systems of choice for the project, being the most widely adopted environment in which applications are consumed.

The core scientific, medico-social topic that Senior-TV approach lies on is “aging in place”, described by the Center for Disease as "the ability to live in one's own home and community safely, independently, and comfortably, regardless of age, income, or ability level” [5]. Other key notions are formal and informal care at home for the elders in need, community care, ontologies of elderly needs, of services to be provided, of carers and other stakeholders, decision on personalized and permanently updated Formal Intervention Plans (FIPs) for monitoring and helping the old person in need, etc.

The most efficient approach of all these topics for designing an useful and easy to use ICT-based app is to closely cooperate with voluntary end users, i.e. old people (over 65 years of age) living and cared in their homes, enrolled in accordance with well established inclusion/exclusion criteria, as well as with the ethical and legal provisions related to studies that involve human subjects (the informed consent form, personal data protection measures, exit strategy issues and the definition of ethical control instruments within the consortium and the three pilots involved in the project: Cyprus, Romania and Slovenia) [6].

At the beginning of the project, the envisaged methodology for accomplishing the project tasks involves the detection of end users’ needs and preferences related to their formal and informal care at home that can be offered by the Senior-TV prototype. In later stages of prototype’s

progressive development, the voluntary end users will provide their opinions and suggestions about the usability and usefulness of the versions alpha and beta of the prototype, in real life field trials. All these will be collected and analyzed grace to a unique approach within the three pilots, synthesized in the Pilot's Workbook. This workbook will include the testing protocols (questionnaires, interviews, diaries etc,) and the ethical and legal instruments adopted by the consortium.

As instruments for end users' feedback collection, analysis and extraction of indications for prototype further improvement, various standard methods will be adopted (e.g. MoSCoW prioritization method), as well as various Excel calculus preconfigured files tailored on the standard questionnaires (e.g. ASQ-PSSUQ) adapted to the needs of a given testing phase and of the overall project.

The project takes into account the cultural and administrative diversity of Southeast Europe, in terms of seniors' care systems.

Envisaged Impact of Senior-TV Project

The impact of Senior-TV project lies on the aimed enhancement of life quality and social insertion of seniors living alone at home, in urban or rural areas. Its aim also relates to the European and international initiatives and programmatic documents dealing with healthy and active ageing.

Senior-TV meets the requirements and actions promoted by The Strategic Implementation Plan of the European Innovation Partnership on Active and Healthy Aging, launched by the European Commission [7].

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All members of Senior TV consortium

Experimental Smart GSM Based Control System Acting As a Proposed Solution for South Africa Smart Home Deployments

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Introduction

According to [2], due to the increase of environmental concerns, lighting control systems will play an important role in the reduction of energy consumption of the lighting without impeding comfort goals. As mentioned in the IEA Annex 31, energy is the single most important parameter to consider when assessing the impacts of technical systems on the environment [2]. Energy related emissions are responsible for approximately 80% of air emissions and central to the most serious global environmental impacts and hazards, including climate change, acid deposition, smog and particulates [3]. Lighting is often the largest electrical load in offices, but the cost of lighting energy consumption remains low when compared to the personnel costs and energy saving potential is often neglected. An optimized energy supply environment has to be achieved if South Africa (SA) has to maintain reasonable pricing and universal access to energy for the majority of the population, as result the energy demand in South Africa has fast exceeding supply, leading to instances of load shedding and high costs implications. According to [8], the SA vision 2040 is a transformational journey that the Gauteng province is embarking on to create a Smart City in which the Citizens, and Businesses of Johannesburg, Pretoria can sustainably live, work and interact. Therefore, the "Smart Utility" concept is the cornerstone to deliver a Smart City [8]. Nowadays, the innovative technologies have become an integral part of human life.

According to [1], various load control method and technology such as power line carrier (PLC), telephone modem, Internet, Bluetooth, and ZigBee were established and developed to facilitate comfort for humans. In 2010, [6] introduced a control system of indoor intelligent Lighting which is based on power line carrier communication. The power line is used to transmit the analogue or digital signals with high speed. Not only power line technology but also wireless remote control and GSM network are used

to combine for remote the indoor intelligent lighting and controlling the sensing [7]. Architecture for power monitoring system using the wireless sensor network technology is proposed in 2011 [6]. [4], presented the modelling and simulation of electrical load control system using RF technology. The goal of the Internet of things (IoT), combines current network infrastructure technologies with wireless computing, voice recognition, internet capability and artificial intelligence in order to create an environment where the connectivity of devices is embedded in such a way that the connectivity is unobtrusive and always available. The content of this research work follows a simplified strategic planning process. It was conducted as a literature review which starts by introducing the current state of Smart Grid Deployment in African countries and South Africa, based on articles, and continues to research the existing literature in order to discover theories behind smart grid deployments.

Network Infrastructure/Architecture

The project approach for designing this system was to use Arduino microcontroller-based control module that receives its instructions and commands from a cellular phone over the GSM network by receiving a string in a form of a text message via an SMS message. Arduino is an Open Source computer hardware and software company, project and user community that designs and manufactures kits for building digital devices and interactive objects that can sense and control and the physical world [3]. The Arduino microcontroller it's a tool used for coding that will be for providing the means for the interaction between the devices (The Arduino microcontroller and the Arduino shield); this is filtered such that there should be a sort of an agreement on the commands being sent and the expected string to be received from the mobile operator (cell-phone). The coding also provides the means for telecommunication between the user and the specified requirement (control and monitoring system in this case). As reflected from Figure 1, is a GSM mobile communication networks infrastructure. The basic terminals for the GSM networks are on the BSS (This is a Base-Station System which- comprises of the base station controller and the base station controller which controls the incoming and the outgoing lines or subscriptions), the OSS (Operation and Support System- the functional entity from which the network operator monitors and controls the system). The last and important terminal on the GSM network is the SS (The Switching System- this on the GSM network and is responsible for the performing all the subscriber-related functioning-dial in's and out of the network).

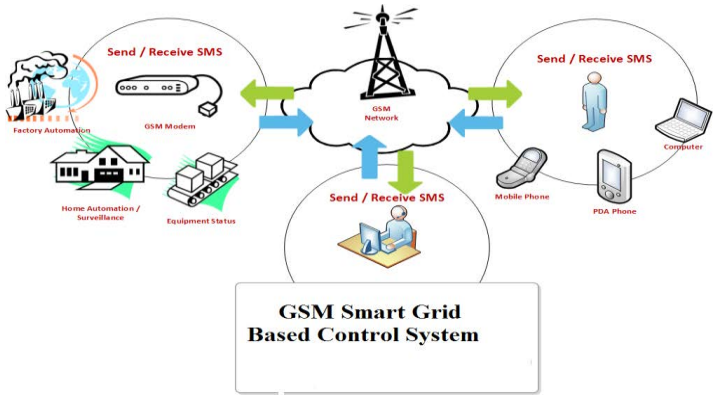

Figure 1: A GSM Mobile Communication Network Infrastructure [1]

Performance Requirements & Design Constraints

The support for effective communication on a GSM network is almost available on all available networks today as long as the subscriber from which is to be dialed from is active on the network. The GSM networks was established and found the most powerful and expanding digital telephone system. The proposed solution was designed to be using a voltage of about 5V, this brings to a point whereby there has to be a stepping down transformer to support a minimum voltage of the Arduino on the circuit. In addition, the aimed solution the project proposes for security implementation approach is that, the system uses a both hardware and software notification procedure or methods. This could include; reporting theft with reliable and quick notification or source assurance. The new technology of the SIM cards needs to be authenticated before the subscriber can be registered on their network. This can bring about a good security implementation since the received string of commands to be commanding the system can be traced and be picked up from the network. Table 1, illustrates a summary of components used with associated specification.

Table 1: Hardware and Software Specification Components

Software & Hardware Components	Specification
GSM modem/shield	GSM modem is a specialized type of modem which accepts a SIM card and operates over a subscription to a mobile operator.
Lights/ Bulbs	Acting as output, 150 W=0.150 Kw
MSC	This is responsible for performing all the telephony switching

	functions on the GSM network.
HLR	This is database used for storage and management of subscriptions.
AUC	This unit is a database comprises temporary information about the subscribers that is needed by the MSC in order to service the visiting subscribers.
Communication Link	To establish an effective communication link between the controller and PC for bidirectional data transfer.
Microsoft visual studio	For Graphical User Interface.
Embedded C	For Microcontroller Chip.
GSM SIM300 Module	Used for Wireless Communication.
Microcontroller C8051F350 & a PC	For Controlling Various Sensors.. PC for observation of controlling software

Research Methods and Tools

The content of this research work follows a simplified strategic planning process; it was conducted as a literature review. The information was gathered through literature assessment and this was conducted through the use of case studies like white papers, conference papers, journals and peer-reviewed articles with the aim of investigating and accepting various GSM methods and tools that are currently available.

Therefore an experimental scientific research approach with GSM Open Source tools were conducted and applied in the study in order to address the main research objectives. Evaluation and validation of the developed GSM system was conducted from the lab environment by following further tests and reviews. As showed in Figure 2, is a Flow Diagram of GSM controlling program. Firstly, the system initializes each module, and then turns off all electrical loads. Then, the microcontroller sends the command of AT + CMGD = 2 for clearing the second data storage space in the SIM card of GSM module. When the user sends the short messages to Wireless device, GSM module will send that command to the Arduino microcontroller. After that the microcontroller will turn on/off load according to the received command and show the current status on the Load Control Device (LCD) or output display. The microcontroller sends a command (such as AT+CMGS="+66868273639" and “SW1-ON SW2-ON SW3-OFF”) to the GSM module for informing the current status to the user.

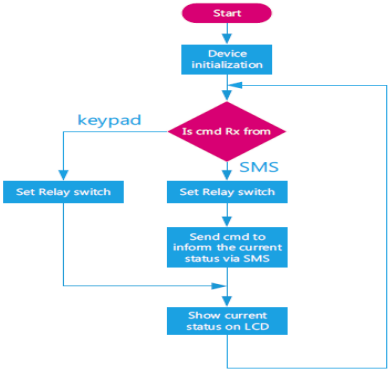

Figure 2: Flow diagram of GSM Controlling Program

Results

As reflected from Figure 3 & 4, illustrates a prototype of our solution. It demonstrates or shows the applications of the microcontroller being applied or used to design few of the systems that can solve real world problems.

Figure 3: Arduino Microcontroller and Arduino Shield

Figure 4: Prototype Tested on Operation

Conclusion and Future Work

The world indeed has become a global village and GSM based control system with new innovation and ideas can be generated that it can further

enhance its capabilities. The remote control and monitoring of several home appliances is a subject of growing interest in communication networking to provide such control. We have designed a control system which is based on the GSM technology that effectively allows control from a remote area to the desired location.

Acknowledgement

Thanks to Professor Mphahlele, Mr. Mapundu and Mr. Mnguni for their dedication and contribution.

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From User Needs and Requirements to Use Cases for ICT Services Addressed To Elderly with Cognitive Impairments

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Introduction

IN LIFE is a H2020 project, targeting to offer ICT based services, with the aim to lengthen the independent living for elderly with cognitive impairments, through ICT services that support all type of needed activities. Support is foreseen for their caregivers too. Currently knowledge and tested AAL services form the basis for IN LIFE to build its further developments.

The paper presents the methodology followed and its outcomes in order to identify the most urgent needs in autonomous living, socialization and mobility of older adults with cognitive impairments and match the IN LIFE project proposed tools and services to them through the extraction of relevant, cost-efficient and inclusive use cases (UCs). The methodology is based on review of related project results, articles and local workshops.

User Needs and Requirements

With the aim of gathering the users' needs, while not repeating previous research studies, the user needs assessment is initially based on the review of the results obtained in previous projects and publications. IN LIFE reviewed 14 previously funded EC projects. This review provides a relevant insight on user requirements and needs of elderly and carers, as gathered by following a User Centered Design approach within several projects in the same area. This information is valuable to specify systems requirements, and to adjust the intended services/UCs to these needs. The projects were different in their technical development and user sample number, but all shared the same end-user types and included relevant ICT developments. A template was developed with quantitative and qualitative areas to be filled out: the main objectives of each project, the actors involved, the instruments and procedures for gathering information and the variables assessed.

In addition, 24 publications were studied, giving insight on age-related problems which influence daily difficulties and ICT interaction, with emphasis on design challenges, technologies and technical requirements.

Finally, 6 local workshops were carried out. 193 participants (of which 67 carers) were enrolled in total in the workshops, to gather their user requirements and needs and to validate the systems presented to them. The mean age was 79.25 (SD=8.077) years old and as it was expected the sample was mainly composed of women (70%), according to the normal population distribution on ages over 65. 59% of the elderly live alone.

During the local workshops, 16 services related to the main technological support systems planned to be implemented in each country were presented.

Table 1: Summary of services presented at the workshops.

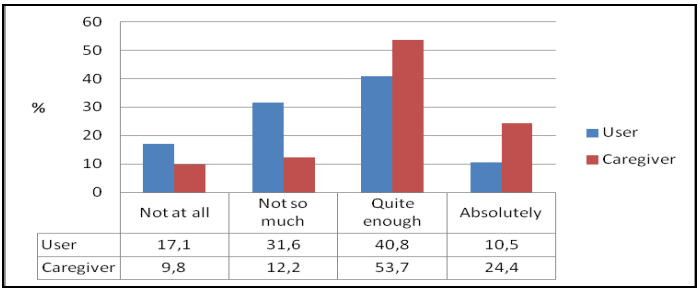
Country	Use cases presented
Spain	Transport support module; BOARD Daily Living Functions assistant
Sweden	Talking Mats; Conversation support app
UK	Games and social activity (LIM); Communication and socialization in daily life with films, pictures and music from past and historic events (CIRCA)
Slovenia	Security functions and eDoorman module; Fall detection and behavioural monitoring; Care giver monitoring& supervision tool; Care giver scheduling and reminding module
Netherlands	Activitiy monitoring; Web based exercising &health monitoring
Greece	Guardian Angel vital signs remote monitoring tool; Car driving ability assessment and enhancement; MLS Navigator with panic button; Brain games functionality.

Results

Summarising the results of projects and literature analysis, the most prevalent users' needs are related to social inclusion (contact with family members and health professionals), reminders, privacy and safety issues, leisure activities (gaming) & health monitoring. The needs that have been categorized as of high importance within those projects that covered them are: medicine reminders, social inclusion, contact with family members & emergencies. The mobile phone and PC are the most preferred ICT platforms by the elder users, followed by standalone systems and Interactive TV. Regarding the dialogue mode with these platforms, touching and speaking are the most preferred ones both for primary and secondary users.

Most of the workshop participants are not used to computers and tablets, nor for using it to access to internet. Yet the most used device is the mobile phone; however, 35.6% of the participants never used a mobile phone. The daily use of the internet by 89% of the participants that use internet daily in the whole sample, is a feature of the Sweden and UK groups. The foreseen

services perceived usability was relatively high, as stated by users (51,3%) and caregivers (78,1%). Most of the participants stated that they would use these services in the future, which is an indicator of motivation to use.



	Not at all	Not so much	Quite enough	Absolutely
User	17,1	31,6	40,8	10,5
Caregiver	9,8	12,2	53,7	24,4

Fig.1. Usability of the services presented.

User requirements

At the end, a final list of requirements was created according to the literature & projects review and the workshop information. Overall, 200 requirements were listed in the categories shown below:

Table 2: User requirements categories

1. MCI related to biological changes	**4. Design requirements**
1.1. Biological deficits (perceptual deficits, motor, cognition)	4.1. Fonts
1.2. Deficits in relation to the daily environment (at home, driving, etc.)	4.2. Sound and volume
2. General needs	4.3. Contrast and colour
2.1. The need for general and personalized information	**5. Specific interfaces**
2.2. The need for health monitoring and perceived safety	5.1. Videophone
3. System requirements to adapt to the users characteristics	5.2. Cognitive stimulation
3.1. General system requirements	5.3. Daily Management system
3.2. Societal requirements	5.4. GPS
3.3. Privacy concerns	5.5. Avatar
	6. Specific for advanced Dementia
	6.1. At home
	6.2. Bathroom
	6.3. Bedroom
	6.4. Kitchen

An extraction of the user requirements is given below, as example:

System requirements to adapt to the users characteristics: Societal requirements

- Services should be economically efficient and make life costs accesible;

- Reduced health and social care costs for the local communities;
- Increase ability of the formal caregivers to provide better quality care;
- Creation of new business opportunities;
- Influence on health and social care policies;
- The system should minimize the caregivers' overload, distress & anxiety;
- The system should facilitate social inclusion;
- The system should provide all info centrally (medical, transport, etc.).

