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of the

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NCeHT2006

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Minister's Greeting to NCeHT2006 Participants

Finnish Views of eHealth Development

Dr. Liisa Hyssälä, Minister of Health and Social Services

Dear participants of the 6th Nordic Conference on eHealth and Telemedicine,

First, I would like to welcome you all to this event in our beautiful capital. It is a pleasure to see that so many foreign guests from many continents have taken part to this Nordic conference. The conference topic, "From tools to Services", highlights very well the current situation. Previous independent telemedicine activities are now summoned up to comprehensive services for our citizens. The Nordic Countries have for many years been pioneers and now we can share the experiences with both the European and the wider international audience.

Currently, many European Union Member States have already defined policies of their own on adoption of electronic patient records. This has been mainly done with national or even regional solutions, frameworks and standards. To have interoperability between these systems is, of course, a real challenge per se. It is also important that our citizens receive proper health services when they stay in other Member States. EU cooperation in eHealth will be important when forming the prerequisites for patient mobility.

In Finland, the overall coverage of electronic data systems for health is good. For example, there are electronic systems for patient information in every hospital and primary health care centre. Information exchange between these systems is in regular daily use in many areas. Much remains to be done, however.

Perhaps the most interesting issue to be reported here is our quite recent decision to have a national centre for the electronic distribution and storing of patient records. The responsibility has been given to the Social Insurance Institution of Finland. The Institution has a long experience in a big number of electronically managed social and health insurance benefits that cover the entire population. The decision also includes a list of other technology services at national level which all health care units, including private unites had to use. This decision, along the government financing and Ministry's strengthened role in the future, will give new possibilities to steer and analyse the development.

Also, I would like to stress the importance of training of health care personnel. A competent personnel and a well-managed IT infrastructure are the key elements for developing and implementing electronic services and policies. We have only just started this work and a conference like this strongly contributes to the target. It is a pleasure to note that also the Nordic Cooperation Forum for Telemedicine supported by the Nordic Council of Ministers decided to meet in the framework of the conference.

In addition, I would like to point out one important subject. We should not think that health comes from health care systems or eHealth technology alone, as health is to a major part determined outside the health care sector. I am sure that with new technology we can improve quality and productivity of health care. However, we need to remember that we are not dealing here with technology only. Also the collaboration of all players must be promoted and the processes reformed.

Finally, we can realize true citizen empowerment. This means that we inform citizens and support their own life management by giving them easy access to reliable

information on health and welfare and by offering new, flexible way to take contact with service system.
With these words, I would like to wish all the conference participants a very successful and interesting stay in Helsinki

Welcoming greetings from the Nordic Telemedicine Association

Jarmo Reponen
President of Nordic Telemedicine Association in 2006

The First Nordic Conference on Telemedicine in the current conference series was held in 1996 in Kuopio, Finland organised by Finnish Society of Telemedicine and University of Kuopio together with telemedicine groups from various Nordic countries. The initial conference learned a lot also from teleradiology and telemedicine conferences organised earlier by SPRI in Sweden. The main idea of the new conference series was to bring together various scientists, developers and users from all the Nordic Countries and share development ideas and experiences. All the Nordic countries have been forerunners for telemedicine because of their advanced communication technology. They also share the same standards in health care delivery and medical education.

From the beginning, it was agreed by the telemedicine institutions that the Nordic Conference will be arranged biannually on a rota basis in different Nordic Countries. In 1998 the conference was organised in Reykjavik, Iceland; in 2000 in Copenhagen, Denmark; in 2002 in Tromsö, Norway and in 2004 in Umeå, Sweden. After that, the rota has started once again from the beginning.

It was also agreed that a conference of this magnitude needed a formal supporting organisation to coordinate the collaboration efforts and to ensure continuity. The Nordic Council of Ministers (http://www.norden.org) kindly supported economically a basic survey of the implementation of telemedicine in the Nordic Countries conducted by Dr Thomas Stensgaard from Greenland. The Nordic Council also supported the start-up activities of the new organisation.

Finally in March 1999, a group consisting of two members from each of the five Nordic countries (Denmark, Finland, Iceland, Norway, Sweden), and autonomous areas of Greenland and the Faroe Islands gathered together to formally establish the Nordic Telemedicine Association (NTA). Later on, representatives from the autonomous area of Åland Islands has also joined NTA. The main aim of the organization is to strengthen and expand telemedicine activity in and between member countries and to promote collaboration with the outside world. NTA aims towards collaboration with other telemedicine groups and organizations, especially the national ones within our member countries. Officially, since 15. April 2003, NTA was established as a legal oganization under Norwegian laws by the Brønnøysund Register Centre. The first president of NTA was Siri Uldal from the National Centre of Telemedicine in Tromsö, Norway. NTA was established as a federation of various national organisations and the national telemedicine and eHealth associations are permanently represented in the board.

The mission of the Nordic Telemedicine Association is to facilitate Nordic co-operation and co-operation between Nordic countries and the rest of the world in the field of telemedicine and telecare, and co-ordinate the arrangements of a Nordic Telemedicine Congress every two years.

Since 1999 the association took over the coordination task between the conference organisers in the various Nordic countries. The collaboration has been successful in program planning and networking in preparations. NTA has also assisted Nordic Minister Council and Nordic University Network (NordUnet) community with its expertise in various projects. NTA has also been a link to a more international audience, NTA is represented in the ISfTeH board and the official journal of NTA is Journal of Telemedicine and Telecare. More information of the activities is available through the association website (http://www.nordictelemedicine.org). The Nordic forum has enabled an easy and cosy way to share experiences with a common background of Scandinavian public health care systems and relatively sparsely populated countries.

During the course of past ten years we have seen the ever widening use of information technology and telecommunication in health care. The focus of development has shifted from individual telemedicine applications to citizen centered care and eHealth solutions. Comprehensive service models and interoperable infrastructure is a basis for future development. This is reflected in the main theme of present conference: "From Tools to Services".

The program of the 6th Nordic conference on eHealth and Telemedicine is very comprehensive and interesting. Keynote speakers promote the best experiences from Nordic Countries as well as from other more far away countries like the United States, Ireland and Japan. The European Union has also contributed to the program. Finally the Scientific program consists of 72 high quality oral presentations plus a poster exhibition. The session themes cover a wide range from eHealth and healthcare systems and structures to mobile applications and from medical records to clinical telemedicine and citizen empowerment. The participation to the conference is also more international than ever: a strong input is seen from the new Baltic states as well as from Japan.

For the Nordic Telemedicine Association this conference has been a major task which has not been possible without a major input from our collaborators. We are very grateful to our closest collaborators in National Development and Research Centre for Welfare and Health (STAKES), Finnish Society of Telemedicine (FST), Finnish Social and Health Informatics Association (FinnSHIA), Helsinki-Uusimaa Hospital District (HUS), Finnish Ministry of Social Affairs and Health and National Technology Agency of Finland (TEKES) for their contribution. Also we thank the Academy of Finland for their economical support. Finally we thank all the exhibitors and sponsors for their trust. The support from various international committee members, the national telemedicine societies and individuals from the Nordic Countries has been crucial for the arrangements. Our sincerely hope is that this conference is a nice start for a new ten year period in our conference rota.

We feel ourselves to be privileged to invite you to actively take part of this event, present your work and ideas, listen to the very best solutions that the Nordic and international experts have accomplished and also enjoy the beautiful nature of Finnish summer!

The NCeHT2006 Organisers

The planning and preparation of the 6th Nordic Conference on eHealth and Telemedicine has been a joint effort of the following organisations:

- **STAKES - STAKES Unit for eHealth & eWelfare (STY)**
- **Finnish Society for Telemedicine (STLS)**
- **Hospital District of Helsinki and Uusimaa (HUS)**
- **Finnish Social and Health Informatics Association (FinnSHIA / STTY)**
- **TEKES - Finnish Funding Agency for Technology and Innovation**

In the next pages, you can find a brief description of each organisation's profile and activities.

STAKES Unit for eHealth & eWelfare

STAKES, the National Research and Development Centre for Welfare and Health, is a sector research institute under the Finnish Ministry of Social Affairs and Health. STAKES began its operations on 1 December 1992. The predecessor bodies were the National Agency for Welfare and Health and the National Board of Health. The core functions of STAKES are research, development, and information production and dissemination. It also supports the Ministry in implementing the strategy of the administrative branch.

The STAKES Unit for eHealth and eWelfare operates within the STAKES Information Division that also has the role of a statistics authority. The Unit was introduced in June 1997, then under the name of The Centre of Excellence for Information and Communication Technology - "OSKE". The function of the eHealth and eWelfare Unit is to engage in research and development and provide expertise on Information Society issues in the social and health sector, where the use of information and communications technology is a key priority area.

The Unit contributes to the development of the service delivery system in health and social care through the utilization of information technology solutions. It offers information by maintaining a web service for social care professionals ('Sosiaaliportti' - http://www.sosiaaliportti.fi/), as well as the Classification Centre, which produces the national versions of the most important classifications in social and health care (e.g. ICD 10).

The STAKES Unit for eHealth and eWelfare bases its work on multidisciplinary research and development, national and international co-operation. Our experts evaluate policies, processes and action models in the context of information society developments in social and health care, conduct research, issue publications, organise relevant seminars and conferences. In addition, they actively participate as expert advisors in national preparatory work and dialogue on information society issues in social and health care.

More information on the Unit's work is available at:
http://sty.stakes.fi/FI/index.htm

Finnish Society for Telemedicine
A National eHealth Team Builder

The Finnish Society of Telemedicine (FST) was founded on the 11th of January 1995, the second national society formed after the American Telemedicine Association. The society is multi-professional: physicians, nurses, engineers, salesmen, research staff, educational staff and health administrators. Current yearly census of individual paying members is more than 200, enterprise and institutional members are at 20, and honorary members come from four continents.

The main activity of FST is the Finnish National Conference on Telemedicine and e-Health, which is organised on a yearly basis. The conference rotates between different cities and telemedicine sites in order to give local organisers the possibility to promote their achievements. During past years, the national conference has included international sessions on the current telemedicine situation in Scandinavian and Baltic countries. One of the ideas of the conference is to create a forum, where users, researchers and providers can meet and exchange floating ideas freely. FST also organises seminars, lectures and presentations on specific themes. It forms a network of experts, which contributes to scientific courses and different symposia. Since 2004 FST has delivered the Finnish e-Health prize.

FST is the founding member of Nordic Telemedicine Association (NTA), and a member of the new International Society for Telemedicine and eHealth (ISfTeH). All of our members benefit from these forms of collaboration: they are affiliate members to the international associations, receive reductions in conference fees, and a regular information flow exists discussing international developments. The Finnish Society of Telemedicine is a matchmaker between various players in the eHealth field and it provides a neutral forum where users and providers discuss issues together.

http://www.fimnet.fi/telemedicine

Hospital District of Helsinki and Uusimaa

Hospital District of Helsinki and Uusimaa is a joint authority founded in 2000 by municipalities in Uusimaa Province. About 20,000 skilled professionals work in its 21 hospitals in various parts of Uusimaa. Their important work brings help to some 475,000 patients each year. Studies have shown that patient satisfaction with treatment at HUS hospitals is good.

Helsinki and Uusimaa Hospital District is responsible for producing specialist medical services for the population of 1.4 million residing in its member municipalities. In accordance with a national agreement on division of labour, treatment of the most demanding, rare and expensive illnesses is concentrated at HUS.

All of the major medical specialties are represented at HUS: surgery, internal medicine, anaesthesiology, phoniatrics, physiatrics, obstetrics and gynaecology, illnesses of children and adolescents, neurology, neurosurgery, ophthalmology, otorhino-laryngology, imaging, laboratory specialties, psychiatry, oncology, dermatology and allergology and venereal diseases.

Radiology and laboratory services and catering services are organised as municipal commercial enterprises. Construction and real estate services and laundry services are produced by subsidiaries wholly owned by HUS.

The Chief Executive Officer is responsible for operational activities, and the joint authority administration of the entire hospital district constitute his staff.

The hospital district's joint medicine supply is responsible for purchasing and storage of drugs.

HUS hospitals located in Helsinki along with Jorvi and Peijas Hospitals form the Helsinki University Central Hospital HUCH, whose tasks include not only demanding treatment of patients but also research and teaching. The hospitals in the Hyvinkää, Lohja, Länsi-Uusimaa and Porvoo hospital areas are local hospitals that look after their patients well and also busy teaching hospitals.

http://www.hus.fi

Finnish Social and Health Informatics Association – FinnSHIA

Finnish Social and Health Informatics Association (FinnSHIA) connects researchers, educators and actors in health care environments and organizations to promote health informatics research, education and application of health information technologies and systems. FinnSHIA is the national member society of the International Medical Informatics Association (www.imia.org) and the European Federation for Medical Informatics (www.efmi.org).

The Finnish Social and Health Informatics Association has been established in 1976 and today there are over 130 members in the association, and the association hostes a mailing list on health informatics with more than 300 subscribers. FinnSHIA has been involved in organizing Medical Informatics Europe (MIE)-conferences and World Congresses on Medical Informatics (MEDINFO), and the association hosted the MIE-conference in Helsinki in 1985. FinnSHIA organizes every year a national research seminar on health informatics, this event collects more than 20 papers yearly from young scientists and the seminar papers are published as proceedings. The FinnSHIA association also organizes other seminars and workshops yearly on various topics and themes. More information on the association and contact coordinates can be found at: http://www.stty.org

Tekes – Finnish Funding Agency for Technology and Innovation

Tekes is the main public funding organisation for research and development in Finland. Tekes funds industrial projects as well as projects in research organisations, and especially promotes innovative, risk-intensive projects. Tekes offers partners from abroad a gateway to the key technology players in Finland.

The FinnWell healthcare technology programme (2004 – 2009) is one of the most extensive technology programmes funded by Tekes. The total value of the programme is €150 million, of which Tekes invests about half and the participants of the programme fund the other half.

The objective of the five-year programme is to improve the quality and profitability of healthcare, and to promote business activities and export in the field. The underlying idea of the programme is that technology only improves the quality and profitability of healthcare services if new procedures are simultaneously developed in as innovative a manner as the products themselves.

Three kinds of projects will be funded by the programme:

- Development of technologies for diagnostics and care
- Development of IT products and systems that support care, follow-up or prevention of illnesses
- Development of the operational processes of healthcare

www.tekes.fi/finnwell

Keynote Speakers

The National Health Project - TerveysHanke

Dr. Kimmo Leppo
Ministry of Social Affairs and Health, Finland

The Nordic countries share the main principles in organizing health and welfare services. In addition, many of the challenges in the future are common for us. Demographic changes, social problems, patterns in working life, globalization and development of public finance require us to seek new kind of solutions in providing services for all citizens in a more effective way.

The Finnish Ministry of Social Affairs and Health has recently published strategies for social protection for the next decade. We have defined four strategic lines that are: promoting health and functional capacity, making work more attractive, reducing poverty and social exclusion and providing efficient services and reasonable income security. Information and communication technology (ICT) will have an important role in health promotion and in providing efficient services. ICT enables efficient management of client information and process management using real-time data. Citizens´ position can be improved by giving everyone access to reliable information on health and welfare and the health system. Citizens can be offered the option of managing their own information and performing transactions with the service system in a flexible way.

Achievement of these goals by 2015 presupposes national guidance by authorities as well as a nationwide information systems architecture meeting the demands of data protection and information security. A lot of efforts have already been made as a part of the national health project started in 2002. Nationally required standards for electronic health record systems have been specified. At this moment electronic health records are in general use almost in every health centre and hospital. The national standards should be implemented in these systems by the end of 2007.

The experiences of our national development project have proved, that the information management system should at least in part be organized at national rather than regional or local level. We are currently drafting the legislation concerning the utilization of electronic patient data. According to the upcoming legislation at the heart of the national ICT infrastructure for social and health care will be a national digital archive for patient documents. It will offer services for data exchanging, data archiving, administrating patient´s consent and giving citizens access to a certain part of their own data. The archive will be built in recent years and the purpose is to extend it to cover social services records in due course. The service is to be maintained by the Social Insurance Institution.

Another actual national project is the designing of the health-info portal for citizens. According to studies health is one the most searched themes in the Internet. The amount of the information increases all the time but the challenge is the finding of the information needed by the user and the evaluation of its reliability. The National Public Health Institute is now building an Internet service in which the best possible information about health and illnesses as well as services can be easily found. This portal will support the citizens, professionals and communities in making health decisions which are based on evidence-based information. The Healthinfo-Gateway supports the common objective of the EU to improve the citizens' access to high-quality health information.

eHealth from Research to Implementation - The Perspective of the EU Commission

Dr. Octavian Purcarea
Scientific Officer, EC-DG Information Society and Media

Member States are directing their health policies to subscribe increasingly to the paradigm of citizen-centred services. This implies, inter alia, the need to improve patient safety along the full continuum of care, and to support citizens with tools that enable them to become both well-informed and self-assured patients, and with optimal medical services independent of their location within the European Union.

The European eHealth Action Plan of April 20041 provides a mid-term roadmap for the development of interoperable healthcare systems in and across Member States. To progress towards interconnected and collaborative health services at the regional, national and pan-European level, further concrete and structured steps are urgently needed.

A long history of research and deployment in the information and communication technologies for health area (comprised of almost two decades of European research programmes and more than €550 million of funding) formed the basis of this action plan.

The eHealth action plan was in fact one of a trio of Communications launched in 2004 which provide substance for these new, proposed initiatives on eHealth interoperability in so far as they were based on both the challenges of patient mobility in Europe2 and methods of solution-building created around the open method of coordination3.

The eHealth action plan should therefore allow the European Union to achieve the full potential of eHealth systems and services within a European eHealth Area. This concept is further pursued by the 2005-launched strategic framework i2010 – European Information Society 2010 which sets as priorities the completion of a Single European Information Space, the promotion of innovation, and strong support for the inclusion of all European citizens – topics which are at the heart of eHealth interoperability.

The priority issue which must be pursued vigorously in order to reach these goals and to face international competition is the overriding theme of comprehensive eHealth interoperability: eHealth systems must be interoperable to facilitate and foster the collaboration of health care professionals and organisations, and the various stakeholders must cooperate and involve themselves to solve legal, organisational and policy barriers.

Member States have realised that implementing eHealth interoperability is a long-term process requiring a sustained commitment with respect to political involvement and resources. Achieving interoperability is seen as a goal that can be achieved only gradually – application by application – and is often envisioned using a ten-year framework, if not longer.

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[1] eHealth action plan part of COM(2004) 356(final): e-Health – making healthcare better for European citizens: An action plan for a European e-health area.

[2] COM (2004) 301 entitled *Follow-up to the high level reflection process on patient mobility and healthcare developments in the European Union*.

[3] The open method of coordination in relation to health care is addressed in the Communication from the Commission COM(2004) 304 *Modernising social protection for the development of high-quality, accessible and sustainable health care and long-term care: support for the national strategies using the 'open method of coordination'.*

In the strategic framework i2010 – European Information Society 2010, the European Commission in collaboration with Member States representatives and with the support of relevant stakeholders are building a process of implementation of eHealth interoperability of eHealth applications with a special focus on patient summaries, patient and health professionals identifiers and emergency data set. These cover the domains of political, social, and regulatory issues; appropriate processes and structures to achieve eHealth interoperability; technical standardisation; semantic interoperability; and certification and authentication processes.
The result of this process will be a set of guidelines on eHealth interoperability, which will be issued in 2007 as well as an agreed process to implement these guidelines in the various Member States and at the Union level.

References

[1] eHealth action plan part of COM(2004) 356(final): e-Health – making healthcare better for European citizens: An action plan for a European e-health area.

[2] COM (2004) 301 entitled *Follow-up to the high level reflection process on patient mobility and healthcare developments in the European Union*.

[3] The open method of coordination in relation to health care is addressed in the Communication from the Commission COM(2004) 304 *Modernising social protection for the development of high-quality, accessible and sustainable health care and long-term care: support for the national strategies using the 'open method of coordination'*.

Renewing the Health Care Service Processes through ICT

Ravi Nemana

Center for Information Technology in the Interest of Society (CITRIS) at the University of California, Berkeley.

Information and communication technologies (ICT) have already had a significant impact on health care and the delivery of health services. From Telemedicine to electronic health records to RFID to embedded sensors, a variety of health ICTs have been shown to improve operational and administrative efficiencies, clinical outcomes, documentation and information flow in a variety of global settings, from the home to rural health centers to large urban hospitals. However, adoption and benefits have not been uniformly distributed and replicability of successes has been difficult. What does the future hold for ICT in health care? Where are the trends leading us? What can ICT do to improve the quality, cost, efficiency and capacity of the healthcare serivce? This presentation will cover these topics and the research areas that may lead us to radically novel ways of using ICT for health care and in our daily lives, and it will focus particularly on the capacity issues in healthcare and the role of adoption of ICT.

What Do We Know about the Effectiveness of Telehealth?

Dr. Risto P. Roine

Chief Physician, Helsinki and Uusimaa Hospital District, Finland

The rapid development of information and communications technology has aroused growing interest also in the area of health care faced with the challenge of meeting increased demands with limited budgets. In this context telemedicine has been seen as a potentially effective and cost-saving tool for providing fair and equitable services in the future.

However, before adoption into routine use, a new technology must be proved to be superior (more effective) to the technology it is intended to replace. This is of significance especially regarding telemedicine which may have favourable features, but the existing system may serve the population well and also be capable of improvement. Besides being effective, a new technology should also be proved to be cost-effective, i.e. give better value for money than the old system.

The scientific literature on telemedicine is growing at a fast pace. Unfortunately, the vast majority of the studies are pilot projects that provide mostly interim assessment information. This information gives an indication of the feasibility and, at the best, efficacy (i.e. effectiveness under ideal conditions) of a telemedicine application, but by no means a definite demonstration of the value of telemedicine applications. Such studies therefore, are of only limited value for decision makers faced with the question of whether or not to start a new telemedicine service.

A number of systematic literature reviews on the effectiveness of telemedicine have come to the conclusion that although useful clinical and economic outcomes data have been obtained for some telemedicine applications, good quality studies are still scarce and generalizability of most assessment findings may be limited. Also reviews on the cost-effectiveness of telemedicine have generally come to a similar conclusion that there currently is no good evidence that telemedicine is a cost-effective means of delivering care.

The most convincing evidence on the efficacy and effectiveness of telemedicine so far has been reported for teleradiology (especially neurosurgical applications), telepsychiatry, transmission of echocardiographic images, teledermatology, telehomecare and on some medical consultations. However, even in these applications, most of the available studies have reported results of pilot projects and short term outcomes and have not shown clear benefits of long term or routine use of telemedicine.

In a recent systematic review on telecardiology most of the best quality studies dealt with home monitoring or rehabilitation of heart failure patients and demonstrated benefits through reduction in hospital admissions, decreased hospital stay, and lower hospital costs. Studies on other cardiology indications were for the most part deemed to be of poor quality. For decision-making purposes, they can thus only be regarded as providing preliminary indications of benefits and costs.

Despite the already decades long history of telemedicine, the need for assessment of effectiveness remains for most telemedicine applications urgent. Furthermore, there is a need to consider safety, economic impact and access issues so as to inform decisions on planning and implementation of future health care services, and on standards of care. Decision makers should note the need for follow-up of preliminary studies in order to obtain reliable outcomes data for telehealth applications.

Sociological Perspective of Home-care Technology Projects in Norway

Ms. Gunn-Hilde Rotvold
Program manager, Norwegian Center for Telemedicine, Norway

Sociological perspective of Home-Care technology projects in Norway gives possibilities for a broad approach. My presentation will mainly focus on how technology projects can affect the future nursing and caring services in Norway.
Equal access to health care is an underlying principle in the Norwegian welfare system: Access to health care should depend on medical need rather than ability to pay. Telemedicine and e-health have come to be regarded as an essential instrument in realizing top-level health policy objectives. By implementing technological solutions and employing personnel who can use them, it is possible to bring health services and treatments to where people live. Telemedicine and eHealth can be a tool in reducing barriers between patients and health services, and can provide the feeling of closeness at a distance.
A major driving forces for home based health services are the increasingly growing aging population, and the potential cost benefits from giving them care and medical treatment at home, as an alternative to hospitalisation. By using interfaces such as the TV and a set top box as entrance into the digital world, the services will be easy to use for those not familiar with an ordinary PC. Especially for elderly people, unfamiliarity with PC's and the Internet could be major barrier for seeking health information in the digital world. Focus is put on treating and caring of selected groups of chronically ill people at home.
Specific services that will be possible on the basis of a generic infrastructure are:

- Services for monitoring human medical conditions
- Health related e-learning modules
- Video-conferencing services

Home- care technology projects in Norway are also focusing on how nursing and caring services can be improved by use of electronic interaction.
This will enable us to fully exploit the potential of using the home as an arena for care and medical treatment.
The national strategy for electronic interaction in the health and social- services sector, Te@mwork 2007, highlights the need for a national commitment to support coordinated development of electronic collaboration with and within municipal health and social services. To a growing extent, telemedicine and e-health is used as a tool to communicate patient information between institutions and service levels in the health sector. The nursing and care service is currently not included in this network, but are now at the starting point to reap the benefits inherent in electronic collaboration.

A municipal programme for electronic interaction shall lead to closer and improved cooperation between primary health services, specialist health services and social services.

In 2004 five municipal best practice projects were established. The best practice projects are intended to be of a nationally innovative nature with transfer value for other municipalities, and to include trials of specific measures for electronic collaboration
The best practice projects will help to bring electronic interaction and telemedicine in the nursing and care service a large step further.

ICT in Welfare and Health Service Delivery - Telemedicine in Japan

Professor Dr. Sumio Murase
President, Japanese Telemedicine & Telecare Association, Japan

Introduction

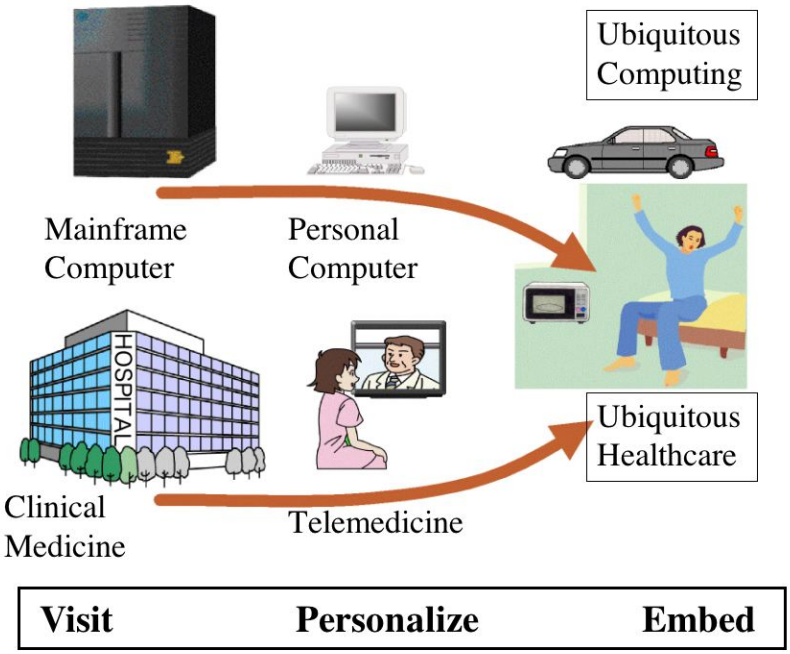
In 1971, Japanese telemedicine started with trials of remote diagnosis, as efforts to provide medical care to mountainous regions. Cable television system was temporarily set up in the region, and diagnosis was carried out using a video monitor. Electrocardiograms were also sent through an ordinary telephone line. This was a rather pioneering approach for telemedicine in the world. However, telemedicine did not get familiar soon in Japan, because of narrowband networks and legal restrictions. The legal restrictions derived from Article 20 of the medical practitioners law. The article prohibits medical care without meeting the patient. Until then, it was not made clear whether telemedicine violated the law or not. In 1997, the Ministry of Health, Labor and Welfare eliminated legal anxiety by publishing notification that telemedicine does not contravene the Article 20. Over the same time period, broadband network infrastructure was rapidly improved and telemedicine was synchronously spread in Japan [1, 2].

Overview

Our survey found that 944 projects had been conducted during the period from 1997 to 2003, and 288 telecare projects were in progress in 2003. Most of projects were organized by hospitals in public sectors, including national university hospitals. However, a few commercial companies were able to provide a service of teleradiology without public support. Comparing these results with those of the 1997 report, projects in progress was increased about 90% in the number from 151 to 288. As for the classification of the 288 projects, about 20% were in telepathology, while telecare and teleradiology were about 30% each. However, it is worth to notice that there was a prominent expansion in telecare, by about four times. Both of teleradiology and telepathology projects were mainly conducted among medical institutions as remote conferences among doctors. On the other hand, telecare projects involved patients at home. Although the percentage of the telecare was only 30%, each telecare projects for the patient consisted of more participants than other projects for doctors.

Ubiquitous healthcare

As telecare, it is important to measure biological data everyday. Therefore, devices for telecare must be improved in the usage. The concept of convenient use is expanded further, and it became possible to measure biological data without consciousness of using devices. This kind of unconscious approach to healthcare should perhaps be called ubiquitous healthcare [3].



For example, a teapot which can monitor a user has been introduced and is gaining popularity in Japan. This is an electric water pot which has a packet communication function built into it. When the user pushes the button for supplying hot water, the timestamp data is automatically transmitted. According to the pattern of the usage, the health condition of the user would be evaluated. In Japan, this is chiefly used to ascertain the health of elderly people who live alone. Another ubiquitous healthcare method is brought to us with motion sensors. This is derived from the security system, but if the level of movement is evaluated precisely, we could monitor sleeping, outgoing and etc. Anomalies in the health condition may be confirmed at an early stage.
Beds and toilets also could be good devices for ubiquitous healthcare. By simply lying down on the beds the heart rate and the respiratory rate are measured. Everyone uses the toilet every day. The weight, body fat, body temperature and sugar in the urine can be measured by the toilet. Actually, prototyping was carried out about four years ago, and the development is progressing in order to incorporate more advanced functions.

Telecare into Space

Japanese Space Agency is planning to launch Japanese Experimental Module (JEM) Christened Kibo ("Hope") to International Space Station (ISS) in tree years. Japanese astronauts are going to stay at JEM for some months. Telecare can be applied to the health management for the astronauts. For the first step of telecare at ISS, we have conducted experiments transmitting biomedical data (blood pressure and the oxygen saturation concentration in blood) between Shinshu University and the Tsukuba Space Center. A manometer attached to a wrist and a pulseoxymeter with a shape of ring were tested.