All the results presented above are included in [1].

IN LIFE Use Cases

Based on a dedicated template, an intial set of UC descriptions was prepared by the partners that lead the development/adaptation of a specific module/system. The responsible partners then further specified and optimised the UCs relevant to their module/system, after reviewing the literature review, the projects and workshops results. The UCs cover the 4 main areas of IN LIFE innovative developments: travel support, independent living support, socialization and carers support. The UCs cover all types of care for the elderly, i.e. living at home, hospital, elderly home.

In total 47 detailed UCs were derived. Each UC description encloses a level of prioritization. 41 are seen as 'essential', 4 as 'secondary' and 2 as 'supportive'. This means that the 41 essential use cases are to be tested at the project pilots, while the rest will be tested only if there are available resources (in terms of time and cost). Each UC contributor undertook to match the key findings from the user needs/literature surve.

Conclusion

The final use cases reassure the initial project plans, detail the intended developments in a UCD fashion and provide a strong link to the user/carer community at the site. Several requirements were gathered through three different procedures: literature review, analysis of projects carried out within the expertise of the consortium and 6 local workshops with representative users. Integrative methodologies were used with the aim of generating a comprehensive list of user requirements that guides the technological adaptation of the systems, without ignoring the need of modularity and making the multilevel requirements, needs and technological challenges homogeneous for a pragmatic approach.

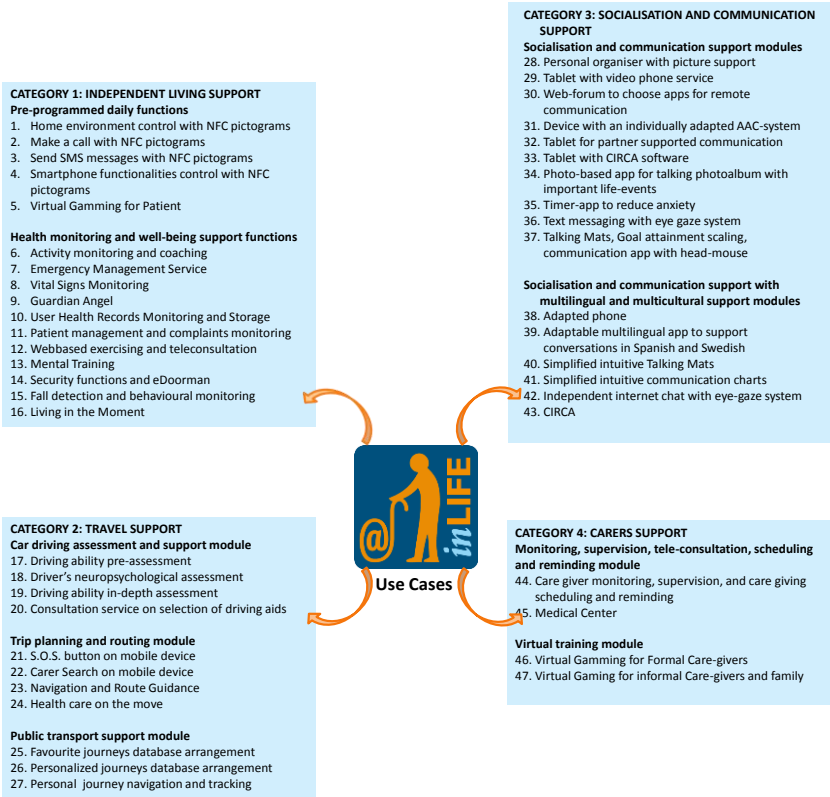


Fig. 2. IN LIFE Use Cases.

The finaly developed use cases reassure the initial project plans, detail the intended developments and provide a strong link to the user/carer community at the sites; whom the consortium wishes to engage as "Results owner", in a UCD fashion. By allowing the users to identify their needs and wants in the final use cases description, they are much more motivated to actually contribute in their realisation and use.

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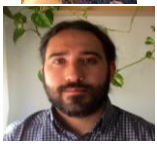

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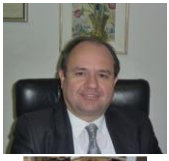

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Implementing a Telecardiology Strategy in a Geriatric Institution in Pelotas – Brazil

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Introduction

In 2010, there were perhaps 524 million people over the age of 65 in the world, whereas in 2050 that number will be over 1,5 billion. Interestingly, most of that increase will happen in the developing world [1]. As life expectancy has grown exponentially, worrying governments and health service providers, that demands adapting to a different scenario that includes new standards of both infrastructure and specialized health service delivery, allowing the elderly population to live actively increase. Due to the biological characteristics of aging, chronic diseases become more frequent in this population, requiring preventive strategies and early treatment. In this context, cardiovascular diseases deserve special attention as they represent the leading cause of death. Currently, there are an increasing number of institutionalized elderly people to whom telemedicine and eHealth technologies represent a viable and inexpensive option towards providing specialized and personalized services.

Telemedicine is the provision of health care services using information and communication technology, in situations where the health care professional and the patient, or two health care professionals, are not in the same location [2]. According to the World Health Organization, telemedicine is defined as "the delivery of health care services, where distance is a critical factor, by all health care professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities" [3]. Among the vast range of medical disciplines in which telemedicine is applied, cardiology is one of the fields with the largest experience and one of the most developed. Based on that, tele-cardiology presents as an important tool to support the health care of a geriatric population.

Objectives

Implementing a Telecardiology Strategy - through tele-ECG and specialized second opinion – for the monitoring and identification of potential cardiovascular diseases in institutionalized elderly people.

Methods

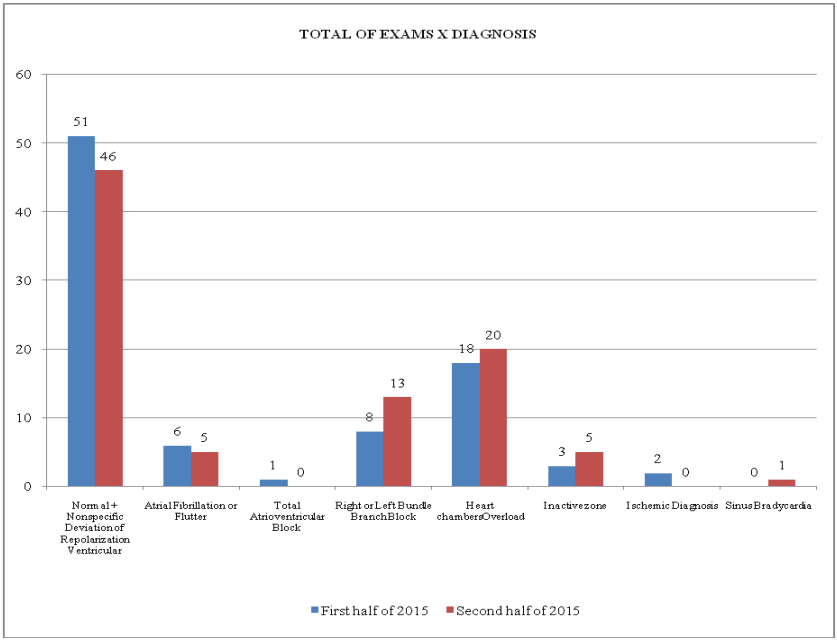
The project was implemented at the AMP, a century-old geriatric institution, headquartered in the downtown area of the city of Pelotas. Currently it serves as a geriatric home to 90 elderly people, with a maximum capacity of 110. The responsibility of designing and technically establishing at the Beggars Asylum of Pelotas (AMP) was of the e-Health team of the Instituto de Cardiologia doRio Grande do Sul (IC/FUC) together with the AGM e-Health Company (Brazil) and the nursing staff of the AMP. The project is funded by a donation received from a private tractors company headquartered in Brazil.

The digital ECGs are locally recorded and transmitted for remote cardiological interpretation. The analysis of exams is done by four cardiologists via Android® equipped smartphones, also available through tablets and conventional computers. All patients go through an ECG examination on admission and the exams are repeated every 6 months or whenever needed upon medical request. Also, all those whose ECGs showed evidence of disease in the initial report, are repeated more frequently aiming to improve the clinical follow-up.

Results

The average age of the elderly residents of the AMP is 80 years. The most frequent ECG diagnosis observed in the first half of 2015 were: 57.3% (51) of ECG tests showed normal diagnosis or nonspecific deviation of ventricular repolarization; 20.2% (18) heart chamber overload; 9% (8) right or left bundle branch blocks; 6.7% (6) atrial fibrillation or flutter; 2.2% (2) with evidence of ischemic diagnosis. After 6 months all ECGs were repeated and the second round of analysis showed small differences when compared to the exams recorded at admission, namely: 52.2% (46) of ECG exams showed normal diagnosis or nonspecific deviation of ventricular repolarization; 21.6% (20) heart chamber overload, 13,6% (13) left or right bundle branch blocks; 5.7% (5) atrial fibrillation or flutter (Figure 1).

Figure 1 – Graphic showing the distribution of exams x diagnosis



Discussion

Healthcare assistance of elderly people represents a major challenge, a reality for both institutionalized and ambulatory ones. Among old patients, 92% have at least one chronic disease and 77% suffer from at least two [4]. In other words, it means that there has been a huge increase in older people who are always sick rather than intermittently ill [1]. Nowadays, telemedicine and eHealth strategies are recognized as important tools to improve the assistance and general care of patients, either at home or in nursing home settings. A literature review of evidence for telemedicine in chronic disease was reported by Bashshur et al [5]. Telemedicine support may accelerate the diagnostic workup and allow the early identification of cardiovascular diseases in a broad range of conditions [6]. Sending the ECG images via a multimedia message service has been suggested to be a practical and inexpensive tele-cardiology procedure [7].

The implementation of a tele-cardiology strategy – through a mobile tele-ECG platform – at the AMP, in the city of Pelotas, began in January 2015 aiming to optimize the health assistance locally. As part of the protocol, it was suggested that patients with evidence of disease identified during the

first round of recorded ECGs should have an appointment a clinical cardiologist. Among the most frequent diagnosis, the presence of atrial fibrillation, a common cardiac rhythm disturbance that increases in prevalence with advancing age, deserves special attention. Data from the literature shows that more than one third of patients with atrial fibrillation are eighty years old or more [8]. This cardiac rhythm disturbance is in close relation to chronic diseases, meaning to be statistically associated with five-fold increased risk of stroke [9], three-fold risk of heart failure and two-fold risk of dementia [10].

Tele-ECG Room

During the pre-clinical phase of cardiac arrhythmic diseases, telemedicine screening may detect cases of asymptomatic atrial fibrillation [11]. Atrial fibrillation with symptoms other than palpitations is a common finding in elderly patients.

Telemedicine support, therefore, improves the atrial fibrillation diagnosis sensitivity in such patients and may be useful towards at-home identification of subjects with atypical presentation [12, 13]. At present, aiming at minimizing the potential risks caused by atrial fibrillation, an anticoagulation strategy based on the recommendation of standard guidelines has been proposed [10], including the remote monitoring of the selected patients.

Conclusion

Numerous care models can be applied to geriatric institutions aiming to qualify patients' general assistance, and, at the same time, provide additional tools and support to healthcare professionals on duty. In that sense, the tele-cardiology network implemented in a Brazilian geriatric institution represents a step forward. As part of a global eHealth assistance, both tele-dermatology and tele-diabetes are under implementation at the AMP.

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Measuring the Impact of ICT for People Living with Cognitive Impairment

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Introduction

The prevalence of dementia is rapidly increasing with age and usually starts with memory and cognitive complaints. Most elderly people with cognitive impairments want to live independently for as long as possible [1]. Improving the health and well-being of older people should be a health, social and political priority. New technologies can support living independently at home and overcome any related problems occurring on a daily basis and are related to significant activities of daily life [2]. ICT explosion the last few decades has created a field of assistive and care technologies to increase and maintain the independence of various patient groups.

Many usability and user experience studies have been carried out focusing on the potential of these technologies to improve independence, cognitive functioning or healthcare provision. Most of the times, these efforts focus on either the system (i.e. improving the system and identifying usability faults) or the person in controlled or semi-controlled situations and testing sessions and usually focus only on one area (e.g. Quality of Life (QoL), user experience, healthcare costs of one system or application).

The real-life pilots within the European IN LIFE project (http://www.inlife-project.eu/) aim to fill in this existing gap by investigating and measuring the effect the use of one or many ICT technologies can have on diverse domains of their lives (e.g. safety, health, transportation, communication, fun, etc.).

The IN LIFE platform and the integrated services and applications (Table 1) will be tested in 6 Europe-wide pilots in Greece, Netherlands, Slovenia, Spain, Sweden, and UK, with over 1200 elderly with cognitive impairments, 600 formal and informal caregivers, and 60 other stakeholders.

Objectives

The aim is to assist people with cognitive impairment in different living arrangements and measure the impact of using the INLIFE platform to their lives regardless of user group membership. The Gestalt notion holds true in the case of IN LIFE platform, the use of each services/tools is not the same as accessing and using the whole IN LIFE platform (i.e. the whole is greater than its parts). Certain objectives fall under the main aim and are as follows:

- Measure user experience and usability related measures;
- Continuously gather and analyze data from all relevant sources (i.e. user, service, system);
- Measure the impact of these services and of the IN LIFE platform has in their daily lives;
- Increase in QoL because of using the IN LIFE system and services;
- Create a large with standardized or easily comparable data and metadata for external researchers to replicate and use.

The services

The interoperable services that will be integrated into an open, cloud-based, reference architecture on the IN LIFE platforms and will be evaluated during the long-term pilots are shown in the table below.

Table 1. Categorization of services

Category	Services
Independent living support	Daily function assistant
	Activity monitoring and coaching
	Mental training
	eDoorman
	Fall detection and behavioural monitoring
	Leisure support
	Guardian angel
	Physical activity monitoring
	Language Behavioural Prediction Test
Travel support module	Car driving ability assessment and enhancement
	Trip planning and routing support
	Public transport support
Socialization and communication support module	Socialization and communication support
	Multilingual & multi-culture support
	Care giver scheduling and reminding

The IN LIFE Evaluation Framework

An evaluation framework is developed for a long-term evaluation of using ICT solutions targeting daily activities (performing daily activities at home, travelling, cognitive exercises, communication with others, etc.). The evaluation framework will define the primary and secondary dimensions of the evaluation process. It needs to be robust-but still permissive for corrections- and anticipate any evaluation-related risks. Therefore it presents the foundation on which the pilot plans will be based on. The dimensions are the following:

- The actual users' interaction with the apps/services and the system;
- Longitudinal and real life testing with large sample sizes;
- Continuity and complexity of real-life observations;
- The benefits and added value (value propositions) for the users and the health care system;
- Diversity of apps and tools.

The Pilot Plans

The pilots are divided into two phases (conditions): a) the Baseline condition (8 months) and b) the Treatment condition (6 months) (Figure 1).

During the first 8 months of the pilots, the current experiences and daily activities of the participants will be captured as they are without the influence of the IN LIFE project. However, if participants are currently using any services, then they will also use them during the baseline condition.

Participants

As participants we call the representatives of addressed user groups: a) people with mild cognitive impairment (MCI), b) people diagnosed with early or later stages of dementia, and) users with cognitive impairment and co-morbid conditions.

Methods

This is a large scale longitudinal study in 6 European pilot sites (Greece, Slovenia, Spain, The Netherlands, and UK) and two conditions lasting 14 months. The longitudinal study is based on the idea to compare the everyday living experiences of people with cognitive impairment with and without the IN LIFE system.