Conclusion

The areas where telemedicine is needed are expanding from houses to the space station. Telemedicine would be an essential technology everywhere, since medical resources are restricted in the world. Telemedicine, the technology and service of the effective and efficient health management, will improve and promote our healthy life.

Acknowledgements

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References

[1] Estimation and Promotion of Medical Information Technology, Heisei 11 annual report granted by Health Labour Sciences Research, 2000
[2] Telemedicine in Japan, Heisei 15 annual report granted by Health Labour Sciences Research, 2004
[3] Proceedings of The Third Ubiquitous Healthcare Forum, 2006

Abstracts of Oral Presentations

Session A1
eHealth & Healthcare Systems and Structures

Thursday, August 31 2006

Helsinki Hall

11:00-12:30

A1-1 **eHealth: From Policy to Practice**
Päivi Hämäläinen; *Hannele Hyppönen* (*FINLAND*)

A1-2 **Implementing eHealth: Nordic Experiences**
Persephone Doupi; *Päivi Hämäläinen* (*FINLAND*)

A1-3 **Iberian Telepathology Network**
Luis Goncalves[1]; *Fernando Izquierdo*[2]
[1](*PORTUGAL*); [2](*SPAIN*)

A1-4 **A Roadmap towards Healthcare Information Systems Interoperability in Greece**
Alexander Berler; *Anastassios Tagaris*; *Pantelis Angelidis*; *Dimitris Koutsouris* (*GREECE*)

A1-5 **Implementation of Evidence-Based Medicine Guidelines Through a Portal Service**
Pekka Mustonen (*FINLAND*)

A1-6 **International Nomenclatures in Shared Healthcare in the Czech Republic**
Petra Preckova; *Jana Zvarova* (*CZECH REPUBLIC*)

eHealth: from Policy to Practice

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Keywords: eHealth, Health policy, Implementation, Evaluation

Introduction

A policy is a decision made in a political process about what an issue (e.g. Health Care) should be like. Policies are expressed in political declarations, laws and financing decisions. Policies include all methods and practices, which have been agreed up on and are estimated to have an impact on the issue. Policies are implemented in different processes, which according to current interpretation include both top down and bottom-up-processes [1].

A common goal for all health policies is to increase health benefits [2]. From the viewpoint of citizens, key benefits are service quality, access to care and satisfaction to services. Health policies reflect common societal policies, which reflect political trends in the society. From the societal perspective, key questions in health care revolve around cost-benefits and efficiency of services [3]. These questions are reflected also in social and health care technology policies.

Evaluation of implementation of health policies is not very common but some works have been done in Finland and abroad [4, 5]. The impacts of policies in health care practices become visible gradually and in a long time-perspective. The authors studied how the objectives stated in the Finnish National Social and Health Care Information Technology Strategy [6] have survived and turned into health care practices during the 10 years after the publication of the strategy [7].

Methods

Authors tested a method for a long term policy implementation analysis. The policy studied was the Finnish National Social and Health Care Information Technology Strategy (1995). The research tasks were 1) to identify types of implementation processes, 2) to follow consistency of ideas of the strategy through the processes and 3) to study how they were implemented in practice.

Common methodology for policy-analysis is to use a comparative analysis method. As data, we used 3 types of documents: 1) public documents on national level decision making about eHealth between 1994-2005, which were created for the purpose of initiating an implementation process 2) documents describing objectives of central eHealth projects established to implement the policies in practice 3) reports on national surveys and evaluations of the state of the art of eHealth in Finland in 2005.

From the 1st data set we collected the key policies or ideas for implementing eHealth as stated in the Strategy, the implementation processes within the 10 year time span, and the compared the consistency of the ideas throughout the implementation processes. From the 2nd and 3rd set of data we listed the key project objectives/ outcomes comparing them to the ideas stated in the strategy.

Results

The results show that many ideas of the strategy can be followed through the implementation process, but have changed in 10 years time. Technology-orientation has strengthened; client-centeredness, health promotion and client participation have diminished. The idea of seamlessness has survived, but has not been implemented in

practice. Changes in organisational structures, training of personnel or development of statistics have not been implemented in practice. Electronic information exchange such as eReferrals, discharge letters, laboratory results and digital x-rays have become usual. Regional networks for sharing electronic patient record information is increasing but is a part of acute care procedures, not a full integrated care concept. The modernization has happened during the past few years. eServices for patients such as making appointments or having a secure internet connection to the care provider are still rare. These results support the findings that the main emphasis has been given to promoting the organisation oriented technical development, not the patient centred care.

Discussion

The implementation has followed theoretical models of policy implementation and the top-down-implementation model. The challenge is to strengthen a more dialogical development paradigm and strategic steering in order to combine versatile objectives and practical needs. A need exists for multi-disciplinary evaluation covering the whole implementation chain from (policy) objectives to policy impacts.

References

[1] Goggin M, Bowma A, Lester J ja O'Toole Jr LJ. Studying the dynamics of public policy implementation: a third-generation approach. In; Implementation and Policy Process, Opening Up the Black Box. Green Wood Press, New York 1990:181-197.

[2] Murray C, Evans D. Health Systems Performance Assessment: Goals, Framework and Overview. In Murray C, Evans D, ed.. Health Systems Performance Assessment. Debates, Methods and Empiricism. WHO Geneva 2003.

[3] Docteur E, Oxley H. Health-System Reform: Lessons from Experience. In: Towards High-Preforming Health Systems. Policy Studies. OECD 2004:19-85.

[4] Bossert TJ and Parker DA (1984): The political and administrative context of primary health care in the third world. Soc Sci Med 18:693-702.

[5] Hämäläinen PM, Home Respiratory Care; Implementation of Policy and Practice. Acta Universitatis Tamperensis 673, Tampere 1999.

[6] Finnish National Social and Health Care Information Technology Strategy (1995). Sosiaali- ja terveysministeriön työryhmämuistioita 1995:27, Helsinki 1995.

[7] Hämäläinen, P, Hyppönen, H. Sosiaali- ja terveydenhuollon tietoteknologian hyödyntämisstrategian pitkän aikavälin toimeenpano. Sosiaalilääketieteen aikakauslehti (in print).

Implementing eHealth: Nordic Experiences

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Keywords: eHealth, Telemedicine, Health services

Introduction

For over a decade, Nordic countries have been in the forefront of ICT and eHealth developments in Europe and worldwide. In this paper, we focus on selected strategic areas of activity to review and contrast the present progress and eHealth trends in the Nordic countries. Understanding of eHealth development requires evaluation covering the whole implementation sequence, from policy objectives, via deployment, to policy impacts. As a first step, the descriptive analysis of the Nordic eHealth experiences offers a useful reference point for other countries planning and deploying eHealth. In addition, the analysis of present status and future targets allows us to identify areas where most fruitful international collaboration could be established in the near future.

Methods

In the framework of the eHealth ERA project, a Coordination Action funded under the 6th FP of the Information Society DG, information and data on 25 European countries was collected by means of a specially developed structured template, covering various aspects of eHealth policy, implementation and related research. Information was collected through desktop searches, review of scientific and grey literature, presentations and direct input of national experts. The data collection and update period was between October 2005 and March 2006. The identified material was subsequently analysed with the following aims: to identify the most common key priorities in national eHealth strategies; to compare these priorities against those set in the European Commission's eHealth Action Plan and to contrast the stated national priorities against actual deployment activities. The results presented and discussed in this paper concentrate on the material concerning the Nordic countries.

Results

We identified the following key priority areas in national eHealth strategies across the reviewed EU countries: integrated health information networks, Electronic Health Record (EHR) (including standardisation and accreditation schemes), information for citizens & professionals (health portals), e-prescription, patient identifiers and use of cards in health care. Most of these areas are also main areas of eHealth activity in the Nordic countries, with the exception of the use of cards.

Denmark's main priority and emphasis has been on communications. Following up on MedCom - the Healthcare Data Network, the present flagship application is the National Health Portal, providing not only health information services, but also the main entry point for access to and provision of healthcare services. In Finland the emphasis has been on the establishment and wide-spread adoption of seamless service chains, which also include social care. Concrete progress has been accomplished with regard to the Minimum Data Set and applications for professionals. A pilot project for ePrescribing is underway and the National Health Portal is to be launched next spring. Iceland's main focus has been on messaging, telemedicine and Electronic Patient Records (EPRs), while the national network is presently under construction. Norway has established the National Health Net and extensive broadband infrastructure and made considerable

advancements in Telemedicine and home care, particularly in the north. Main future aim is the integration of health and social care, while an ePrescription pilot is under way. For Sweden, telemedicine has been a long tradition. The ePrescribing project has been very successful, as well as the National Network - SJUNET. Currently, emphasis is on systems' integration and on providing patients with access to their own information.

Discussion

eHealth development in the Nordic countries has generally followed a step-wise approach, progressing from smaller to larger scale achievements and gradual consolidation of applications. In several of the European level eHealth priority areas, Nordic countries have already achieved significant accomplishments. In spite the similarities in healthcare system structures and overall policy profile, distinct differences exist, too. Particularly, these differences concern: the choice of priority areas (to some extend) and the focus of corresponding deployment actions, the progress level attained in each area, the legislative and regulatory framework and the areas of infrastructure and finances. It is precisely this variability in approaches that can provide us with insight on the spectrum of strategic choices and their impact in eHealth deployment. Latest trends in the Nordic countries include the move towards international health information networks, the return to the centralized management model and the increased attention to the needs of patients and citizens.

To fully comprehend the processes of eHealth advancement, there is a need to look deeper into the background features of each country. Geographical needs to serve remote areas, for example, may explain the progress in telemedicine in countries like Norway and Iceland. The interest in minimum data sets in Finland may be attributed to high EPR usage levels and a long history of collecting statistical information for health care providers. The explanation of other, less obvious phenomena requires additional policy and implementation-oriented research that can give fruitful information to countries planning the next steps in their eHealth development processes.

References

[1] Doupi P, Hämäläinen P (editors). *The European eHealth Innovation Oriented RTD- Report.* eHealth ERA Project D2.2, March 2006 (draft).

[2] Doupi P, Hämäläinen P. eHealth developments in the Nordic and Baltic Regions. *Annual Review Book,* World Hospital Federation, 2006; 157:151-2.

[3] Nordic Council of Ministers: Health and Social Sectors with an "e". A study of the Nordic Countries. TemaNord. 2005; Copenhagen.

[4] Hämäläinen P, Hyppönen H. Sosiaali- ja terveydenhuollon tietoteknologian hyödyntämisstrategian pitkän aikavälin toimeenpano. *Sosiaalilääketieteellinen aikakausilehti* (article in Finnish, *in print*).

Iberian Telepathology Network

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Introduction

Virtual slides (while slides scanning) are available nowadays in multiple solutions, that we have classified in robotized microscope-based and scanner-based systems. These systems have demonstrated their usefulness in telepathology asynchronous sessions. UICC Telepathology Consultation Center and European Organization for Research and Treatment of Cancer (EORTC) Tumor Bank are good examples of the use of digital pathology imaging for telepathology. We have created an Iberian Telepathology Network (ITN) with the aim of creating an efficient teleconsultation coordination center between pathology departments of Portugal and Spain, using modern virtual slide systems.

Methods

Different Pathology slides scanning systems (Aperio ScanScope T2 & T3, Nikon Coolscope with EclipseNet VSL, and Olympus SIS .slide) are used in the five slides managing centers that initially are participating in the network in Portugal (Hospital do Espiritu Santo in Évora, and Hospital do Alentejo), and Spain (Hospital of Badajoz, Military Central Hospital in Madrid, and General Hospital of Ciudad Real). For a better coordination of these centers, we decided to implement a unique multimedia portal using web services, with the collaboration of mediaWeb Platform.

Results

The telepathology network classifies the telepathology sessions according to the measures needed to maintain patients' confidentiality. With these criteria, sessions are implemented using *virtual private network (VPN)* and (high degree of procedural security needed when patient identification between two centers is needed); using web pages transmitted through SSL and Web-based certificate enrollment when secure identification of partners are needed; and the conventional http, non-encrypted web pages for sharing public information.

Conclusions

Nowadays, we are in the initial phase of the development of the network, with two scanning systems already working, and after the pilot study during the First Virtual Slide Congress in Internet, we agree that the virtual slide technology is adequate for our objectives, and the full development of the network will be possible at the end of this year.

A Roadmap towards Healthcare Information Systems Interoperability in Greece

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Keywords: Interoperability, Regional Networks, HL7

Introduction

It is paradoxical that, although several major technological discoveries such as Magnetic Resonance Imaging, Nuclear Medicine and Digital Radiology, which facilitate improvement in patient care, have been satisfactorily embraced by the Medical community, this has not been the case with Healthcare Informatics. Thus, it can be argued that issues such as Data Management, Data Modelling and Knowledge Management have a long way to go before reaching the maturity level that other technologies have achieved in the Medical sector.
A variety of reasons could be proposed for this issue [1-2], though with a short analysis it becomes rather clear that modern ICT present integration problems within the Healthcare sector because of the way the latter is organised. Healthcare is a strongly people-centred sector in which ICT has been considered more as an intruder, as a "spy" to the healthcare professionals' way of doing things and as a competitor to this people-centred model. Thus, if ICT intend to prove its advantages towards establishing an information society, or even more a knowledge society, it has to focus on providing service-oriented solutions. In other words, it has to focus on people and this has not been the case in most of the circumstances**.**

Methods

The Greek E-business forum (www.ebusinessforum.gr) initiated a new focus group regarding e-health and interoperability, which took the codename Z3. This focus group gathered more than 150 decision makers, medical informaticians, healthcare practitioners and other individual involved in healthcare. The focus group in 2005 prepared an exhaustive questionnaire that was filled by the focus group members. The following list of open issues was depicted from those questionnaires:

1. Political issues are strongly biasing the government's decision making strategy. In that sense, politics tend to change continuously, creating a lack of high level strategy.
2. There is no national strategy for medical terminology, information systems security, disaster recovery, data interchange protocols, etc.
3. Greek medical institutions are understaffed regarding their need for the successful adaptation to new information and communication technologies.
4. As the public sector is concerned, the Focus Group noticed that procedures do not comply to the introduction of ICT, thus creating a draw-backing inertia of the National Healthcare System.
5. High level leadership mostly focus on day to day management than towards introducing the necessary structural changes to support ICT.
6. There is a strong lack of vision amongst leadership, starting top down from the high level administration.

7. The Greek medical ICT market is very small to enforce correct bottom up solutions, thus existing solutions simply follow the complex and bureaucratic way of doing things in the Greek public medical institutions.
8. The user requirements and technical specifications proposed to the implementers often lack of severity, clarity and business scope.
9. There is no follow up of other worldwide best practices, and visionaries are restricted to deploy strategies that never succeeded to overpass the design phase.
10. The proposed time management of government ICT project is unrealistic and do not take into consideration the complexity of the healthcare sector.
11. Fund management and human resources management is not clear and are both mostly spent in unrealistic projects that to not promote ICT as success cases.
12. The high level leadership lacks of ICT knowledge and cannot focus correctly upon the benefit of the correct introduction of integrated information systems in Greek medical institutions. A large majority of questionnaire reported a techno phobic approach of the political and administrative leadership.
13. The Greek healthcare sector has four decision making groups (Ministry of Health, Ministry of Education, Ministry of Social welfare and Ministry of Defence) thus making the business rules extremely bureaucratic creating a business environment that lacks of homogeneity in matters of terminology and procedures.
14. The social security sector is also extremely complex and not homogenised in procedures, insurance coverage, and support to citizens. This is due to the separate route that each ministry has followed for its institutions. Even today with the operation of a general secretariat for social security, the Greek Government has not succeeded yet to create the correct environment for the citizen, despite the efforts of the last years.
15. The human factor lacks of expertise and training in ICT, thus making almost impossible to locate the correct amount of key users or early adopters to promote ICT.
16. It is extremely difficult to implement business reengineering projects in the public sector. Nevertheless, many efforts are in the process of implementation.
17. The reaction to change is quite large, since techno phobia has passed from top management to a large number of employees, thus creating a hostile environment for ICT visionaries

Results

The integration of existing and forthcoming information systems represents one of the most urgent priorities in order to meet the increasing clinical, organisational and managerial needs [3]. In that context, the use of standards is essential since data processing needs vary widely in the complex regional healthcare environment. All RHA have a major concern in evaluating the existing operational hospital information systems (HIS) and other information system infrastructure in order make a decision on whether to maintain or replace them. In Greece, more than ten distinct vendors have installed healthcare IT related products (Hospital Information System - HIS, Laboratory Information System – LIS, Radiology Information System – RIS, etc) that mostly work independently as IT niches. It is known that the lack of healthcare information standards

is one barrier to the broad application of IT in health care units. The inability to share information across systems and between care organizations is just one of the major impediments in the health care business's progress toward efficiency and cost-effectiveness, as well as, the absence of a unique national or even regional patient identifier in Greece. Integration of these existing diverse systems with the future information systems to come remains problematic with a number of competing approaches, none of which alone represent the perfect solution. Current practice shows that the most promising approach to achieve a Regional Healthcare Information System is to use, where applicable, a HL7 message-based communication system implemented by an asynchronous common communication infrastructure between healthcare sites.
Another important feature of the proposed solution is that it creates an interoperability framework that can be replicated from one healthcare institution to another. In that sense, common interoperability messages can be used to interconnect heterogeneous information systems within a healthcare institution or even at a regional healthcare level if a centralised information system is in place, as depicted in Fig.1.

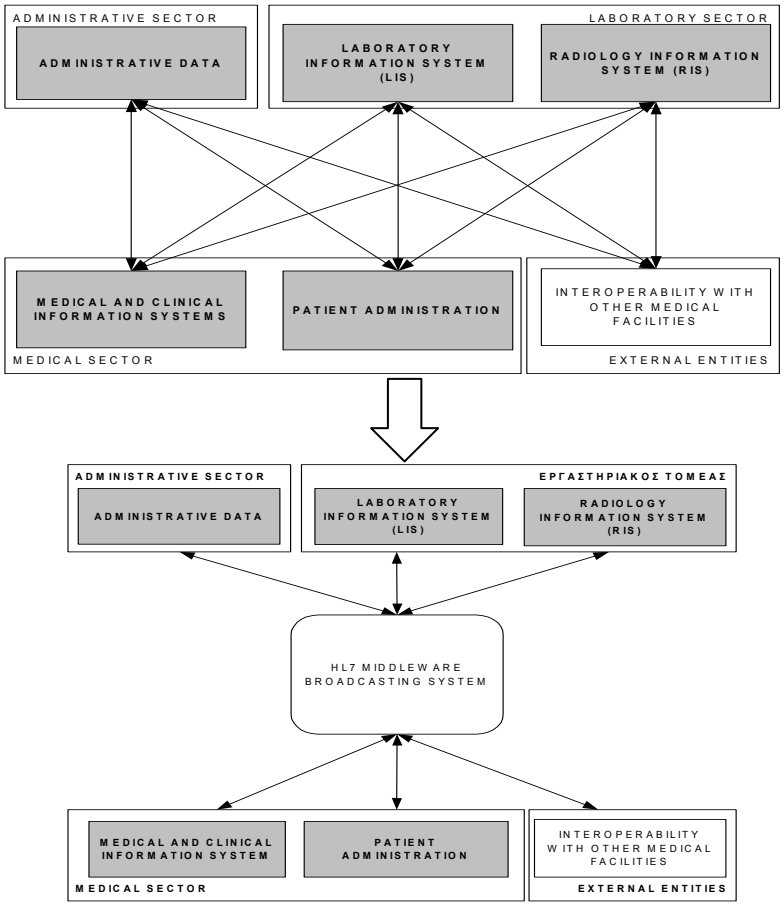

Figure 1. Creating an Interoperability Framework

Discussion

The Focus Group reached consensus regarding the establishment of an interoperability roadmap described in ten recommendations:

1. Deployment of an interoperability framework based upon common communication interfaces.
2. Assessment and sustainability of existing information systems in medical institutions, based upon a specific scorecard methodology.
3. The Healthcare informatics market should strongly focus towards standards conformance and standards maintenance. Consensus based processes for the deployment of the basic standards functionality are of critical importance (i.e. implementing integration labs).
4. HL7 is mature enough to solve most of the interoperability issues in Greek and many more than simple data interchange.
5. HL7 standards should be refined to meet peculiarities of the Greek healthcare system is such issues exist.
6. HL7 Hellas can assist the Greek ministry of health in the required standardisation process that is needed to implement a national interoperability platform (terminologies, processes, workflows, performance indicators, etc).
7. Specific task forces, standardisation teams should be established immediately, under the umbrella of an information authority or of an independent scientific society such as HL7.
8. National interoperability conformance statements must be implemented based upon the work done by IHE (Integrating the Healthcare Enterprise) with the use of HL7 and DICOM conformance statement templates and methodologies.
9. Greece should follow the work done by international task force created by standardisation bodies such as ISO, CEN/TC 251, HL7, openEHR, etc. This is especially valuable as the creation of a national EHR is regarded.
10. Immediate involvement of Greek experts and knowledge workers in international standardisation processes.

References

[1] Stegwee R., Spil T. (2001), Strategies for Healthcare Information Systems, Idea Group Publishing.

[2] Iakovidis I. (2000), Towards a Health Telematics Infrastructure in the European Union, In "Information technology strategies from US and the European Union: transferring research to practice for healthcare improvement", Amsterdam, IOS Press.

[3] Jane Grimson, William Grimson and Wilhelm Hasselbring, "The SI challenge in Health Care", Communications of the ACM, 43(6), pp 49-55, 2000.

Implementation of Evidence-Based Medicine Guidelines through a Portal Service

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Key words: eHealth, Evidence-Based Medicine, guidelines, implementation, internet, portal

Introduction

Evidence-Based Medicine came to the fore in the early 1990s and has become a major driving force for many national healthcare organisations. The term and concept originated at McMaster University, Canada. It has been defined as "the integration of best research evidence with clinical expertise and patient values" [1]. Evidence based medicine's biggest future challenge is one of knowledge translation, ensuring that clinicians base their day-to-day decision making on the right principles and on current best evidence [2].

A comprehensive collection of Evidence-Based Medicine Guidelines has been established in Finland during the past fifteen years. A clear classification of the strength of any available evidence has been established by using a simple coding system from A to D later adjusted to match the criteria of the GRADE Working Group [3]. The database contains nowadays > 1 000 guidelines, > 4 400 evidence codes with summaries providing links to Cochrane reviews. In electronic format EBM Guidelines has been supported from the beginning by several other databases such as medical journals, National Current Care Guidelines and picture database, all together comprising an entity called Phycisian´s Database. Until year 2000 the electronic versions were published on a CD and EBM Guideline database also as a printed book.

Six years ago a commercial health portal was founded to promote the usage of EBM Guidelines in daily practice. The intervention was to enhance the use of evidence-based information through an Internet-based solution. Usage of the guidelines has been monitored through a log file analysis.

Methods

The portal service was meant for the health care professionals and the right to use was on commercial basis. From the beginning the right to use the contents was based on a contract between the health care organization and Duodecim Medical Publications Ltd, the provider of the service. Organizations were identified and granted access via IP-number recognition.

Since the launch of the service the use of the guidelines has been monitored through log file analysis and licence agreement details. Log file recordings of used search terms and usage of guidelines are utilised for continuous improvement of the contents in order to meet the needs of the users.

The architecture and launch of the portal service were planned in close cooperation with the key representatives of the major customers, the medical directors of all the 21 health care districts of Finland.

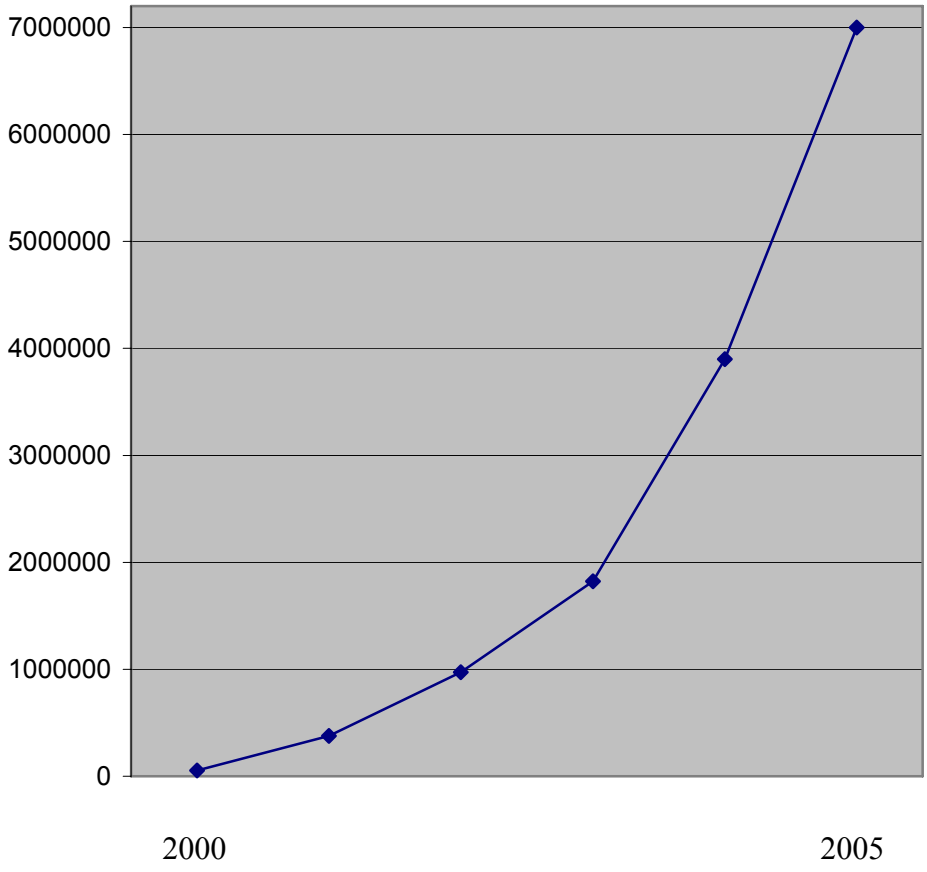
In order to enhance the interest to the portal service other useful contents such as: Pharmacopea, Cochrane Library, Intensive care guidelines, ICD-10, health related news were included.

The annual user-licence to the service entitled the customers to a number of training sessions for the employees. The training was organized by using the medical students as instructors.

Results

In the five years the usage of the portal has dispersed over the Finnish health care. All the 21 health districts licensed the portal from the very first year and nowadays > 98% of the 250 health centres have licensed the portal for their employees.
The usage of Phycisian´s database has grown exponentially (Fig. 1). In 2005 more than 7 000 000 articles were opened by approx. 16 000 practicing physicians and other health care professionals. Appox. 50% of all the opened articles are from EBM Guidelines – database.

Fi**gure 1.** The number of opened Phycisians database -articles per year (2000-2005)



More than 90% of the opened articles are being opened during working hours (07-17) and from the IP-numbers of the public and private health care providers.

Discussion

Because of the underlying database technology, all visits to the pages can be counted. Records convincingly show that the health portal has been welcomed by the system. Furthermore, the providers seem to seek information mostly in those problems, which they do not encounter in everyday practice. Even the seasonal trends can be seen, eg., both the tick-borne Borreliosis (Lyme disease) serologically verified infections and the related EBM Guidelines -searches reach their peak during late summer [4].
To our best understanding the success of the implementation of EBM-Guidelines has been promoted by some specific features of Finnish cultural and technical infrastructure, eg.:

- high penetration of the Internet technology

- one dominant culture and value basis of all health care
- single municipal ownership of all public health care facilities
- the impossibility to gain economically from unwillingness to cooperate
- almost identical university curricula in all the five medical faculties
- a respected scientific society and it´s publishing company as the operative player with almost 100 % membership coverage among the Finnish-speaking phycisians
- right timing

We have no hard evidence on whether the vast number of opened articles, thus consultations to EBM Guidelines have any impact on unifying or changing clinical practices. We found it impossible to set up a randomized controlled trial due to the fact that practically every healthcare professional in Finland uses the guidelines, and it was impossible to define any valid control group for a controlled set up. However, there is evidence that guidelines in general are effective in changing processes and outcomes of care [5, 6] if the implementation into daily practice is successful [7, 8]. Additionally, previous log file studies from the use of EBM Guidelines reveal that the necessary information is found in more than 94 % of the search occasions and based on blinded analysis of patient records and on user interviews the guidelines are followed in more than 85% of the cases [9].

During the past few years EBM Guidelines has been translated into several languages (eg. English, German, Russian) and if successful implementation appears in certain areas or countries tempting settings for a randomized controlled trial may appear.

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References

[1] Sackett DL, Straus SE, Richardson WS, et al. Evidence-based medicine. How to practice and teach EBM, 2nd ed. London: Churchill Livingstone, 2000.

[2] Guyatt G, Cook D, Haynes B. Evidence based medicine has come a long way (Editorial) BMJ 2004 ;329(7473):990-1.

[3] The GRADE Working Group, Grading Quality of Evidence and Strength of Recommendations. BMJ 2004 328: 1490-1494

[4] Jormanainen V, Jousimaa J, Ruutu P, Kunnamo I. Physicians´ database searches as a tool for early detection of epidemics. Emerg Inf Dis 2001; 7: 474-476.

[5] Thomas L, Cullum N, McColl E, Rousseau, N, Soutter J, Steen, N. Guidelines in professions allied to medicine., Cochrane Database of Syst Rev 2000; 2: 1317-1322

[6] Grimshaw J, Russel I. Effect of clinical guidelines on medical practice: a systematic review of rigorous evaluations. Lancet 1995; 362: 1317-1322

[7] Grol T, Grimshaw J. From best evidence to best practice: effective implementation of change in patient´s care. Lancet 2003; 362: 1225-1230

[8] Cranney M, Qarren E, Carton S, Gardner K, Walley T. Why do GPs not implement evidence-based guidelines? A descriptive study. Fam Pract 2001; 18: 359-363

[9] Jousimaa J. The clinical use of computerized primary care guidelines [Doctoral dissertation]. Kuopio: University of Kuopio; 2001

International Nomenclatures in Shared Healthcare in the Czech Republic

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Keywords: metathesaurus, ontology, classification, nomenclature, electronic health record

Introduction

Insufficient standardization in medical terminology presents one of the prevailing problems in processing of any kind of medical-related data. More than ten synonyms may often be found for a single medical term. And even more significant problem arises when the "synonyms" are not fully semantically equivalent or when they are generally understood in different ways. Usage of such synonyms in scientific terminology leads to inaccuracy and misunderstanding. Various classification systems, nomenclatures, thesauri and ontologies have been developed as a result of common endeavour directed to the unification of medical terminology. Unfortunately, the fact that there is more than one hundred of incompatible systems brings complications. The necessity of software tools supporting conversion between major classification systems and recording relations among terms in heterogeneous sources became obvious. Apparently, the most extensive project addressing these issues is the Unified Medical Language System (UMLS) [1]. One of its main components – the UMLS Knowledge Source Server (UMLSKS) – was used to evaluate the applicability of international nomenclatures for shared healthcare in the Czech Republic (CR). This paper presents not only the problematic issues that we have identified, but it also suggests a methodology on how to deal with presented mapping problems.

Materials and Methods

The UMLSKS is of significant help while trying to standardize medical terminology that is used in various Czech healthcare-related systems. It identifies classification systems in which a given term appears. It also reveals narrower and broader terms and semantic relations to other medical terms. In order to standardize the clinical content of health-related applications used in CR, we focused mainly on searching within the SNOMED CT classification system [2]; however, we also searched all the other classification systems when relevant. Standardized terms may, for example, be referenced while modelling Electronic Health Record (EHR) systems using archetypes [3].

Results

In order to determine the suitability of individual terminological thesauri, first we have performed an analysis of how the Minimal Data Model for Cardiology (MDMC) [4] could be mapped to various terminological classification systems. MDMC is a set of approximately 150 concepts, their mutual relations and integrity restrictions. The results show that approximately 85 % of MDMC concepts are included in, at least, one classification system. More than 50 % are included in SNOMED CT. In further details, the concepts may be divided into five classes as follows. *Trouble-free concepts* may be mapped directly. *Partially problematic concepts* have several mapping possibilities to different synonyms, which differ slightly in their meanings and classification codes. *Concepts with a too small granularity* describe a certain characteristic on a too general level so that classification systems only contain terms of a narrower meaning. On the

other hand, *concepts with a too big granularity* describe a certain characteristic on such a narrow level that classification systems only contain terms of a more general meaning. And finally, there are also *concepts that cannot be found in classification systems* at all. While analyzing the attributes of the Data Standard of Ministry of Health of CR (DASTA) [5], we have obtained similar results. However, prevailing structured concepts within this standard are limited to laboratory data, which are specified in large details by means of the National Classification of Laboratory Items [6]. Finally, we have analysed mapping concepts of selected clinical modules of commercial hospital information systems, e.g., the specialized ECG module of the WinMedicalc clinical information system [7]. As this module is a very specialized one, we managed to map only about 60 % of all concepts. Prevailing problems are connected with a too big granularity of concepts in such specialized models.

Discussion and Conclusions

Close cooperation with specialists is required while solving described mapping problems. It is often needed to choose the right standardized synonym substituting a certain technical term. Such a substitution has to be done very carefully, not to loose information and not to misinterpret it. In case some loss of information seems unavoidable, a better way is to describe a non-coded term using a set of several coded terms; preferably including their semantic relations. If neither this is applicable, the cooperating specialists should try to replace the "indescribable" terms by better standardized ones. In some cases it may also be possible to add a certain term into an upcoming revision of a certain coding system. In case none of the mentioned methodologies works, one has to cope with the fact that standardized mapping cannot be performed. Restricted interoperability is often inevitable from the very root of the problem, e.g., insufficient harmonization of clinical content of heterogeneous EHR systems. However, usage of international nomenclatures and metathesauri in healthcare is the first essential step towards interoperability of such heterogeneous systems; and it is the core for shared medical care. Only this is the way leading to effectiveness, financial savings and to reduction of patients' stress.

Acknowledgements

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References

[1] United States National Library of Medicine, National Institute of Health, Unified Medical Language System, 2005. Available at http://www.nlm.nih.gov/research/umls/.

[2] SNOMED International®, Systematized Nomenclature of Medicine – Clinical Terms, 2005. Available from http://www.snomed.org/snomedct/.

[3] Beale T.: Archetypes and the EHR. In: Stud Health Technol Inform. 2003, pp. 238-244.

[4] Tomeckova M.: Minimal Data Model for Cardiology – Selection of Data (in Czech). In: *Cor et Vasa*, Vol. 44, No. 4 Suppl., 2002, p. 123.

[5] Lipka J., Mukensnabl Z., Horacek F., Bures V.: Current Communication Standard DASTA of the Czech Healthcare (in Czech). In: Zvarova J., Preckova P. (eds.): *Information Technology in Health Care*, EuroMISE s.r.o., Praha, 2004, pp. 52-59.

[6] Ministry of Health of the Czech Republic, Data Standard of the Ministry of Health of CR and National Classification of Laboratory Items, 2004, http://www.mzcr.cz/index.php?kategorie=31.

[7] Subrt D., Raska J., Bures V.: Structuring of Information in the WinMedicalc Hospital System (in Czech). In: Zvarova J., Preckova P. (eds.): *Information Technology in Health Care*, EuroMISE s.r.o., Praha, 2004, pp. 33-51.

Session B1
Clinical Telemedicine

Thursday, August 31 2006

Terrace Hall

11:00-12:30

B1-1 **Status of Digital Radiology Image Archiving and Transfer in Finland**
Jarmo Reponen; *Ilkka Winblad*; *Päivi Hämäläinen*; *Maarit Kangas* (*FINLAND*)

B1-2 **Consultations in a Telemedicine Project in Iceland**
Margret Valdimarsdottir (*ICELAND*)

B1-3 **Tele-ECG - a Component in Nearby Care Development**
Owe Svensson; *Holger Holst*; *Berggren Gunilla* (*SWEDEN*)

B1-4 **The Teleconsultation in General Practice. A Randomized, Controlled Study of a Remote Consultation Experiment Using a Videoconferencing System**
Olavi Timonen (*FINLAND*)

B1-5 **Tele-Home-Care in the Future - a Danish Pilot Project**
Ole Winding (*DENMARK*)

B1-6 **Evaluation of Clinical Consultations in Telemedicine**
Thorgeir Palsson; *Margret Valdimarsdottir* (*ICELAND*)

Status of Digital Radiology Image Archiving and Transfer in Finnish Hospital Districts

Reponen J[1], Winblad I[1], Hamalainen P[2], Kangas M[1]
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Keywords: Picture Archiving and Communication Systems, Teleradiology

Introduction

Teleradiology has been one of the first applications of telemedicine in Finland. The first experiments were made in 1969 and in 1994 all the five university hospitals had teleradiology services (1). Picture Archiving and Communication Systems (PACS) started to develop in our country after implementation of DICOM (Digital Imaging and Communication in Medicine) standard in 1995 and the first filmless hospitals started production towards year 2000 (2).
The Finnish national strategies towards the information society have emphasized the social and health care sector as one of the main targets. Radiology information systems are a key element in the development of a multimedia medical record. Many problems concerning telecommunication, system integration and standardization have been solved first for the radiology platform. FinnTelemedicum (Centre of Excellence for Telehealth) at the University of Oulu and Stakes (the Finnish National Research Centre for Welfare and Health) conducted a survey on the usage of information technology in health care in 2005 (3). Several questions in this survey were also included in a similar survey by FinnTelemedicum in late 2003 (4). Both surveys were done as an assignment of the Ministry of Social Affairs and Health and their main purpose was to gather information on the implementation level of national information society strategies. The current status of the radiology information systems as a part of the electronic patient record (EPR) will be discussed.

Methods

A structured web-based questionnaire was e-mailed both in 2003 and 2005 to all public health service providers in the hospital districts. The questionnaire consisted of questions about the status of PACS and regional image distribution / archive systems and teleradiology. The current status PACS was discussed also in a telephone interview with the heads of radiology departments and a cross reference was made to the installation information provided by the commercial PACS vendors in Finland. The survey recorded also the usage ratio (of the total image production or distribution) and the lifetime of the systems.

Results

Responses were obtained from all the hospital districts of Finland (100 %, n=21). The results of 2003 and 2005 on PACS installations, teleradiology and regional image distribution / archive services are presented in Tables 1 and 2. As teleradiology services could be independent of PACS or a real regional archive, also a cumulative result of any kind of image transfer services is given.

Table 1. PACS installations in Finnish hospital districts (n=21) in 2003 and 2005

Measure:	2003	2005
PACS in production phase	12/21	15/21
PACS in pilot phase	4/21	2/21
PACS in installation phase	10/21	4/21
PACS usage > 90%	6/21	15/21
PACS usage 50 - 90%	3/21	1/21
PACS usage < 50%	4/21	1/21

Table 2. Teleradiology and regional image distribution / image archive systems in Finnish hospital districts (n=21) in 2003 and 2005

Measure:	2003	2005
Teleradiology in production phase	13/21	16/21
Teleradiology in pilot phase	4/21	2/21
Teleradiology usage > 90%*	2/21	5/21
Teleradiology usage 50 - 90%	2/21	0/21
Teleradiology usage < 50%	11/21	9/21
Reg. Archive (with PACS) in production phase	3/21	10/21
Reg. Archive in pilot phase	0/21	3/21
Reg. Archive usage > 90%*	0/21	3/21
Reg. Archive usage < 50%	3/21	4/21
Cumulative Results: **		
Image Transfer: Either regional archive or teleradiology service in production	13/21	18/21

* Not all the hospital districts gave answer to the usage question.
** In 2005 two hospital districts did not any more have teleradiology as a separate service, but included it within regional archive services from their PACS.

Discussion

The adoption of PACS and teleradiology in everyday practice is high in Finland. Starting 10 years ago, the progress in past two years has been fast especially for PACS, and during the year 2006 all the hospital districts will have a PACS in production. The target is to have a real filmless environment, which makes PACS a real component of EPR. Also the utilization of teleradiology has increased, but at the same time new regional image archives are taking the role of previous teleradiology applications for consultations between primary and secondary care. It will be seen if traditional teleradiology will find new applications e.g. in division of extra radiology workload.

References

[1] Reponen J. Teleradiologia Suomessa.[in Finnish] Suom Lääkäril 1996; 51:1875-1878.

[2] Reponen J. Telemedicine and eHealth Network in Northern Finland. Int J Circumpolar Health 2004; 63: 429-435.

[3] Univ. of Oulu and Stakes. FinnTelemedicum -Stakes eHealth survey. Unpublished interim results, 2006.

[4] Kiviaho I, Winblad I, Reponen J. Terveydenhuollon toimintaprosesseja ja asiointia tukevat atk-sovellukset Suomessa. Osaavien keskusten verkoston julkaisuja 8/2004.

Consultations in a Telemedicine Project in Iceland

Thorgeir Pálsson[1], Margrét Valdimarsdóttir[1], Rúnar Reynisson[2], Jörundur Kristinsson[3], Ásgeir Haraldsson[4,5], Hannes Petersen[5,6], Dóra Lúðvíksdóttir[5,7], Sigurður Kristjánsson[4,5], Margrét Oddsdóttir[8,5], Steingrímur Davíðsson[9], Gestur Þorgeirsson[10,5],

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Keywords: Telemedicine, videoconference, store-and-forward, consultations

Introduction

The aim of the project was to evaluate the usefulness of using telemedicine for clinical consultations in Iceland and to gain information and experience for further organisation of Telemedicine in the country. Organisational factors were of primary interest. Doctors in six specialties in Landspitali University Hospital and private practice and Primary Care Physicians from five Health Care Centers in Iceland participated in the project. Patients who entered the Health Care Centers on the examination period were offered to participate. In total 40 patients participated. Different procedures of Telemedicine suited for each specialty with store-and-forward (S/F) or videoconference were examined. In the beginning of the project a questionnaire survey was sent to all Primary Care Physicians in the Country to investigate their interest and motivation in using Telemedicine in healthcare service[1,2]. Apart from Telemedicine consultation, the Health Care Centers had also the opportunity to follow lectures from the University Hospital in videoconference. The project was run from August 2003 to October 2005 and it has valuable results for those beginning to consider Telemedicine in daily healthcare service.

Methods

The project was structured on the following 5 stages :
The first included preparation and organisation of the project and survey for Primary Care Physicians. Telemedicine is not a routine service and therefore Icelandic doctors cannot expect to have this possibility for the clinical consultations. The second stage was trial period where technical equipment and surroundings in Hospital and Health Care Centers were adjusted to the project. The third stage was the main stage where consultations with both videoconference and S/F techniques were made. The fourth and fifth stages included assembling the evaluation data and the final report.
The evaluation data was sampled using online forms on the Internet for the doctors and paper forms for patients. The forms addressed issues such as technology, results of the consultation and on the doctors and patients personal experience of the Telemedicine.
The Primary Care Physicians prepared the case for consultation by sending via electronic mail (E-mail) information to the Specialist but without identifying the patient. The appointment for videoconference consultations was scheduled using E-mail. During the videoconference, both the patient and Primary Care Physician participated on the distal end. In S/F consultations, the Specialist answered directly via E-mail. Clinical data for the consultations was assembled using electronic stethoscope, spirometry, otoendoscope, Electrocardiogram (ECG) and digital cameras for dermatology.

Results

In general the doctors and patients were content with the use of Telemedicine, which was found helpful in almost every case. From clinical point of view the digital camera, otoendoscope, ECG and spirometry proved useful, but the electrical stethoscope less so. S/F consultations in dermatology were the most "popular" specialty in the project. The doctors were in general satisfied using the videoconference equipment but old equipment and the need for technical assistance caused some problems. All the patients who participated in a videoconferencing consultation rated that it was at least as good to have the specialist remotely as if he was in the same room. More thorough results concerning doctors and patients evaluation will be given in the lecture.
Organisational factors will be present on workflow, institute organisation, cost and technical service.

Discussion

In short: The results of the project were promising. The experience clearly demonstrated that many factors need considerations, for a consultation service to function properly. These factors include diverse issues, such as telecommunication, the doctors involved are interested in the using the Telemedicine service, good organisation of the Telemedicine consultations and the necessity that hospital and Health Care environment adapt to using Telemedicine equipment and the service. Telemedicine needs to be incorporated in daily work and the organisation of the work is important but it the workload should not be allowed to increase because of Telemedicine. The Primary Care Physicians extended their knowledge in near all the consults.
The results indicate that Telemedicine has a role in Icelandic Healthcare[3] but attention must be paid to organisation of the consults, cost and technical details. More information will be presented on those factors. The general organisation of the healthcare can be affected by using Telemedicine and the role of Healthnet will be of importance for such purpose.

Acknowledgements

The authors would like to acknowledge the support of Rannis – The Icelandic Centre for Research, for funding of the project.

References

[1] In Icelandic, in Icelandic Medical Journal : Margrét Valdimarsdóttir, Jörundur Kristinsson, Thorgeir Pálsson, Ásgeir Haraldsson, Hannes Petersen, Margrét Oddsdóttir, Rúnar Reynisson, Sigurður Kristjánsson, Áhugakönnun um fjarlækningar meðal heimilislækna. Læknablaðið 2004. 90;332-333.

[2] Margrét Valdimarsdóttir, Thorgeir Pálsson. 5th Nordic Conference on eHealth and Telemedicine

[3] Thorgeir Palsson, Margret Valdimarsdottir. Review on the state of Telemedicine and eHealth in Iceland. International Journal of Circumpolar Health 2004.63:4.327-333.

Tele-ECG - a Component in Nearby Care Development

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Keywords: eHealth, Telemedicine, ECG, Nearby care

Introduction

Nearby care is an important component in modern health care provision by the side of planned and specialised care. Nearby care is the entrance port to the care processes, but is also the level of care that manage diseases requiring frequent contacts with the health care. Nearby care is, from the patient's point of view, meant to be a seamless care involving care from the municipality, primary care and the nearby hospital. This development is in Sweden hampered by obstacles due to organisational borders.
Patients with chronic heart diseases are rather frequently seen at the nearby hospital's acute department. Many of these patients are old and are subject to home-based health care in elderly homes or private homes. When these patients feel a change in the health state or symptoms from the heart, the nurse from the municipality is in most cases consulted for advice. The nurse's base for an advice is knowledge of the patient history, blood pressure and pulse rate. This rather limited information for decision may cause admissions to the nearby hospital's acute department for extra security reason. A transport to the hospital is very uncomfortable for many elderly patients and means an additional load to the acute department. In this project we will investigate if an actual ECG and a telephone call to a physician at the nearby hospital's acute department will change the nurse's decision pattern. We will investigate if this added information base for decision will avoid unnecessary transports to the hospital, but also if this may speed up the process for patients with non-typical symptoms where an acute visit at the hospital is important. We will also investigate if the nurse/physician communication will cause other types of changes in disease management as for example changes in pharmaceutical treatment.

Methods

Portable ECG-devices and telecommunication service from Telemedizinische Service und Gesundheits Zentrum GmbH (TSGZ) in Bad Segeberg Germany is used for this project. The service comprises a small ECG device for 12-lead ECG (Card Guard 7100^{TM}) and a telephone transmission to a server at TSGZ in Bad Segeberg that converts the ECG signals to an ECG-chart and sends it by mail to the acute department at the nearby hospital. This type of devices has been validated in a study with 128 patients where patient recorded ECG were compared to conventional 12-lead ECG [1].
This type of devices has been used by patients with chronic heart failure [2] or by general practitioners to send ECG for interpretation by cardiologist [3]. Our approach is to supply nurses (about 30 devices) at elderly homes and in home care teams with the device as a support to management of patients with heart related symptoms. The device will be used only in non-acute situations while the ordinary emergency call is used for the acute situations. The nurses have got ECG-devices and a telephone number to the nearby hospital's acute department. When a patient complains of discomfort that may be heart related, the nurse will register an ECG and send it to the emergency department as described above. Thereafter the emergency department is called by the nurse to give

additional information regarding the patient's symptoms and discuss further actions with the physician. An evaluation form will be filled in after each ECG-transmission.
This project is a part of the Interreg III B project "eHealth for regions" and telecardiology applications based on this service will also be implemented in Finland, Lithuania, Poland Germany and Denmark.

Results

The project started its running face mid of February 2006 and finish June 2007. The preparation face contained information and education to each team separately. Evaluation forms was created for the municipality nurses, the nurses at the acute department and the physicians who receives the ECG for consultation. The evaluation forms show the decisions taken based on the tele-consultation. We will evaluate medical, level of care and comfort aspects.

Discussion

This project contains no technical development but is focused on a new way of working for the nearby care. One side-effect of the project might be to bridge gaps between organisational borders. Another side effect we already noticed is that the GP may ask the home care team to use this device to take routine ECG at the patient's home instead of transporting the patient to the primary health care centre for this purpose.

Acknowledgments

This project is partly financed by the Interreg III B Baltic Sea Region Programme.

References

[1] Schwaab B, Katalinic A, Riedel J, and Sheikhzadeh A. Pre-hospital diagnosis of myocardial ischaemia by telecardiology: safety and efficacy of a 12-lead electrocardiogram, recorded and transmitted by the patient. Journal of Telemedicine and Telecare 2005;11:41-44.

[2] Roth A, Kajiloti I, Elkayam I, Sander J, Kehati, and Golovner M. Telecardiology for patients with chronic heart failure: the "SHL" experience in Israel. International Journal of Cardiology 2004; 97:49-55.

[3] Molinari G, Reboa G, Frascio M, Leoncini M, Rolandi A Balzan C and Barsotti A.The role of telecardiology in supporting the decision-making process of general practitioners during the management of patients with suspected cardiac events. Journal of Telemedicine and Telecare 2002; 8:97-101

The Teleconsultation in General Practice. A Randomized, Controlled Study of a Remote Consultation Experiment Using a Videoconferencing System

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Keywords: telemedicine, teleconsultation, videoconferencing, patient satisfaction, primary health care,

Introduction

The background to this study was, firstly, the shortage of doctors in the remote areas in Finland and secondly, the possibilities to use new IT-technology in the organization of health care services. The aim was to find out whether it is possible to organize consultations between GPs and patients as remote work by using the videoconferencing equipment. In literature the results of the studies on teleconsultations in remote areas have been positive in many special fields from the point of view of operating the system, patient satisfaction and costs. However, there are only few studies of teleconsultations available in the area of general practice.

Methods

The aims of this study were to identify the technical solutions teleconsultation requires and to report on the implementation of the solutions and process of the teleconsultations. Two hypotheses were to be tested in the study: first that patients treated in the traditional way were more satisfied than teleconsultation patients: the second was that while a sizeable patient group could be treated remotely, teleconsultation would prove to be more expensive than the traditional consultation.
The teleconsultation part of the study was organized so, that the patient and a trained nurse were in Puolanka Health Center and the GP in the city of Kajaani (100 kilometers away). The videoconferencing system worked on the LAN in the Kainuu area. The study group consisted of two random groups, 508 patient visits were treated as remote work and 490 visits were treated in the traditional way in Puolanka Health Center.
In addition to the diary of technical problems and the patient satisfaction questionnaires the measures of the study were the analysis of success in the consultation and the account of the return consultations in the remote group. A part of consultations were videotaped and the success in transfer of information was analysed from those tapes. The cost of the consultation was calculated, and sensitivity analysis was used to examine the cost of teleconsultations for diabetic patients.

Results

The results indicated that with a local area network it is possible to build a well functioning, reasonably priced teleconsultation system. The patients were equally satisfied with the teleconsultation as with the traditional consultation. The transfer of information in teleconsultations was good enough to make reliable diagnoses. It is estimated that three out of four from a random population in general practice could be treated in teleconsultation.

Discussion

Although it is about 30 % more expensive to treat patients by teleconsultation than by the traditional method, the advantages of the teleconsultation model are that it enables an efficient transfer of information and know-how regardless of distance, and that it enhances considerably the traditional scope of health care services.

Tele-Home-Care in the Future - a Danish pilot project

Ole Winding, MD.Sc , Klaus Phanareth MD, Ph.D.
Danish Society for Clinical Telemedicine

Introduction

For the first time in Denmark, using telemedicine, we have treated an in-patient with COPD (Chronic Obstructive Pulmonary Disease) at the patient's home.

Methods

By a simple set-up using an ADSL-line, the patient's own television and telephone combined with an inexpensive video conference system linked to monitoring devices and a standard medication box, it was possible to perform a ward round as in the hospital. The doctors at the telemedicine centre performed a consultation including investigation, (make a) diagnosis and medication of the patient.

Results

The patient in the pilot study was well able to perform the self-monitoring (spirometry, pulse oximetry, pulse, temperature, stethoscopy) procedures and the transmission of data to the telemedicine centre. The face to face video consultation was very useful for both the patient and the doctor. The patient even expressed confidence and security by using the system.

Discussion

The project is expected to demonstrate a significant reduction in admission time for patients with severe COPD, enhanced quality of life, increased cost-effectiveness of medication including compliance and a decreased re-admittance rate.
This pilot project may demonstrate to the health authorities, the medical profession and to the public, that a greater part of clinical health care can take place in the patients own home in a cost effective way.

Conclusion

We conclude that even very simple and inexpensive (less than one bed-day in hospital) home-care-system, can enhance the medical quality, life quality, patient satisfaction, and cost benefit to the Hospitals and other health care authorities, as shown in many other studies outside Denmark.

Evaluation of Clinical Consultations in Telemedicine

Margrét Valdimarsdóttir[1], Thorgeir Pálsson[1], Rúnar Reynisson[2], Jörundur Kristinsson[3], Ásgeir Haraldsson[4,5], Hannes Petersen[6,5], Dóra Lúðvíksdóttir[7,5], Sigurður Kristjánsson[4,5], Margrét Oddsdóttir[8,5], Steingrímur Davíðsson[9], Gestur Thorgeirsson[10,5],

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Keywords: Telemedicine, videoconference, store-and-forward, consultations, evaluation

Introduction

In a two years project, Telemedicine consultation was being evaluated. First, to evaluate if Telemedicine could be used for clinical consultations. Second, to gain experience for various forms of Telemedicine for future development of Telemedicine in daily use in Icelandic Healthcare.
The participants were 5 specialties in one University Hospital, one specialist private practice and 5 Health care centers. The clinical cases were selected by the doctors in the Health care centers, they were 23 for the hospital specialists and 17 for the private practice. The consultations were provided both by "live" consultations (Videoconference), 11 cases and also by Store and forward method for electronic request and report (e-mail), 29 cases.
The project is being described in another presentation [1].

Methods

The Evaluation was performed for :

- Technical factors
- Clinical consultations
- Patient participation
- Organisational factors

Evaluation of technical factors

Equipment and technology for Telemedicine, whether "live" or Store and Forward consultations is regarded to function fully or almost so. Although it was decided to evaluate the technology and to demonstrate why technical problems existed, if any.
The duration of the consults were measured and also the response time in both "live" and Store and Forward.

Evaluation of clinical factors

The emphasis was to demonstrate if Telemedicine did make any difference in the consultation and treatment of the patients for both "live" and Store and Forward.
The clinical cases were selected by the doctors in the health care centers.

Patient participation

Questions were mostly related to if use of Telemedicine affected social factors and how patients regarded Telemedicine as method for delivering healthcare to them.

Organisational factors

The questions were aimed evaluate if and how consultations using Telemedicine could be performed in daily work, both in the health care centers and also in Hospitals.

Results

Evaluation of technical factors

In the "live" consultation using videoconference equipment, the technology worked properly in approx 90 % of the cases. Different age of the equipment in various sites resulted in occasional problems. The communication technology worked well.
The patients were content in using the technology.
The technical evaluation for Store and Forward showed that most equipment worked well. Problems were from external sound problems when using the electronic stethoscope and photographic knowledge when using digital camera.
The duration of the consultations was approx. 30 min. for both "live" and Store and Forward but the range was considerable. The response was generally within one day but up to 7 days.

Evaluation of clinical factors

Telemedicine did work well for clinical consultations both for "live" and Store and Forward. The affect on diagnosis and treatment was different in both cases but usually substantial (50 – 70% of the cases). Generally were the doctors content with using Telemedicine for clinical consultations.

Patient participation

The patient reaction was almost unanimous: very content with both using and having Telemedicine as a method for delivering healthcare to them.

Organisational factors

Usually, the consultations could be performed in existing daily work. However it was generally felt that changes in work flow, more time for consultations and permanent changes in the organisations (especially in hospitals) were needed.

Discussion

Technology and equipment for providing clinical consultation with Telemedicine is present. Good technical support and service is however needed as with any medical device. The evaluation demonstrated how telemedicine could make difference in diagnosis and treatment and in what extent. By using Telemedicine additional information were gained in the consultation work.
Patients were very content in using Telemedicine and would recommend other patients to do so.
The organisational issues are of concern and there changes are needed. One concern from the doctors in the Health care centers is access to specialist in the hospitals.

Acknowledgements

The authors would like to acknowledge the support of Rannis – The Icelandic Centre for Research, for funding of the project.

References

[1] Margrét Valdimarsdóttir[1], Rúnar Reynisson , et. al. Consultations in a Telemedicine Project in Iceland. NCeHT 2006.

Session C1
Special Focus: Eye and Heart

Thursday, August 31 2006

Aurora Hall

11:00-12:30

C1-1 **Information Technologies for Human Health – Clinical Decision Support Project**
A.Paunksnis, A.Lukoševičius, G.Dzemyda, A.Kriščiukaitis, A.Vainoras (*LITHUANIA*)

C1-2 **Eye Fundus Image Processing for eHealth Diagnostic System**
Darius Jegelevicius; *Valerijus Barzdziukas*; *Martynas Patasius*; *Vaidotas Marozas*; *Arunas Lukosevicius* (*LITHUANIA*)

C1-3 **Clinical Decision Support System for Ophthalmology-Cardiology Framework**
Vaidotas Marozas; *Darius Jegelevicius*; *Martynas Patasius*; *Arunas Lukosevicius* (*LITHUANIA*)

C1-4 **Automated Optic Nerve Disk Parameterization**
Povilas Treigys; *Vydunas Saltenis*; *Gintautas Dzemyda*; *Valerijus Barzdziukas* (*LITHUANIA*)

C1-5 **Retinal Screening for Diabetic Patients Performed with Mobile Digital Fundus Camera System**
Riku Lemmetty; *Kari Mäkelä* (*FINLAND*)

C1-6 **Early Assessment of Heart Rate Variability to Predict In-Hospital Complications after Acute Myocardial Infarction**
Giedre Baksyte, *Viktoras Saferis, Andrius Macas, Mindaugas Tamosiunas, Algimantas Krisciukaitis, Julija Brazdzionyte* (*LITHUANIA*)

Information Technologies for Human Health – Clinical Decision Support Project

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Keywords: eHealth, decision support, diagnostics, ophthalmology, cardiology

Introduction

EU countries are planning to assign 4-6% of the health care budget to the IT needs, especially orienting it to patient centered research and innovation eHealth projects [1]. Since harmonization of national and EU health related projects is particularly supported [2], Lithuania is implementing the eHealth strategy [3] by the pilot national projects creating the common infostructure [4] and particular R&D components of the integrated national eHealth system.

This report covers the architecture and review of general results of the R&D project "Information technologies for human health – clinical decision support "IT Sveikata" – „IT Health" (duration 2003-2006, supported by Lithuanian State Science and Studies Fund as the first national R&D priority research area project).

The aim of the project was to join the efforts of researchers from 6 national institutions from areas of technology and medicine and to improve the health care quality by focusing attention directly to the needs of the patient and the physician and by supporting diagnostic decisions using IT tools in pilot fields of ophthalmology and cardiology.

Particular objectives and tasks of the project are oriented into three interrelated clusters: 1) Development of clinical decision support strategies based on multi-objective analysis methods using quantitative parameters, pilot databases of medical images and signals, telemedicine networks; 2) Modeling physiological status of human as a complex adaptive system with the aim to predict, support and evaluate clinical decisions impacting him; 3) Development and evaluation of networked information system and user interfaces for making the preventive clinical decisions and decreasing risks of diseases and disabilities.