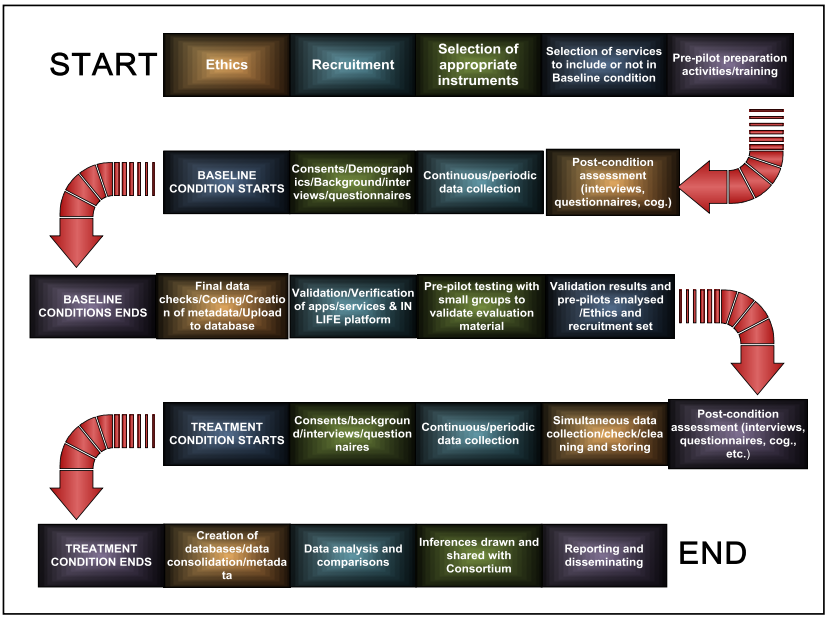

Fig. 1. The pilots' execution steps

Cognitive functioning will be monitored at the beginning and ending of each condition to ensure appropriate assessment is carried out by a trained specialist with the diagnostic instruments used. Further cognitive assessment will be carried out within the framework of the pilots' conduction to enable creation of categories (i.e. clustering of users) but it is important to clarify that the classification of participants to the addressed user groups will be performed by an affiliated clinician and not by the evaluation teams (except from the cases when there is such clinician in the team). Therefore, the same participant will be clinically assessed four times during the lifetime of the project and, when feasible, the clinical assessment will be carried out during their scheduled follow-up visits.

Conclusion

This large scale conduction at different European sites is an excellent opportunity to actually measure the use and added value of personalized ICT services. Continuous data gathering for long time and large samples aims to counterbalance the possible effect of other extraneous variables, such as changes because of lifestyle adjustments, deterioration of condition, temporary/chronic health problems, psychological and financial issues and

loss. The highly sustainable ubiquity in every day assistive technologies and the emerging highly sophisticated technologies to support Internet of Things (IoT) into everyday life is a reality and this large study will act not only for filling the gap in current research about adherence and true value but also will estimate the potential of large IoT studies to these populations and the requirements to be filled for such an endeavor to prove feasible.

Acknowledgments

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Non-Contact Sensing of Vital Signs, Physiological Perspective on Current Research and Future Research Directions

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Abstract: ***N*on-contact, usable and a single sensor with multi parameter vital sign monitoring can improve tele-health in an affordable and sustainable way.**

Introduction

Usable and clinical grade vital sign monitoring is corner stone of telemedicine. Emergence of wearable and non-contact sensing is a good development in this step. IEEE SAI (sensor acceptance index) is too an important direction in this regard [1]. If vital sign sensing can be non-intrusive as well comprehensive (multiple parameters) and integrated, this will be a great boon for telemedicine. Research on wearable is well documented as well the need for non-intrusive sensing; however there aren't much work on non-contact sensing. Focus of this paper is hence in non-contact sensing.

Non-Contact Vital Sign Monitoring

Some of currently available methods for non-contact vital sign monitoring are infra-red (IR) video [2], Doppler radar sensor [3], ultrasound [4] laser Doppler [5] thermal imaging [6] and video camera [7-9]. As number of smart phones are more than world population [10], camera based methods are more practical and feasible for continuous unobtrusive monitoring of vital signs.

Camera Based Vital Sign Monitoring

PPG is a non-invasive technique which detect the blood volume changes in a blood vessel, during cardiac cycle using the principle of wavelength-dependent variation in light absorption coefficient for different tissues [11, 12]. By recording video of face with webcam, the red, green and blue (RGB) color sensor picks up a mixture of reflected signals. Different parameters

which can be detected using PPG technology are heart rate, respiratory rate, arterial blood oxygen saturation, blood pressure, cardiac output [11, 13], heart rate variability [7, 13] and temperature [14] (Fig. 1).

Non-Contact Vital Sign Monitoring with Remote PPG

A. Heart Rate

Green band in the red, green and blue (RGB) color sensor gives the strongest cardiac pulse signal due to high absorption by hemoglobin in green range. Heart rate detected from the video signal was accurate compared to ECG, the standard method [13]. But heart rate is affected by movement, face resolution, region of interest, duration of analysis and the distance and angle between illumination source and the camera [15, 16].

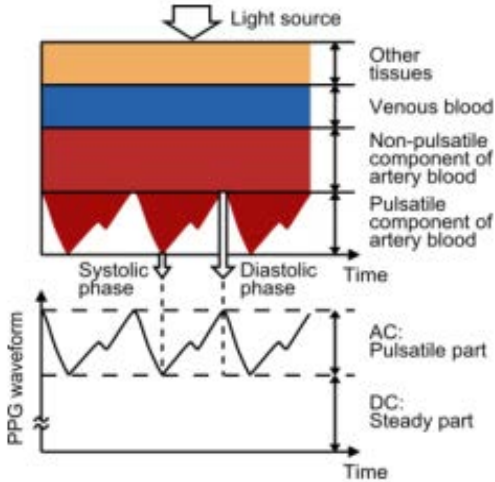

Fig. 1 Wearable photoplethysmographic sensors-past & present. Electronics, Tamura et al., 2014

B. Heart Rate Variability

Heart rate variability (HRV) is estimated from blood volume pulse obtained by webcam [7, 13]. HRV detected from an ECG and the mobile phone camera was shown to agree favorably [13]. Challenges stay with motion artefact and ECG is much better in ambulatory setting [17].

C. Respiration Rate

Respiratory rate can be derived from pulse wave width, respiratory induced variation (amplitude, intensity and frequency) in PPG signal [18]. RR derived from PPG strongly correlates with standard reference sensor under controlled settings but affected by movement [19]. Physiological variations such as vasoconstriction, coughing, a deep gasp or yawn also affect the PPG signal [20]. Estimation of respiratory rates by camera

becomes increasingly challenging at respiratory rates higher than 20 breaths/min [21].

D. Oxygen Saturation

Blood oxygen saturation (SpO2) detected by non-contact method (reflectance spectrometry) [22] is consistent and comparable with the data obtained from a traditional blood volume pulse (BVP). Motion artifact [13], calibration, angle changes caused by subject motion, as well as changes in the spectrum of the incident illumination, region of interest chosen and different subjects are challenges in this method [9, 22].

E. Blood Pressure

Smart phone camera can record blood pressure (BP) with an accuracy of 95- 100% [23]. BP can also be recorded from pulse transition time (PTT) but along with PPG it also needs ECG recording [24]. Vasomotor tone and pre-ejection period are the confounding factors in measurement of BP from pulse transit time [25]. Studies have shown that maximum error between the cuff method and the cuff less method was 14 mmHg and systolic blood pressure was measured more accurately than diastolic blood pressure [24].

F. Temperature

With infrared thermographic imaging (IRTI) skin temperature behavior in general can be recorded [26]. The correlation of IRT temperatures with the core temperature was significant but weak ($r<0.45$). Gender, age, and distance of measurement influenced the accuracy of IRT temperature [27].

Conclusion

There is a strong correlation between these parameters derived from camera recordings and standard reference sensors under controlled settings e.g. subject sitting still with ambient light in front of camera. However, these parameters are limited in accuracy and usability. E.g. these signals are affected by motion, illumination, surrounding environment, ROI dimensions etc. [15, 17-18]. In addition, a lot of work is done regarding heart rate and respiratory rate but more studies are needed on oxygen saturation, blood pressure and temperature estimation.

Implementing a simple camera, is feasible to measure multiple physiological parameters. Camera based vital sign monitoring technology can be a solution towards easy and affordable health monitoring tool for population, despite of its limitations.

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Offering Personalized Cloud-Based ICT Solutions to Elderly with Cognitive Impairments

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Introduction

ICT solutions have proved to be very important for the independent living of elderly people with cognitive disabilities. However, a major challenge is in providing a holistic service that can address all aspects of a person's life and the challenges posed by cognitive impairments.

This paper presents the conceptual architecture of a cloud platform that is being developed in the context of the IN LIFE H2020 EU project and aims at supporting the independent living of seniors with cognitive impairments through interoperable, open, personalised and seamless ICT solutions. This platform is based on the OSGi modular architecture and its main goal is twofold: on the one hand to allow service providers to easily register and integrate their products into the IN LIFE platform, and on the other hand to enable easy, transparent, personalised and contextualised access to all the supported services to the elderly cognitive impaired end-users and their caregivers.

Related Work

A considerable number of EU-funded Ambient Assisted Living (AAL) projects have launched in the past few years. In the vast majority of them, non-cloud based architectures are adopted for the deployment of the proposed solutions. Some projects focus on the establishment of reference architecture for AAL systems, such as universAAL **Error! Reference source not found.**, which provides also runtime support for software components and services on different types of hardware devices, typically used in AAL environments. Moreover, the OASIS FP7 project **Error! Reference source not found.** introduced semantically-enabled reference architecture for seamless integration of external web services and interconnected devices followed also by the REMOTE AAL project **Error! Reference source not found.**. SOPRANO **Error! Reference source not found.** also introduced an ontology-centered platform for offering affordable AAL solutions.

Cloud computing features have been also utilized by some AAL projects. DOMEO **Error! Reference source not found.**, for instance, used integrated cloud services for tele-presence. GoldUI **Error! Reference source not found.** maintains a cloud-based secure user profile managed by a trusted relative or carer. A service-oriented software architecture to supply network services with cloud computing modalities was introduced by SOCIALIZE **Error! Reference source not found.**. iWalkActive **Error! Reference source not found.** provides navigation cloud services for people with walking disabilities. However, none of the aforementioned projects is entirely based on a cloud-based architecture for the provision of various types of AAL services.

The present paper goes one step beyond the state of the art by presenting the conceptual architecture of a cloud platform for AAL services delivery, which is based on existing reference architectures (such as the ones provided by universAAL and OASIS) and extends them further by introducing advanced functionalities for easier service registration/integration, and transparent, personalised and contextualised access to all the supported services.

The IN LIFE Framework

IN LIFE is setting up a cloud infrastructure for AAL services delivery towards supporting elderly people with cognitive impairments in a variety of indoor and outdoor activities by also providing help and instructions to caregivers. Moreover, it enables service providers to easily integrate their products in the IN LIFE framework, and offers easy, transparent, personalised and contextualised access to all the supported services through an application centre. The so-called *Application Centre* is the main interface through which an end-user can interact with the IN LIFE system. It communicates with the IN LIFE OSGi-based framework, the heart of the whole system, which is deployed in a central server, as presented in ***Fig. 1***. This enables the *Application Centre* to have access to all the supported AAL services and also to the semantic information stored in the IN LIFE ontologies. Through its web interface, it enables registration of users with different roles (i.e. elderly with cognitive impairments, caregivers, service providers) to the IN LIFE platform. During registration, a user profile is created and stored in the so-called *User Ontology*. The semantic definition of users is based on the modeling approach of the ACCESSIBLE project **Error! Reference source not found.** that follows the International Classification of Functioning, Disability and Health (ICF) **Error! Reference source not found.**, as well as on the *Profiling Ontology* of universAAL **Error! Reference source not found.**.

The *Application Centre* enables also service providers to register and easily describe their products (***Fig. 2***a). The corresponding information is stored in a semantic manner within the so-called *Service Ontology* following the OWL-S standard **Error! Reference source not found.**. A sample OSGi application *(https://github.com/InLifecerthiti/InLife-sample-application)* then can guide service providers towards the actual integration of their services into the IN LIFE platform.

Towards selecting the most proper set of services to be called based on user characteristics, current activity and current health status, semantic matchmaking is applied on: a) the user profile retrieved from the *User Ontology*, b) data retrieved from the *Sensor Ontology* coming from sensors connected to the IN LIFE unobtrusive monitoring services, and c) services' specifications and usage statistics retrieved from the *Service Ontology*. The main goal of matchmaking is to propose services to the end-users through the *Application Centre* (***Fig. 2***b), based on their role, status and context of use, and also to identify and resolve problematic cases by automatically selecting the most proper set of services to be called in a single or combined manner (service composition). For instance, if an elderly user has fallen while being outside, the matchmaking process will trigger the immediate automatic notification of the corresponding caregivers through SMS by providing also the position of the elderly. In this case, the following three services offered by different providers are used in a combined manner: a) a service for identifying if user has fallen, b) a service for identifying user's position, and c) a service for sending SMS messages.

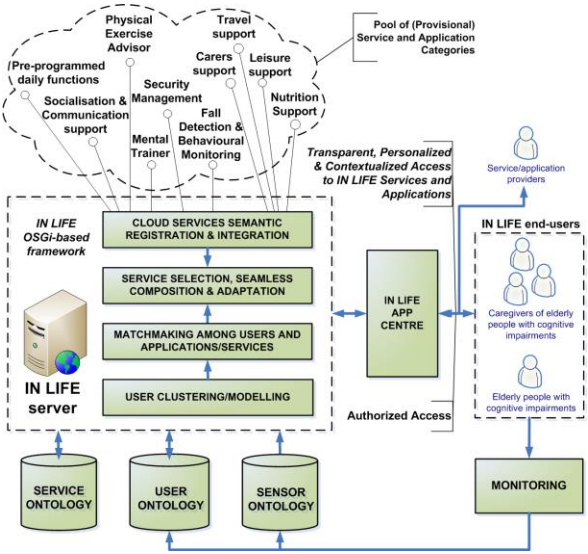

Fig. 1. IN LIFE conceptual architecture

(a) Registering an AAL service (b) Using the supported services

Fig. 2 IN LIFE Application Centre

Through the IN LIFE *Application Centre*, assisted people have access to all the supported services (***Fig. 2***b) and can also connect with preferred caregivers. On the other hand, caregivers can manage their scheduled tasks (e.g. visits to assisted elderly), and also monitor the health status and service usage statistics of connected assisted persons.

Conclusions and Future Work

In the present paper, the conceptual architecture of the IN LIFE cloud platform was briefly presented. A first version of the *Application Centre* has been already implemented and special focus is currently given in the registration of all the supported AAL services through the *Application Centre* as well as their actual integration into the IN LIFE platform. Future work will include the analysis of statistical approaches towards implementing a hybrid matchmaker that will be based not only on semantic rules but also on statistical data. Moreover, as the project evolves, further refinements in the structure of the ontologies may be needed.

Acknowledgment

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Reliable Information on Accessibility-Related Standards: IN LIFE Contribution to Facilitate the Application of Standards

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Introduction

Given the fact that a) all EU Member States have signed the United Nations Convention on the Rights of Persons with Disabilities (CRPD), b) the EU concluded the CRPD on 22 January 2011 in its capacity as a regional integration organization, and c) several EU Directives and national laws have been formulated to implement the CRPD in 2016, the standards to which these laws frequently refer in fact become part of the law. Therefore, knowledge about accessibility-related standards is important for organizations and individuals developing devices and pertinent software (incl. apps and web services), or rendering services to PwD.

Not least due to a number of R&D-projects carried out in FP 7 of the EU, standards securing technical interoperability (IOp) for the establishment of and cooperation among the infrastructure(s) of institutions rendering services in the field of accessibility, have led to fairly mature and stable infrastructures. These developed incrementally out of a series of EU projects, whose last one was universAAL (UNIVERsal open platform and reference Specification for Ambient Assisted Living). Therefore, the infrastructure of the EU-Project "IN LIFE" (INdependent LIving support Functions for the Elderly) is building up on the above-mentioned results.

The solutions recommended by universAAL refer first of all to pertinent standards in the fields of the general ICT (information and communication technologies) and medical informatics or health informatics. However, technical IOp is only one of several facets of interoperability which may include protocol IOp, service IOp, application IOp, user perceived IOp (according to ETSI) or technical IOp, organizational IOp and semantic IOp (according to conventional views).

Semantic IOp focuses on written (and maybe also spoken) texts, but the communication with or among persons with disabilities (PwD) comprises information in different modalities beyond written and spoken language. So there is also a gap here in standardization with respect to methodology

standards (focusing on principles and methods) and content standards (for the communication with or among PwD as well as between PwD and their care givers, on the one hand, and the supporting ICT tools, on the other hand) – not to mention among those ICT tools.