Architecture of the project and methods applied

Targets of present pilot project were ophthalmology and cardiology – fields where images (e.g. eye fundus) and signals (e.g. ECG) are among most informative sources of differential diagnostics. Project architecture was composed using the method of multidisciplinary integration of following activities:

- Holistic modeling and research of fundamental relations of physiological processes, development of concepts of diagnosis and monitoring;
- Registration and parameterization of diagnostic signals and images, selection of most informative parameters, creation of databases and interfaces;
- Data mining in databases and clinical decision support using learning algorithms, remote access to services and employment of expertise of physicians;
- Development of prophylactic, prognostic, diagnostic and treatment recommendations using the knowledge accumulated.

Main scientific problems were related with consistent interrelated methods of parameterization of signals and images, selecting most informative diagnostic parameters for support particular clinical decisions, clinical decision support strategies based on multi-objective analysis methods, creation of appropriate databases, including signal and image banks (to be integrated into national eHealth system) and remote client

interfaces as well as fundamental research of physiological phenomena and their use for the quantitative evaluation of health status.

Results

Results contain:
Modeling of physiological condition of human being as a complex adaptive system was used to evaluate and substantiate its influence on medical decisions. Regulatory, cardiovascular and executing (muscles) systems were taken into account.
Methods and software for eye fundus image parameterization – including automatic recognition of optical nerve region, automatic outlining of this region and calculation of geometric parameters of the optical nerve and excavation. Tracking of blood vessels using morphological segmentation and automatic measurement of diameters, bifurcations and tortuosity parameters. Calculation of the set of parameters reflecting the diagnostically important eye bottom features. The method of excluding of the network of blood vessels form fundus image was developed enabling improved diagnosis of retinal damages.
Method evaluating P wave morphologic changes in electrocardiogram was elaborated for investigation of cardiac autonomic regulation efficiency (sympathetic / parasympathetic nervous system balance);
Prognostic criteria, based on automatically estimated criterion of chest impedance signal were elaborated for usage in intensive care department in the acute period of myocardium infarct;
Specialized database for ophthalmology and cardiology was created with possibility to store signals, images and corresponding parameters needed for data mining and decision support. Remote client interfaces using Java applets were developed which enable connection to the remote central decision support server and obtain the answer to the clinical question.
First attempts to elaborate methods for holistic methods of functional condition of the patient were made using diagnostic parameters used in cardiologic and ophtalmologic departments.
Special software for sharing medical information by Internet was elaborated for collection of ophtalmological data for consulting and learning purposes.

Discussion

Pilot eHealth project builds an ophthalmologic and cardiological component to be integrated to the national eHealth system at the centre of which is Electronic Health Record EHR. Elaborated parameters should be included in the EHR and gradually supplemented by other medical specialties. In the case, when EHR will comprise all information about citizen health, clinical decision support will cover not only ophthalmology and cardiology, but many other problems. The project makes first methodical attempt to be followed.

References

[1] EC Communication “eHealth - making healthcare better for European citizens: An action plan for a European e-Health Area” http://europa.eu.int/information_society/doc/qualif/health/COM_2004_0356_F_EN_ACTE.pdf)

[2] “Mobilising EU Funding for Health EU Financing and National Opportunities in the New Member States” (http://europa.eu.int/comm/index_en.htm)

[3] Lithuanian eHealth strategy 2005-2010 (http://www.sam.lt/images/Dokumentai/eSveikata/esveikata_strategija_web020.doc). Šis

[4] Development of eHealth system in Lithuanian health care sector (feasibiltu study) http://www.sam.lt/images/Dokumentai/eSveikata/gs_esveikata_web_version.pdf

Clinical Decision Support System for Ophthalmology-Cardiology Framework

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Keywords: eHealth, signal processing, Health services, Evaluation

Introduction

WEB technologies enable easy access to medical information resources, changes the way of clinical work and medical research. The specialised WEB services or databases for clinical decision support do exist [1, 2, 3, 4]. However, since the medicine tends to reach the holistic approach for patient treatment, the demand for integration between medical specialities and tools supporting such integration tends to strengthen. We present the system supporting the integration of two medical specialities: ophthalmology and cardiology. Such integration is reasoned, because the retinal blood vessels are the only part of cardiovascular system that can be normally observed non-invasively.

Methods

The developed system consists of these parts: "Data acquisition", "Decision support" and "Expert system".

The core of infrastructure of the system is the database, implemented in MS SQL Server. It is designed to be easily extensible (especially in case of broadening of the domain). The database gets filled with data using the user interface for data acquisition, consisting of both simple Web-based Data Entry Forms, and tools (Java Applets) for parameterization of the eye fundus images and ECG signals. Since some of the algorithms are already implemented in MATLAB, they are accessed from Applets through XML Web Service (implemented in ASP.NET 2.0) which serves as a proxy to the compiled MATLAB code, directly accessible as a COM or .NET component.

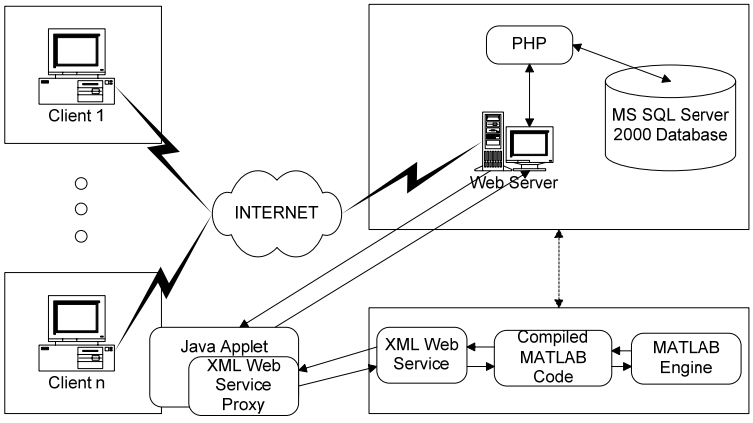

Figure. 1. High level structure of the system

The clinical case under investigation is evaluated by "Decision support" part of the system. The decision support is based on comparisons with other cases with known diagnosis and clinical data available in database. The results of comparisons of relevant

parameters are presented for the user. In addition, this part is planned to be used for medical research when database will contain adequate number of clinical cases.
The third part "Expert system" is used for training and education purposes of medical doctors.

Results

The prototype of the system is designed and implemented. The database includes by now 20 cases with both ophthalmological and cardiological data. The integrated set of automatic data parameterization tools consist of:

- Tool for parameterization of optical disc in eye fundus images;
- Tool for parameterization of retinal blood vessels;
- Tool for estimation of autonomous heart regulation using P wave morphology.

The preliminary evaluation of the system shows that execution time of parameterization tools is acceptable for online use.

Discussion

The developed system is under evaluation. The main advantages of the proposed system are: easy remote access from different places, the extensibility to other medical specialties, and easy integration with other tools for automatic parameterization of medical data, the potential for holistic medical research.

Acknowledgements

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References

[1] Garcia J, Martinez I, Sornmo L, Olmos S, Mur A, Laguna P. Remote processing server for ECG-based clinical diagnosis support. IEEE Transactions on Information Technology in Biomedicine. 2002 Dec; 6(4): p.277-284.

[2] Paracha MA, Mohammad SN, Macfarlane PW, Jenkins JM. Implementation of web database for ECG. Computers in Cardiology, 2003 21-24 Sept; p.271-274.

[3] Hamarneh G. Digital Image Analysis of Fundus Photographs on the WWW. Technical Report R002/1999 (S2-IAG-99-1), February 1999, Department of Signals and Systems, Chalmers University of Technology, Sweden.

[4] Jegelevicius D, Marozas V, Lukosevicius A, Patasius M. Web Based Health Services and Clinical Decision Support. In: Duplaga M, Zielinsky K, Ingram D, editors. Transformation of Healthcare with Information Technologies, series Studies in Health Technology. IOS Press; 2004; Vol. 105: 27-37.

Automated Optic Nerve Disk Parameterization

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Keywords: eHealth, Image processing, Optic nerve disk, Localization, Approximation by the ellipse

Introduction

The ways of a better fundus image evaluation is the use of modern informational technologies for processing and parameterization of the main structures of the eye fundus. Changes of the optic nerve disc can be associated with numerous vision threatening diseases such as glaucoma, optic neuropathy, swelling of the optic nerve head, or related to some systemic disease. Automated localization and parameterization of the optic nerve head is particularly important in making a diagnosis of glaucoma, because the main symptoms in these cases are links between the optic nerve and cupping parameters and differences in the symmetry between eyes.

Methods

The area of OD is occupied by vascular tree. We used the grey level morphology scheme proposed by Mendels *et. al.* [1] for the removal of vascular tree on each colour band. Next, the Canny [2] edge detector was implemented to achieve the boundary point images from the grey level ones. While introducing non-static threshold selection values the Otsu [3] method was used, and the optic nerve disk localization was accomplished by the circular Hough [4] transform. Finally, the least squares method, proposed by Fitzgibbon *et. al.* [5] was applied in ellipse parameters calculation depending on gathered OD point set after the Canny - Otsu filtering.

Results

The test data set consisted of 54 retinal images provided by Kaunas University of Medicine department of ophthalmology. The results were evaluated by two criteria: optic nerve disk position in retinal image identification and approximation by ellipse accuracy.

In the first case, for the OD there was only one false result which leads proposed algorithm to the accuracy of 98%. In the second case, for the approximation by ellipse we compared parameter space formed of major, minor axis and horizontal, vertical diameter of the ellipse obtained from the points set by hand, and ellipse got from the points gathered automatically. The overall average error rate achieved for the major axis of ellipse was 5%, for the minor axis – 6%, for the horizontal diameter – 9%, and for the vertical diameter of the ellipse – 7%. Some examples of a proposed algorithm are provided in Figures 1, 2, 3

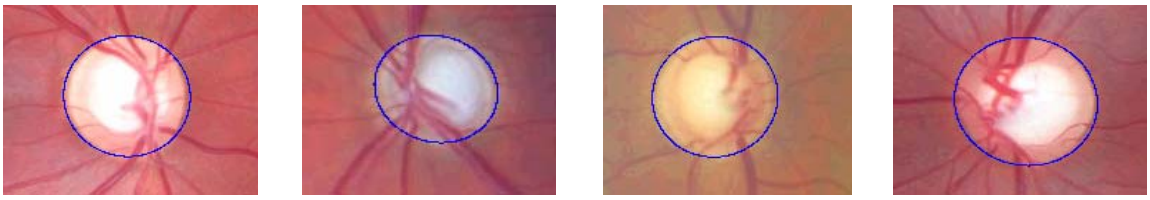

Figure 1. Excellent approximation by the ellipse

Figure 2. Good approximation by the ellipse

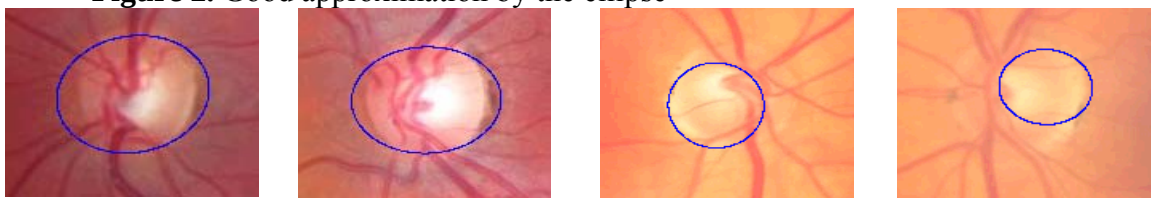

Figure 3. Poor approximation by the ellipse

Discussion

This research provided an efficient algorithm for automatic optic nerve disk localization and approximation by the elliptical curve.

After the vascular tree has been removed from OD area, we implemented the edge detection algorithm with dynamically selected threshold values. These values are calculated for each retinal image depending on the intensity level. For the optic nerve disk centre localization, the use of Hough transform showed itself excellent. Next, the parameters of the ellipse were calculated using least squares method.

The main disadvantage of the proposed algorithm is that the least squares method is very sensitive to the external boundary points. This explains average error rates on the compared ellipse parameters (case of Figure 3).

The next step for the improvement is to calculate the parameter describing approximation quality. The algorithm provides the way of tracking changes of OD in the parametric form, and it can be used in clinical decision support.

Acknowledgements

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References

[1] Mendels F, Heneghan C, Thiran J. Identification of the optic disc boundary in retinal images using active contours. Proceedings of the 3rd Irish Machine Vision and Image Processing Conference, 1999; 103-15.

[2] Canny J. A computational approach to edge detection. IEEE Transactions on Pattern Analysis and Machine Intelligence 1986; 8(6):679–98.

[3] Otsu N. A threshold selection method from gray-level histograms. IEEE Transactions Systems, Man and Cybernetics. 1979; 9:62-6.

[4] Ballard D. Generalizing the Hough transform to detect arbitrary shapes. Pattern Recognition. 1981; 13:111–21.

[5] Fitzgibbon A, Pilu M, Fisher R. Direct least-squares fitting of ellipses. IEEE Transactions on Pattern Analysis and Machine Intelligence, 1999; 21(5):476-80.

Retinal Screening for Diabetic Patients Performed with Mobile Digital Fundus Camera System

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Keywords: Digital Fundus Camera, Telemedicine, Mobile Unit, Retinal Screening

Introduction

Early detection of retinal damage is one of the most important aspects in the preventive treatment of diabetes [1]. Seinäjoki Central Hospital has been using a mobile digital fundus camera system since 1999, the hospital was actively involved in the design and specification of the original system. It has been possible to perform routine retinal screenings of diabetic patients in the health care centres of the South-Ostrobothnia Hospital District due to the mobility of the equipment. This mobile retinal screening system was the first of its kind in Finland. This paper focuses on the impact of the system.

Methods

The equipment consists of two digital fundus cameras that are connected to a network server, where the digital images are stored. The image can be viewed immediately with the digital imaging and viewing software Eyecap on the computer display and transmitted via network to Seinäjoki Central Hospital. The images which require consultation of the specialist are transferred to the Central Hospital. The camera system is transported to regional health care centres where the screening studies of diabetic patients are carried out.

Figure 1. Mobile digital fundus camera system with transport equipment

Technical specification of the mobile system:
Non-Mydriac Retinal Camera:
Canon CR 6 – 45 NM with Sony DXC 950P 3CCD Colour Video Camera
Computer:
Pentium III 450 MHz with 14.1" XCA TFT Screen
128 MB RAM/ 9,3 GB Hard disc
24 x CD ROM
10/100 Ethernet/ Internal 56 K Modem
EyeCap sofware

Results

The number of procedures before and after establishing the mobile digital fundus camera system at the eye department of Seinäjoki hospital was compared. Other changes in the procedures carried out at the eye department are also reported. The regional differences between South-Ostrobothnia and other provinces without mobile digital fundus camera system were also studied.

The total number of screenings carried out from 1999 to 2005 is **15 180** cases. The number of patients screened per year (2004 & 2005) is approximately 3000 out of a total case pool of 8000. That covers approximately 80 to 90 percent of all diabetes patients in the province of South-Ostrobothnia. On average this means that each patient is screened once every 2,5 years. Preliminary results show that the mobile system has made possible screenings that could not have been made at the central hospital. Therefore, the coverage of the diabetic screening in the South-Ostrobothnia has improved. In addition, the patients are very satisfied with the mobile screening system because they prefer to be screened at the local health center rather than at the central hospital. The number of cases referred to the eye department for follow-up studies has decreased from 49 in year 2000 to 23 in 2004 and 13 in 2005. On the other hand, the number of cataract findings has increased: from approximately 50 cases in 2000 to 120 cases in 2004 and 2005. This has enhanced cataract patients' quality of life because cataracts were detected at the earlier phase of the disease.

Discussion

Mobile digital fundus system of the South-Ostrobothnia Hospital District was the first of its kind in Finland. The major reason to establish this kind of system was the need to improve the screening service. It was not possible to cover all rural areas with traditional fundus imaging. The only economical way to improve the service was to establish a mobile unit. At this point, the mobile screening system covers efficiently the whole province. The impact of the system is evident in the changes in frequency and type of procedures at the eye department of Seinäjoki Central Hospital.

Acknowledgements

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References

[1] Bachmann MO and Nelson SJ. Impact of diabetic retinopathy screening on a British district population: case detection and blindness prevention in an evidence- based model. J. Epidemiol. Community Health 1998;52;45-52

Early Assessment of Heart Rate Variability to Predict In-Hospital Complications after Acute Myocardial Infarction

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Keywords: Heart rate variability, prognostic value, acute myocardial infarction.

Introduction

Cardiac autonomic control is profoundly deranged after acute myocardial infarction (AMI), with evidence of impaired vagal control and high levels of sympathetic activity. Heart rate variability (HRV) is an established non-invasive marker of cardiac autonomic nervous activity in patients recovering from AMI. The association of higher risk of post-infarction mortality with reduced HRV was first shown in 1977 [1]. The predictive value of HRV was independent from the conventional risk stratification factors used in clinical practice. The standard measurements for the analysis of HRV comprise time domain indices, geometric methods and components of the frequency domain [1]. Measurements of HRV are generally performed on the basis of 24 hour Holter recordings (long-term recordings) or on shorter periods ranging from 0.5 to 5 minutes (short-term recordings). A low HRV has been shown to be a powerful predictor of cardiac events in patients surviving an AMI, nevertheless there is a lack of detailed assessment of HRV in the early period of MI, especially during the first 24-72 hours, from long-term recordings, and the value of different HRV parameters in predicting dangerous complications of MI is not clear.

Methods

We prospectively studied 108 consecutive patients admitted to the Intensive Care Unit of the Department of Cardiology of Kaunas Medical University Hospital between 2002 and 2004 with acute myocardial infarction. Exclusion criteria were chest pain lasting for more than 24 hours, pacemaker rhythm, rhythm other than sinus rhythm, severe valvular heart disease, patient's refuse to participate in the study. All the patients gave informed consent for the research protocol, which has been approved by the institutional review board. In-hospital prognostic end-points were death and non-fatal events: post-infarction angina, progressive heart failure, pulmonary edema and cardiogenic shock.
HRV was assessed at day 1 and 3 by a 24h recording using "HeartLab" system [2]. 24h recordings were processed by time-domain methods and short-term recordings of the first 5min of each hour of the recording were processed by frequency domain methods as recommended by the Guidelines [1]. Due to longer intervals of muscle artifacts, intermittent atrial fibrillation, recording problems caused by excessive sweating and chest movements during the acute phase of MI, a minimum of 18 hours of analyzable data, we considered 63 recordings to be suitable both, for time-domain and frequency-domain analysis. Statistical analysis was performed using SPSS 12 for Windows. Discriminant analysis was used to select the combination of statistically significant variables and predict the complications.

Results

We included the following HRV measures into the model: time-domain measures – HRV triangular indexes of day 1 and 3, frequency-domain measures – power in low frequency range (LF), power in high frequency range (HF), LF and HF expressed in normalized units (i.e. LF or HF/ (total power-very low frequency power)x100), and LF/HF ratio of day 1 and 3. F statistics was used to evaluate the significance of the parameters for group discrimination, and a classification model was selected running a stepwise analysis, including the variables that minimize the general Wilks'A statistics. Such a procedure of discriminant analysis selected two statistically significant parameters for discrimination of the groups: LF of day 3 and LF n.u. of day 1 with statistical significance $p<0.001$. General Wilks' A statistics in the range from 0.729 to 0.675 shows that the variables are suitable for discriminating the groups. Fisher's linear discriminant functions were used for classification: we determined the prediction of complications by functions $f$yes and $f$no:

$f$yes = - 12.374 + 0.121 * LF 3/1000 + 0.528 * LF n.u. 1

$f$no = - 18.169 + 0.278 * LF 3/1000 + 0.606 * LF n.u. 1.

The rule of classification: the case is attributed to the group of patients where complications occurred if $f$yes > $f$no, and to the group without complications vice versa. The average effectiveness of classification was 79.4%, the occurrence of complications was correctly predicted in 85.0% of cases, and the absence of complications - in 76.7% of cases. Almost identical classification results after Lachenbruch's procedure confirm the stability of the classification rule and the fact that there is no excess of discriminant variables.

Discussion

We selected LF on day 3 and LF in normalized units on day 1 as the most significant variables for prediction of in-hospital events. It complies with the results published by C.Carpeggiani [3] and N.Singh [4]. In all the three studies the frequency-domain parameters were selected to predict the outcome of MI.

Acknowledgements

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References

[1] Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Eur Heart J 1996;17:354-81.

[2] Drėgūnas K., E.Povilonis. Cardiac output and hemodynamic monitoring system "Heartlab". "Biomedical engineering" (Proceedings of International Conference), Kaunas 1999, p.100-105.

[3] Carpeggiani C, L'Abbate A, Landi P, Michelassi C, Raciti M, Macerata A, et al. Early assessment of heart rate variability is predictive of in-hospital death and major complications after acute myocardial infarction. Int J Cardiol 2004;96:361-8.

[4] Singh N, Mironov D, Armstrong PW, Ross AM, Langer A. Heart rate variability assessment early after acute myocardial infarction. Circulation 1996;93:1388-95.

Session A2
Electronic Patient Records I

Thursday, August 31 2006

Helsinki Hall

14:00-15:30

A2-1 **A Decentralised Model for EHR Data Integration**
Johan Gustav Bellika; *Gunnar Hartvigsen* (*NORWAY*)

A2-2 **Nationally Standardized Electronic Nursing Documentation in Finland by the Year 2007**
Kaarina Tanttu; *Helena Ikonen* (*FINLAND*)

A2-3 **Developing an EPR Integrated Evidence Based Medicine Decision Support (EBMeDS) System in Finland**
Jorma Komulainen; *Ilkka Kunnamo*; *Minna Kaila*; *Taina Mäntyranta* (*FINLAND*)

A2-4 **Evidence Based Medicine Electronic Decision Support Study**
Tiina Kortteisto; *Pekka Rissanen*; *Helena Varonen*; *Jorma Komulainen*; *Minna Kaila* (*FINLAND*)

A2-5 **Application of Textmining Based Clinical Documents in Integrated HIS, Co-occurrence Structure of Terms among Incident/Accident Reports**
Tadamasa Takemura; *Masahiro Hirose*(*JAPAN*)

A2-6 **Electronic Patient Record System in the South-Eastern Finland: Experiences in the Special Health Care of the Kymenlaakso Hospital District**
Pasi Pöllänen; *Juhana Suurnäkki*; *Anne Kallio*; *Tarja Huopainen*; *Eija Javanainen*; *Timo Kallio*; *Ulla Larinkari*; *Ermo Haavisto* (*FINLAND*)

A Decentralised Model for EHR Data Integration

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Keywords: Medical Informatics, Computerized Patient Records, Distributed search

Introduction

Many countries invest huge amounts of money in providing clinicians with access to electronic health record (EHR) information about their patients to improve care and health for the patients and reduced cost of running the health service. However, getting access to EHR information, which in most countries are currently stored decentralised, raises issues as patient privacy and system scalability.

The most interesting approaches for sharing information between health institutions is the common architecture approach [1], for which the degree of decentralisation is a good axis to classify the current approaches. The approaches may be divided into 1) centralised systems, where all data is stored in a centralised repository, 2) centralised index approaches, where data is stored decentralised but indexed centrally, and 3) decentralised data storage approaches that do not rely on centralised indexes with sensitive information. In the last category, the system can not be dependent on centralised storage of sensitive information like in what institution a patient's record exist.

The ERDIP evaluation of architectural approaches [2] showed that all evaluated models had important disadvantages like scalability or patient privacy concerns. The E-toile system (type 3) [3], solves the privacy issue, but seems to store EHR data in an encrypted form which makes secondary use of the data difficult. HYGEIAnet, the regional health information network of Crete, use a type 2 system [4].

Methods

We presents a new architectural model for access to EHR data stored in distributed EHR systems to address some of the shortcomings of current models and 2) the results of an analysis of the proposed model. The architectural model has been used in an analysis aimed at predicting some of the benefits and drawbacks of the proposed approach. During the analysis, our architectural model have been compared to the architectural models used in the ERDIP demonstrators in UK [2]. However, experiments, a full scale implementation, deployment and evaluation study of the proposed model are necessary to give undisputable evidence for the performance of the system and the architectural model.

Results

Our approach is a type 3 approach. To enable access to the EHR data, each health institution needs to integrate a dedicated server with the EHR system. The basic principle that enables a solution, is to search all EHR systems for information about a specific patient. To enable the system to scale, we limit the number of hosts searched by linking the patient identifiers and the address of system hosts to geographic codes in mapping tables. In the mapping tables each geographic code corresponds to a set of health institutions or EHR hosts. When EHR data needs to be compiled, all EHR systems covered by the geographic codes, that the patient identifier is linked to, are searched for extraction and transfer of the EHR data. The extracted EHR information may be merged and visualised to the requester. By using this approach it is possible to

tell that the patient has a EHR record in one of the institutions covered by a geographic code, but not which one. The system is bootstrapped, or reorganized at any time, by exporting the person identifiers, together with the geographic codes to the system server that perform the mapping.
According to the analysis, the proposed model will have the following anticipated beneficial properties: 1) no central repository of sensitive information about patients need to be used, 2) EHR data is as current as the source systems supplying it, 3) ownership of data is kept local, 4) duplication of EHR data is avoided, and 5) available EHR data is assembled when needed. The disadvantages of the approach are that; 1) data may be unavailable due to downtime of EHR systems, and 2) the speed of data retrieval may be slower than solutions based on centralized storage of data.

Discussion

The approach described makes it possible to provide access to complete and up-to-date EHR data maintained by many health institutions independently. Our approach is based on a common architecture [1], and use of a global reference schema to map the local data to something all systems understands. A common interface to clinical data , and a system for authentication, authorisation and encryption is also necessary. Our approach diverts from other approaches by being independent of storing "sensitive information" outside health institutions. This feature may be very important in countries where centralised storage of sensitive information is impossible. Compared to the HYGEIAnet approach it seems unproblematic to ensure that the latest information about the patient is extracted and made available. One problem with our approach is the fact that we cannot tell if something is unavailable, or what kind of information that is missing if one EHR host for some reason is inaccessible. We can discover that such a situation has aroused and simply ask the patient if relevant medication information exists in that institution. Use of a pre-fetch strategy based on time schedule data, may reduce the impact of this problem, but such a strategy may affect the data currency issue negatively.
Our implementation of the distributed EHR data access needs to be subject to experiments to establish what response time that may be achieved using the infrastructure. Pervious experiments (using a peer-to-peer organisation) involving extraction of data from 50 experimental servers (with Intel P4, 3GHz processor) simultaneously, show a response time of about 4 seconds, which is probably slower than what is achievable using a centralised repository. However, our approach provides a solution in situation where central data repositories can not be used. In addition, with our approach, no EHR systems need to be replaced and previous investments are maintained [5].

Acknowledgements
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References

[1] Grimson J, Grimson W, Hasselbring W. The SI challenge in health care. Communications of the ACM 2000;43(6):49-55.
[2] NHS Information Authority. ERDIP Evaluation N6 Product P2. Technical Architecture Review. 2002 18th September. URL: http://www.nhsia.nhs.uk/erdip/pages/docs_egif/evaluation/technical/tech-arch-rev.pdf Accessed 30.05.2005.
[3] Geissbuhler A, Spahni S, Assimacopoulos A, Raetzo M, Gobet G. Design of a Patient-centered, Multi-institutional Healthcare Information Network Using Peer-to-peer Communication in a Highly Distributed Architecture. Medinfo 2004;2004:1048-52.

[4] Tsiknakis M, Katehakis DG, Orphanoudakis SC. An open, component-based information infrastructure for integrated health information networks. Int J Med Inform 2002;68(1-3):3-26.

[5] NHS Information Authority. West Surrey ERDIP Demonstrator - Technical Architecture Review Update. NHS Information Authority 4 February. 2003 Accessed 31.05.2005.

Nationally Standardized Electronic Nursing Documentation in Finland by the Year 2007

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Keywords: Terminology, Classification, Nursing process management, Multiprofessional EPR

Introduction

Finland has adopted a national health program which requires information management to establish a basis for health care delivery, health services documentation, care management and evaluation of different parts of care. Nursing documentation has been developed lately by testing the suitable of international nursing classification systems and terminology in the structure of the Finnish patient records. The electronic nursing documentation is not unified in Finland and it doesn't connect with nationally recommended multiprofessional core documentation of the patient history.
The national challenge in Finland is to unify and standardize electronic nursing documentation, to connect it with the nationally recommended multiprofessional core documentation of the patient history and the national code server.

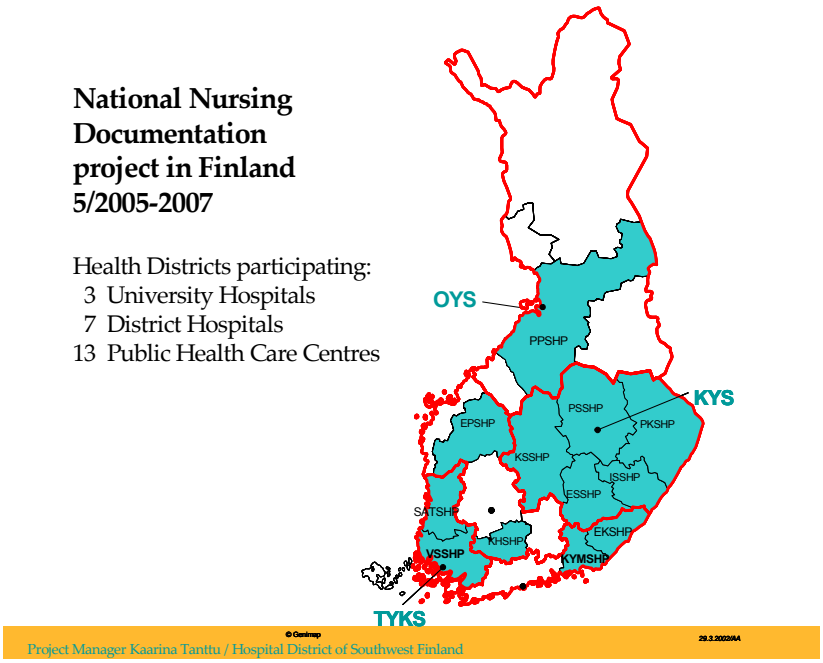

Figure 1. The coverage of the national nursing documentation project in Finland

The nationally defined structured nursing documentation is piloted in 23 health care organizations during 2005−2007 by the support of the Ministry of Social Affairs and Health. Piloting covers special care, primary care and homecare. The nursing process is used as a structure for the documentation. The classification components of The Finnish Nursing Intervention Classification [1] based on the Clinical Care Components developed in the United States by Dr. Virginia Saba [2], provide the structure for documenting nursing care. Classification for outcomes and the core data for nursing summary will be developed. Finnish OPC−Classification is used to measure the patient care intensity.

Aims

The main aim is to develop a nationally unified and standardized nursing documentation by the year 2007. The second aim is to use the standardized nursing data to manage and assess the quality of the nursing process. The third aim is to integrate the nursing documentation into the multiprofessional patient record.

Method

The nationally defined structured nursing documentation is piloted in 23 health care organizations during 2005−2007 by the support of the Ministry of Social Affairs and Health (Figure 1).
Piloting covers special care, primary care and homecare. The nursing process (= nursing core data) is used as a structure for the documentation.

NURSING CORE DATA IN FINLAND
1. Nursing diagnoses/needs
2. Nursing interventions
3. Nursing assessment and outcomes
4. Patient care intensity classification
5. Nursing summary/epikrises

Incl. unigue identification

Ministry of Social Affairs and Health 2004:18

The Finnish Nursing Classification (FiCNI) based on CCC (= Clincal Care Classification) is used for describing nursing needs and interventions. The components of FICNI are:

Activity	Physical regulation
Coping	Respiration
Elimination	Role relationship
Fluid volume	Safety
Health behaviour	Self care
Health services	Psychological regulation
Medication	Sensory
Nutrition	Skin integrity
	Continued treatment

Classification for outcomes and the core data for nursing summary will be developed. Finnish Oulu Patient Classification (= OPC) is used to measure the patient care intensity. Piloting started on 1 th October 2005 and ends on 30th September 2007.

Evaluation

The multiprofessional testing of electronic documentation and classified nursing needs and interventions will be evaluated. The process of clinical care and its electronic documentation and the location of information will be described and evaluated from a multi-professional point of view with the help of the User-driven implementation method [3] to integrate patient information system to the practices. The method is based on looking at the information system as a process, which has an impact on all the elements within the organisation. The method is developed for describing the implementation, applying and evaluation of an information system. The actor, the tool

and the work task are used to describe the organizational context, where the information system is implemented and to which the implementation processes are related. The phases of the implementation process are description, training and use. Pilot evaluations will be carried out by continuous observation and patient case studies.

Conclusions

Results of the study will be expected during the year 2006 and the final report will be published by the end of the year 2007.

References

[1] Ensio Anneli (2001). Modelling of nursing interventions. Publication of Kuopio University, Series 4.

[2] Saba V (1992) Home health care classification (HHCC) of nursing diagnoses and interventions. Caring 11, 50 – 57.

[3] Nurminen Markku I, Reijonen P & Vuorenheimo J . 2002. The organizational implementation of information system - experiences and directions. Publications of Turku City Health Centre, Series A, 1/2002.

Developing an EPR Integrated Evidence Based Medicine Decision Support (EBMeDS) System in Finland

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Keywords: electronic decision support, electronic patient record, evidence-based medicine, decision-making

Introduction

Evidence based medicine (EBM) has a long tradition in Finland. First national Current Care guidelines were published in 1997, and currently altogether 67 guidelines are freely available in the Internet [1]. In addition to that, Evidence-Based Medicine Guidelines (EBMG) database, including more than 1200 clinical articles, is available for most practicing physicians in the country [2].

Implementation of the EBM guidelines is a great task. Recent systemic reviews have shown that automatic electronic decision support systems, especially when available at the point of care, can be effective in supporting professionals in decision making [3,4].

Electronic patient record (EPR) systems are widely used in Finnish health care. According to the Ministry of Social Affairs and Health, national standards including the core data structure of EPR will take place during the year 2007. This makes it possible to integrate patient data with the EBM data, and thus actively provide professionals with various on-line decision support tools, including reminders, alerts, prompts and interactive forms written in Javascript, at the point of care.

Methods

A project for developing an EPR integrated decision support system (EBMeDS), covering various medical specialities and organisations in both primary and secondary health care, was started in 2005. At first, alternative ICT-architecture models were critically analysed and tested. Secondly, a model for authoring, reviewing and maintaining the decision support tools was created, and their production was organised. Subsequently, two pilot projects for implementation and a research project have been started.

Results

The ICT-architecture is based on HL7 CDA R2 structured data provided by the EPR to the EBMeDS program via a common interface. The EBMeDS software then communicates with the decision support databases and sends the selected reminders, alerts and prompts back to the EPR. This architecture allows the decision supports databases to be maintained by the EBMeDS organisation, and thus supports their high quality and reliability.

The evidence and knowledge underlying reminders, prompts and alerts are written in script descriptions (SD), which have a common form. The form includes the code and name of the SD, the description of it's function and logic, links to evidence summaries that grade the level of evidence, the reminders, prompts or alerts they produce,

discussion of possible harms, references, and meta-data containing keywords, author, publisher and dates of creation and next scheduled update.
Accordingly, decision support for drug therapy will be managed by integrating various medication databases with the EPR's. These include databases for indications, contraindications, interactions, allergy groups and pregnancy and breast-feeding.
Two hospital districts (Pohjois-Savo and Kymenlaakso) were chosen for the first pilot implementations. In Pohjois-Savo, an EBMeDS system for the treatment on diabetes will be implemented both in primary and secondary care units. Especially, a system for quality assessment for treatment of childhood diabetes is under development. In Kymenlaakso, EBMeDS will be utilised to facilitate the integrated care pathway of the surgical hip patients, together with implementation of decision support for medical treatment. Both of the pilot implementations are planned to start in 2006.
The research project for feasibility and effectiveness is ongoing. It will be described in more details in another abstract in this congress.

Discussion

In the present project, individual patient data will be integrated with carefully edited EBM knowledge to produce reliable decision support for health care professionals working in various organisations. A technical model is described and tested, and management of the processes for creating, reviewing and maintaining the decision support is planned. Implementation, which is a great task, is currently on its way. A careful research of the system's usability, acceptability and effectiveness is planned, and will be started together with implementations.

Acknowlegements

The authors would like to aknowledge the Finnish Medical Society Duodecim, the Finnish Funding Agency for Technology and Innovation (Tekes), Duodecim Medical Publications Ltd., the Centre for Pharmacotherapy Development, the Pohjois-Savo and Kymenlaakso hospital districts, Stakes and ProWellness Ltd for their financial support to the project.

References

[1] www.kaypahoito.fi

[2] www.terveysportti.fi

[3] Garg AX, Adhikari NK, McDonald H, Rosas-Arellano MP, Devereaux PJ, Beyene J, Sam J, Haynes RB. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes: a systematic review. JAMA 2005;293:1223-38.

[4] Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. BMJ 2005;330:765.

Evidence Based Medicine Electronic Decision Support Study

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Keywords: electronic decision support, evidence based medicine, focus group

Introduction

Research evidence is easily available to practising physicians via the Internet. Practice guidelines are intended to summarize research information into a readily usable format. Finland has a wide and longstanding experience in this area (1, 2), and here physicians consider the use of electronic guidelines timesaving and helpful (3). Current systems demand that the physician actively searches for information. However, clinical advice could be provided actively, even when the physician does not recognize the need for it.
According to two systematic reviews (4, 5) many clinical decision support systems improve practitioner performance. Four features, which independently and significantly improved clinical practice, can be identified: 1) automatic provision of decision support as part of clinician workflow, 2) provision of recommendations rather than just assessments, 3) provision of decision support at the time and location of decision making and 4) computer based decision support. There is scant evidence on how well these systems work in clinical practice and especially in different clinical areas (6).

Methods

Aim of the study is to find out whether computerised reminders, prompts and alerts to physicians or nurses triggered by data in the electronic patient records improve patient care. At first, qualitative research is needed to gather information of health care professionals' expectations and needs. This will be utilised in modifying the decision support tools. Subsequently, effectiveness will be studied in a randomised controlled trial to assess the impact of the system on treatment choices and patient outcomes.
As the initial part of the study, we made focus group interviews with primary and secondary care physicians in different areas of Finland. Two moderators (MK and HV) guided the groups' discussions according to a structured interview guide. The discussions were started by introducing the EBMeDS project and clarifying it with three illustrative examples. The opinions of the participants were gathered on the following themes:

- What clinical or administrative topics are thought to be desirable for decision support?
- In what kind of situations decision support is not considered appropriate?
- What are the possible advantages and disadvantages of decision support?
- How often would physicians wish, accept or tolerate feedback given by the decision support system?
- What are believed to be the barriers and facilitators of an effective implementation of decision support?

The interviews lasted on average 1.5 hours. They were audio taped and transcribed. We invited new groups as long as substantially new information arose. Altogether 39

physicians were interviewed in seven focus groups. The data was analyzed according to the following principles: 1) all the material read to get an overall impression of the opinions, 2) the opinions coded according to discussion themes, 3) the contents within each theme condensed and abstracted and 4) the contents summarized to establish the concepts that reflect the opinions, ideas and expectations of decision support which the physicians expressed on.

Results

The results of the focus group study will be presented in the congress.
The main preliminary findings are:

1. collectively positive attitudes toward decision support although the physicians have many negative experiences about the usability of electronic patient records,
2. lot of specific targets for usage,
3. the decision support system must be tailorable according to user or environment
4. foreseen disadvantages include excessive trust in the system which can lead to lessening in own thinking.

Discussion

Computerised decision support integrated with the electronic patient record is a potentially effective tool in implementing the evidence based clinical practises. Our results are utilised in planning and implementation of a decision support system. In addition to this qualitative study, surveys will be used to assess feasibility of decision support. The effectiveness and possible side effects of the decision support will be studied in a randomised controlled trial.

Acknowledgements

Authors would like to acknowledge the Finnish Funding Agency for Technology and Innovation (Tekes), the Finnish Office for Health Technology Assessment at the National Research and Development Centre for Welfare and Health (Finohta/Stakes), Duodecim Medical Publications Ltd., ProWellness Ltd. and the Centre for Pharmacotherapy Development for their economical support to the study project.

References

[1] Mäkelä M, Kunnamo I. Implementing evidence in Finnish primary care. Use of electronic guidelines in daily practice. Scand J Prim Health Care 2001; 19(4):214-7.

[2] Varonen H, Mäkelä M. Practice guidelines in Finland: availability and quality. Quall Health Care 1997; 6(2):75-9.

[3] Jousimaa J. The clinical use of computerised primary care guidelines; 2001.

[4] Garg AX. et al. Effects of computerized clinical decision support systems on practitioner performance and patient outcomes. JAMA 2005; 293(10): 1223-38.

[5] Kawamoto K. et al. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. BMJ 2005; 330: 765-772.

[6] Varonen H, Kaila M, Kunnamo I, Komulainen J, Mäntyranta T. Tietokoneavusteisen päätöksentuen avulla kohti neuvovaa potilaskertomusta. Duodecim 2006:122:1174-81. [Review in Finnish]

Application of Textmining Based Clinical Documents in Integrated HIS, Co-Occurrence Structure of Terms Among Incident/Accident Reports

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Keywords: HIS, Incident/accident report, mutual information, text mining

Introduction

Under strong guidance of Japanese Government along e-Japan policy [1], hospitals in Japan rushing into developing electronic health record systems. Although discussion among researches medical informatics to define whether "best" way to obtain "structured" health record through a certain guidance, the political pressure makes hospitals EHR in easiest way for daily clinical activities regardless of the discussion, that is, writing free text into digital storage. On the other hand, once HIS system introduced into daily clinical activities, the clinical staffs want to integrated any possible clinical documentation works into HIS to reducing the their daily task derived from full of copy & paste editing. Thus, once developed, HIS tends to hold various kinds of clinical documents in the same storage in the same manner, that is, in free text. Kyoto University Hospital introduces new HIS in the beginning of 2006 aiming to integrate all possible clinical documents including EHR into one unified system. On the course, Kyoto University integrate even incident accident reporting system on the new HIS. The system accept initial report from a anonymous clinician through web-base interface, and then each case put into discussion table over groupware environment to promote further collaboration of clinical staffs. Consequently, the data generated through the system cannot be fully structured as structured input tends to discourages reporters by its complicatedness and to prevent discussion for better understandings. On the contrary, as the clinical record is a powerful tool for further collaboration of clinical staffs, clinical record must have same kinds of nature. To enjoy another advantage of clinical data, that is, to use as knowledge base, chunk of free-text based documents requires automatic document analysis.
As incident accident record has same nature of health record, and Kyoto university already holds digital data of incident reports for a couple of years, the authors applied some basic document analysis techniques to the reports to examine possibilities of the techniques.

Methods

1. incident/accident reporting system
An incident / accident reporting system was implemented at Kyoto University Hospital in March 2000, just after the occurrence of a serious medical adverse event. This research examined 1400 reports between 2002 and 2004.
2. Text mining
Text mining is the technology which combines natural language processing and data mining technique. Targeting for text data, text mining uses some element technologies to compile data for the purpose of mining. In that case, mainly morphological analysis is carried out in order to extract the elements which compose sentences and sorting and clustering are carried out based on relative relations of these elements or based on quantitative judgment. The new attempt made in this study is using mutual information

in order to calculate co-occurrence structure. The co-occurrence structure of terms is displayed on tools which are developed on this time.

3. visualization

When the co-occurrence structure of terms, visualization by drawing a network chart is said to be more effective than grasping them quantitatively. Visualization using charts gives an overall view of how a word is associated with other words, instead of describing the word-to-word relations numerically [2]. Following gives the outline of the visualization tool which indicates a level of a co-occurrence relation between terms by forces.

Results

Figure 1 shows co-occurrence word relations on the tool.

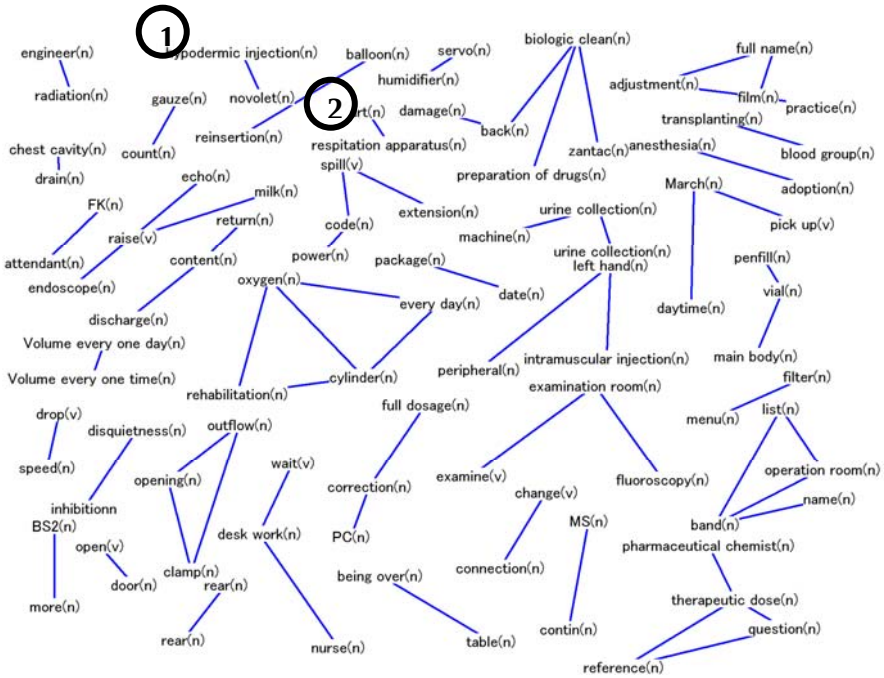

Figure1. Co-occurrence word relations

Conclusions

Figure 1 shows many latent words relations. For instance, circle 1 is “hypodermic injections”. Circle 2 is name of commodity of insulin preparation that is very strong co-occurrence. The visualization may lead us to discovery of some unexpected relations. As the document analysis is such a powerful tool, applying them on HIS integrating various clinical documents may allow celebrative analysis of documents to emerge new findings.

References

[1] e-Japan, http://www.kantei.go.jp/jp/singi/it2/kettei/ejapan2004/040615honbun.html

[2] Ricky K, et al, Automatic Structuring of radiology Free-Text Reports, Radiographics. 2001 Jan-Feb; 21(1):237-45.

Electronic Patient Record System in the South-Eastern Finland: Experiences in the Special Health Care of the Kymenlaakso Hospital District

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Keywords: Integrated electronic patient record system, Regional network, eHealth

Introduction

Kymenlaakso Hospital District and the South Carelian Hospital District together with the local health centres determined in 2003 common goals for their joint actions (1). These goals included the following: 1) the information moves, the patient less, 2) improvement of the safety of patients, 3) making it better possible for the private and the third sector organisations to take part to the publicly funded health care, 4) maximization of the utilization of the medical know-how in the South-Eastern Finland area, 5) shortening of the patient's waiting time, 6) improvement of the client-orientedness of the public health care, 7) improvement of the lab sampling so that it is possible for the patient to give her/his sample in the nearest health care organisation, 8) establishment of a call centre to advice people in health matters and when needed to guide them to appropriate units in the health care system, to minimize unnecessary visits to physicians, 9) centralization of the on-call services in the area. To achieve these goals the Hospital Districts (special health care) and the local health centres (basic health care) took the Effica electronic patient record system (TietoEnator) including the electronic patient records, digi-dictation, electronic consultation, and a regional access to all records of the patient into use and formed the South-Eastern Finland Patient Record System KAAPO (incl. ca. 0.31 mill. inhabitants and ca. 7000 health care professionals). In addition a call centre (EnsiNeuvo) and an internet service base (Nettineuvo, EU ESR proj.no: 83193) for citizens' health matters were established. Both EnsiNeuvo and Nettineuvo adviser nurses and midwives had on a contractual basis access to the regional KAAPO patient record system. The present study was performed to see, if these goals had been achieved with the means of a regional patient record system, the call centre and the internet service.

Methods

In the special health care of the Kymenlaakso Hospital District, the patient record system was taken into use in May 2004-September 2005 in 6 steps. Integrations to clinical laboratory information system (LIS) through Weblab Clinical web browser interface (to Multilab LIS) and to Agfa radiology information system (RIS) were built simultaneously. The Weblab Clinical integration was taken into use immediately after the electronic patient record system, followed by the Agfa RIS. All the personnel (1434 physicians, nurses, psychologists and physiotherapeutists) were educated in a class environment before the production environment was taken into use. Special attention was paid to informing the personnel sufficiently through electronic and traditional media. Hardware and software needs were mapped beforehand and the management of the various departments was informed about their special requirements. The software were tested in test environments and then downloaded to the computers centrally through the net. In some cases, it was necessary to load the programs manually at spot.

A pilot of the electronic patient record system was organized before the production phase in selected units. A separate pilot on structured electronic nursing documentation was also arranged. In the legal context, it was especially taken care that the requirements of the Act on Personal Data (523/99) and the Act on the Patient's Rights and Position (785/92) were fulfilled. As the Kymenlaakso Hospital District did not have an earlier electronic patient record system, only a LIS and certain programs for reporting, it was necessary to ascertain a sufficient education of the personnel. A simple analysis was done to see, if the Regional Electronic Patient Record System KAAPO, the EnsiNeuvo call centre and the Nettineuvo internet service had been efficient in the achievement of the goals stated in 2003.

Results

Clearly, the goal no: 1 (see above) had been achieved in the case of laboratory measurements and as the patient data from all the organisations were available to the appropriate personnel and the reports from the regional data warehouse to managements through the regional reporting system (KAARA), allowing comparisons of the figures of the various organisations, also the goal no: 2 had been fulfilled. The regional patient record data system had also made the goal no: 3 possible, although the private sector organisations had this far not made the investments necessary to get joined into KAAPO. Discussions about this were however under way. In regard to goal no: 4, decisions to centralize certain functions to certain hospitals in the whole KAAPO area had been made (possibility to see patient's all records in all the hospitals of the KAAPO region with her/his permission made this possible). There had also been discussions to direct the patient to operation in that hospital of the KAAPO region where the queue was shortest to fulfil the goals nos: 5 and 6, but the decision-makers were waiting for the patient administration parts of the Effica system to be taken into use. This would occur in the special health care of the whole KAAPO region in 2006. The availability of the digital images from all the KAAPO organisations will also help in achieving the goal no: 6. The goal no: 7 had been fulfilled, but due to lack of lab personnel in certain units, it was still recommended for the patients to use the lab of the hospitals for giving samples for their measurements. The goal no: 8 and partially also the goal no: 9 (basic health care) had been achieved in the Kymenlaakso Hospital District, but the centralization of the on-call services in the whole KAAPO region was still to come in spite of the regional patient record system.

Discussion

The present results show that the regional patient record system together with LIS, RIS, a call-centre and an internet patient service had made it possible to achieve most of the goals stated by the KAAPO Supervisory Board in 2003 (1). Further development is however needed to get all of these achievements into every day practice in the whole region and, according to the decision in principle by the Council of State on securing the future of health care (2), in the whole state.

Acknowledgements

The KAAPO project was funded by the municipal organisations and by the Ministry of Social Affairs and Health (National project for securing the future of health care).

References

[1] KAAPO Supervisory Board. Minutes of 13 Mar 2003.

[2] Council of State. Decision in Principle by the Council of State on securing the future of health care. Ministry of Social Affairs and Health. Brochures 2002:6eng. ISSN 1236-2123. ISBN 952-00-1235-4. (available in: http://pre20031103.stm.fi/english/eho/publicat/bro02_6/chap1.htm).

Session B2
Virtual Organisations

Thursday, August 31 2006

Terrace Hall

14:00-15:30

B2-1 **The Israeli Case – Creating a Virtual Organization by Fully Integrating Electronic Records and Establishing eHealth as a Comprehensive Service**
Ran Goshen (*ISRAEL*)

B2-2 **Regional Health Information Network and eServices in HUS**
Kari Harno (*FINLAND*)

B2-3 **E-learning as a Part of Further Education in Hospital Environment Case: Vaasa Central Hospital**
Anna-Kaisa Rainio; *Pia Haglund*; *Mikko Häikiö*; *Annika Backlund* (*FINLAND*)

B2-4 **Online Messaging Efficiency in Chronic Patient Care – International Evaluations on the Potential of eHealth Applications**
Karita Ilvonen (*UNITED STATES*)

B2-5 **Assessment of the Technical Quality of Telemedicine in Multidisciplinary Team Meetings for Breast Cancer within a Randomised Trial.**
Tom Gardner[1]; *IH Kunkler*[1]; *Michele Macnab*[1]; *Sally Swann*[1]; *RG Fielding*[1]; *John Brebner*[1]; *RJ Prescott*[1]; *Ross Maclean*[2]
; *Udi Chetty*[1]; *Angela Bowman*[1]; *Glyn Neades*[1]; *JM Dixon*[1]; *Melanie Smith*[1]; *Andrew Walls*[1]; *John Cairns*[1]; *Robert J Lee*[1] [1](*UNITED KINGDOM*); [2](*UNITED STATES*)

B2-6 **Monitoring the Web Presence of Evidence-based Healthcare Sites**
Kristian Lampe (*FINLAND*)

The Israeli Case – Creating a Virtual Organization by Fully Integrating Electronic Records and Establishing eHealth as a Comprehensive Service

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Keywords: information management, medical records system, inter-institutional relations, Israel.

Introduction

In its report to President George W. Bush, the President's Information Technology Advisory Committee testified in June 2004 stating that, "…the greatest improvements in quality of health care and cost savings will be realized when all elements of the health care system are electronically connected and speak a common technical language - that is they are interoperable… capable of supporting common technical standards and full interoperability and reporting performance on quality measures…"(1). Being led by the Departments of Defense and Veterans Affairs, multiple initiatives to share clinical information have been reported (2). In testimony given last September before the VA committee, the reviewers stated: "Much work remains before the departments achieve their ultimate goal - interoperable electronic health records and two-way electronic exchange of computable patient health information."(3). I will report on the successful medical information sharing network in Israel that covers 65% of the population and enables thousands of caregivers to access integrated and comprehensive clinical information at the point of care without data centralization.

Methods

Clalit Health Services provides full healthcare services to approximately 3.8 million patients through 14 hospitals (5500 beds), 1200 clinics, 80 labs and 35 imaging institutions (4). The organization employs approximately 20,000 care professionals, each of which can create medical data and, more importantly, request real-time data about patients. The medical information systems in the organization differ from one another and lack unification between the systems and the various centers utilizing them. The challenge was to improve patient care by providing caregivers consolidated clinical information, on line, at the point of care, regardless of where information was created. Data needed to be collected, on-demand, from the decentralized sources within the organization and integrated into information that would be reliable and available. This needed to be done without replacing the existing legacy systems, changing their functions or the way they operated. The solution also needed to utilize existing infrastructures such as LAN, WAN networks or the internet; as well as a web-based viewer while adhering to the most stringent requirements of information security and privacy protection.

The minimal data set required by the end-user was defined, and a pilot project to test the proposed solution's architectural structure and viability was designed. The success of a pilot implementation utilizing the dbMotion™ Solution served as the basis for its full implementation throughout Clalit in 2000. This prompted two of the country's largest independent state-owned medical centers (Rambam and Sheba Medical Centers – 900 & 1700 beds, respectively) to join this cross enterprise health information network in 2004 using the same platform and approach.

The dbMotion Solution consists of dbMotion Nodes serving the different members of the network. A Node may serve a single hospital facility, multiple sites or campus

environments and acts as a mediator providing the rest of the network with an interface to the Clinical/Operational system in use at that facility; a "gate" through which the specific facility requests and receives information from the network.
This architecture eliminates the need for a central data repository, creating a sustainable environment with no single point of failure. This structure minimizes the load on existing IT infrastructure and allows any type of system (i.e.: EMRs, remote services, data warehouse, research warehouse, etc.), regardless of it structure, the standards its supports and the technology it uses to participate in the network. dbMotion's federated architecture, together with role-based access control, helps safeguard the confidentiality of private medical records. In addition, the use of Nodes in such a way supports high degrees of flexibility and scalability which are important in such a network.

Results

The dbMotion Solution provides web-based clinical information exchange with online, on-demand aggregation and integration of clinical information components from dispersed, distributed sources and their transfer within seconds to authorized users according to different usage profiles and security policies. It provides available, real-time medical information while maintaining the highest level of information security; enabling caregivers to make decisions based on more complete medical information. Based on retrospective data analysis proving decrease in unnecessary admissions, prospective randomized return-on-investment studies have been designed and are being processed to document its cost effectiveness.
The number of users quickly grew from a few dozen to thousands (today >8750) in a matter of months. Today, this cross enterprise health information network serves over 4 million patients and provides real-time information at the point of care throughout Clalit Health Services, Rambam and Sheba Medical Centers. Usage analysis for the year 2005 amounts to 6 million logins, 51 million pages of integrated data reviewed, 2 billion records in systems of distributed Clinical Data Repositories, and an average response time of below 8 seconds.

Discussion

In some projects around the world attempts are being made to address the challenges of medical information sharing by employing solutions which involve the establishment of a centralized data repository. Such projects enjoy, in the short run, a high level of synchronization between the project participants with its seemingly straightforward approach. However, as a system begins to develop, the limitations of such a setting in terms of information confidentiality, system flexibility and scalability and reliability become evident. dbMotion's large-scale implementation based on its solution allows for easy scalability and is web-based thereby necessitating no data centralization and providing near real time sharing of clinical information at the point of care. Its success has revolutionized healthcare in Israel. Implementations in Europe and North America are currently underway.

References

[1] United States. President's Information Technology Advisory Committee, United States. National Coordination Office for Information Technology Research and Development. Revolutionizing health care through information technology report to the President. 2004; [cited; available from: http://purl.access.gpo.gov/GPO/LPS52723].

[2] Johnstone R, Buckley J, Bestilny S, Medical Records Institute. Alberta Mental Health Information System: a province-wide community mental health system initiative. Newton, MA: MRI; 1997.

[3] Koonz LD, United States Congress House Committee on Veterans' Affairs, United States Government Accountability Office. Computer-based patient records: VA and DOD made progress,

but much work remains to fully share medical information: testimony before the Committee on Veterans' Affairs, House of Representatives, Washington, D.C.: U.S. Government Accountability Office; 2005.

[4] Nurit N, Bruce R, Revital G. Hospital-community electronic medical record. 2006 [cited; available from: http://www.healthpolicymonitor.org/result.pdf].

Regional Health Information Network and eServices in HUS

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Introduction

The necessary cultural change to achieve a transformation of health care work by integrating primary and secondary care with information technology may be deeper than it sounds (1). First of all, the different actors in health care must be actively networking together. The care between them must be genuinely seamless so as to allow a global assessment of the clinical condition. In addition, the responsibility to orchestrate the care must be defined clearly. Incentives must be adapted along these functional requirements. Unnecessary clinic (and hospital) visits should simultaneously be reduced to a minimum.

Services of the RHIN

The Hospital District of Helsinki and Uusimaa (HUS) covers 21 hospitals and over 60 health centres. These health care organisations serve over 1, 4 million citizens, whose patient data may be accessed online irrespective of its origin. The Regional Health Information Organisation (UUMA) has provided means for modern, innovative *e*health services.

eReferals and eConsultations – electronic referrals and interactive remote consultations

We have set up a wide-area referral network between primary care and three university hospitals. This network was initially launched in 1990. In the university hospitals all specialties are involved. In 2002 there were 67,000 e-referrals transferred between the Helsinki University Hospitals and primary care. The solutions extend from the initial VPN use (Vantaa) to EDIFACT standard (Espoo) and HL-7 (Helsinki). A transition to standardized HL7 messages utilizing C-way message transfer systems (HUSway) through a single Network Access Point (HUSnap) is in progress. We expect over 100.000 *e*Referrals in 2005.

Navitas Link directory – for locating and viewing patient data from diverse information systems

The link directory is a central reference database containing links to patient data stored in their legacy systems. The upgrading of the legacy systems is made possible by application integration across the extended regional infrastructure. Provider access is possible by web browsers and patient information includes (primary care/hospitals) visits, critical data, EOE (laboratory and imaging), images and reports, laboratory results, referrals and discharge letters. All data is sorted according to social security coding, which is standard procedure in Finland.
The service was launched in 2003 and presently half of all (15/31) the municipalities, as well as hospitals, are connected to the RHIN and apply the link directory for regional exchange of information. Currently there are over 2.000 professional users.