As most standards concerned with eAccessibility&eInclusion are focusing on technical or medical aspects of accessibility, not on the human communication aspects (comprising inter-human communication and human-machine communication), stakeholders, such as care givers for a PwD, service institutions for PwD, ICT developers for pertinent tools and systems, public administration specifying tenders including eAccessibility aspects, would find it extremely difficult to identify the most relevant standards for the intended purpose among hundreds.

This contribution concentrates on providing and analyzing information on:

- State of the art of standards concerning eAccessibility eInclusion;
- Need for transparency concerning pertinent standards;
- Proposal for a system to evaluate standards dynamically.

State of the Art of Standards Concerning eAccessibility&eInclusion

So far the EU-Project IN LIFE revealed that the access to information on standards related to accessibility in general is not easy at all. Many standards relating to general ICT and medical informatics of health informatics also have a bearing on accessibility, especially if they are needed to develop larger technical infrastructures. IN LIFE identified more than 400 standards concerning eAccessibility&eInclusion on aspects such as human factors (HF), design for all (DfA) or universal design, and ambient assisted living (AAL).

This means that particularly organizations/institutions providing care services and developers of pertinent ICT support tools and services are at a loss when it comes to finding specific information about standards for their target group(s).

The IN LIFE “Standardization Plan” (SP) has the overall aim:

- To investigate pertinent existing standards and ongoing standardization activities,
- To identify gaps, where support for ongoing standardization activities would be useful, or
- To initiate new standardization activities, if necessary.

While compiling a database with information on pertinent standards it was found that they are partially overlapping, contain many outdated or even withdrawn standards, and do not provide enough information of the standards to be really useful to potential users. Furthermore, standards are

subject to systematic/periodic review – for instance every 5 years in ISO – when it is decided, whether they are confirmed, revised or withdrawn. Thus about 40% of the entries taken from various sources required revision.

In addition, the categories chosen for grouping standards depend on the main objective of the respective compilation and, therefore, are not comparable. Usually only one category is assigned, although many standards cover several categories. Besides, its limited granularity makes it difficult to compare standards and find out, whether they are useful for a given purpose. Thus, the existing categorization needs redesign.

Need for Transparency Concerning Pertinent Standards

The existence of several hundred standards at international level in a comparatively 'narrow' field, such as eAccessibility&eInclusion indicates that there may be a need for more transparency in order to facilitate the use of these standards. Just the difficulty to find information on such standards can be a risk factor and is not helpful in terms of sustainability.

Risks

In IN LIFE deliverable D9.1 it is clearly described to what extent standards are – or may become – legally relevant. Thus insufficient knowledge about pertinent standards (e.g. due to difficulties to find reliable information) is a risk factor. As such, it needs to be considered in the risk management of stakeholder institutions/organizations.

Sustainability

It is increasingly recognized that the investment in terms of public funding or private efforts for the caring of PwD is already quite high and will increase parallel to the ageing of society bringing forth more PwD, and increasingly also persons with multiple disabilities. Therefore, concerns about sustainability are going to grow. It is widely accepted that standards are also an important factor for securing sustainability which in connection with the caring of PwD among others can refer to:

- Affordability of services and tools for individual PwD and their care givers;
- Investment security with respect to the establishment of systems and services for organizations/institutions providing services to PwD and their care givers;
- Investment security with respect to companies developing ICT support tools or services;
- Worthwhile investment by public administration in establishing or reforming their institutions or systems for the caring of PwD.

Alignment of strategic management standards

Last but not least, eAccessibility&eInclusion is also an issue in corporate social responsibility (CSR), another aspect of strategic management. ISO recognized the need for harmonizing or aligning standards on management systems by providing identical structure, text and common terms and definitions for future standardised management systems. This will ensure consistency among such standards and make integrated use simpler, as well as make them easier to read and, in so doing, be better understood by users.

Non-conformance to standards

Efforts for such a harmonization or alignment of standards are probably also necessary in the field of eAccessibility&eInclusion. In any case, neglecting standards related to eAccessibility&eInclusion could potentially become a problem under several strategic management aspects. Wrong decisions can damage the reputation of an organization/institution, or even end up in liability cases. Therefore, the availability of reliable information on pertinent standards decreases the risk to run into such problems.

Proposal for a System to Evaluate Standards Dynamically

The database developed so far is a useful result for the project, but data would become outdated already in a few months, as standards are subject to periodic reviews and revisions, or may be withdrawn, if considered obsolete. Therefore, a continuous updating mechanism would be desirable.

A more detailed indexing of the content of standards would be desirable. There are examples, such as Standards Map (http://www.standardsmap.org/) providing information on over 170 standards, that make standards, codes of conduct, audit protocols addressing sustainability hotspots in global supply chains comparable and indicating their usefulness for certain purposes.

Such efforts need constant funding. An alternative would be to design a system for active user participation which would allow users among others

- To share and compare information on individual standards and related other regulatory documents and evaluate them in a participatory, user-driven way;
- To formulate recommendations for using, extending, revising, withdrawing and merging standards;
- To provide weighted keywords on the content of individual standards and vote on proposed keywords.

Adapting crowd sourcing to the information on and evaluation of standards would not only result in easily available and more reliable information on standards, but also allow to compare the content and usefulness of standards for given purposes, thus reducing risks or other problems and fostering the awareness of the value of standards in general.

Outlook

The world of standardization today is highly complex with many competing or cooperating stakeholders. Joint efforts to make the IN LIFE database of information on standards in the field of eAccessibility& eInclusion accessible and sustainable may be a good basis not only for improving access to standards, but also for harmonizing or aligning pertinent regulations as much as possible or necessary.

Acknowledgment

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Smart-home Intelligent System Based upon Counting Process and Habits Modelling for Non-Intrusive Daily Home Support

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Abstract: **Very often a pattern can be seen in the performing of daily activities. This article introduces our concept of a smart home adapting itself to its inhabitants by analyzing their habits, and thus offering them a tailored non-intrusive home support, whether a loss of autonomy occurred or not.**

Introduction

Activities of daily living are approximately the same for everyone every day: One person tends to wake up at the same time every morning, takes a shower every evening for about 10 minutes, etc. Everybody does the same things, but in a different way, making every one of us unique.

Nowadays, a lot of "smart homes" are being developed, but only a few of them yet are really smart, in a sense where the smart home is designed for only one kind of public. We think a smart home should try to act in a more human way, meaning that it should first discover a new situation (or person), try to understand what it saw, and then act accordingly. However, the home is something to which we are usually quite close, because we set it in our own way. Therefore, the smart home must not bring too many visible changes to the home, so that inhabitants do not feel in a foreign environment in their own home.

Counting Process and Habits Modelling

Even when a loss of autonomy occurs - due to ageing or accidents - we can still find patterns in the persons' habits. Those patterns can be detected by analyzing frequency, duration and time of an activity, and thus being able to recognize patterns in a person's daily life. Exploiting those patterns could help assisting people in their daily life while respecting their privacy. When implemented at home, this habits recognition system would lead to the creation of a smart home environment tailored to the persons' habits and issues, providing a non-intrusive daily home support.

We propose here a personalized smart home environment that can compensate the loss of autonomy of its inhabitants by interacting intelligently with them. The system will first discover the person's scheme by counting his/her activities as non-intrusively as possible, and then try to understand what it saw by modelling the person's habits to finally be able to map the different daily parts in accordance with the individual. For instance, the system could automatically open a door when it knows where the person is heading to in the house, offering some additional comfort.

Technological Investigation

This intelligent interaction requires monitoring some key parameters, while being as respectful as possible of the person's privacy. We consider that three parameters are enough to properly monitor a person's habit at home.

The first parameter being monitored is the electricity consumption. This measurement would be done room by room, in order to know which device is used and when. This would allow us to approximately know what the person is doing – for instance, watching TV – and help us locate him/her. We could also detect some unusual behaviors, such as having the stove turned on in the middle of the night.

Another parameter being monitored is the water consumption. As for the electricity consumption, the monitoring would be done room by room. This could help the smart home determine when is the person is using the toilets, or whether the person has a proper hygiene or not. Eventually, we could think of a solution monitoring the person's hydration.

For both of these parameters, the technology used is already well developed. There are already connected devices measuring the power consumption for an outlet that you can remotely enable or disable. You can also monitor which device is used by watching devices' noise patterns [1]. Similar measurements are becoming possible at relatively low cost for the water consumption, requiring the modification of only one water fixture at home [2].

Finally, the third and last parameter is probably the most important and complex to manage. The two previous parameters are based on well-known technologies, but our third parameter is the in-home person's movements. Movements will allow us to know precisely in which room the person is, and what is his/her posture [3]. Determining the posture will help the smart home determining what kind of activity the person is currently doing, and thus act accordingly to help the person if he/she needs some assistance.

The three parameters monitored aim to the same goal: monitoring a person's activity in order to offer comfort and assistance in daily life. Each

of them take a different approach doing that, which will allow the system to have a clear idea of what kind of activity the person is doing. It can also be seen as a safety checking, because each activity can be detected and checked by at least two of the parameters.

Potential Uses

This smart home can have many kind of target. We think one of the most interesting targets for our system is elderly population with loss of autonomy. This is to whom our system can have the most valuable outcome, for both the person and local healthcare systems would benefit of it. Indeed, our system can be used as a diagnosis tool for people with degenerative diseases. The smart home could be of great help to check change in a person's behavior, due to a cognitive disease such as dementia or Alzheimer.

Other targets could be interesting for our project, with minor modifications. For energy consumption conscious users, our system could be derived to display energy and water consumption by device, in order inhabitants to know which devices are consuming the most and what they could do to reduce their electricity and water bills.

Conclusion

Our system is able to adapt itself to person's daily life by measuring three parameters: electricity consumption, water consumption and the person's movement. We devised this system to be as non-intrusive as possible, so inhabitants can keep their privacy. It acts in a human way, meaning that it first discover the person's activities, then try to understand these in order to propose actions to the person, in order to provide more comfort and safety. This system could benefit to healthcare, especially for people with loss of autonomy, to help monitor changes in a person's behavior, and provide appropriate help to the person.

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The "Digital Pathologies Concept": New Methodologies and Approaches for Future Digital Applications and Resources

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Abstract: **The digital technology has removed many obstacles to communication and interaction. However, a lot of people cannot access digital technologies due to loss of autonomy. Some solutions exist through additional application layer for internet browsers for example. The aim of such top layer applications is to make websites accessible by adjusting to physical, sensory, and/or cognitive pathologies. But, even without being disabled, everyone regardless of age and health condition can be confronted to a critical situation that prevents from effectively interacting with digital applications. This article introduces our concept of digital pathologies and the different means employed to improve people's lives and provide more comfort and well-being.**

Context

Digital technology is now present everywhere and has created huge opportunities for communication, sharing information, e-commerce, shopping, etc. However, a recent study has found that 17% of the French population lack the basic of digital knowledge, and skills required to take the benefits that technologies offer. It's also says that 67% do not use the online services for administrative procedures [1]. At the same time, technological progress made people excluded from digital technologies because the use of the Internet and the digital object is perceived as complicated and not helpful. 56% of them are seniors; they face obstacles, like the fear of modern technology, the lack of adequate training and visual disturbances [2]. Furthermore, when websites, technologies, or tools are poorly designed, they can create barriers that exclude people. Remember also that one day or in other, each of us have to face a device failure, a mobile phone breakdown, and not everyone can afford a new digital object, due to their high costs of selling and repair. All of these aspects constitute today the major obstacle to digital technology development and uses, and prevent the users from reaping the benefits that technologies and services

should offer. All this leads up to get into trouble and introduces a new concept of “digital pathologies” (Fig. 1) through which everyone can become disabled.

Fig. 1: Example of pathologies that prevent the use of digital

Concept

We propose to set up an online service platform (Fig. 2) focused on three axes: the community aspect, adapted tutorials for everyone, and an accessible website. The community aspect is placed first in sharing digital objects between clients, where everyone is free to offer digital items online. The real-time support will allow the users to contact our services, with their agreement; we will have access to their computer data to guide them in terms of use, so that it can appropriate the digital object and thus ensure data confidentiality. The proposed tutorials will be adapted to everyone according to their level of apprehension to digital by setting difficulties level. An expert, a technician for example, will be able to access a tutorial, using a digital jargon that would not include a person who understands only the basic of digital knowledge. Accessibility to the website will be suitable for everyone, whether in terms of use or understanding, and those by making the content responsive, which means that the web page can be

viewed using many different devices: desktop, tablet, and phones, the web page should look good, and be easy to use, regardless of the device [3]. By regrouping multiple services in one place, this platform will create social ties, providing a technical and financial solution, making people well-adapted to living with the technological progress.

Fig. 2: The main axes of the platform of service

The content of the website of our platform service will use a design easy to understand, regardless of the user's experience, knowledge, language skills, or current concentration level by offering a wide range of language, arranging information consistency in relation with its importance, thus avoiding unnecessary complexity (Fig. 3).

Perspectives

In the long term, training in the digital appropriation will be implemented within the structure, giving users a support in the use of technology and digital objects.

Fig. 3: A brief presentation of several issues and solutions

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The Implementation of the Integrated Medical Care Provided for the Elderly Patients (65+) with Chronic Diseases

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Introduction

Integrated care in Poland is one of the most important concepts related to management and organization of healthcare systems. It should improve the quality and rationalization of costs of medical services through coordination of the provision of care and a cooperation between hospital care / primary care (outpatient clinic) and social care [2, 3]. To ensure a better quality of life for people aged 65+ with chronic diseases, it is needed to bear the economic burden of chronic diseases (that makes 46% of the global burden caused by all diseases) by health care system. Senior patients suffering from chronic diseases may be supported by information- communication technologies, mainly mobile ones, and that is a subject of an area called m-Health. So far, Polish patients are provided with medical care within the current state health care system, mainly without any ICT support in delivery of care and share of information. To achieve the objectives of the Care Well project (grant agreement no: 6209 83) there have been implemented necessary scenarios and business model processes. The main aim and subject of the Project is "Multi-Level Integration for Patients with Complex Needs". Therefore, the system design involves the integration of three subsystems: Educational - Information Platform (Mobile/Social), Integration Platform (Service Buss) and Monitoring Platform. All the integrated subsystems are able to meet and cover specific requirements, which are put for the health care system in the region (country) [5].

Organization and Communication Using IT Platforms

At the stage of preparation for implementation there have been identified requirements, which were then transferred into the BPM process model. This model was consulted with specialists and then their approval was followed by the implementation of telecare process [1]. The Integration Platform is mainly supposed to take care of the implementation of telecare in accordance with the modelled procedures and allow for an

adequate response in any situation. It was done using the API (Application Programming Interface) to give applications access to connect and essentially communicate with other programs. Another task of the integration platform is storing, processing and sharing of electronic medical data as well as the results of quality of life questionnaires.

Key aspects in the design of a modern system of telecare is the integration of technological solutions, and the existing information systems, as well as the applicable procedures of patient care with mobile technologies in telecare. These issues are the subject of numerous works on computer systems and their clinical effects [2, 4]. These actions should find a way to show the benefits and how to teach the end user, that is a patient, how to operate mobile measuring devices at home. Therefore, the system design involves the integration of three subsystems:

- Educational - Information Platform (Social);
- Integration Platform (Service Buss);
- Monitoring Platform.

Each of the above mentioned systems functionally meets the requirements of the identified key aspects. The Monitoring Platform is responsible for operation of measurement devices. It is based on mobile devices for telemonitoring of stable and unstable outpatients. A call centre worker monitors the patients' medical parameters and contacts a doctor or nurse when a patient's health status is exacerbated. Next the doctors or nurses evaluate the patient's medical parameters, determine the cause and act on the results. Patients can be reached by the call centre worker via an Android video application.

The most important issue is the reliability of the measurements in the context of user authentication. It is unacceptable to assign mistaken measurements to a patient. It is a must to have on one hand, suitable authentication, authentication and data security, and on the other hand, greater ease of use and reliability. To meet these requirements it is necessary to take these constraints into account at the stage of designing a subsystem which is supposed to manage its tasks.