Results

eReferrals and eConsultations

One promising area of *e*health is the electronic referral, which not only speeds up the transfer but also offers an option for communication between the primary care physician and the hospital specialist. By sharing information and knowledge remote

*e*consultations between primary and secondary care physicians evolve into a new working environment for integrated delivery of *e*services between the health care providers. Besides transferring data or information between providers, networking partnerships have to be structured by mutual agreements.
The *e*referral module has been in production for over ten years and has gone through extensive assessment studies by us (2-6) or analyzed by third parties (7-8). In these studies the *e*referral system has decreased the need for secondary care services by reducing first visits to outpatient clinics by 36 % and in less urgent cases by 50 %. The system allows more patients to be treated at less expense. Because all patients are thoroughly examined beforehand, the numbers of repeat visits as well as direct costs remain lower. We have shown convincingly that the interactive use of an *e*Referral system improves access to an adequate level of care and even large scale use results in more timely appointments. By prospective follow-up studies we have been able to prove that the quality of health care using remote *e*Consultations is consistent with outpatient face-to-face visits.

Navitas link directory

The core of the regional Navitas service is the Navitas Link directory. It is a service which maintains a regional directory of links pointing to patient and treatment information located in any of the connected health care information systems in the region: each participating organization has its own patient information system in addition to the 11 presently stand-alone patient information systems in HUS. HUS has also many other clinical information systems e.g. the laboratory system and HUSpacs, which have all been connected to the link directory.
At the moment there are 15 patient information systems connected to the Link directory. A specific adapter software has been installed locally into each of the systems through which links are fed into the Link directory. Links are HL7 (Health level 7)/ CDA (clinical document architecture) compliant messages containing the identification of a patient and a short description of the contents of the particular patient record. No actual records are stored into the Link directory.
Navitas has a regional user database and centralized authentication and authorization services; this enables the participating organizations to have complete control over their own users. The health care professionals can access Navitas from their personal workstations using a web browser. The data transfer is encrypted and only private, dedicated networks are used to transmit the data. Viewing of the patient data through the links requires the patient's informed consent. The information is queried by the Navitas Link directory from the patient information system itself. The view provided by the Link Directory is a read-only view, structured in a user-friendly and visual way.
The Navitas Link directory service is available today for the health care professionals in the Hospital District. The directory contains information from 1.4 million citizens. Currently there are about 9,5 million links in the database. The number of links has been minimized in order to make it easier for the professional to get a holistic view on the patient's medical history. In HUS, for example, several visits are grouped into one care period.

Summary

The initial benefits from the *e*services have emerged in relation to access to care, quality of care and economics. Studies on the assessment of the *e*services have been launched in the hospital district to reveal new information that may be used to develop the services further.

Supervised disease management care by clinicians using *e*consultations to primary care physicians' targets the aim for an equal quality of care to be available in all parts of the Hospital District. As a result, *e*referrals and *e*consultations have resulted in more timely appointments at the outpatient department.

The *e*referral system has decreased the need for secondary care services by reducing first visits to outpatient clinics. The system allows more patients to be treated at less expense. Because all patients are thoroughly examined beforehand, the numbers of repeat visits as well as direct costs remain lower. Fewer examinations are needed and by avoiding overlapping examinations, costs have been reduced.

References

[1] Harno K, Grönhagen-Riska C, Pohjonen H, Kinnunen J, Kekomäki M. Integrated regional services: are working process changes desirable and achievable? Journal of Telemedicine and Telecare 2002; 8 (suppl 3):26-28.

[2] Harno KSR. Telemedicine in managing demand for secondary care services. Journal of Telemedicine and Telecare 1999; 5:189-192.

[3] Lillrank P, Paavola T, Harno K, Holopainen S. The impact of Information and Communication Technology on Optimal Resource Allocation in Healthcare. International Conference on TQM and Human Factors – towards successful integration. Linköping, Sweden 1999.

[4] Harno K, Paavola T, Carlson C, Viikinkoski P. A prospective study of an intranet referral system between primary and secondary care on clinical effectiveness and costs. 3rd Nordic Congress on Telemedicine, Copenhagen, Denmark 2000:64.

[5] Harno K, Paavola T, Carlson C, Viikinkoski P. Improvement of health care process between secondary and primary care with telemedicine – assessment of an intranet referral system on effectiveness and cost analysis. Journal of Telemedicine and Telecare 2000; 6:320-329.

[6] Harno K, Arajärvi E, Paavola T, Carlson C, Viikinkoski P. Patient referral by telemedicine and videoconferencing in orthopaedics – effectiveness and cost analysis. Journal of Telemedicine and Telecare 2001; 7:219-225.

[7] Wootton R. Recent advances: Telemedicine. BMJ 2001; 323(7312):557-60.

[8] Roine R, Ohinmaa A., Hailey D. Assessing telemedicine: a systematic review of the literature. Canadian Medical Association Journal 2001; 165(6):765-71.

[9] Pohjonen H. Image fusion in open-architecture PACS-environment. Computer Methods and Programs in Biomedicine 2001; 66: 69-74.

[10] Kinnunen J, Pohjonen H. PACS in Töölö hospital. Computer Methods and Programs in Biomedicine, 2001; 66: 31-35.

[11] Harno K, Roine R, Pohjonen H, Kinnunen J, Kauppinen T. A framework for systematic assessment of the regional HUSpacs after the reengineering of hospital and external processes. CARS 2002, Computer Assisted Radiology and Surgery; 618-622. Lemke MW, Vannier K, Inamura AG, Farman KDoi K & Reiber JHC (editors). Springer-Verlag Berlin Heidelberg 2002 and CARS.

E-learning as a Part of Further Education in Hospital Environment Case: Vaasa Central Hospital

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Keywords: E-learning, pilot course, hospital, personnel

Introduction

A hospital environment puts a lot of pressure and challenges on further education because of its special needs and requirements. First of all most of the employees have 3 shift work so it is hard to reach everyone at the same time. Lack of nurses, turnover among nurses and special health care have also their demands. When the greatest motivation for hospital staff is offering high quality services to patiens[2], the best way to keep up that motivation is to offer staff opportunities to develop their skills. When the personnel often changes and health care is changing to be more and more IT-based (e.g. EPR), an effective and functional way to arrange further education is distance education in form of e-learning. At the moment Vaasa Central Hospital arranges language and data courses on the Internet.

There are some 160,000 inhabitants in the whole hospital district, 51% of them Swedish-speaking and 49% Finnish-speaking. Vaasa Central Hospital has over 2000 employees of which 49 % have Swedish as mother tongue and 50 % of them have Finnish. Because of the language divisions the hospital is bilingual, and the patients are addressed in their mother tongue. This puts a great strain on the language education of the personnel.

Methods

At the moment netcourses that support proficiency are language and data courses. Data and language skills are reguired from almost everyone that works in a modern organisation in the area of health care.We decided to put our optional self-access entities that support professional skills on the Internet because there are lots of employees among us that have different skill levels and some of them might lack the basic skills supporting duties.

In our netcourses there is always a teacher, a tutor or both to support and guide the students when needed. Before the beginning of a course there is always a schooling occasion on using the e-learning platform which in our case is an open source platform Moodle. The occations are not obligatory but most of the students want to participate in them and find them useful. The courses lasted 2 - 3 months during which time the students had to go through the material and return all the assignments. In practice, completion of netcourses is being rewarded the same way as the completion of traditional courses. The students are authorized to our education data system and get a certificate from the course if wanted.

Table 1 shows that the total amount of participants in pilot courses has been 113 students. of which 17 has dropped out in some point. Among participants there are many different occupational groups working in hospital for example nurses, doctors, hospital attendants, secretaries etc. Our virtual learning environment works via Internet so it is reachable from work and home.

Table 1. Pilot courses and the amount of participants in Vaasa Central Hospital

Pilot courses	Participants	Drop-outs
Swedish for nurses I	19	2
Swedish for nurses II	12	1
PowerPoint (in Swedish)	19	5
Outlook (in Swedish)	22	3
Outlook (in Finnish)	13	1
Word (in Finnish)	12	2
Information search on Internet (in Finnish)	16	3
Total	**113**	**17**

Results

The results from the pilot courses have been positive. Most of the participants feel that they have learnt a lot. There were quite significant differences in activiness of the participants but mainly the activeness was good. The amount of participants in pilot courses is shown in table 1. According to the participants the biggest advantage of e-learning is its independence from a particular time and place. Also the support functions such as help via e-mail, discussion groups and phone consultation got a lot of credits. Feedback was collected with the help of an e-form and was send by e-mail to all participants from which totally 42 answered. The results of pilot courses show that the main points that need to be focused on in the future are different kinds of support functions and increase in interactivity[1]. Professional education will also be a part of our e-learning in the future.

Discussion

The biggest challenges in increasing e-learning are the attitudes and fears that have to do with information technology, technical functionality of both the Internet and the equipment and insufficient computer skills that many participants have. The personnel in health care is dominated by women and becoming middleaged[5]. According to a recent research, the attitudes towards information technology of this target group are negative and their skills are lacking. A research by Stakes (National Research and Development Centre for Welfare and Health) made in 2005 shows that at least 30 % of the health care personnel that took part in the study do not know how to use computers effectively enough and are in need of schooling in the basics of information technology[5]. Two things that we also should remember are three-shift-work and quickly changing situations that do not only create great challenges to operative management[4] but also to education.

Another essential challenge is to keep netcourses interesting and multifaceted and to keep up the motivation of the participants. Keeping courses interesting and the motivation high are as close to each other as concept and challenge. Increasing diversity and motivation can be made possible by using more multifaceted exercises and interactivity. This is without dispute a big challenge but the keywords are careful planning and well co-ordinated implementation. Arranging education in a virtual e-learning platform changes also the job descriptions, cost structure, teaching and learning arrangements and equipment requirements in an organization[3].

References

[1] Haglund, Pia. E-learning at a Workplace. CASE: Vaasa Central Hospital. Vaasa Polytechnic 2006.

[2] Ham C. Improving the performance of health services: the role of clinical leadership. The Lancet 2003; 361, 1978-1980.

[3] Korpi, Niemi, Ovaskainen, Siekkinen ja Junttila. Virtuaalinen oppimisympäristö koulutusta järjestävän organisaation työvälineenä. Jyväskylän yliopisto tietotekniikan tutkimusinstituutti 2000.

[4] Mark BA. What explains Nurse's perceptions of staffing adequacy? JONA 2002; 32, 234-242.

[5] Sinervo, Leini & Noora von Fieandt. Tietotekniikka sosiaali- ja terveysalan osaamisen kehittämisessä. Stakesin Aiheita 2005; 5.

Online Messaging Efficiency in Chronic Patient Care – International Evaluations on the Potential of eHealth Applications

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Keywords: patient-physician messaging, efficiency, chronic patient care, patient health records

Introduction

As Finland, along with other European countries, is driving towards integrated health records and e-prescription models, consumer centric healthcare is also going online. Patient Health Records (PHR) and Patient-Physician messaging applications are increasing in number[1]. Patients are looking to access their lab results, graph their results online and consult their physician by messaging. These services are now being piloted in many European countries. Current literature is generally focused on somewhat limited populations or attributes[1] and focusing on satisfaction of the early adopters. Operations management point of view and efficiency studies are needed to justify investments to IT.

International benchmark evaluations presented in this paper, were done in order to provide valuable insight into changes in efficiency and patient behavior. This paper provides an overview of two extensive studies, done in California during 2005-2006. Both of the studies looked at online healthcare delivery systems and their efficiency in providing chronic patient care. A significant portion of chronic care is routine in nature (e.g. blood value measures) and can be replaced by asynchronous messaging.

Methods

This paper discusses an overview of two extensive studies of two northern California providers, Palo Alto Medical Foundation (PAMF) and Kaiser Permanente. The objective was to understand and measure the effects of patient-physician messaging on primary care services. A variety of methods were used to analyze the phenomenon of PHRs and patient-physician messaging efficiency. Extensive literature review and several expert interviews were conducted to understand the phenomenon and current challenges were performed at PAMF. Statistical data analysis of 5000 patients and 5 years time period at PAMF compared pre-post messaging cohorts with non-messaging control groups. More specific analysis was done on type II diabetes patients cohort of 381 patients, divided into 127 online messagers and two control groups. We used EHR data to analyze the effects of the messaging intervention. Changes in demand were controlled for age, sex and other chronic conditions. The analysis determined use of resources and changes in demand patterns. Individual case studies of patients using the systems were also looked at, by mapping their use of resources. These analyses of individuals are very clear examples of how the demand changes its nature with the messaging intervention. We also surveyed primary and internal care doctors on their perceptions on effects to workflow, efficiency and quality of care with an online survey of 17 questions that was sent to 150 doctors. Although we used diabetes patients are our case cohort, the methods and general findings are applicable to other patient groups as well. In the on-going study at Kaiser Permanente

Results

We found patient-physician messaging to change the way patients use healthcare services. Messaging increased the amount of phone calls significantly. Many of the routine interventions moved to the new less time consuming media. Messaging was found to stop a growing demand for appointments as well. Handling lab test results online system takes less than 10% of what it used to take via phone and letter, due to automation and new workflows. This alone can result in major time-efficiency improvements. The physician survey findings included positive changes in the physician workflow. The physicians reported most of the messages to discuss routine healthcare problems. Messaging was preferred over other channels in providing lab results, doing follow-up and answering to medication questions. The physicians claimed that the online service increased quality of care by providing better access to health information, improved patient communication, better disease management and better access to care. Many of the previous studies have reported physician fears of being overwhelmed with messages; this was proven groundless. Physician attitudes towards these systems were mostly positive and in support. Both of the studied systems had positive impacts to provider efficiency.

Discussion

The studies resulted in several lessons learned that are important for European healthcare organizations in implementing similar systems. European patients are likely to adapt to these systems without problems, since Internet penetration is high and it is used for many aspects of daily life already. We are also closer to understanding eHealth best practices and the way workflows are affected and should be organized in these systems. With reimbursement, providers will likely be more inclined to communicate with patients electronically[3]. Our results support the findings of many authors including Liederman (2006), White (2003) and Baker[4] in the earlier literature. The papers published from these studies will add significant operational understanding to the current knowledge and pragmatic support to organizations implementing patient centric online care.

References

[1] White C, Moyer C, Stern D, Katz S. A content analysis of E-mail communication between patients and their providers: patients get the message. Journal of American Medical Informatics Association 2004; 11:260-267.

[2] Brooks R, Menachemi N. Physicians' use of email with patients: factors influencing electronic communication and adherence to best practices. Journal of Medical Internet Research. 2006. Vol 8 (1) e2.

[3] Liederman E, Lee J, Baquero V, Seites P. Patient-physician web messaging. The impact on volume and satisfaction. J Gen Intern Med 2005; 20:52-57.

[4] Baker L, Rideout J, Gertler O, Raube K. Effect of an internet-based system for doctor-patient communication on health care spending. Journal of American Medical Informatics Association. 2005; 12: 530-536.

Assessment of the Technical Quality of Telemedicine in Multidisciplinary Team Meetings for Breast Cancer within a Randomised Trial.

Gardner T[1], Kunkler IH[1], Macnab M[1], Swann S[1], Fielding RG[2], Brebner J[3], Prescott RJ[1], Maclean R [4], Chetty U [1], Bowman A [5], Neades G [5], Dixon JM[1], Smith M (1), Walls A [6], Cairns J[7], Lee RJ[1].

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Keywords: telemedicine, videoconferencing, cancer, multidisciplinary team, trial

Introduction

Multidisciplinary team (MDT) working is an integral part of UK cancer policy. MDTs for breast cancer, including surgeons, radiologists, pathologists, oncologists and breast care nurses traditionally meet 'face-to-face'. Increasingly, in the UK, geographically distant cancer professionals participate in discussions of patient details and review of imaging using telemedicine (TM) [1,3]. The technical quality of audio, video, radiology and pathology is a key aspect of the safe and reliable use of TM for shared MDTs between remote cancer professionals.

Aim: To assess perceptions of technical performance of telemedicine (TM) among breast cancer professionals and the trial team during TM delivered MDTs within a randomised trial: TELEMAM. Setting: Three sites: The Edinburgh Breast Unit (the cancer centre), and two cancer units in district general hospitals (DGHs), Dumfries and Galloway Royal Infirmary (DGRI) and Queen Margaret Hospital, Dunfermline (QMH), all in Southern Scotland.

Methods

Over a 12 month period 473 patient discussions held at multidisciplinary breast cancer team meetings (MDTs) were randomised to standard ' face to face' meetings (28) or linked by teleconferencing and teleradiology to the breast team at the Edinburgh Cancer centre (48). MDTs were weighted 2:1 in favour of TM. Five TM MDTs did not take place due to technical problems. Each site was equipped with a high quality fully integrated VC suite and were connected through a mixture of NHS Internet Protocol (IP) networks (up to 768kbs [QMH]) and ISDN (384kbs [DGRI]).

A technical conduct form, using a 5-point scale ranging from 'very poor to very good' was used by the trial team to collect information in regard to the quality of three data modes: audio, video and image data during each videoconferenced MDT. The form was used to rate the quality of the data modes for individual patient discussions. Additionally, the form contained three categories to define why data was not available. The robustness of a TM link was also recorded and reasons for failure were given if this occurred during a meeting. Additionally, in a post-trial questionnaire breast cancer professionals recorded their perceptions on a 10 point scale from 'very poor to very good' of the technical quality in six categories: visibility of participants, image quality, audio quality, synchronicity, efficiency and reliability.

Results

Technical quality rated by breast cancer professionals

The aspects of technical quality with the lowest average ratings were synchronicity and images (mammogram/pathology), while audio and efficiency of the link were rated the highest. However the quality of the six aspects was very similar (Table 1), each being rated on average in the middle of the scale (0 to 10).

Table 1: Responses to questions on the post-trial questionnaire concerning the overall technical quality of the link during videoconferenced MDTs

Conference Modes	Mean (SD)
Visibility of participants	5.1 (1.8)
Images – mammogram/pathology	4.7 (2.2)
Audio	5.2 (1.8)
Synchronicity – continuous communication	4.5 (1.7)
Efficiency	5.4 (2.0)
Reliability	4.9 (1.9)

Technical quality rated by TELEMAM trial team

For both links between the cancer centre and the two DGHs there were clear improvements from the first to the second 6 month period in the quality at the local DGH site of the audio, video and imaging using VC. In both periods the video quality at each DGH was rated lower than both the audio and imaging. For the link to DGRI, the quality at the cancer centre of the audio, video and imaging were all fairly similar in the two 6 month periods. In contrast, for QMH there were definite quality improvements at the cancer centre in all three parameters between the first and second 6 months.

Discussion

The breast cancer professional's perception of the technical quality of the link for telemedicine-led MDTs during the trial averaged half way on the scale. The average audio score by all participants was just over 50% which compares to 50% of participants in another study considering video quality to be sufficient [2]. The average video score of all participants, which includes visibility of participants (5.1) and images (4.7), was low in comparison to the video in previous research [2]. The images were not transmitted for diagnostic purposes but for the purpose of discussion. Despite this they were perceived as being below the middle score available. The perceived improvement in quality over time seen by the trial team could be related to the resolution of network issues outstanding at the star of the trial. This concept is supported by continued and increased VC use by a variety of groups. It is also possible that increased familiarity with both the equipment and the new procedures involved in TM MDT meetings could account for some of the improvements over time.

Acknowledgements

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References

[1] Axford, A.T, Askill C and Jones, A.J. Virtual multidisciplinary teams for cancer care. Journal of Telemedicine and Telecare 2002; 8 (Suppl 2): S3-4.

[2] Delaney, G., Jacob, S., Iedema, R. et al. (2004) Comparison of 'face-to-face' and videoconferenced multidisciplinary clinical meetings. Australasian Radiology; 48 (4): 487-492.

[3] Kunkler, I.H., Fielding, R. G., Brebner, J. et al. (2005) A comprehensive approach for evaluating telemedicine-delivered multidisciplinary meeting in southern Scotland. Journal of Telemedicine and Telecare; 11 (suppl 1) 71-73.

Monitoring the Web Presence of Evidence-based Healthcare Sites

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Keywords: webometrics, cybermetrics, Internet, World Wide Web, evidence-based healthcare organisations

Introduction

During the last 10-20 years, the practice of medicine and the delivery of healthcare have witnessed an unparralleled demand for and supply of scientific evidence. Information producers, such as guideline developers1, systematic reviewers2 and health technology assessment agencies3, have discovered the internet - a medium for rapid and affordable distribution of information. The vast amount of information, however, makes it difficult for any information provider to get their message through. A web site that several other web sites link to is a key element in creating a strong web presence and hence improving one's ranking in search engine results. This study aims at clarifying how the link popularity of some key sources of evidence-based information develops over time. The information obtained helps in understanding the process of establishing a strong web presence and the behaviour of search engines.

Methods

The total number of web pages with inbound links to the home page of the observed sites was monitored regularly (1-month intervals) with two search engines (Google and AltaVista). Also the number of true external sites with such links was monitored with AltaVista. The follow-up time was 17 months for the Finnish sites and 10 months for the Swedish site. The Google PageRank index was followed up for a period of six months, using Google Toolbar.

Results

The development of web presence over time was analyzed using 5 Finnish web sites and one Swedish site. The following Finnish sites were observed: Finnish Office for Health Technology Assessment (FinOHTA), National Research and Development Centre for Welfare and Health (STAKES), Terveysportti (a Finnish health portal, TP), Current Care Guidelines (CCG), and the Centre for Pharmacotherapy Development (ROHTO). The Swedish Council on Technology Assessment in Health Care (SBU) was included for international comparison.

At baseline, STAKES home page was clearly most visible in these two search engines. FinOHTA, TP and SBU had a medium visibility in relation to the other sites. CCG and ROHTO started with very low visibility. (See table 1)

Over time the two search engines display very different changes. The visibility of the home pages in Google is fairly stable: the 17-month changes remain mostly between -7% and +15%. The only exception is CCG, which greatly increases its visibility (+1586%). Changes in AltaVista are more marked and variable particularly for all pages (from +14% to +570%), but also for external pages (from 13% to 656%).

After 17 months, the visibility of CCG and ROHTO is clearly better in both Google and AltaVista compared to the baseline. Other sites have not achieved similar changes, but they are still more visible when measured with absolute numbers. CCG has, however,

reached others in Google. In the AltaVista results the number of external pages with inbound links in relation to the number of all pages with inbound links shows peculiar variation. For FinOHTA and TP, a declining tendency can be observed, i.e. over time a smaller share of the pages with inbound links are true external pages. For some sites the relation remains fairly stable over time (STAKES, KH, SBU). For ROHTO the tendency is upwards: during the first months approximately 40% of the pages with inbound links and towards the end of the period nearly 100% of such pages were external. Google PageRank was a very stable indicator of link popularity. All rankings remained the same (4 to 7) for all sites for the six-month follow-up, with the exception of CCG's rank increasing from 5 to 6 during the last month.

Table 1. Number of pages with inbound links over time.

LINK TARGET	ALL PAGES WITH INBOUND LINKS						EXTERNAL PAGES WITH INBOUND LINKS		
	Google N change in %			AltaVista N change in %			Altavista N change in %		
	Base-line	12 mo.	17 mo.	Base-line	12 mo.	17 mo.	Base-line	12 mo.	17 mo.
FinOHTA	94	101 +7%	100 +6%	702	1010 +44%	1280 +82%	190	200 +5%	220 +16%
STAKES	1210	1220 +1%	1130 -7%	14700	30100 +105%	32600 +122%	2870	9740 +239%	3930 +37%
TP	205	108 -47%	236 +15%	473	1150 +143%	1060 +124%	472	834 +77%	847 +79%
CCG	14	38 +171%	236 +1586%	76	223 +193%	243 +220%	76	206 +171%	232 +205%
ROHTO	0	23 NA	55 NA	10	52 +420%	67 +570%	9	51 +467%	68 +656%
SBU	127	137 +8%	144 +13%	997	1120 +12%	1140 +14%	1000	1120 +12%	1130 +13%

Discussion

The level of web presence and the observed changes varied considerably. The sites with a more marked and stable online presence belong to older organisations than those with less established presence. This is a probable explanation for the observed differences. The two search engines behaved differently. The collection of Google seems to be more stable than that of AltaVista, in which a considerable growth was observed. Even Google's stability can not be clearly evaluated, since this study did not explore whether the relatively stable numbers reflect a stable collection of pages, or whether the numbers remain the same although the pages in the collection actually change (but not the number). The general trend of all sites was towards a better web presence: over time more and more sites point to them, suggesting their role as useful information sources. Two of the sites that started with a very limited web presence managed to clearly improve their presence during the follow-up time. Changes in the link popularity were observed more clearly directly from the search engines; Google PageRank was a more stable indicator of web presence.

Follow-up of the web presence of one's own organization is a relatively simple process. When conducted in a systematic manner, it may assist in developing and implementing effective communication strategies. The effects of changes in site structure and user interface, as well as of various promotional interventions may - at least partially - be evaluated through the analysis of link popularity.

References

[1] http://www.g-i-n.net
[2] http://www.cochrane.org
[3] Banta D. The development of health technology assessment. Health Policy 2003; 63(2):121-32.

Session C2
Mobile Applications I

Thursday, August 31 2006

Aurora Hall

14:00-15:30

C2-1 **From Contact Teaching to Web-based Tele-healthcare Education in Finland**
Riitta-Liisa Kortesluoma; *Ilkka Winblad* (*FINLAND*)

C2-2 **Mobile Self Care and Connectivity**
Timo R. Nyberg (*FINLAND*)

C2-3 **User Acceptance of a Mobile Diary for Personal Wellness Management**
Elina Mattila; *Juha Pärkkä*; *Marion Hermersdorf*; *Jussi Kaasinen*; *Kai Samposalo*; *Janne Vainio*; *Juho Merilahti*; *Juha Kolari*; *Minna Kulju*; *Raimo Lappalainen*; *Ilkka Korhonen* (*FINLAND*)

C2-4 **Hypertension and Diabetics Electronic Monitoring System**
Mansour Aldajani; *Mansour Aldajani* (*SAUDI ARABIA*)

C2-5 **eHealth in Hospital at Home – Videophone in Care Delivery**
Hannu Pietiläinen; *Tommi Autio*; *Paula Lonkila* (*FINLAND*)

C2-6 **A Mobile Tool for Research and Diagnosis of Acute Mountain Sickness (AMS)**
Maija Marttila-Kontio; *Mikko Heinonen*; *Marko Hassinen* (*FINLAND*)

From Contact Teaching to Web-based Tele-healthcare Education in Finland

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Keywords: tele-education, web-based course, e-learning environment

Introduction

Telemedicine is one of the most rapidly developing areas in health care, as a result of current social and health policies, the contemporary need to cut costs, the needs of the population, and advances in information technology (especially network services) and software and IT developments. At the same time, continually falling prices have reduced the technical and economic barriers to implementing telemedicine. In Finland, both pilot projects and working applications using telemedicine have been developed and are in use at every level of healthcare. Telemedicine affects the methods of diagnosis and care at primary and specialized care in areas such as radiology, psychiatry, neurology, surgery, ophthalmology, pathology, dermatology and other specialties. There are also telemedicine activities underway in the fields of nursing, healthcare administration, different therapy services, clinical chemistry, etc.

The successful development of telemedicine and its effective use require education in telemedicine. Early in 1997, it was decided in the Open University of Oulu to start a course in telemedicine. In September, the same year the course entitled "Introduction to Telemedicine" was offered to 36 students of the Faculty of Medicine. The first course was almost entirely delivered through contact teaching in Oulu.

In spring 1998, the course was delivered by distance education and was therefore available outside the city of Oulu. Real-time telecommunication, including the methods of audio and videoconferencing provided a 'remote classroom', supported by local tutoring and group work. The course consisted of contact lectures in a lecture hall coinciding with live interactive videoconferencing to one or more remote sites.

The participation has been very laborious, because the students were from different parts of Finland, in some cases at a distance of 400 km. The assessment of the students' performance has been problematic for the same reasons. The students answered the exam questions at home and mailed their answers to the teachers. After checking and commenting on the answers, the teachers mailed them to the Open University where the results were recorded and the results were passed on to the students.

In order to better serve the students and respond to an increasing demand among students and health care personnel to have education on tele-healthcare, the next step was to promote a learning environment based on computer –mediated activities and e-mail. In 2005 we developed a web-based course, entitled 'The Basics of Tele-healthcare' with interactive characters. The learning model was a modern and expanded version of traditional learning by correspondence.

Nine of the twelve double lectures (90 min) were videotaped for future use simultaneously with conventional contact teaching. Three lectures were conventional contact lectures, but those were afterwards videotaped in a studio without an audience. All videotaped lectures were complemented by power-point presentations on the website as well as by links to other websites for other databases. The duration of the video material was fifteen hours in all, with the same factual content as the conventional contact lectures.

In order to exploit and test the videotaped material with the power-point presentations and web-site links, the material was edited, indexed and stored in the server of the University. New students were given usernames and passwords for the e-learning environment of the university, called Optima. In Optima, there were links to the educational material as well as instructions for use. It served also as a platform for interaction between the teachers and students.
The students, who were health care professionals, had two months access to the web site. They were encouraged to ask questions and give comments on topic-related subjects in the discussion area of Optima. The discussions were possible in a public (access for all students and teachers) or private (only for a nominated student or teacher) area. In Optima there was also an area, where the teachers and students introduced themselves to each other with a photograph and short story about their background. In that area the students could also express their expectations about the course.
To assess the students' performance we arranged an exam with four questions in the end of the course. The length of each answer was to be about 500 words and could e answered at home using Optima, they also had to prepare an essay (about fifteen pages long) on one of six topics given by the teachers. The time provided for completing the task was three weeks.
The students returned the exams and essays first in the private area of Optima. The teachers then assessed the essays and commented on them in the same area. The students got optimal answers for the questions from the teachers with instructions about self-assessment. When the students sent their self-assessment to the teachers, the teachers then gave the final grades.

Methods

In order to further develop this pilot web course, we took feedback from the students (n=14) after the course. They responded anonymously on a web questionnaire with structured Likert Scale questions. A typical question posed a statement and asked the respondent to choose from: Strongly Agree - Agree - Undecided - Disagree or Strongly Disagree. The responses elicited were summarised using a mode which is suitable for easy interpretation. Moreover, an open ended question was included in the questionnaire. The data obtained was analysed by inductive content analysis.

Results

The response rate was 50%. The preliminary results show that the duration of the course (2 months) was suitable. On the whole, the course was assessed as good and it corresponded very well to the demands of the students' tasks at work. The technical level of the video lectures videotaped both in the studio and during the contact teaching was assessed as good. The students regarded the video lectures on the web as equal to the contact teaching when assessed in relation to learning. They considered that the course was much more accessible when delivered through the web, even though it paid the price of lower interaction.

Discussion

The preliminary results encouraged us to further expand the course and research its content and realisation from the points of view of undergraduate and postgraduate education.

References

[1] Barnett V. Sample Survey principles and methods. Hodder Publisher; 1991.
[2] Campbell, A. (ed.) International Encyclopedia of the Social Sciences, Biographical Supplement, New

York: The Free Press; 1988.
[3] Gordon Cox C, White D, Brinson H, Ramey D. Distance learning: health education for ninth-grade students. Journal of Telemedicine and Telecare 2000; 6(4) Suppl 2:S8-10.
[4] Kortesluoma R-L, Rajaniemi H. Telemedicine: university-level education in Finland. Journal of Telemedicine and Telecare 1998; 4(1): 61.
[5] Likert R. A Technique for the Measurement of Attitudes, New York: McGraw-Hill; 1932.
[6] Downe-Wamboldt B. Content analysis: method, applications, and issues. Health Care Women Int. 1992; 3(3):313-21.

Mobile Self Care and Connectivity

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Keywords: Mobile Self Care, Connectivity

Introduction

Many different mobile self care applications exist and they require different degrees of connectivity, which can be divided into four categories: body area network (BAN); wireless local area network (WLAN); mobile network (Mobile Network); and wide area network (WAN). This presentation studies self care applications and their connectivity needs and possibilities. Challenges remain to make the technologies interoperable.

Self Care Applications

Mobile self care systems typically monitor common vital signs such as blood pressure, electro cardiogram, pulse rate, breathing rate, body activity, and weight. Blood tests, questions or physical tests are also integrated to the mobile monitoring systems such as the monitoring of blood glucose, pain or eye sight. Often the body area network BAN is used to collect this information from the measuring device to the data terminal. Mobile applications are also used as support tools for educating the patients to better self care.

Mobile self care systems are most often made functionally available over the mobile network. There is no need to plug the wire to the Internet, telephone modem or any other system; modern mobile network is always connected. Most mobile self care systems use the Internet as a complimentary means for communication with the patient. The tabletop or laptop computer and Internet offer bigger screen, easier keyboard and often a better connection speed as the mobile terminals. However, today a good quality and fast Internet service is available over the mobile 3G network in the new mobile terminals as well. The 3G network replaces the WLAN in many cases.

Making the most of Technology

Mobile self care meets the needs of patients who require continuous care and who do not want to be bound to one location. Mobile systems also offer a preventative method to make all people more aware of the influences that lifestyle has on their health. Many functional technologies exist which offer mobile self care solutions. The challenge of mobile self care systems is no longer in the technology. The challenge is in easy-to-use systems and training healthcare professionals and patients to use them correctly and effectively.

Self Care Connectivity

Different mobile applications require different connectivity, which may be divided into four categories: body area network (BAN); wireless local area network (WLAN); mobile network (Mobile Network); and wide area network (WAN).

Body Area Network (BAN) and Mobile Self Care

Often manual use or a wired connection to the mobile terminal is a good choice for body area networking. BlueTooth is the wireless BAN which is currently preferred by many medical technology industries. It has strong support from big wireless companies and is standard in many modern mobile handsets. However, in mobile medical equipment the amount of information transmitted is typically small and the equipment is

personal, so there is no need for either the large data transfer capacity or the open network connectivity of BlueTooth. Alternative technologies include Zigbee, radio frequency identification (RFID) technologies, and IrDA which are cheaper, simpler and have lower power consumption. The manual input or a wire is still a good choice.

Wireless Local Area Network (WLAN) and Mobile Self Care

WLAN technologies are widely used in hospitals, but WLAN devices are seldom suitable for true mobile applications, as they require relatively big batteries to support their power needs and their roaming is limited. As for BlueTooth, they offer more data transfer capacity than is needed for simple monitoring applications. The benefit of WLAN systems is the well-established standards. Many mobile self care applications exploit the WLAN systems, including locating applications, CoIP and connectivity between portable devices such as laptops. WLAN is wireless local, it is not mobile.

Mobile Network and Mobile Self Care

Most mobile networks are capable of conveying medical data, since even the old GSM data 9.6 kBits is enough for transferring a good quality 12-lead ECG signal. However, mobile networks are developing at a varying pace in different geographical areas, and the reliability of the data transfer is a critical factor. In many cases the SMS data transfer capacity would be sufficient, but the time delay can be an issue in medical emergencies. With the WDMA and GPRS networks it is possible to transfer MMS messages, small pictures and video clips and continuous data. This is the preferred network for modern mobile healthcare applications today. In practice the new 3G network will make it possible to have CoIP e.g. video consultation and Internet over the mobile network. It is fully operational and competitively priced.

Wide area network

Now almost ubiquitous, the internet is a WAN which serves as an excellent platform base for mobile self care information systems. It economically allows all necessary data transfer, as well as voice and video consultations almost anywhere in the world. The 3G will make it mobile. This solution will be cheap and easy to use and maintain.

Conclusion

Mobile healthcare can be delivered without using all mentioned connectivity options but in many cases they are all in use. Interoperability is still an issue in the mobile systems industry, and the integration of mobile self care systems will present challenges. Nevertheless, the integration of mobile self care technologies may be faster than the integration of traditional health records, which have been extremely slow and unwilling to adopt any changes that would make interoperability possible.

References

[1] Ylisaukko-Oja A, Vildjiounaite E, Mäntyjärvi J, Five-Point Acceleration Sensing Wireless Body Area Network - Design and Practical Experiences, Proceedings of the Eighth International Symposium on Wearable Computers (ISWC'04), Japan, 11/2004

[2] Junker, H., Stäger, M., Tröster, G., Blättler, D., Salama, O., Wireless Networks in Context Aware Wearable Systems, EWSN 2004: 1st European Workshop on Wireless Sensor and Networks, Germany, 19.-21. January 2004.

User Acceptance of a Mobile Diary for Personal Wellness Management

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Keywords: wellness management, cognitive behavioural therapy, mobile phone application

Introduction

The modern lifestyle – energy-rich diet and sedentary and stressful lifestyle - has increased the prevalence of, e.g., obesity, work-related stress, and sleep problems. Depending on the definition, 40-60% of Finnish adults are overweight and over 30% have sleep problems. About 28% of workers in Europe report work stress. The healthcare system does not have the resources to overcome these problems.

These problems arise from a mixture of personal and environmental factors, and individual effort is the main key to coping with them. Cognitive Behavioural Treatment (CBT) is a psychological method for managing behavioural problems. CBT aims to identify the behaviours that maintain the problem in question and through this recognition process, to change them permanently. The key mechanisms of CBT include self-monitoring of one's behaviour; identification of the problem-maintaining processes; making small changes in them; and monitoring the effects of these behavioural changes. CBT based interventions have been successfully applied in management of weight, stress, and sleep problems. [1-3]

An ICT (information and communication technologies) based tool can support the CBT approach for wellness management. [4] Optimally, the platform for such a tool would be a light-weight, portable, and personal trusted device that promotes long-term continuous use by a nomadic user. The device should have sufficient processing power and memory, advanced user interface (UI) and capability to provide visual feedback, and wireless communication capabilities. In addition, a stand-alone application, running locally in the device would support the use anywhere, anytime, and especially during the "gaps" in life, e.g. while waiting for a bus.

Methods

We developed a Wellness Diary (WD) concept for personal wellness management. Mobile phone was selected as the implementation platform because it fulfils our requirements for the platform and has high penetration (e.g. 97% of Finns have a mobile phone). WD was implemented as a stand-alone application on Symbian Series 60 (S60) mobile phone platform and integrated with the S60 calendar to provide a sense of familiarity to the users. Our goal was to incorporate the central ideas of CBT into the application in a simple and usable way. WD is a tool for recording wellness related self-observations and getting objective graphical feedback on them. The user inputs self-observations in specific forms, similar to the standard calendar input forms. Graphical feedback is generated based on the self-observations and displayed in the application. The implementation has been described in more detail in [5]. The user acceptance of the concept was studied in two studies with two different implementations.

Study I: The WD implementation for weight management (variables: weight, steps, exercise, diet, fat percentage, feelings, and health related events) was studied in a three-

month study with 29 users (20/9 males/females, mean age 39.4 years). The study protocol consisted of a start-up session (1.5h CBT based weight management lecture and 20min usage instructions for WD), two individual usability interviews including questionnaires (at 2 weeks and 3 months), and an ending session. The users were instructed to make self-observations in the variables they felt useful.

Study II: A more general health management implementation of WD (variables: weight, steps, exercise, sleep, stress, blood pressure, and health related events) was studied in a three-month study. The subjects were 17 volunteers (3/14 males/females, mean age 54.5 years) who were participating in an occupational rehabilitation program. The users filled usability questionnaires at the end of the study.

Results

The results are presented as the percentage of users agreeing or strongly agreeing to statements presented in the questionnaires. In Study I, the results are presented from both interviews (beginning of the study; end of the study).

Study I: WD was considered easy to learn to use (93%; 89%) and simple (86%; 93%). The users found WD helpful in weight management (83%; 79%) and the percentage of users strongly believing in WD's helpfulness increased during the study from 38% to 54%. WD motivated the users to observe their diet (86%; 71%) and be physically more active (66%; 71%). The users considered weight, exercise, and steps as the most important variables. At the end of the study, 64% of users wanted to continue to use WD.

Study II: Also the users in Study II considered WD fairly easy to learn to use (76%). Making entries to WD was perceived effortless (88%) and graphical feedback useful (76%). Blood pressure, weight, and exercise were considered as the most important variables.

Discussion

WD is a mobile application for psychologically based personal wellness management. As a stand-alone mobile phone application, WD enables location and time independent use. WD was well-accepted by two different user groups in two different studies. The positive results in Study II user group indicate that WD is suitable not only for the technically oriented young people, but also for middle-aged and older users previously not accustomed to using this kind of technology. Based on the results, the simplicity and ease of use were important factors in promoting the use of WD. The users in Study I appreciated the CBT based philosophy of WD, especially how it acknowledged and supported the user's own responsibility in making weight management decisions. These results indicate that Wellness Diary supports CBT based wellness management.

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References

[1] Wadden TA, Sternberg JA, Letizia KA, Stunkard AJ, Foster GD. Treatment of obesity by very low calorie diet, behavior therapy and their combination: a five-year perspective. Int J Obes 1989;13 Suppl. 2: 39-46.

[2] Grime PR. Computerized cognitive behavioural therapy at work: a randomized controlled trial in employees with recent stress-related absenteeism. Occup Med 2004; 54(5): 353-9.

[3] Jansson M, Linton SJ. Cognitive-behavioral group therapy as an early intervention for insomnia: a randomized controlled trial. J Occup Rehabil 2005; 15(2): 177-90.

[4] Pärkkä J, Van Gils M, Tuomisto T, Lappalainen R, Korhonen I. A wireless wellness monitor for personal weight management. Proc. of ITAB-ITIS 2000 – IEEE EMBS International Conference on Information Technology Applications in Biomedicine; 2000 Nov 9-11; Arlington, Virginia, USA. p. 83-8.

[5] Lamminmäki E, Pärkkä J, Hermersdorf M, Kaasinen J, Samposalo K, Vainio J, et al. Wellness diary for mobile phones. In: Hozman J, Kneppo P, editors. IFMBE Proceedings, Vol. 11: Proceedings of the 3rd European Medical & Biological Engineering Conference – EMBEC'05; 2005 Nov 20-25; Prague, Czech Republic. p. 2527-31.

Hypertension and Diabetics Electronic Monitoring System

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Keywords: eHealth, Telemedicine, Blood Pressure, Hypertension, Blood Sugar, Diabetics, Measurement, Monitoring, Database, Internet, Mobile communication, Saudi Arabia.

Introduction

Hypertension and Diabetics are by the far the most commonly spread diseases among adult men and women in Saudi Arabia and probably around the world. In Saudi Arabia, about 25% of adults are hypertensive [1, 2]. This makes any effort to control these diseases of high importance. Both diseases are measured using manual as well as electronic techniques. The measurement usually happens at the time of the patient's visit to the health care centre. Health care staff can make better use of the readings if they are taken frequently and systematically. Having a record of the readings for a long period of time helps health care staff to better diagnose the patient's individual cases and therefore help in the treatment process. Moreover, reliable statistics of blood pressure and blood sugar are usually hard to obtain because patient's readings are scattered in their medical records.

Methods

In this paper, we present an electronic mean of centralizing the measurement and monitoring of blood pressure and blood sugar for patients without any limits to the patient's physical locations and geographical distributions.

The blood pressure and blood sugar measurement and monitoring system is depicted in Fig. 1. The internet and mobile communication are used as the mean of communication and data exchange between the different parts of the system. The process in this system goes as follows. Registered patients measure their blood pressure and/or blood sugar through any mean; manual, electronic, etc. Then, they use their mobile phones or devices to send their readings using the Short Message Service (SMS) in a text format to the central computer. The central computer, which is equipped with a wireless modem, receives these readings and stores them in the central data-base. The system can accept various SMS text formats. These formats were designed to allow patients to send the readings in a short time. The system can alarm doctors of up normal patients' conditions through the SMS system.

A web site has been developed specifically for accessing the database. Doctors and other health care staff, patients, and administration can access the database to brows and retrieve the patients' readings through the web site with multi-layers authentication. Data are displayed in both tabular and graphical formats. A sample of the graphical representation is shown in Fig. 2. Doctors can also add comments and recommendations directly through the web site. These comments are stored in the patient's record and displayed beside the readings. The web site also includes some general medical advices for patients and instructions on how to send the readings to the central computer. It also includes a discussion forum for users to communicate among each other and get updated with advances in treatment and diagnoses of the two diseases.

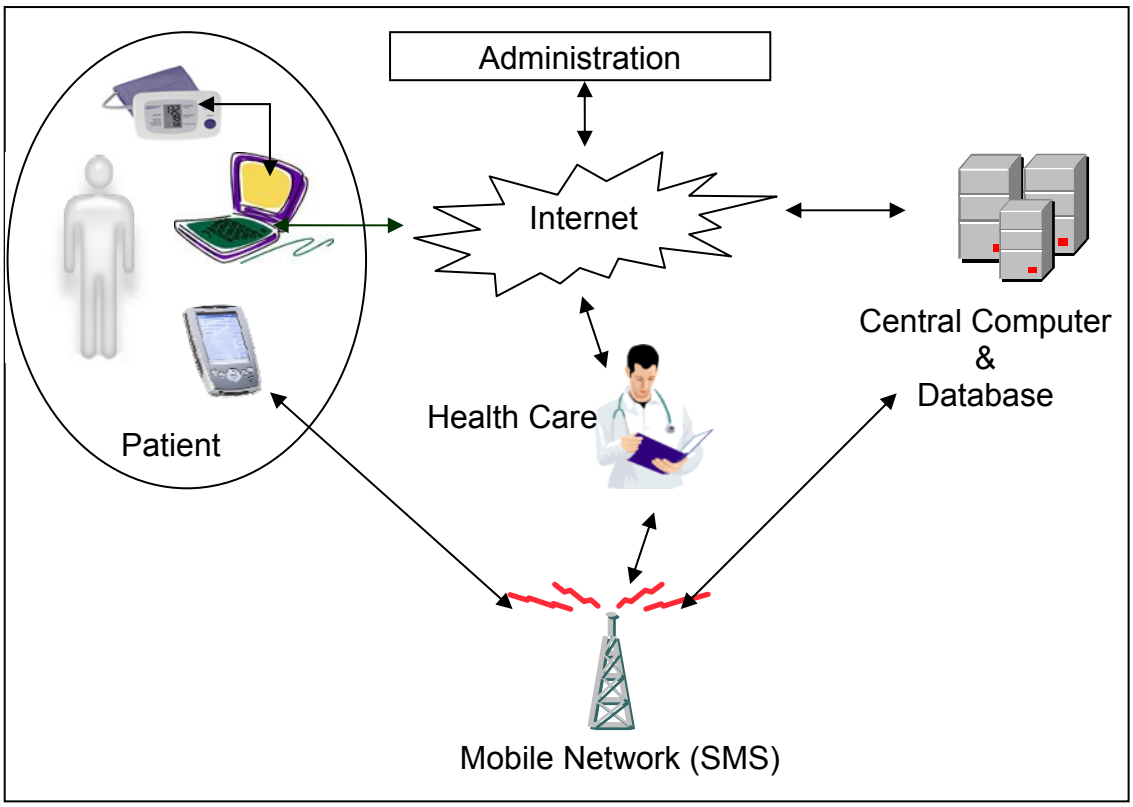

Figure 1. *Structure of the Blood Pressure and Diabetics Monitoring System*

Patients who can not make measurements by themselves are provided with electronic measurement devices that connect to their personal computers at home. A software package is also provided which takes and sends the readings per patient's request or every specific period of time. The software also includes a quick questioner for up normal readings. Patients are optionally asked to respond to this questioner and the results are also sent automatically to the central database through a wireless modem. Doctors can access the questioner results together with the readings and, therefore, may get a better insight about the condition of the patient.

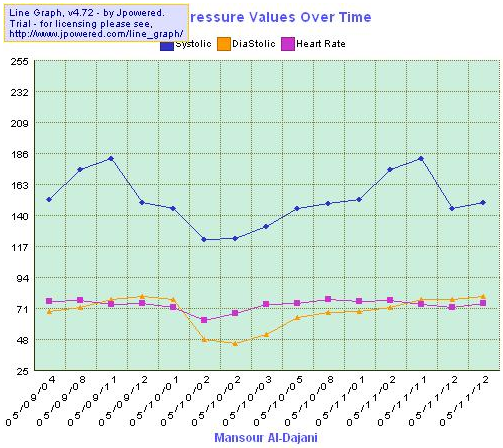

Figure 2. *Sample of blood pressure graphs shown in the website.*

Furthermore and as a direct advantage of this project, the blood pressure and sugar readings available in the database constitute an updated and moderately accurate source of information. This information could directly be utilized for various statistical analysis

and research purposes. This could lead to a better awareness and control of the two diseases.

Discussion

The electronic measurement and monitoring system was built on a project funded by King Abdulaziz City of Science and Technology, Saudi Arabia. The project lasted two years and it is currently in operational condition. The implementation phase of the project will involve the ministry of health and its affiliated health care institutes. It will also involve a spectrum of private health care centers that are carefully chosen to cover different parts of the country. This will assure that the data received from patients will cover a modest geographical distribution.

Acknowledgements

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References

[1] Al-Nozha, m. M., Ali, M.S., and Osman, A. K., "Arterial hypertension in Saudi Arabia ," *Eastern Mediterranean Health Journal***,** Volume 4, Issue 2, 1998, pp. 382.

[2] Warsy, A. S. and El-Hazm, M.A. " Diabetes mellitus, hypertension and obesity — common multifactorial disorders in Saudis," *Eastern Mediterranean Health Journal***,** Volume 5, Issue 6, 1999, pp. 1236-1242**.**

eHealth in Hospital at Home – Videophone in Care Delivery

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Keywords: eHealth, Hospital at Home, Video Phone, Technology Supported Care

Introduction

Oulu University of Applied Sciences (Oulu Polytechnic) and University of Oulu have been collaborating for several years to develop videophone technology applications in health care (Autio 2004). As the time patient stays in hospital is getting shorter there is a growing need to develop new ways to organize care at home. The need for special health care for various groups of people at home is needed. A new kind of a Hospital at Home started in Oulu five years ago. The development has been fast and the number of patients is growing every year.

According to the US Office for the Advancement of Telehealth the concept telehealth means the use of electronic information and communication technologies to support long-distance clinical health care, patient and professional health-related education, public health and health administration. In this project telehealth is based on the new information and communication technologies what offer many ways to develop health care. The videophone technology is opening new ways to organize health care between the hospital and home.

In the Hospital at Home the role of the nurse and the patient is different than in the traditional hospital. Videophone devices are at the patients´ homes and nurses communicate with their patients via videophone. Having a live video connection differs from the traditional telephone connection. The nurse can see the patient and she/he can show to the patient how to act at home e.q. in using some device. In a country with long distances this means not only savings in travelling costs but also better possibilities in getting high standard health care at home.

This research project started in the beginning of 2005 and will end in the end of September 2006. In this paper the experiences and results of the videophone use in health care are presented from the Hospital at Home point of view. Final results are not yet available but the description of the process and preliminary results already show significant new dimensions in health care in the Hospital at Home.

Methods

In this videophone project, researchers, nurses and patients are working together developing new ways to apply high technology into health care. This means more interaction and collaboration. The declining face-to-face communication in care situations seems not to be an essential issue. All the nurses also make home visits to all their patients. Data has been collected of this technology supported home care by interviews (individual, focus group), participatory observations, videotaping and questionnaires. In the very beginning all the nurses and the doctor were interviewed. During the research project home care situations were video taped and after each session both nurses and patients were interviewed. In the end of the project all the nurses and the doctor will be interviewed again.

Results

According to preliminary results videophone fits very well for everyday use in the Hospital at Home. Nurses can communicate with their patients seeing and hearing not only the patient but also his/her surrounding (e.g. other family members) at home. Results show that nurses are very satisfied for the videophone contacts with their patients. Technical problems sometimes were disturbing the communication but live connection itself was a big help in their work. Also the patients saw it easy to contact the nurse via videophone and it was very useful to see and hear the nurse from the distance. Saving the costs (time, driving a car, fuel, car service, insurances etc.) is inevitable but not the key point in developing new communication technologies (Jääskeläinen 2004). The quality of care is not diminishing when using videophone. On the contrary high standard care is possible to achieve, and what is meaningful, it can be structured from patients needs.

Discussion

The information age needs new approaches to traditional way of thinking and doing in health care. The term modern or new technology refer to "...not just one piece of equipment, but the entire globally interconnected assemblage of new communication, transmission, and information technologies" (Wise, 1997). The development is fast and new broadband networks and easy communication systems are opening possibilities what may drastically change the traditions e.g. in health care organizations and in care delivery practices. The importance of developing and applying new technology into health care is based on the fact that nowadays there are few areas of production, engineering, education or public services that do not include ICT as an integral component. Health care has been a key operator in customizing software to manage many routine operations (monitoring, patient records etc.). Far more complex question is how to manage the distance in every day care situations as the patient is at home. Various dimensions (structural, cognitive, human capacity, interaction) affecting new practices (Syväjärvi 2005) show how hard it is to take all these into account when developing new models of work in traditionally constructed organizations. But changing needs of people are followed by new social and organizational innovations supported by hi-tech applications. These may open totally new practices in health care organizations.

References

[1] Syväjärvi A. Human Capital and Information Technology in Organizations and in the Management of Strategic Personnel Resources. (Inhimillinen pääoma ja informaatioteknologia organisaatiotoiminnassa sekä strategisessa henkilöstövoimavarojen johtamisessa) [dissertation]. Acta Universitatis Lapponiensis 83. Rovaniemi. University of Lapland; 2005.

[2] Wise J. Macgregor. Exploring Technology and Social Space. London, New Delhi; SAGE, Thousand Oaks; 1997.

[3] Jääskeläinen J. eWelfare. Productive Information Technology in Welfare Services. (Tuottava tietotekniikka hyvinvointipalveluissa). Sitra reports 41. Helsinki. Edita Prima Oy; 2004.

[4] Autio T. (ed.) Video Phone in Personnel and Customer Training in Social and Health Services. From Hailuoto to Elsewhre (Haimuumaa) – Project Report. Work Science Report no 19. Oulu. University Print; 2004. (Kuvapuhelin sosiaali- ja terveysalan henkilöstö- ja asiakaskoulutuksen välineenä. Hailuodosta muuhun maahan (Haimuumaa) –hankkeen loppuraportti. Työtieteen hankeraportteja No 19. Oulu. Oulun yliopistopaino; 2004).

A Mobile Tool for Research and Diagnosis of Acute Mountain Sickness (AMS)

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Keywords: AMS, Telemedicine, Diagnosis

Introduction

Acute Mountain Sickness (AMS) is a variety of symptoms (headache, nausea or loss of appetite, sleeping problems, giddiness, vomiting, difficulty breathing at rest, abnormal or intense fatique [1]). AMS occurs when a person ascents to a high altitude too fast without adequate acclimatization. Acclimatization is a process in which body adapts to high altitude and deficiency of oxygen. Depending on seriousness of AMS symptoms, recommended treatments are aspirin, stopping ascent, rest or descent [1].
Early diagnosis of AMS is essential to avoid serious complications such as cerebral or pulmonary edema both of which are life threathning conditions. The difficulty of providing medical care in high altitude mountain environment makes early diagnosis critically important.Various physiological parameters can be used to diagnose and predict AMS. The blood oxygen saturation level (SpO2) decreases with ascent to high altitude and increases with acclimatization.
Lot of work has been done in the area of AMS [2] but still there is minor number of technical solutions for early diagnose of AMS [3].

Methods

Our solution is based on researched architecture [4] and consists of wireless $Sp0_2$ measurement device that is connected via Bluetooth to a personal digital assistant (PDA) (see Fig.1). An AMS diagnosis device has to be very lightweight in situations where every extra gram has to be taken into account. In addition, a wireless system and continuous measurement guarantees mobility to a climber. In the ad-hoc net, the $Sp0_2$ device is acting as a slave and the PDA as a master, where communication follows a protocol of the device manufacturer.
The $Sp0_2$ device is inserted into a glove and the PDA into a warm place (for better battery lifetime). Continuous measurement data is automatically transmitted into the PDA without user interaction. If $Sp0_2$ value drops under a given level, measurement application alerts the user and can also show a treatment recommendation. Application is implemented in visual programming language, LabVIEW [5], which offers wide range of predefined tools for measurement and communication. In addition, LabVIEW's PDA Module sets the scene for building usable applications capable to run and display in a PDA device.

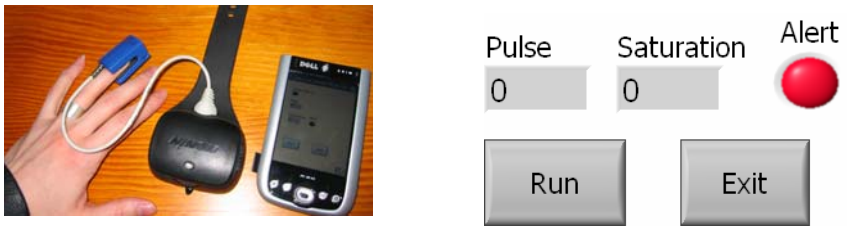

Figure 1. On the left: AMS-measurement devices: NONIN 4100 oxygen saturation measurement device [6] with wristwatch-shaped BT-transmitting module and PDA. On the right: the user interface of the AMS diagnosis application.

Results

We built a simple and usable system to measure a level of the blood oxygen saturation and pulse. The system alerts, if the oxygen saturation level drops down and there is arising risk to getting AMS. Implementation process of the system was easy because of the application development environment specialized for building wireless measurement systems. User interface (see Fig 1) is as easy to use as possible.

Discussion

Where there is not wide range of AMS diagnosis tools, our wireless AMS diagnosis system is one simple step to come closer to a proper observing of vital functions of a climber and improve early diagnosis of AMS.
When introducing the AMS diagnosis system into a define environment, the sensor head of $Sp0_2$ measurement device has to be more ergonomic than present version. The system has not been tested in a defined environment, so, in such situation, the increasing power consumption of handheld devices has to be taken into account.

References

[1] Dr. Sergio A. Saracco: Adapted Recommendations A.R.P.E. France

[2] Honigman B, Theis M, Koziol-McLain J, Roach R, Yip R, Houston C,et al. Acute Mountain Sickness in a General Tourist Population at Moderate Altitudes. Annals of Internal Medicine. 1993; 118(8).

[3] Mundt C, Montgomery K, Udoh U, Barker V, Thonier G, Tellier A, et al.A Multiparameter Wearable Physiologic Monitoring System for Space and Terrestrial Applications. Transactions on information technology in Biomedicine, 2005;9(3).

[4] Hassinen, Marttila-Kontio, Saesmaa, Tervo: Secure Two-Way Transfer of Measurement Data, ITNG 2006, Las Vegas, 12.4.2006.

[5] National Instrument, www.ni.com

[6] Nonin Medical Inc, Nonin Model containing Bluetooth® Technology Specification.http://www.nonin.com/documents/4100%20Specifications.pdf

Session A3
Electronic Patient Records II

Thursday, August 31 2006

Helsinki Hall

16:00-17:00

A3-1 **The Role of Integrated Hospital Information System (IHIS) on Mashhad Hospitals Performance Promotion- 2005**
Gholamreza Moradi;*Naser Shafiee* (*IRAN (ISLAMIC REP.)*)

A3-2 **Comparing Core Content of Electronic Health Records**
Kristiina Häyrinen; *Jari Porrasmaa* (*FINLAND*)

A3-3 **Medication Management and Documentation in the EHR**
Kaija Saranto; *Anneli Ensio*; *Hannu Valtonen* (*FINLAND*)

A3-4 **Implementing Electronic Prescription Systems – A Comparison Between Two Approaches**
Lauri Salmivalli[1]; *Hannele Hyppönen*[1]; *Karina Tellinger*[2]
[1](*FINLAND*); [2](*SWEDEN*)

The Role of Integrated Hospital Information System (IHIS) on Mashhad Hospitals Performance Promotion-2005

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Keywords: Integrated Patient Records, Integrated hospital information systems, Hospital performance promotion.

Introduction

Integrated electronic patient record is the main part of integrated hospital information systems, which not only increases hospital performances but also enable health care providers in better health care decision-making.
Hospitals need clinical and financial information for new changes. The health informatics domain is developed and focused on those technologies that help the health care provider in decision-making on patient's care. This consideration is evident in clinical activities, researches, education and management of hospital (2). Hospital managers need all information hospital processes (3). HIS enables hospital managers to have information in any time and place and then decide according to them. According to basic information Decision-making, will create hospital performance promotion and increased efficiency and effectiveness (4). The objective of this study is determining the role of IHIS in hospital performance promotion.