The next subsystem is an Integration Platform whose main task is to integrate all the subsystems and enable their use to cover specific requirements which are put before the health care system in the region (country). At the stage of preparation for implementation there are identified requirements, which are then transferred into the BPM process model [1]. The most important task, as well as most difficult task to be completed by mid subsystem is to educate patients that the use of telecare increases their safety and a quality of life. An Educational Platform can be accessed by patients and carers through authentication via Smartphone

application. The information on the platform consists in educational material about chronic conditions meant to help patients manage their situation better, as well as specific information targeting informal similar to other authors' works [3, 4].

Material and Method

The main Project action was preparation of the material for the Ethics Committee, which was supposed to agree on a research project, in accordance with the applicable legislation. A proposal to the Bioethical Committee was also prepared.

Another element of the work in the project design was based on modelled telecare processes presented and then selection of the suppliers of technical solutions, i.e. Platform. The integration and implementation work followed by training of medical staff - doctors and nurses. Individual technical support for patients means that it includes a set of 50 mobile phones, smartphones L65 LG (LG-D280n) for each patient. And in addition:

- Patients of Group A (diabetes) have received the Diabetic set including glucometer - ProfiLine Blutzucker-Messsystem - 20 pcs;
- Patients of Group B (POHP) have received COPD set including peak flowmeter (Asma-1 Vitalograph) and pulse oximeter (PC-60NW) - 5 pcs;
- Patients of Group C (hypertension) have received blood pressure meter (SeniorLine BT model TD-3128- 15 pcs;
- Patients of Group D (heart failure) have received pulse oximeter (PC-60NW) and a weight scale- 10 pcs.

The criteria for inclusion of patients into the follow-up observation are age 65-85; combination of not less than 2 types of diseases: hypertension (ICD I10), diabetes (ICD E11), chronic obstructive pulmonary disease (ICD J44), heart failure (ICD I50). Another required condition is to obtain at least 60 points according to the Barthl scale.

Qualifying took place on the basis of analyzing of information card of hospital stay. Patients qualified for observation, were divided into two groups. The target size of both groups is 50 people. In Group I there were qualified persons covered by telemonitoring, who were provided with measuring devices depending on the disease entity. In Group II there were enrolled patients not covered by telemonitoring and who received no measuring devices.

Table 1. Characteristics of enrolled patients at the project

Measurement	Total	Missing	Intervention	Control	p-value
Sample size (n)	*100*		*50*	*50*	
Age	74.49 (6.67)	*0*	73.76 (6.66)	75.22 (6.66)	**0.276**
Gender		*0*			**0.016**
Female	51 (51%)		32 (64%)	19 (38%)	
Male	49 (49%)		18 (36%)	31 (62%)	
Longest held occupation		*0*			**1.000**
Manual	77 (77%)		39 (78%)	38 (76%)	
Non manual	23 (23%)		11 (22%)	12 (24%)	
Unemployed (but able to work)	0 (0%)		0 (0%)	0 (0%)	
Unemployed (unable to work)	0 (0%)		0 (0%)	0 (0%)	
Homemaker	0 (0%)		0 (0%)	0 (0%)	
Housing tenure		*1*			**0.362**
Owners	95 (96%)		49 (98%)	46 (93.9%)	
Renters	4 (4%)		1 (2%)	3 (6.1%)	
People older than 18 living in household, median (IQR)	1 (1,2)		2 (1,3)	1 (1,2)	**0.139**
Mobile use (Yes)	36 (36%)	*0*	22 (44%)	14 (28%)	**0.145**
PC use (Yes)	92 (92%)	*0*	48 (96%)	44 (88%)	**0.269**
Height (cm)	166.41 (9.07)	*0*	167.84 (8.68)	164.98 (9.31)	**0.115**
Weight (kg)	80.79 (12.51)	*0*	81.94 (12.58)	79.64 (12.47)	**0.361**
Body Mass Index (BMI)	29.2 (4.24)	*0*	29.18 (4.72)	29.23 (3.75)	**0.955**
Heart rate (bpm)	74.11 (6.57)	*0*	74.52 (3.36)	73.7 (8.69)	**0.536**
Systolic blood pressure (mmHg)	130.05 (7.86)	*0*	127.7 (7.12)	132.4 (7.93)	**0.002**
Diastolic blood pressure (mmHg)	79.95 (5.5)	*0*	79.62 (4.34)	80.28 (6.48)	**0.551**
Oxygen saturation (%)	94.4 (2.42)	*0*	93.52 (1.94)	95.28 (2.54)	**<0.001**
Blood glucose (mg/dl)	120.75 (45.89)	*0*	118.96 (37.62)	122.54 (53.24)	**0.699**
Primary disease					
Primary disease CHF	23 (23%)	*0*	10 (20%)	13 (26%)	**0.635**
Primary disease COPD	8 (8%)	*0*	5 (10%)	3 (6%)	**0.715**
Primary disease DIABETES	38 (38%)	*0*	20 (40%)	18 (36%)	**0.837**

The total number of patients (100) has been recruited for LSV Pilot site; 50 patients have been assigned to the intervention group, and 50 to the control group.

Participants have a mean age of 74.49 years, being a bit older in the control group, but without statistics significance. According to gender distribution, there are differences between groups Female 64% in intervention group and 38 % in control group.

The selection of the control group (control) and intervention group with equipment (Intervention) was not conducted following the exact proportions of Men /Women (the proportions are reversed). It was random selection. This is why the average age in the control group is higher by almost 2 years but the difference is not statistically significant.

The enrolment in both groups seems to be appropriate According to income households - it is a kind of privacy and was not recorded.

More surprising is the over-representation in the control group the number of patients with congestive heart failure, i.e. was 52% comparing to 4% in Intervention group (with devices). Similar is the case with dementia but in reverse proportions. There is a small difference in mobile and PC use between groups and the low percentage of subjects familiar with the mobile phone (36%) and high with PCs (92%).

Within clinical control parameters which were assessed, it is interesting to point that there were no differences between control and intervention group. There is a missing values for HbA1c(All) and creatinine levels (37). It is due to the inclusion of the control of these parameters among the ones that need to be reviewed in order to control each disease.

Results are comparable between both groups which are very prevalent for DIABETES primary disease; both for the intervention and the control group, and are prevalent for Congestive Heart Failure CHF as a secondary disease.

Another significant characteristic of participants is their level of functional dependence, measured by Barthel Index. In this case there are no differences between the intervention and the control groups and all present a median of 100 indicating autonomy. According to the baseline mental health, both groups present mean values corresponding to normality.

Conclusions

The paper describes the development of and the enrolments for telecare procedure concerning patients aged between 65-85 years with at least 2 chronic diseases. Due to specificity of the group of elderly patients there are some problems with using smartphones and measuring devices. Initially, in the first months, the patients got upset and stressed. Some of them could not cope with the performance of measurement. They did not know **how to operate smartphone.** One input to the charger was broken. They used to **turn off their smartphones** immediately after the measurement was completed. It caused that the measurement result came later. Some of them may still want to do this in order to save money on electricity, as many senior patients have financial problems. Comparison of medical and social care given to this group of patients to the other group consisting of those, who are not included in the home monitoring, but provided with regular medical care, within the current Polish health care system, will be described in next articles.

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Usefulness of a Telemedicine Program in Refractory Congestive Heart Failure Patients

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Introduction

Hearth failure (HF) is an increasing public health problem associated with high levels of morbidity, mortality, reduced quality of life [1] and high costs [2].

Chronic congestive heart failure (CHF) patients undergo frequently to hospital readmission due to a worsening of haemodynamic conditions, poor adherence of therapy and incomplete clinical follow-up after discharge. The highest risk period for rehospitalisation is the month after discharging [3] with up to 24% of patients should be readmitted [4]. The clinical surveillance (within the first week) seemed to be effective in reducing hospital readmission. Many readmissions are known to be attributable to modifiable factors that can be addressed with high quality post-discharge care [5]. Multidisciplinary HF disease management programmes can reduce hospitalisation rate, improve clinical outcomes [6] and improve significantly quality of life [7].

Home telemonitoring is one modern and effective disease management model to improve the medical care, quality of life, prognosis of chronically ill patients [8] and to reduce costs.

Objective of this study was to evaluate the efficacy, the costs and the acceptance by patients and caregivers of our model of telemedicine in a high-risk CHF population.

Methods

We decided to experience the telemedicine project in some areas of ASLCN1 (Italy) and it was established as Coordinating Centre the Cardiovascular Rehabilitation-Heart Failure Unit SS Trinita' Hospital in Fossano. The hospital medical board approved the clinic protocol. We performed a prospective observational study in high risk/refractory CHF

patients who were monitored by programmed home visit contacts aimed to discover alarm parameters and adherence of medical therapy.

High risk/refractory CHF patients were defined as patients with age>70 years, left ventricular ejection fraction (LVEF) <30%, Brain Natriuretic Peptide (BNP)>250pg/ml, NYHA class ≥III, diastolic filling pattern grade≥2 and finally number of hospital admission ≥2 per year (≥2 criteria to be verified). Patients were included after discharge from Cardiovascular Rehabilitation (15%), Heart Failure Unit (57%) or outpatients (28%).

The clinic protocol included before discharge the following: a) a physical examination b) individualized HF disease education emphasizing symptom recognition and reporting c) explanation of telemedicine project d) signature for informed consent e) discharge plan including medication list sent to family physician.

The physical examination was performed by a cardiologist and focused on hemodynamic status and volume assessment. Volume assessment included taking blood pressure in the supine position, performing a bedside evaluation of jugular venous pressures and looking for any evidence of oedema. The examination also included a point-of-care laboratory evaluation to detect electrolyte abnormalities and any deterioration in renal and hepatic function. [9] Patients were asked to bring all prescription medication and to observe non-prescription one e.g. correct diet. A cardiologist explained telemedicine project to patient and to family members or caregivers and collected signature for informed consent. Family physicians were involved in the project and for patient's enrolment, their consent was considered mandatory.

After discharging, the clinic protocol included also the following: a) patient's enrolment in telemedicine project b) planned follow-up c) structured telephone support.

Tele monitoring of physiological parameters in patients with CHF may lead to early identification of decompensation and may allow for intervention before hospital readmission [8]. Planned follow-up involved many participants including a cardiologist as Project Director, a biologist and nurse as Project Coordinator, two cardiologists, specialized nurses and home care nurses and finally family physicians.

Planned follow-up consisted in a home visit within one-week after the hospital discharge and then every two months or before according to the clinical conditions. The visit might be required by patients or by their caregivers if symptoms of worsening heart failure developed. At least every four months, a visit performed by a cardiologist consisting in physical examination, laboratory data examination, modification or reconfirmation of medication list has been planned.

The home-visit was performed by a home care nurse and consisted into a complete check of therapy adherence and general health status by the compilation of a preformed questionnaire; control of blood pressure and of body weight with a precision balance; of oxygen saturation and finally 12-leads electrocardiogram. Home care nurse was equipped with a kit (KIT Lifechart Home_ Meditel s.r.l) that consists in a briefcase containing one tablet, a precision balance, an oximeter, an electronic sphygmomanometer and 12-leads electrocardiograph (HeartView P-12/8 i) (Fig. 1).

HearthView P-12/8 is a portable electrocardiograph capable of recording 12-leads electrocardiogram (ECG) or, using the special selector, 8-leads ECG. It is equipped with only three cables and four electrodes embedded. This device is extremely handy, absolutely reliable and small size (length 109 mm; width 64 mm; thickness 34mm) (Fig. 2)

Fig. 1

Fig. 2

The tablet comes with applications to manage the monitoring of patient. During the visit, the nurse launched the application, and a folder with the patient's personal data was opened. The tablet is able to give compact operative instructions for performing interactive measurements. At the end of each single measurement, devices send the data wirelessly to the tablet. During each visits the final step was to compile the preformed questionnaire.

All these data were sending from the tablet to server through the Internet and inserted into a net platform (LifeChart Meditel) accessible by encrypted connection protected. Cardiologists working in the Coordinating Centre read the data.

Five alarm parameters were scheduled: 1) worsening of NYHA ≥one class; 2) heart frequency<40/min or >110/min or in case of complete arrhythmic frequency; 3) angina pectoris or syncope; 4) increase of body

weight>2-3Kg with peripheral oedema and 5) oliguria (<500ml/day). In case of important modification of alarm parameters, the cardiologist decided to inform the emergency, the patient's family physician or to programme a clinical control.

Between one home visit and another, post discharge care consists in structured telephone support performed by specialized nurse educated for triage. Every fifteen days or every seven days, in more severe cases, patients were contacted by phone and their general health status was checked by the same preformed questionnaire of the home visit. Also in this way, in case of important modification of alarm parameters, the nurse decided to inform the cardiologist and this one decided to inform the emergency, the patient's family physician or to programme a clinical control.

For evaluation of the acceptance of our telemedicine model, a satisfaction-preformed questionnaire was submitted to patients.

Results

Forty-four CHF patients (25 males and 19 females), mean age 81 years old entered this clinical experience. All patients were visited at home (totally 178 visits). In 43% of the cases, patients developed alarm parameters. In particular, this happened once in 25% of the patients, twice in 16% of patients and four times in 2, 3% of patients.

A clinical controls were planned into 24-hours in 18% of the patients, only 11% of patients were admitted in ED or hospital (18%) for acute decompensation. During the follow-up, lasted months, 29% died from heart problems and 9% dropped out from the counselling.

The number of hospital admissions for heart failure decreased considering the year before and a year later than the enrolment in the project (from 35 hospitalization for HF /year to 12 hospitalization for HF/year; p=0.0001). Moreover, in the 44 HF patients followed, the accesses in ED for suspect HF reduced from 21/year to 5/year (p=0.0001).

The cost-analysis related to this project considered the costs for medical consultation, nurse visits, hospital reimbursement for CHF hospitalization and for ED examination and was performed in a cross-over model, comparing the costs determined by the same patients included into the project the year before and the year after the beginning of the enrolment. The economic expenditure for the 44 CHF patients followed reduced from 116.856 Euros to 40.065 Euros/year.

The quality questionnaire that explored the customer satisfaction of patients and caregivers was compiled by 27 (61%) enrolled. The questionnaire (dividing between unsatisfied/sufficiently/moderate degree of

satisfaction / high degree of satisfaction) demonstrated a high degree of satisfaction in 20/27 cases. (Tab. A)

TAB. A	Satisfaction questionnaire	
How to assess the number of visits received at home?	0-40%	(4)
	40-80%	(23)
	80-100%	(0)
What is the possibility of carrying out checks at home instead of in hospital?	0-40%	(0)
	40-80%	(10)
	80-100%	(17)
Do you prefer to carry out checks at home instead of in hospital?	0-40%	(1)
	40-80%	(11)
	80-100%	(15)
Is the presence of a nurse at home helpful?	0-40%	(0)
	40-80%	(7)
	80-100%	(20)
Were caregivers satisfied with the visit at home instead of in hospital?	0-40%	(0)
	40-80%	(20)
	80-100%	(7)
Have additional check-ups required by the doctor been helpful?	0-40%	(0)
	40-80%	(21)
	80-100%	(6)
Would you recommend to a friend, if needed, this telemedicine service?	0-40%	(0)
	40-80%	(7)
	80-100%	(20)
Notes: 0-40% low satisfaction 40-80%:medium satisfaction 80-100%: high satisfaction; in brackets - number of patients		

Discussion and Conclusions

A follow-up program tailored for refractory CHF patients should be provided to avoid unnecessary rehospitalisation. Elderly patients with HF represent most of subjects (70%) admitted to hospitals for acute cardiac decompensation; the length of hospitalization lasts usually>2weeks in geriatric wards and readmission is frequent [10]. Recently, the OPTIMIZE –HF study [11] included more than 30 000 CHF patients discharged from 215 hospitals, described the short length of hospitalization (4 days) but a 21.3 % of rate of readmission within 30-day. This study [11] evidenced as an early (one-week) outpatient clinical follow-up after discharged had lower probability to be readmitted within 30-day. In the IN-HF Outcome, an Italian nationwide registry, the 30-day mortality after discharging for an acute episode of heart failure proved to be 2.8% and hospital readmission 6.2% [12]. Older age, longer in-hospital stay, the necessity of inotrope use, worsening NYHA class identified heart failure

patients discharged home that are at highest risk of death or readmission. According to the huge number of CHF patients discharged from our hospital, easy and practical prognostic parameters able to predict adverse outcome are mandatory in order to allocate correctly our resources and established tailoring specific follow-up [13].

In our experience, a telemedicine surveillance in high risk CHF patients determined a continuous and active contact between patients/caregivers, Heart Failure Clinic and family physicians permitting to early evaluate signs and symptoms of acute decompensation saving frequent hospital readmission (during the first year of follow-up) and reducing the expenditure. The quality questionnaire clearly underlined how patients/caregivers felt the telemedicine model as useful and satisfactorily.

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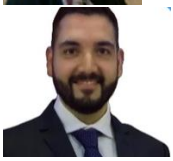

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Vers'O: a Support Device to Promote Hydration for Elderly People

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Abstract: **In 2003, a heat wave produced many casualties and allowed us to become aware that part of the population is sensible about dehydration. Some recommendations do exist, but only as advice, involving education of persons and caregivers. Unless the actual water intake is evaluated these recommendations are bound to be inefficient. This article introduces our concept of device to help to manage our real needs, but also instill a new way to hydrate ourselves.**

Context of Dehydration for Elderly People

Water is essential to the functioning of our body. The quantity of water contained in the body is based on a balance between expenses and intakes, which must be maintained permanently. As described in [1], "body water is maintained within narrow limits. However, if water losses are not sufficiently replaced, dehydration occurs. Extreme dehydration is very serious and can be fatal. More mild dehydration (about 2% loss of body weight) can result in headaches, fatigue and reduced physical and mental performance". Aging has a natural impact on water balance and causes a delay in the onset of thirst. When thirst occurs to the elderly, it is already synonymous with dehydration.

Besides physiological changes linked with aging, other obstacles can increase this risk or reduce elderly people's abilities to hydrate properly, such as weakening of some motor or cognitive abilities, as well as pathological, environmental or iatrogenic factors. There are a lot of risks factors and everything encourages elderly to less hydrate themselves while they are more sensitive to dehydration. But we had to wait until the 2003 European heat wave (and estimated 70 000 people excess mortality) to become aware of the dangers for the elderly population. However, the issue of dehydration for the elderly is not restricted to critical situations, such as during heat waves, but must be a daily concern, both for people living at home and in institutions. Risk is always present, even for healthy subject. The consequences of dehydration are numerous and often uncharacteristic. It can make it difficult to identify as causes.

In addition to individual clinical consequences, dehydration is a major public health problem with direct and indirect significant economic repercussions: Hospitalizations, falls and loss of autonomy impacts (caregivers, institutionalization, etc.) In France, 3 out of 4 adults have the feeling of being well hydrated. But 8 out of 10 adults do not follow the benchmarks hydration. However, many communications about the importance of drinking enough are made and known. It is also difficult to rely only on caregivers. They can be multiple or stay shortly. Prevention with education is bound to be inefficient. It becomes necessary to act directly on behavior of people. With these observations, the concept of our project is to facilitate and stimulate hydration of people in loss of autonomy and to reduce the risk of functional decline in link with dehydration, can bring into dependence.

Concept of Our Device

Vers'O is an innovative device intended for elderly people to help them for their needs of water intake and hydration. For elderly, the relevant access in terms of quantity to the water can be difficult. We took into account the various obstacles that the people can encounter to be able to delete them more effectively. One of our principal objectives is to incite people to hydrate themselves while limiting modification of users' habits. We want hydration to become simple and pleasant. In order to use on the notion of pleasure, the device allows to vary liquid and to conserve the user's favorite beverage bottle: different brands of water, soda water, fruit juice, etc. By habits or taste, we are used to drink water more or less cold.

Our device can keep the fluid at a temperature selected by the user, with a refrigeration system. This device allows the user to assist him during the pouring of a desired quantity directly into the user's glass. Indeed, the device assists without substituting the user's gesture and preserves his autonomy. We want the user to keep the natural move linked to pouring into a container but we want to remove the liquid's weight when poured. We are designing a mobile object which can be used in different rooms of the house in order to follow the user and encourage him to drink anywhere he wants into his house.

Still in an approach facilitating the access to water, the device makes sure to open and close automatically bottle caps screwed on bottles. They are regularly difficult to open, whether we are young or older, even impossible when suffering from a chronic pathology. But beyond a simple pouring assistant, our device will allow quantifying the amount of water drunk by the person.

In order to incite to drink and to avoid oversights, the device can produce sound and luminous reminders according to needs and wishes of user. Besides, weather conditions having an impact on hydration needs. The device will take it into account by adapting time of reminders between two glasses and the quantity to be absorbed. Elderly are not necessarily equipped with an internet connection. That is why we chose that our object must be autonomous. A screen is on the devise for display main data. An application completes the device allowing its configuration (quantity to absorb daily, reminders, types and time slot). The application also allows having a weekly and monthly follow-up of the absorbed quantities. These data can be used by a doctor to check the good hydration and facilitate a diagnosis. The device can be used by several users at the same time, thanks to a recognition system.

Description of the Device

We realized a first visual 3D picture that provides a comprehensive view of the device and its various functions. With the 3D model, we can see a mobile part (thanks to a handle), including the bottle to pour in the glass, between two fixe parts. On one fixe part, there is a screen to indicate quantity drinking by the user. The green on the picture correspond at the light using like a reminder. The bottle is inside a compartment isolated thermally with two opening windows.

Perspectives

Sedentary elderly are the target of our device. However, the problem of hydration concerns a wider population. For various reasons, many people may have difficulties drinking the right quantity of water and then suffer the consequences. Besides the elderly in loss of autonomy, our device can also be used by all persons who wish to be careful to their hydration. Vers'O was designed as an aid in everyday life, but we asked ourselves if our device have a place as an e-health product. In fact, it tracks an important parameter for good health, may help diagnosis and enables exchange information between user and caregiver. Now we wish to make a prototype from drawings of the concept and enable rapid product development.

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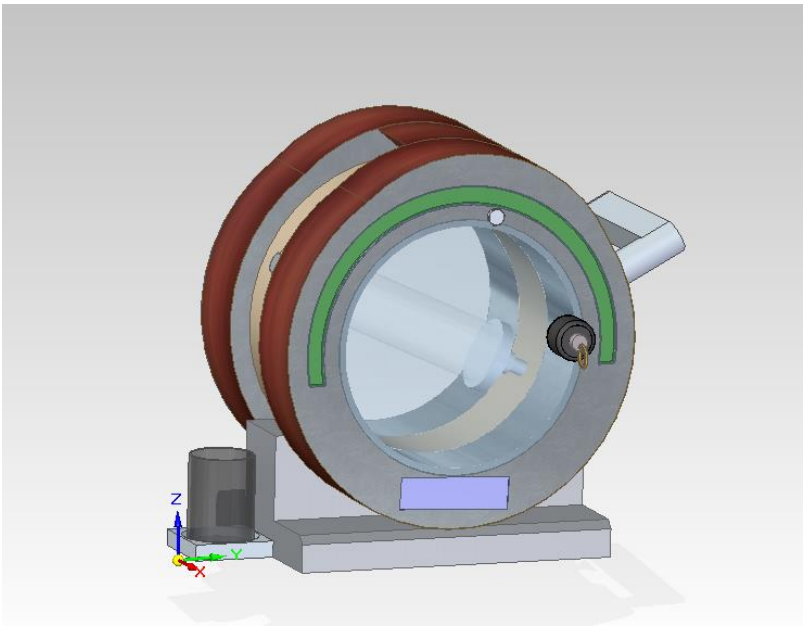

Fig.1: Representation of Vers'O water device

Women, eHealth and Telemedicine within the UN Sustainable Development Goals 2015 – 2030: From a Global Framework to Local Innovative Programs

Complex Telemedical Solution for Fetal Health Monitoring

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Introduction

Cardiotocography (CTG) consists of recording (-*graphy*) the fetal heartbeat (*cardio*-) and the uterine contractions (-*toco*-) during pregnancy, typically in the third trimester. The machine used to perform the monitoring is called a cardiotocograph, known as an electronic fetal monitor (EFM). CTG is one of the most important examinations carried out in obstetrics. Nearly 60 years ago, Doctor Bradfield, Alan Orvan Hess and Edward Hon developed invasive fetal monitoring. A refined (antepartal, non-invasive, beat-to-beat) version (cardiotocograph) was later developed for Hewlett Packard by Konrad Hammacher. Since then, CTG equipment has undergone a number of upgrades.

Now is the time for a breakthrough. CTG examination enables medical personnel to detect conditions threatening the fetus' life at the very early stages [1-5]. Nothing can replace the experience and knowledge of professional medical staff. TeleCTG is a telemedical device, designed to support doctors and midwives. Pregnabit is a mobile medical device that combines a telemedical cardiotocography (teleCTG) with expert remote analysis of CTG readouts by qualified medical personnel (Telemedical Monitoring Centre). It enables CTG monitoring of pregnant women at anytime and anywhere, especially when an extra visit to the doctor’s office is not possible or necessary. Pregnabit combines well-known and proven features of professional stationary CTG device with mobility that we expect from modern devices. It significantly raises the level of prenatal prevention. Pregnabit is a combination of a teleCTG medical device with an innovative telemedical service - complex telemedical solution for fetal health monitoring.

Objectives

The main objective of this work was to determine if specialized medical personnel and patients are ready (open) to use telemedical solutions related

to telemonitoring program during pregnancy, with the use of mobile cardiotocograph (teleCTG) in Poland.

The specific objectives of this work included:

- Determining the opinion of the midwives on mobile telemonitoring of fetal heartbeat and uterine contractions during pregnancy (teleCTG),
- Determining the opinion of pregnant women on a mobile telemonitoring of fetal heartbeat and uterine contractions during pregnancy (teleCTG).

Materials and Methods

A survey (interviews) was conducted among 73 midwives in different age groups. The largest group consisted of midwives aged 25-30 (46%), 31-35 yrs were 12%, aged 36-40 - 12%, 41-45 years old were 10%, 46-50 years old - 10%, years old 51-55 - 7% and 56-60 yrs old - 3%. The majority of all respondents were undergraduate (38%) or graduate (49%) midwives with long professional experience. 30% of all managing private practices or working in private health facilities.

The survey (interviews) of pregnant women was carried out on a group of 100 pregnant women or up to a year after giving birth. Most respondents were women in the so-called <<physiological pregnancy>> (84%), aged 25-30 (45%) or 30-35 (35%), with higher education degree (84%), from big cities (81%).

After presenting the rules of performing teleCTG examination, both groups were asked to complete a questionnaire consisting of open and closed questions on the topic of stationary and mobile teleCTG. Not all the answers were required and therefore some of them were selective. All the examinations were carried out in Poland and include Polish citizens.

Results

The expectations, needs, opportunities and barriers for telemedical solutions according to midwives

Almost each surveyed midwife believes CTG examination to be safe (96%) and useful (97%) in their daily practice, and, therefore, routinely and willingly uses (recommends) the CTG after 32 week of pregnancy (65%) (sometimes also doctor recommends it). CTG examination is perceived as a non-invasive, easy, safe, fast, cheap and effective way to monitor the fetal well-being. The main advantages of CTG include: the ability to verify whether uterine contractions have started, and the ability to detect threats (irregularities), so that if necessary, the diagnostic tests may be extended, and save the life of a child. Therefore, CTG allows for better prevention in

pregnant women. In addition, midwives pay attention to the psychological aspects, such as calming the pregnant woman down (the feeling of security). Also legal aspects are important, such as appropriate medical documentation (evidence in court cases). 15% of the surveyed midwives do not perform this examination due to the lack of equipment, because it is the doctor who manages available stationary CTG device or their (midwives') scope of responsibilities is different. Most midwives (65%) admit, however, that often they meet patients who visit hospital only to have CTG examination done (at least once a week). Another 31% of midwives said that this happens at least once a month.

The surveyed midwives show a clear interest in the possibilities posed by telemedicine. 12% of them already use mobile telemedical solutions, and 43% have positive attitude to such solutions and would like to make use of such solutions in their daily practice. In addition, 13% are quite skeptical, but would like to try such solutions, and only 4% do not trust such solutions and would not use them.

The expectations, needs, opportunities and barriers to entry for telemedical solutions according to the pregnant

The results of the survey show that in Poland pregnant women, even with <<physiological pregnancy>> often (73%) or at least occasionally (18%) use private medical services of doctors. However, the private medical services of midwives were never used by surveyed pregnant women (62%) or were visited very rarely (9%). Up to 31% of pregnant women used medical facilities only in order to have CTG examination performed. Pregnant women (91%) consider this examination to be reliable, safe and unobtrusive, and the disadvantages include: the necessity to stay in lying position throughout the examination, uncomfortable straps, need to get to the medical centre and wait in the queue. Pregnant women are really interested in the telemedicine to monitor the fetal well-being (teleCTG) – 92% declared interest in such a solution and will be happy to use it at home. The main needs that such a solution cater to are an increased sense of security (reducing the stress), the child's safety through immediate diagnosis of a possible life-threatening condition, saved time and comfort (no need to travel nor wait).

Conclusions

Midwives believe CTG examination to be prognostic and useful in their daily practice, that is why they use it routinely, although they also note that there are problems with its availability, which the use of telemedical devices in this area may resolve, and at the same time enhance prevention. Midwives do not use their legal right to diagnose fetal well-being using

cardiotocographic method in <<physiological pregnancies>> on their own: they perform CTG examinations every day, but most have not completed specialized CTG course and do not interpret self-made records (they use the support of a doctor). Moreover, midwives are open to telemedicine solutions and new opportunities that promote their self-reliance and are addressed to them, and would be happy to extend their competences in this respect. Besides midwives recognize significant psychological aspect, which may be solved with teleCTG (a greater sense of security and comfort).

Pregnant women have to struggle with obstacles associated with the cardiotocographic examination performed in the standard way (problems with registration, availability, travel to the medical center, queue), which can be eliminated with the use of telemedical solutions. Although most pregnant women were in <<physiological pregnancy>>, they used private medical services provided by doctors, but rarely used those provided by midwives. The vast majority of them are interested in remote monitoring of the fetal well-being without leaving home– CTG has a chance to increase their comfort, a sense of security and strengthen prevention programs for pregnant women– the role of the midwife in this field may, and should be of a significant importance.

Resume

In 2013 in Poland 370 962 children were born, including 369 576 live births. Dead births up to 6 days after birth amounted to 1 386 and 846 ended in death cases. Infant mortality in 2013 in Poland equaled to a total of 2232 – infant mortality factor was 6.7 ‰. This sustained high perinatal mortality indicator made us think. In our opinion, telemedicine solutions in the cardiotocographic field (teleCTG) are able to improve these statistics. It would naturally increase the prevention and result in better quality medical services. The very adaptation of such a solution is not a trivial issue, but growing importance of private health care, as well as rapid development in the field of health information technology on a global scale, make us feel optimistic. The use of telemedical services in the world is a growing trend, and it is anticipated that in Poland we will observe the same tendency [6].

The power and reach of mobile technologies can overcome geographical distance and restrictions connected with the direct access to professional health care, while providing a more comprehensive and individualized approach. Surveys that we carried out show clearly that Poland is open to the telemedical solutions in the field of obstetrics [7].

The use of mobile teleCTG would limit the number of visits to medical care facilities, when for other reasons it would not be necessary (only visit

in order to perform CTG recording). This would help improve decision-making through remote consultations with specialists. It would also reduce costs of patient handling and increase comfort of the examination. And this directly translates to increased sense of security for pregnant women and reduced stress levels, which affect their overall well-being.

For pregnant women it is essential to have both a sense of security (easy and unlimited access to checkup examinations), as well as the convenience of examinations (especially in the third trimester of pregnancy when travelling is difficult and additionally there is increased possibility of infections, which is also stressful for women). For this reason, the use of telemedical solutions to monitor the well-being of the fetus (such as Pregnabit) seems to be ideal. However, we must remember that telemedicine cannot replace contact with your doctor/midwife, but should allow for more efficient diagnostics and prevention, which can even save the lives of both a child and a woman.

Telemedicial solutions should support professional medical personnel and pregnant women by giving them the possibility of comprehensive child health monitoring anytime and anywhere. Increased prevention through telemedical solutions should be a priority for all people working on the expansion and improvement of medical services.

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Educating Nurses about Telehealth for Clinical Practice

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Introduction

Advances in telehealth technology and applications are contributing to meeting the health care community's goals of increased access, improved quality and decreased cost for people with health care needs worldwide. As citizens become more comfortable with the benefits of health technology, barriers to its use should diminish. All providers who are motivated to use telehealth need to be constantly learning how to develop, implement and evaluate technology designed to support desired outcomes. Nurses work in many different telehealth-related roles; a key aspect of telehealth nursing success is education from pre-entry to graduate levels.

The purpose of this paper is to describe an array of education content and processes for nurses who use telehealth technology and applications.

Telehealth Education and Nursing

What is meant by telehealth education? Most health care providers already use technology in their work, from basic assessment tools to the most sophisticated diagnostic and treatment tools. The World Health Organization defines eHealth as "the use of information and communication technologies (ICT) for health. Examples of eHealth include treating patients, conducting research, educating the health workforce, tracking diseases and monitoring public health" [1]. Here we see that the overlay of information and communication technologies (ICT) helps to distinguish health care education from telehealth education. The application of telehealth ICT requires an appreciation for the technical, safety and legal aspects of how health data are acquired, stored, transmitted and used in different health care settings [2].

The need for integration of telehealth concepts and technology in technical or pre-baccalaureate nursing programs is being increasingly recognized. A study of telehealth education in nursing curricula found that more than 88% of nursing school deans and directors (33% response rate) agreed that telehealth had to be part of any curriculum [3]. Types of telehealth experiences for students of nursing that were supported by more than 63% of faculty respondents included telehealth tools (e.g., real-time

video), remote monitoring, store-and-forward telehealth transmission, and distance education.

Telehealth nursing content at the undergraduate level could include differences between traditional and telehealth care; benefits of telehealth; nursing and interdisciplinary telehealth standards and guidelines; legal and ethical guidelines and professional licensure; privacy stipulations (of data, care recipients, care providers); and safe use and evaluation of telehealth information technology [3, 4].

Undergraduate nursing students benefit from the growing realization among educators that simulation is essential to preparing entry level nurses. Simulation can be used to practice various procedures, prioritize care needs for complex patients, and respond to patient emergencies. Reirson et al [5] used three simulation scenarios with students to assess students' perspectives of telenursing. The scenarios were (a) assisting a patient at home in colostomy management, (b) increasing nursing home staff competence in stroke rehabilitation, and (c) meeting family needs when palliative care is required for the mother. Four student focus groups (6 to 9 per group) generated responses in five major categories: learning a different nursing role, influence on nursing assessment and decision making, reflections on the quality of remote comforting and care, empowering the patient, and ethical and economic reflections. The students found telenursing to be challenging and complex, requiring communication skills, subject-matter knowledge and ICT performance simultaneously.

"There's an APP for that" has become part of the world's lexicon. It is safe to say there are thousands of health-apps available. However, the quality of apps and the rate of actual download are difficult to know. Apps exploit ICT for functionality and dissemination. Nurses will need to learn how to use apps in their practice for diagnosis, monitoring, and managing the complexities of care delivery, evaluation, and interdisciplinary activities [2].

Students and practicing nurses benefit greatly from being able to use apps to access information about drugs used in health care (dosages, effects and side effects, contraindications, and drug-drug interactions). Nurses will also need to know how to advise and educate citizens, patients and families about health-related apps. Populations underserved due to geography or impaired access can be better-served when nurses use mobile phones and apps that support teaching clients or patients and further support relaying data to tertiary care facilities for analysis and care intervention.

Specialty nurses and Advanced Practice Nurses (APN) are two more groups who are learning to add ICT applications and technologies to their practice. Continuing education programs and on-site learning support nurses

increased ability to integrate ICT with their practice. Tele-ICU or eICU nurses provide a 'safety net' of additional surveillance and support to in-house critical care staff with the goal of enhanced outcomes for patients [6]. In addition to being skilled and knowledgeable critical care nurses, eICU nurses must master the art and science of managing multiple ICT applications to include audiovisual tele-ICU monitoring systems [7].

APNs are being encouraged to embrace the use of telehealth and advocate for inclusion of telehealth in their practice [8]. This means that licensure and scope and practice for APNs would have to cover APN telehealth practice [8]. A project that would integrate telehealth education and skills in an APN graduate curriculum in Minnesota aimed to support telehealth as a means for reducing health disparities between rural and urban residents [9]. The developers aimed to improve the APN's knowledge and skills so that employers and clients would benefit. Five acute care and 11 ambulatory telehealth services were used for the project, to include emergency services, stroke care, cardiology, pain management and wound care. The project was successfully implemented and continues to be a requirement for graduates of the program.

Summary

Health care delivery is a multi-disciplinary endeavor, made even more complex in the eHealth environment with the coupling of the necessary ICT infrastructure. However, even with periodic calls for interdisciplinary education programs [10], the nursing profession has well-recognized pathways from basic preparation (community worker or nursing assistant) to the doctoral level. Nurses and students who are motivated to join the telehealth community are aware of the need to constantly improve their knowledge and competence in the modes of ICT relevant to their area of practice. This is accomplished with a commitment to learning whether in a formal academic setting, in continuing education programs or through on-site experience.

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Online Toolkit: Improving Transfer of Learning into Practice from Training Courses on Violence against Women

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Abstract: **Training in Gender Violence (GBV) is essential to raise awarness among professionals to detect and care for victims with a comprehensive approach. This was one of the objectives of the European Project: " A health sector toolkit for implementing learning from violence against women trainings", record number: 2013-1-DE2-LEO04-16120 from Leonardo da Vinci Program, financed with European funds, that have been developed for an association of organizers from four countries, Germany (SIGNAL), Austria (Innsbruck's Medical University), Spain (SACYL) and United Kingdom (HAVEN´S). We worked with different roles in the struggle against Gender Violence from different organizations, and have shared a common goal: improving health care for victims of gender violence through training of the professionals in this field. One of the objectives has been the development of a set of tools to facilitate gender violence training of health professionals and learned to transfer the clinical practice. The content of this website is a part of the result of this project. It is designed in a very easy and friendly way, containing the 28 tools that were agreed between the 4 countries to apply in different contexts, providing certain homogeneity, but with the potential to be adapted and used independently by different organizations. The toolkit (Toolkit) has been published in an online resource (Toolkit) for trainers, organizations and individuals interested in improving their teaching skills in GV. They are divided into the 5 phases of the training depending on which they belong to: preparatory, developing, implementation, post-training and assessment, covering the whole**

process to prepare the best training. Conclusions: We believe that training in GV is the first step in changing attitudes and train health professionals in managing the problem. It is necessary to motivate professionals and adapt content and methodology and assess the impact of it. The creation of this website is a fantastic tool to improve the training and to bring the medical education into the land of blended learning.

Introduction

Violence against women is considered a major public health and human rights concern [1]. WHO affirms that intimate partner violence and sexual violence are a serious risk for women's health [2-3], having multiple effects not only on their health but also in their children's health, on decisions and actions related to their health and on their health opportunities.

Prevalence and importance

Data from the WHO multi-country study on women's health and domestic violence against women reveals that between 13% and 61% of women 15–49 years old report IPV (inter partner violence) at least once in their lifetime; between 6% and 59% report forced sexual violence, or an attempt at it, by an intimate partner in their lifetime; and 1% to 28% report physical abuse during pregnancy. Studies carried out in participant countries show a high prevalence of IPV and sexual violence [4].

The European wide survey carried out in 2014 [5] showed the prevalence rates in Europe for physical, sexual and psychological violence/physical and/or sexual violence by a partner or a non-partner against women since the age of 15 is between 19% to 52% (European Union of fundamental rights). The prevalence of the four countries that have participated in the development of this toolkit was: Austria – 20%, Germany – 35%, Spain – 22% and UK – 44%.

The consequences are several in different areas: Somatic and psychosomatic, psychological, survival harmful strategies (smoking, use of alcohol and drugs, and drug dependence) and reproductive health consequences.

Overall women experiencing IPV or sexual violence report health problems more frequently and make more use of health care services. Many women experiencing IPV or sexual violence do not seek support from the police or other organisations. Health care professionals are often the only professionals who have contact with survivors, who note and treat their injuries, health consequences and other harmful consequences for their victims' health.

Studies confirm unanimously that health care services are in an outstanding position to assist women who experience violence and seek help [1, 3, 5] and health care providers are the most trusted professionals identified by survivors, amongst other things due to confidentiality [5]. Consequently, they have a significant intervention and prevention role in IPV and sexual violence. WHO recommend including systematically IPV and sexual violence in the training of health care professionals and in their continuing education [1].

The Toolkit

The idea of this project was to offer the best possible care to survivors and their children from the organisations, teams and individual professionals who directly and indirectly provide high-quality victim-centred support. It is vital for their ability to respond appropriately and sensitively to the needs of the victims and their families and to ensure the best possible care. In order to do that, this project contributes to bridge the gap between the theory and the practice, creating a toolkit to provide the best practical, good quality and adaptable training and learning tools that can be applied widely across many sectors and countries and which will improve the transfer of knowledge from courses into practice.

This project funded by the Leonardo grant (record number: 2013-1-DE2-LEO04-16120 from Leonardo da Vinci Program), is based on the principle of shared learning – our direct experiences – and also on the collation of answers and learners' views in each of the participating countries. The methodology was observational, deliberately based on the experience of learners and trainers in the field (including doctors, nurses, counsellors, psychologists, psychotherapists, care workers and advocates). The first stage was to gather evidence, collecting their experiences and views, from both, those with advanced knowledge of the subject and others without it. It included all those professionals placed in the principal sector working with domestic and sexual violence, who require baseline information to help identify victims and provide immediate support, referral, channelling and follow up. We analysed what was helpful and what was missing in their training, the methods and tools they told us that were most useful to them, the barriers to implement the acquired knowledge, how was implemented in their workplace and the areas of improvement. And the important findings were:

- The lack of organisational commitment either to understanding the importance of supporting learners in applying their learning in this field or enabling their learning to make a practical difference when back in the workplace;

- The emotional challenges of attending training in this subject could make the learning itself difficult or its application challenging;
- Need of enough data and evidence to raise awareness at an organizational level to provide a very training focus on practical tools that should be delivered by experts working in the field;
- Evaluation of needs.

Using the core themes in the needs assessment, we developed draft tools focusing on organisation/team needs, trainers' needs and learners' needs. These were piloted across the four countries involved and reviewed before finally set them into this toolkit.

We have deliberately kept the range of 28 tools wide and varied, anticipating to the users of the toolkit that they will 'pick and mix' them according to the constraints of their training schedules, their own needs and objectives, the extent to which particular barriers exist for them and the learner audience that they are addressing.

The tools range from generic ones that could be applied to training in almost any subject (focus on organisational commitment such as budget allocation and training reviews through to training request forms that identify the justification for learning and its application in the workplace), to those that are specific for training in domestic and sexual violence, that have been designed to identify and provide practical solutions to the emotional and personal challenges that domestic and sexual violence learning can bring.

The toolkit provides a range of different tools for improving the transfer of learning from training in IPV and sexual violence interventions/support into practice. It should be adapted to the different needs of the trainers, participants and organisations, depending on the roles and the tasks that they perform (type of participants, kind of training, speciality of the professionals). It is divided into 7 groups:

- Preparatory phase (Pre-training): planning, design and preparation of the training activity. It includes 6 tools and 4 examples.
- Starting and developing training in training course (training stage). The objectives are to provide the knowledge and skills needed and improve the attitudes for IPV and sexual violence approach. Includes 11 tools and 10 examples.
- Appropriate training methods for raising awareness, the acquisition of knowledge and skills are also provided.
- For this start-up and development stage, there are 11 tools and 10 examples.
- Implementation of training stage (4 tools)
- Post training support (5 tools)

- Assessment and follow up for the transfer of the knowledge into the practice (2 tools: evaluation and training review form) and 5 examples.

Providing examples on how training can be structured, and suggestions for useful training methods or how to manage disclosures from participants with or without a clinical psychologist involved.

The toolkit is oriented for:

- Trainers offering training in domestic and/or sexual violence;
- Organisations working in domestic and/or sexual violence (with victims or involved in training or raising awareness);
- Individuals interested in the training available.

This care and support for health care professionals is essential to ensure that we can all be as good for tomorrow's patients as we are for today's. Acknowledging the impact that working with the trauma related to domestic and sexual violence can have on the worker, and providing the appropriate support during the learning process and beyond, is our main objective to provide the highest possible care for victims and survivors.

Hopefully the toolkit and its friendly online version will also contribute to raise awareness about domestic and sexual violence, both by its existence and also by widening the knowledge base through those who benefit from using it.

Acknowledgment

The content of this website: http://www.toolner.com/en/ is the result of the European Project: "*A health sector toolkit for implementing learning from violence against women trainings*", record number: 2013-1-DE2-LEO04-16120 from Leonardo da Vinci Program, financed with European funds, developed for an association of organizers form four countries, Germany (SIGNAL), Austria (Innsbruck's Medical University), Spain (SACYL) and United Kingdom (HAVEN´S). They work with different roles in the struggle against Gender Violence from different organizations, and have shared a common goal: improving health care for victims of gender violence through training of the professionals in this field. One of the objectives has been the development of a set of tools to facilitate gender violence training of health professionals and learned to transfer the clinical practice. The content of this site is a part of the result of this project.

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The Use of Information and Communication Technology by Health Workers for Maternal and Child Health Care: A Review of Seven e-Health Projects in Nigeria

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Introduction

The realisation that ICT has the potential to accelerate progress made towards the reduction of maternal and child mortality rates (MMR) resulted in the initiation of several e-health projects to support maternal and child health care (MCH) [1].

This paper examines projects involving the use of ICT for the delivery of MCH information and services in Nigeria. It explores the influence of the use of ICT on health practices and outcomes. It closes by offering prescriptions for future e-health projects that will focus on delivering vital health information to mothers.

A literature search using Google Scholar, PubMed and Global health revealed seven (e-health) projects in which health workers adopted the use of ICT for maternal and child health care in Nigeria. These include: Mailafiya Project – Federal Capital Territory (FCT), Abuja-Nigeria, Maternal and Neonatal Health Care (MNHC) Learning Project Gombe State, Safe Motherhood Project (Abiye) in Ondo State, Mobile Maternal Child Health Information Technology (mMCHIT), Mobile Community Based Surveillance (mCBS), OpenMRS to support Maternal and Reproductive Health in Kaduna State and m-health services for MCH at Federal Medical Centre Owerri. These projects as well as the challenges encountered and lessons learnt in the deployment of ICT for MCH care in Nigeria are presented in the table 1 and 2 [2-7].

Deductions from the Review

The seven e-health projects in Nigeria provides real examples of how ICT could be used to overcome the challenges of cost, limited resources (human and infrastructure), personnel training, access to medical records and response during emergencies. It demonstrated that, through a well-designed MCH awareness-raising and stakeholder education campaign, ICT could be used to reach more people simultaneously, no matter how remote their locations.

In addition, it demonstrated that, using mobile technologies for the delivery of MCH information and services can encourage the adoption of safe MCH practices as outlined by the World Health Organization in 2007, which can lead to behavioural changes. The review also revealed the following crucial factors that can reduce the barriers encountered in

Table 1: An Overview of e-health projects for Maternal and Child Health in Nigeria

Project	Location	Target	Outcomes	Sponsors
Abiye Project: Use of mobile phone for obstetric emergencies and pregnancy monitoring	Ondo	10 health facilities in 2 LGAs 224 pregnant women	Increase in facility utilization & reduction in MMR by 30%	Ondo State Govt. Globacom
OpenMRS project: Use of OpenMRS information system to provide data on antenatal visit, labour, child immunization, diagnosis.	Kaduna	health facility 60 -100 clients per week.	Increased utilisation of the health facility. Creation of patient record without delaying care improved access to patient records	University of Santa CRUZ SCHIST
Society For Family Health(SFH): Use of Call Centres to improve Maternal and Neonatal Health Care.	Gombe,	Families in Gombe	Improved access to health information. 70 enquiries related maternal and neonatal health.	SFH & Gombe State Govt.
Mobile Community Based Surveillance mCBS	Kaduna	TBAs	74 total live births Only 2% deaths	ehealth, Nigeria MacArthur foundation, Population and Reproductive health Initiative
m-health Project Federal Medical Centre Owerri FMC	Owerri,	Pregnant women	43.4% prompt	Telemedicine Unit of FMC Owerri, Ngor Okpuala Health Centre Imo State University. Min of Health,NARSA NIGCOMSAT
Mobile Maternal Child Health Information Technology (mMCHIT) project	815 health facilities in Six States. Sokoto, Bauchi, Niger, Anambra, Bayelsa and Ekiti States	Pregnant Women Midwives	No visible outcome	Nigerian National Primary Health Care Development Agency (NPHCDA) and Duke University, Durham, North Carolina, US
Malahfiya	Abuja	400 communities and 113 LGAs	Increased patients seen by 270% and disease reporting by 900%.	Federal Capital Territory MDG units and Intel Corporation

accessing quality health care by pregnant women, which will have significant impact on reducing maternal and child mortality:

Table 2: Lessons Learnt and Challenges

e-health projects	Lessons	Challenges
1. Abiye Project in Ondo State, Nigeria ICT tools: Phones	Need for strong public-private partnership alliance. Strong political backing from the government is essential. Need to implement programmes using community- based approach. Willingness to adopt technology by health workers. Good transportation system for emergencies.	Shortage of health workers caused by an increase in workload
2. OpenMRS for MCH Kaduna, Nigeria. ICT tools: Computer/Internet	Attitude of health workers (willingness to learn) helped the implementation of the system. Feedback from the clinical staff was important; this helped in creating a sustainable system.	Language barrier, spelling errors, typing speed and overall speed on computer during training. Shortage of medical record officers.
3. Society For Family Health: Use of Call Centres to improve Maternal and Neonatal Health Care.	Awareness that the call centre was a key factor to success of the project.	Irrelevant calls
4. Mobile Community Based Surveillance (mCBS): Nigeria ICT tools: Phones and computer	ICT can be used to reduce delay in accessing healthcare Training of health workers was also key to the success of the project Non- and semi-skilled health workers can be incorporated into a community-based data collection programme	Lack of desire to participate in the programme by some women. Error from questionnaire used for the survey. Insufficient fund to purchase call credit by the TBAs affected the reporting of major events
5. Malahfiya Project: ICT tools:Laptops, camera and automated mobile Labs	Strong political will High staff morale as a result of better pay package and overseas training. ICT deployment for data capture and management Team work.	Difficulty accessing settlements and communities Double presentation by people to obtain many portions of drug People outside the study area taking advantage of the project to access medical care
6. m-health Project Federal Medical Centre Owerri (FMC) Phones:	Staff training was key to success. Cost of phones was borne by FMC; this was key to the success of the project, as the financial burden on users was eliminated.	Challenges were not captured in the presentation.
7. Mobile Maternal Child Health Information Technology (mMCHIT)	Inappropriate integration approach was a major issue that affected the implementation of the Project. mMCHIT solutions were clinic-based instead of being community based	Low IT skill, lack of awareness, faulty hardware/software, maintenance problem and poor mobile network coverage

- Private/public partnerships involving governments, mobile phone service providers and NGOs;
- Political will and involvement of state and local governments;
- Mobility for health workers and ambulance to convey pregnant women during emergencies;
- Training more health personnel to fill existing gaps in workforce;
- Awareness creation, information dissemination;
- ICT channel/IT skills of health workers and

- Robust and efficient mobile phone-Internet infrastructure, supported by traditional ICT media

Recommendations

The review is a step towards charting the way forward for a successful integration of ICT for the delivery of MCH care. Based on deductions from these projects, the following recommendations are offered for consideration for the scaling up of the use ICT for care:

- A broader strategy is required for integrating ICT into MCH care and must harmonise the efforts of all stakeholders.
- Silos projects must give way to a national intervention project that utilises uniform integrated ICT platform.
- ICT services providers and regulatory agencies must operate based on best practice to enable the benefits of reliable and quality services to resonate in the health sector.
- A private public partnership has been proven to be effective for projects implemented with government taking the lead.
- Placing vital information within the reach of mother has been proven to save lives of mothers. Consequently emphasis should be placed on developing and implementing an efficient, user centric information dissemination models.
- Apart from using ICT to disseminate information to mothers to influence behavioural changes in order to save lives, it could also be used to avoid challenges encountered in reaching influencers, policy and decision makers.
- ICT should be integrated into record keeping, information dissemination, capacity building, referrals, diagnosis and consultation.
- Developing a model for effective MCH information dissemination;
- Developing of an ICT integration policy framework.
- Adequate funding for continuous research for ICT integrations should be provided.

A Model for Effective MCH Information Dissemination

To ensure effective MCH information dissemination, a model for the dissemination of focal messages along the continuum of care using ICT was developed. See Figure 1.

Health workers and information professionals compile and process information from research, medical records and practice/experience, and then package or repackage the information into languages, styles and formats that are acceptable to mothers, which can spur the adoption of safe

MCH practices. This is the information processing stage. It is important to target periods before conception to allow time for decision-making. However, this would be an ongoing campaign, as conception takes place on a daily basis.

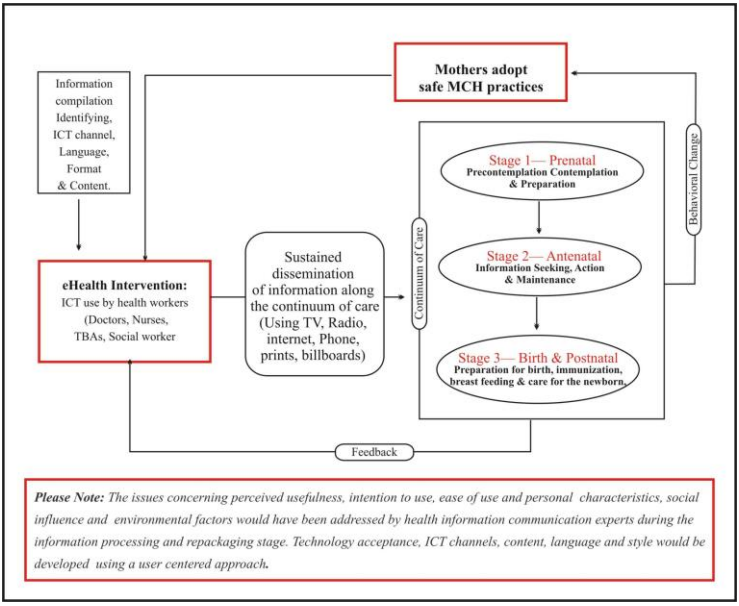

Fig. 1. e-Health Model for Dissemination of MCH information adapted from UTAUT, TTM & HINTS

Further doses of information are disseminated and the mothers begin to seek more information as they take action to change unhealthy behaviour. This is referred to as the Action Stage. Essentially, effective use of old and new media, disseminating the right information (specially packaged to suit the needs and personal characteristics of the target audiences) at the right time, all combine to yield the desired positive behavioural changes and safe MCH practices. Ultimately, adopting safe MCH practices will translate into a reduction in maternal and child mortality rate.

Conclusion

The seven Maternal and Child Health e-health projects in Nigeria represent examples of integration of ICT in e-health. They have demonstrated the positive impacts of ICT in the reduction maternal and

child mortality and provide a learning ground and underscore the enormity of what needs to be done to implement sustainable intervention programs.

Unfortunately statistics on maternal and child mortality indicate that the impacts from these projects are not significant when compared to what is required to meet the millennium development goals. Consequently to amplify the benefits emanating from these projects, it is evident that there is a need to scale-up the level of ICT integration in MCH care.

This requires a multi-dimensional approach that is based on best practices and a cost effective plan. A multi-stakeholder and multi-disciplinary team should champion the course of integrating ICT into MCH care. The approach would be to replicate a uniform e-health model (with slight modifications to suit the peculiarity of each community and target audience), while developing strategies and policies to eliminate hindrances to maximise the benefits of ICT for MCH care.

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Systematic Literature Review on Telemedicine Solutions Implemented for Management of Patients with Heart Failure

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Background

Telemedicine has been applied for management of varies chronic diseases. Heart failure (HF) is a chronic condition that causes a burden for patients and healthcare resources. Method: A systematic literature review conducted to provide an overview of studies evaluating telemedicine solutions that are used for management of patients with HF. Results: The results from selected studies showed that mobile phones and telephones with internet access were the most applied telemedicine solutions. Monitoring of health indexes were mentioned as the most required intervention for patients with HF. Weight, blood pressure, heart rate, oxygen saturation, and ECG were the most often variables that have been measured in these studies. In terms of clinical outcomes, the rate of hospital admission and readmission and patients' self-care and adherence were investigated mostly in selected studies. There were contradictions among the studies in terms of finding significant results. These differences in the results could be drawn from variations in defining the telemedicine solutions, interventions, data collection methods and the focus of the studies. Finally, the most pronounced limitations and challenges in telemedicine related researches were; small sample size, short duration for the interventions and loss to follow-up. Conclusion: Evidence on the usability and effectiveness of telemedicine solutions for patients with HF is still limited. Increasing the interactions between patients and healthcare professionals and offering frequent monitoring of health indexes will reduce the rate of hospitalization, mortality and increase the quality of life, knowledge, and self-care of the HF patients.

Introduction

Chronic diseases are becoming the heaviest burden to healthcare system worldwide. World Health Organization (WHO) reported, from 57 million global deaths in 2008, 63 % were due to chronic diseases that mainly caused by pulmonary diseases, heart failure, cancer and diabetes [1]. In Denmark, approximately one third of the citizens suffer from at least one chronic disease and 60 – 80 % of the healthcare resources are spent on treating and admitting these patients to the hospital [2]. Therefore, due to high costs of the secondary healthcare the traditional model of episodic care in clinic and hospital-based setting is becoming suboptimal for improving chronic disease outcome. More feasible and accessible interventions are required to support patient self-care, reduce chronic hospitalization, and minimize costs of treatments [3]. Cardiovascular disease (CVD) is recognized as one of the important noncommunicable diseases that is a burden to public health worldwide. Based on population-based studies the incidence of heart failure (HF) is 5-10 per 1000 person per year in Western countries. European Society for Cardiology estimated that, there are at least 15 million patients with HF in 51 European countries that require continue treatment, monitoring and management [4, 5]. HF is recognized as an important cause of hospital admission and readmission in patients over 65 years of age in developed countries. In United States approximately 24% of patients with HF are admitted to hospital within 30 day after their latest discharge. Since the demands for frequent monitoring of patients with HF is increasing the use of various telemedicine technologies are recognized as an option for providing improved care worldwide [6]. Telemedicine is defined as a tool in delivery of health services and information by using telecommunication technologies to improve accessibility and quality of healthcare services [7]. This paper will present an overview of studies evaluating telemedicine solutions that had been used for management of patients with HF within the last years.

Material and Method

In order to identify all studies published on the use of telemedicine solutions for management of HF patients, computerized literature searches were performed using the PubMed, Elsevier, and Journal of telemedicine & telecare search engines.

Following keywords and MeSh terms were used “telemedicine”, “telemonitoring”, and “telecare” combined with heart failure. The search for the potential studies was completed by checking the references from original or review articles.

The primary inclusion criteria were the following: articles should be written in English, should be original articles, and use the keywords in the title. The secondary inclusion criteria were: articles should be full-text, studies should be conducted based on randomized controlled trial (RCT), the studies should have a focus on public health, and finally the studies should be published between the years 2008 – 2014. In addition, the scientific validity of the selected studies was assessed according to the Cochrane Collaborations' tool for assessing risk of bias in RCTs and only the studies with high score included in the analysis.

In total, seventy articles were found and according to the primary, secondary inclusion criteria, and Cochrane Collaborations' tool for assessing risk of bias in RCTs, 61 studies were excluded (Figure 1).

Results

Systematic literature search enabled us to identity 70 articles which dealt with telemedicine. The abstract of 49 studies were scanned and 11 full-text articles obtained for closer inspiration. Finally, 9 studies fulfilled the inclusion criteria of the review and were included in the analysis. The scores for the Cochrane Collaborations' tool for assessing risk of bias of the 9 selected studies were between 7 – 4 (7 highest & 4 minimum).

All studies mentioned the internet access in combination with telephone and mobile phone as the most applied telemedicine solutions for patients with HF [8-16]. Six studies were mainly focused on the use of telephone and mobile phone to transfer health indexes including: weight, blood pressure, heart rate, oxygen saturation, and ECG [8-12]. Telemedicine monitoring with the focus of physical monitoring was most required intervention and it has been mentioned in eight studies [8-15]. However, the methods for the monitoring and data transmission were diverse in these studies. Among the selected studies, there were three studies which considered counseling between the HF patients and nurse specialists as an effective telemedicine intervention by using camera counseling [9-10, 12].

The primary aim of integrating telemedicine to the healthcare services is to improve the clinical outcomes and functional status of the patients. All the selected articles investigated possible effects of telemedicine interventions on clinical outcomes of patients with HF. There were in total six studies that examined whether telemedicine interventions could change the rate of hospitalization and readmission in patients with HF [8, 10, 12-14, and 16]. Three studies found reduction in the rates of hospitalization and readmission and the results were statistically significant [10, 12, and 14]. However, other three studies showed no significant difference between telemedicine and the patients with usual care in terms of hospitalization and

readmission [8, 12, and 16]. In terms of self-care and adherence, one study showed that telemedicine solutions significantly increased the self-care with the mean score of 18.9 compared to the mean score of usual care 20.8: the lower the score indicated better results. The most common limitations that had been mentioned in the selected studies were small sample size, short duration for the intervention and the loss to follow-up [8, 10-14].

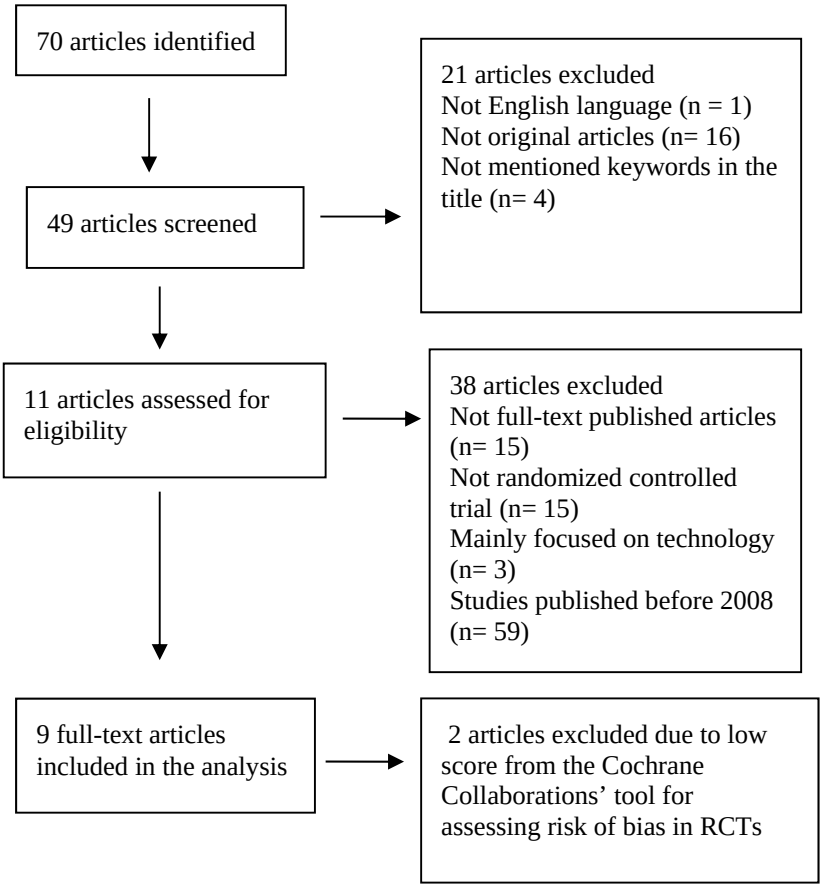

Figure 1: Process of literature selection

Conclusion

The costs for treatment and management of chronic diseases which require constant monitoring such as HF are increasing worldwide. Therefore, healthcare systems are focusing on developing and integrating telecommunication technologies into the healthcare system.

Telemedicine is recognized as feasible and low cost solution for management of HF patients by providing means of interaction between healthcare system and patients, improving patients' knowledge, and self-care management. This systematic literature review provides an overview of studies evaluating telemedicine solutions that had been used for management of patients with HF within the last years.

Based on the reviewed articles, mobile phones and telephones with access to the internet were the most applied telemedicine solutions and monitoring of health indexes are found as the most required intervention for patients with HF according to the selected studies. It is important to mention that in the field of telemedicine further developments and corresponding research are required to explore the highest potential of available solutions and provide optimal are for the patients with chronic conditions.

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