Table 1: Comparative table of manual system and HIS Performances in Dr Sheykh Hospital

Process Name	Decrease average	Increase average
Average length of stay	23%	
Average of Diseases Cost		34%
Order and Result Management	28%	
Patient admission	12%	
Billing	80%	
Per case	87%	
Listing the insured patients	17%	

Methods

This study is an applied research, which is done by a descriptive method. The duration of admission process, patient's billing, personnel per case, ordering and result management and mean of patients length of stay, average cost of five diseases were reviewed and the comparison of these processes in HIS with manual system. The research population include hospitals which implemented HIS in Mashhad University of Medical Sciences and provide study of variables of this research before and after of HIS. Now some hospitals have implemented HIS such as Imam Reza, Qaem, khatam and Dr. Sheykh hospitals. However only Dr. Sheykh hospital included this research and other hospitals have removed from research inclusion, because it was impossible to review the research variables in those hospitals after implementing HIS.

We used interview in manual system processes and chart review in measuring the mean of costs and length of stay processes. We decided to select five diseases with more accessibility in HIS and manual system. for data gathering duration length of stay, the mean of costs processes, we reviewed 30 charts before and 30 charts after HIS implementation for any case. These include gastroenteritis, ARF, appendicitis, cleft palate and unilateral cleft lip.

Results

In total diseases, the mean of patient's length of stay reduced to 23%, the cost mean of diseases increased to 34%. In ordering and result management process 28% was time saving. The time mean of patient's admission process reduced to 12%, in general, the time mean in patients billing process reduced to 80%. In per case process 87% was time saving. During the two steps of HIS the providing of insured patient list decreased to 97.5% and totally the time of the process decreased to 17%.

Discussion

The findings of this study in Dr. Sheykh hospital showed that the mean of processes which affect on patient length of stay (include length of stay process, order and result management process, admission process and billing process) decreased significantly. This added value is very important and directly affects on decrease of cost services, cost manpower and increase of resources utilization management. These factors refer to hospital performance promotion. The mean of diseases cost increased. The reason for this is the increase of annual healthcare fee, which is declared by the government during the 2002 - 2005.

Acknowledgments

We would like to acknowledge the support of the managers HIS in Emam Reza, Qaem, Doctor Sheykh and Khatam Hospitals.

References

[1] Balas EA, Austin SM, Mitchell JA, Ewigman BG, Bopp KD, Brown GD. The clinical value of computerized information services. A review of 98 randomized clinical trials. Arch Fam Med 1996 May;5(5):271-8.

[2] Borzekowski, Ron. "Health Care Finance and the Early Adoption of Hospital Information Systems", BOardof Governors of the Federal Reserve System, 2004

[3] Boudreau, M., et al. (1998).Going global: Using information technology to advance the competitiveness of the virtual transnational organization. The academy of management Executive, 12(4), 120-128

[4] Center for development of Advanced computing (CDAC), http//www. Cdacindia. Com/html/his/sushrut. Asp, 2005.

Comparing Core Content of Electronic Health Records

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Keywords: Medical Records Systems, Computerized; Standards; Medical Informatics; Nursing Informatics

Introduction

The main purpose of an electronic health record (EHR) is to support multidisciplinary communication, cooperation, and decision-making in a patient care process. A unified content and structure of an electronic health record facilitates the utilization of patient data among health care professionals and organizations supporting seamless patient care. In addition, the data in electronic health records are used, *e.g.* in clinical research, health system management, planning of health services, and government reporting. [1, 2, 3]

In Finland as in several other countries around the world, research and development projects are conducted with the main interest of developing an infrastructure for a national health information network; examples include Canada, Australia, England, and the United States. These projects have a number of elements in common, including 1) an aim to justify the patients' role in the use of their own health records; 2) a need to define the core information of these records; 3) a goal to choose and implement standards, nomenclatures, codes, and vocabularies; 4) a need to develop data security infrastructure and policies; and 5) an aim to produce open, standardized and interoperable electronic health record systems for data exchange and information management.

The aim of this paper is to compare the strategies of core information in electronic health records in the above-mentioned countries.

Methods

Information about the core information of EHRs is obtained from the documentation of national projects in Finland [4], Canada [5], Australia [6], and England [7, 8]. In the USA, harmonization of the content of electronic health records is carried out by the Agency for Healthcare Research and Quality, and the goal is to harmonize standards. Therefore, the websites about (AHRQ) has been studied [9]. Documentation of different national projects was reviewed focusing on the definition of the content of the electronic health records. The contents of the electronic health records in the documentation of projects were examined using content analysis.

Results

In **Finland,** the structure and content of EHR have been studied in a national electronic health introduction project. The structure and content of an electronic health record include the standardization of views, main headings, subheadings, and core data elements. Views are subrecords of electronic health records which are comprised of specific data elements. Headings provide the context for the core data elements. The main headings identify the part of the care process in which the core data element is documented; the core data element and unstructured text is documented under the subheading. The core data (Table 1) is defined as the data that must be standardized and structured using vocabularies, nomenclatures and classifications.

In **Canada**, the work for standardizing the content of EHR in the Health Infoway project has been focused on laboratory results, diagnostic imaging, allergies, prescriptions, and medication histories. Moreover, the interest is in documents consisting of unstructured text such as Clinical Summary, Care Summary, and Discharge Summary. First, the business model and the related processes in the development of clinical information in most clinical settings have been described, and in future, detailed information of unstructured text will be compiled.
In **Australia**, a generic clinical information framework has been developed to guide the development of standardized national datasets in the HealthConnect project. The priority lists of health event summaries, EHR lists, and views were also defined. The priority data groups for health event summaries were identified as the recommended level of detail for initial implementation.
In **England**, the goal in the National Programme for IT by the NHS is to share summary care records across organizations. The records contain significant aspects of a person's care. Further, there are detailed electronic health records in organizations. Moreover, disease-specific datasets have been established, and, based on them, the generic core dataset will be defined. The generic dataset means that data that are frequently collected or shared by all national clinical and administrative datasets.
In the **USA**, the national strategy for national health information infrastructure was created in 2001 [10]. Recently, harmonization of health-related data standards received additional support from the federal government, and the set of uniform standards for the electronic exchange of clinical health information to be adopted across the federal government were announced. The implementation of standards will be conducted in pilot projects which have already started. The Continuity of Care Record (CCR) standard is a core data set of the most relevant administrative, demographic, and clinical information facts about patients' healthcare, covering one or more healthcare encounters. Recently, HL7 and ASTM have joined forces to produce a joint CCD (Continuity of Care Document) standard which is based on CCR and CRS specifications.
The preliminary core information of different national EHRs is presented in Table 1. More detailed data items were also defined in some countries. The final results will be achieved after the pilot projects.

Table 1. The core information of EHRs in different countries

The core information	Finland	Australia	USA	Canada	England
The patient identification data (e.g. the patient's name and address)	x	x	x	x	x
The provider's identification data (e.g. the name of the organization and the health care professional)	x	x	x	x	x
The episode of care	x				
Risk factors (e.g. allergies and infectious diseases)	x	x	x	x	x
Health patterns (*e.g.* smoking and alcohol usage)	x	x		x	
Vital signs (*e.g.* height and blood pressure)	x		x		
Health problems and diagnosis	x	x	x	x	x
The nursing minimum data set	x				
Surgical procedures	x	x	x	x	x
Tests and examinations (e.g. laboratory and radiology)	x	x	x	x	x
Information of medication	x	x	x	x	x
Prevention (immunization)	x	x	x		
Medical Statement Medical Certificate	x				

Functional Status	x	x	x	x	
Technical aids (*e.g.* the fact if the patient is using a wheelchair)	x				
Tissue donor will	x				
Living wills	x				
Discharge summary	x	x	x	x	x
Plan for follow-up care	x			x	
Consent information	x		x		
Treatment plans and instructions		x	x		
Health insurance coverage information			x		
Referral information		x	x		
Progress notes			x		
History		x	x	x	
Physical exams			x	x	
Social circumstances		x			

Discussion

The core information of electronic health records varies between countries. The common elements of core information in these countries are the identification data of the patient and the provider, risk factors, health problems and diagnoses, surgical procedures, test and examination, medication information, and discharge summary. According to the common elements of EHRs, it might be deduced that medical information is the only type of information which healthcare professionals need in patient care. However, in all countries, various healthcare professionals use electronic health records and so will the patients in future. The information needs of different users must be taken into account when developing the core information of EHRs.

References

[1] Grimson, J. Delivering the electronic healthcare record for the 21st century. International Journal of Medical Informatics 2001; (64): 111-127.

[2] van Ginneken AM. (2002). The computerized patient record: balancing effort and benefit. International Journal of Medical Informatics 2002; (65): 97-119.

[3] Brender J, Nøhr C, McNair P. Research needs and priorities in health informatics. International Journal of Medical Informatics 2000; (58-59): 257-289

[4] Ministry of Social Affairs and Health. National definition and implementation of the electronic patient record system. Working Group Memonrandum of the Ministry of Social affairs and Health. 2002. [In Finnish]

[5] Canada Health Infoway. http://www.infoway-inforoute.ca/

[6] HealthConnect. http://www.healthconnect.gov.au/

[7] National Programme for IT in the NHS. http://www.connectingforhealth.nhs.uk/

[8] The Health and Social Care Information Centre. www.icservices.nhs.uk/datasets/pages/generic.asp

[9] The Agency for Healthcare Research and Quality. http://healthit.ahrq.gov

[10] National Committee on Vital and Health Statistics 2001. Information for health. A Strategy for Building the National Health Information Infrastructure.

Medication Management in Electronic Nursing Care Plans

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Keywords: Pharmacotherapy, Medication management, Health information system, Evaluation

Introduction

The principles of safe pharmacotherapy are typically summarized in the "five rights": right medicine, right patient, right time, right dose and the right route. Pharmacotherapy is a health care activity that is carried out, as a rule, by health care professionals with training in pharmacotherapy and under their responsibilities. [1,2] In a recent survey focusing on the incidence of adverse care events in Finland more than half of the events were medication errors. Out of these, nearly 34 % were due to poor documentation based on undefined care processes, lack of information or missing instructions.[3] Thus, the documentation of medication administration is crucial for safe and secure pharmacotherapy.

According to earlier studies information systems have reduced the number of medication errors.[1,4] Depending on the architecture of electronic patient information systems, patients' medication information can be located in different parts of the system, either as a separate independent system or as part of the electronic health record, for example. From a patient safety and quality of care point of view, the use of terminologies, classifications and codes is seen as a key factor in preventing adverse drug events.[1]

The Finnish Classification of Nursing Interventions (FiCNI) has been implemented in an electronic health record system that is used in nursing care planning and for making daily notes. This part of the record is used mainly by nurses, but all health professionals have access to it. FiCNI is effectively a cultural revision of the original Home Health Care Classification consisting of 16 components, 77 major categories and 335 subcategories of nursing interventions. The Medication component is divided into three categories Medication Administration, Medication Counselling and Medication Side Effects. The subcategories of the intervention Medication Administration (n=15) consist of different routes of medication delivery, e.g. injections, per os, iv, or inhalation. The categories can be added with narrative information. [5,6] The purpose of this paper is to analyze how this classification system is actually used, i.e. what is actually recorded under various categories. The aim is to define elements to integrate electronic medication order entry system and nursing care plan with daily notes.

Methods

The data were collected during a ten-month period in 2003 from electronic nursing care plans in an electronic patient record system. The anonymous patient data for this study were gathered on two surgical (N=338) and two medical (N=99) wards at one central hospital. The data items included patients' age, place of residence, date, the FiCNI codes and narrative text. The data were analyzed using descriptive statistical methods and the narrative text was analyzed using content analysis. The data were first screened with Excel and further with SPSS 11.5. The narratives complementing the Medication Administration category (N=1043) were read several times and the most frequently used subcategory (G1.1.) Medication Administration per os (n=733) was classified according

to its content: drug, time, cause, assessment and delivery. The data from surgical and medical wards were analysed separately.

Results

While narrative documentation was used to specify the content of both the main and subcategories, in many cases (90%) narrative text complemented the Medication Administration per os subcategory. The narratives mostly described medication as needed not those drugs based on patients' permanent use. The word that appeared most frequently in narratives was *drug* (n=969), including references to its name, dose and route. The drug was most often described by its product name rather than its generic name. Painkillers and sleep drugs were administered most often. The medication administration notes differed so that painkillers were most often documented in surgical wards and sleep drugs in medical wards. The narrative descriptions made frequent use of abbreviations such as mg and tbl. Most narratives consisted of just a single sentence or no more than a couple of words. The time of medication administration was recorded as accurate time or with a phrase "for night".

Discussion

The preliminary findings of the study indicate that the recording in practice does mainly mediate information about drug delivery and doses. This information is, however, available also in the medication order entry system. Information that would be useful for the care of the patients for other members of the personnel is very scarce. It seems that on certain hospital wards nurses need to duplicate drugs' product names and time of the medication several times a day. This causes risk for errors and lost of time.

References

[1] Bates D. Combuterized physician order entry and medication errors: Finding a balance. Journal of Biomedical Informatics 2005:38, 259 – 261.

[2] Galanter W, Didomenico R & Polikaitis A. A trial of Automated Decision Support Alerts for Contraindicated Medications Using Combuterized Physician Order Entry. Journal of the American Medical Informatics Association 2005:12 (3), 269 – 274.

[3] Mustajoki P. Hoitoon liittyvät virheet ja niiden ehkäisy. Peijaksen sairaalan projekti. Suomen lääkärilehti 2005: 60 (23), 2623-2625.

[4] Koppel R, Metlay JP, Cohen A, Abaluck B, Localio AR, Kimmel SE & Strom BL. Role of Computerized Physician Order Entry Systems in Facilitating Medication Errors. Journal of the American Medical Informatics Association. 2005: 12 (10), 1197-1203.

[5] Saba VK. Clinical Care Classification. 2006. http://www.sabacare.com

[6] Jokinen T. Using standardized terminology for documentation of nursing interventions. (In Finnish Standardoitu terminologia hoitotyön toimintojen kirjaamisessa] Master's Thesis in Social and Health Informatics. University of Kuopio, Department of Health Policy and Management. 2005.

Implementing Electronic Prescription Systems – A Comparison between Two Approaches

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Keywords: Health care information systems, electronic prescription, implementation, case study, evaluation

Introduction

Electronic prescriptions are one example of complex inter-organisational information systems in health care, and these types of systems have been or are being implemented in several European countries and the USA over the past years. [1]

Electronic prescribing systems are expected to solve several challenges in health care: rationalizing the medication practices of physicians, providing up-to-date information on the cheapest medication available, reducing overlapping medication, reducing medication errors and adverse drug interactions, decreasing prescription handling costs and increasing efficiency in several organizations. Furthermore, electronic prescriptions are expected to provide more accurate and up-to-date statistical information about medication practices in relation to these issues and hence increase the efficiency of pharmaceutical distribution and improve the planning of national health policy in the long run. [2-8]

However, the starting points and context, process of implementation and technical solutions for Electronic Prescription Systems (EPS) differ from one country to another. Merely, the concept of electronic prescription differs from electronically created and printed prescriptions to electronically transmitted and processed prescriptions.

This paper reports briefly the initial experiences from two implementations of EPS, one in Finland and one in Sweden, from the perspective of the origins and the implementation process of the two systems. Our research questions are:

1. What are the main differences and similarities in the Finnish and Swedish EPS?
2. How has the implementation of EPS proceeded in Finland and Sweden?

Methods

Methodological approach of this study is action research (see e.g. Rapoport 1970). The empirical part of this paper consists of two case descriptions. Data from the Finnish system has been collected through observation, semi-structured interviews, questionnaires and desk-top research. Two of the authors are members of an inter-disciplinary team evaluating the implementation of Finnish EPS. (see also e.g. [7, 8])
The data collection for the Finland – Sweden comparison started with a desk-top study, based on documents available on the internet about e-prescription systems in different countries, Sweden included. The results were documented in the first evaluation report of the Finnish system. [9] The results revealed that Swedish system was spreading quickly, which was not the case in Finland. A more thorough study of the Swedish system was called for. Experiences from the Swedish system were collected through semi-structured group interviews; also one of the authors is member of the Swedish EPS implementation team.

The data was arranged under three general themes: data transfer process and system elements, development and implementation process, and the infrastructure or context of use. Then a more detailed (inductive) analysis for each theme was conducted. This paper reports results from development and implementation process, and the other two themes are covered in other publications. This study is qualitative in nature and does not aim to present generalisable results.

Theoretical approach

The theoretical approach of the study concentrates on how organisations adopt and implement new information technology. For our analysis, we adopt the concepts of "supply-push" and "demand-pull" forces (used earlier by e.g. [10]). Supply-push force derives from the production of the innovative product or process itself, whereas the demand-pull force evolves from the eagerness of potential users to use the innovation.

Both, supply-push and demand-pull are required in order to cause innovation and the distinction is made between these dominant factors. Creating supply-push forces means focusing on encouraging the production and appliance of factors that go into innovating; i.e. support for getting innovative products and processes ready for market and so forth. Under demand-pull, the market must define and articulate demand to potential sources of supply in order to encourage the innovative action, whilst mobilizing acquisition of the innovations by users. [10]

Key results

Electronic prescription was initiated in Finland and Sweden roughly the same time 15 years ago, but since then, their evolution has followed a very different trajectory. By the end of 2005, ca. 42% of prescriptions were electronic in Sweden, whereas in Finland only ca. 800 prescriptions had been written since the first implementation in Joensuu in May 2004.

In Finland the early local pilots with differing technologies triggered in 2001 a national study conducted by regulators defining a suggestion for a national e-prescription concept. The core of the system was a national e-prescription database, where electronically signed e-prescriptions and dispensing information are stored. It is accessed by doctors, pharmacists, social insurance institution and in future also patients and regulators. It will offer feedback to doctors and possibilities to develop a fully electronic compensation system between the Social Insurance Institution and the pharmacies. The concept was built on current (and upcoming) legislation and standards. Experimental degree on e-prescribing came into force in 2003. Without a dedicated health network, two pharmacy and ca 20 EPR systems, specification and implementation of the comprehensive e-prescription system has taken much longer than anticipated. Piloting in 4 hospital districts (out of 21) started in 2004. The struggle now ahead in Finland is to roll out the system and get it adopted by the municipalities and end users.

The main drive to enhance e-prescribing on a national basis in Sweden began in 2000 when Sweden's national pharmacy, Apoteket AB, decided to try and influence the rate of local take-ups. Swedish healthcare is provided through the twenty-one county councils that make up the country's administration, so the delivery of e-prescriptions is a joint effort between each county council and Apoteket. The use of a national e-prescription mailbox and a dedicated health network (Sjunet) were necessary enablers to the take-up of the service. The model is in its initial phase, with data transferred electronically from doctor to pharmacy, where it is printed; the national mailbox is not a

database and doesn't offer any information services. The next step towards a national e-prescription database was taken with a new law that came into force on 1st July 2005. It compels Apoteket to keep a register of all drugs dispensed in the last fifteen months. It also allows pharmacies to hold repeat prescription information for the patients. The register will hold, inter alia, information about the dispensed drug, when and where it was dispensed and to whom. All patients, prescribers and pharmacists will have access to the register; prescribers and pharmacists will require approval from the patient.

The development processes show a top-down versus bottom-up paths in the two countries: In Finland the process started by defining a national solution and its requirements and by organising a national pilot. The diffusion phase has not yet started. In Sweden the process has started from diffusion of a local solution, leading to differing technical solutions. A task now at hand is to harmonise the systems, solve problems of scalability and change to a national database.

Neither the supply-push-force nor the demand-pull-force alone suffices in creating successful innovation. A comprehensive national concept was built in Finland led by the authorities, adoption of which is now a challenge. In Sweden, the concept was built bottom up getting acceptance council by council. It has also been built one step at a time implementing it with minimum requirements. Yet one should bear in mind that this paper is very facile description of the two systems and further research on subject is called for.

References

[1] Salmivalli, L. and O.-P. Hilmola, Business Pluralism of E-prescriptions State of development in Europe and US. Int. J. Electronic Healthcare, 2006. 2(2): p. 132-148.

[2] Mundy, D.P. and D.W. Chadwick. A System For Secure Electronic Prescription Handling. in Proc. of the 2nd International Conference on the Management of Healthcare and Medical Technology. 2002. Chicago, Illinois, USA.

[3] Boonstra, A., Interpretive Perspectives on the Acceptance of an Electronic Prescription System. journal of Information Technology Cases and Applications, 2003. 5(2): p. 27-49.

[4] Bastholm Rahmner, P., et al., Physicians' perceptions of possibilities and obstacles prior to implementing a computerised drug prescribing support system. International Journal of Health Care Quality Assurance, 2004. 17(4): p. 173-179.

[5] Bell, D.S., et al., A Conceptual Framework for Evaluating Outpatient Electronic Prescribing Systems Based on Their Functional Capabilities. J. Am. Med. Inform. Assoc., 2004(11): p. 60-70.

[6] Bell, D.S., et al., Recommendations For Comparing Electronic Prescribing Systems: Results of An Expert Concensus Process. Health Affairs, 2004(25 May 2004).

[7] Hyppönen, H., et al. (2005) "Conducting Interdisciplinary Research: Evaluation of the ePrescription Pilot Scheme in Finland" The Electronic Journal Information Systems Evaluation, Volume 8 Issue 3, pp 187-194

[8] Hyppönen, H., L. Salmivalli, and R. Suomi. Organizing for a National Infrastructure Project: The Case of the Finnish Electronic Prescription. in Hawaii International Conference on System Sciences. 2005. Hilton Waikoloa Village, Big Island, Hawaii.

[9] Hyppönen, H., ed. Sähköisen reseptin pilotoinnin arviointi vaihe I. Osaavien keskusten verkoston julkaisuja. 2005, Stakes.

[10] King, J.L., et al., Institutional Factors in Information Technology Innovation. Information Systems Research, 1994. 5(2): p. 139-169.

Session B3
Mobile Applications II

Thursday, August 31 2006

Terrace Hall

16:00-17:00

B3-1 **Use of Modern Mobile Technologies to Enhance Remote Self-Care Services**
Arto Holopainen; *Fabrizio Galbiati*; *Kalevi Voutilainen* (*FINLAND*)

B3-2 **Textile eElectrodes - An Alternative as ECG Electrodes in Home Health Care?**
Peter Hult (*SWEDEN*)

B3-3 **Wireless Communication in Examinations and Measurements in Healthcare**
Hannu Mänty; *Kari Mäkelä* (*FINLAND*)

B3-4 **A Preliminary Assessment of a Mobile Medical Information System**
Ville Harkke; *Mikael Collan*; *Franck Tetard* (*FINLAND*)

Use of Modern Mobile Technologies to Enhance Remote Self-Care Services

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Keywords: eHealth, Telemedicine, telehealth, GSM, wireless

Introduction

Timely review of patient data with close to real-time feedback is a critical success factor in today's disease management. This paper introduces eHIT Health Gateway, an effective and secure tool, which makes use of mobile technologies to wirelessly transfer data from different measurement devices to the health care provider in real-time. An overview of the system functionality is followed by some important notes about security and privacy and by some existing implementation cases illustrating the functionality of the system in the management of different diseases.

Methods

The system mainly consists of a mobile platform, which collects the information from the measuring devices, and a server platform, which receives the collected data and forwards them to the existing Information System. The mobile platform can be used on different mobile devices such as mobile phones, smart phones and Personal Digital Assistants (PDA).
The Health Gateway is interfaced to a broad range of measuring devices allowing for remote measurement of blood glucose, blood pressure, coagulation, body weight, heart rate, EMG, ECG, oxygen saturation, peak expiratory flow, etc.
The mobile device guides the patient and seamlessly collects information directly from the measuring devices. The patient follows up his/her progress in the therapy directly from the display of the mobile device.
A single mobile device collects, stores and transfers information from different measuring devices, making possible the integration of devices from different manufacturers. For instance a blood pressure meter, a scale and a glucometer can be used together to collect and register key information in diabetes care.
The collected data is then automatically transferred to the health care provider by using a secure GPRS/GSM/3G/WLAN connection. The received information can be stored in the Health Gateway server or directly forwarded to an existing information system. In this way measurement results are always unbiased and they are available to the health care professionals in real-time and in the correct form.
By using the Health Gateway client application, authorised personnel of the health care provider is able to browse the received data and send an almost immediate feedback to the patient, guaranteeing a faster patient treatment process.
The system is also capable of generating automatic alarms according to predefined algorithms. These alarms can be addressed to the health care professionals as well as to the patient.

Results

Most manufacturers of modern mobile devices are replacing infrared and cable interfaces with a Bluetooth connection. The same trend is observable among manufacturers of near-patient measuring devices. However, the communication possibility offered by a number of existing measuring devices is still limited to infrared

or cable. This restricts the number of measuring devices, which can be used with a given mobile device.
To overcome these connectivity issues eHit has designed and manufactured a special hardware adapter module called eLink, which is a standalone, battery-operated and small-sized module that transparently converts measurement device cable and infrared communication into wireless Bluetooth communication. Thanks to eLink, a wide range of existing measurement devices, which would be otherwise impossible to interface, can be taken in use.
The first implementation cases of the Health Gateway system were taken in use over a year ago. Today the system is used by private and public organisations for the management of different diseases.
Overall Health Gateway has shown its potentiality in improving care and treatment making them faster and easier. Direct download of the measured values means also unbiased results The use of the system is very intuitive as patients are guided step by step through the procedure. Patients also feel themselves more motivated, as they can follow the progress of the treatment directly on their mobile devices regardless of time and location. Also the possibility of receiving an immediate feedback from the health care provider can be seen as an important aspect, which increases self-confidence in the patient.

Discussion

Point of care testing is growing rapidly in terms of technology advancements and healthcare economics. The combination of self-monitoring devices with mobile technology presents several advantages in comparison with traditional methods: measurement results are unbiased, available in real-time and in correct form; treatment process become faster and patient can receive feedback almost immediately; motivating treatment progress information are directly available to the patient; evidence based process traceability information; remote measurement and monitoring regardless of patient location; easy to use for both patient and nursing staff.
By harnessing the powerful tools offered by today modern technologies, Health Gateway mobile solution enhances near-patient services and brings point-of-care flexibility a step further.

Textile Electrodes - An Alternative as ECG Electrodes in Home Health Care?

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Keywords: eHealth, Telemedicine, ECG, textile sensors

Introduction

The use of electrocardiogram (ECG) is a well known and widely used method. However, when the home health care is expanding, new demands for ECG equipment is seen. It would be desirable if electrodes would be more comfortable to use, especially for long-time registrations. The contact between electrodes and skin becomes worse with time and electrodes can also irritate the skin. With textile technology of today, yarns can be created with leading materials [1]. Thin threads of metal are spun into yarn and can be used for weaving or knitting fabrics. These fabrics can be used as electrodes for ECG registration, with the advantage of textile properties. By integrating such electrodes in clothes, the electrodes could become more wearable and more suitable for some ECG registrations [2, 3, 4] . The difficulty of distinguishing QRS-complexes will be used for studying signals from textile electrodes. In this study, three different textile sensors was compared in order to investigate influences in the ECG signal caused by material, size or structure. Such influences could contaminate the signal with different types of noise and make it difficult to distinguish the characteristics of the ECG [5].

Methods

The equipment used for the study consists of three textile electrodes made of the materials: a) 100 % stainless steel, b) 20 % stainless steel, 80 % polyester and c) Silver plated cupper isolated with polyester thread. An ECG-amplifier was used for the ecg-recording and the signal was sampled with a DAQ-card and stored in a computer for later analysis.
The ECG-signal from the textile sensors was evaluated by two QRS-detectors [6, 7, 8] modified for this study. Ordinary ECG-electrodes were used as reference signal. The number of detected QRS-complexes was used for comparing the textile sensors and to find any influences caused by the textile electrodes.

Results

Regarding the material the flat knitted 100% stainless steel electrodes were compared to the 20% stainless steel electrodes, no differences could be seen. However when comparing the flat knitted 100% stainless steel electrodes to the silver plated cupper electrodes the difference was significant. Regarding the structure of the material the two types of 100% stainless steel were compared. The result is quite similar but slightly better for the flat knitted electrodes. The result was better for the larger sized electrodes, as expected. Actually the size had the most apparent effect on the result of all investigated parameters.

Discussion

If the size of the electrodes is too small, the sensitivity to the signal is poor, but if they are too large the noise contamination increases. The size of the electrodes was expected to have great influence on the signal quality of two reasons: contact area and within conduction of signals. The result was better for the larger sized electrodes, as expected.

Actually the size had the most apparent effect on the result of all investigated parameters.
Since the 20% stainless steel electrodes consist of less leading material they were expected to present worse results, compared to the difference between the electrodes made of 100% stainless steel and 20% stainless steel was small and difficult to distinguish. In this study the results of the 20% stainless steel electrodes were quite similar to the 100% stainless steel electrodes. Textile properties are better for the 20% stainless steel electrodes and these electrodes are therefore more comfortable and more sensitive to the skin. As expected the woven silver plated cupper electrodes give the worst result of the textile electrodes because of the problem with the contact between skin and electrode.

Acknowlegements

Authors would like to acknowledge the support of the Swedish Agency for Innovation Systems.

References

[1] Samuelsson E, Electrical signal transmission in textile structures, 2005

[2] A. D. N. Noury, C. Corroy, R. Baghai, J.L. Weber, D. Blanc, F. Klefstat, A. Blinovska, S.Vaysse, B. Comet, "VTAMN - A Smart Clothe for Ambulatory Remote Monitoring of Physiological Parameters and Activity," presented at 26th IEEE-EMBS2004, San Francisco, 2004.

[3] R. Paradiso, G. Loriga, and N. Taccini, "A wearable health care system based on knitted integrated sensors," Ieee Transactions on Information Technology in Biomedicine, vol. 9, pp. 337-344, 2005.

[4] M. Catrysse, R. Puers, C. Hertleer, L. Van Langenhove, H. van Egmond, and D. Matthys, "Towards the integration of textile sensors in a wireless monitoring suit," Sensors and Actuators a-Physical, vol. 114, pp. 302-311, 2004.

[5] Geddes L A, Electrodes and the measurement of bioelectric events, 1972

[6] Friesen G M et.al., A Comparison of the Noise Sensitivity of Nine QRS-detection Algorithms, Transactions on Biomedical Engineering, Vol. 37, No. 1, p. 85-98, 1990

[7] Sternickel K, Automatic pattern recognition in ECG time series, Computer Methods and Programs in Biomedicine 68 p.109-115, 2002

[8] Pan J, Tompkins W J, A Real-Time QRS-detection Algorithm, Transactions on Biomedical Engineering, Vol. BME-32, No. 3, march 1985

Wireless Communication in Examinations and Measurements in Healthcare

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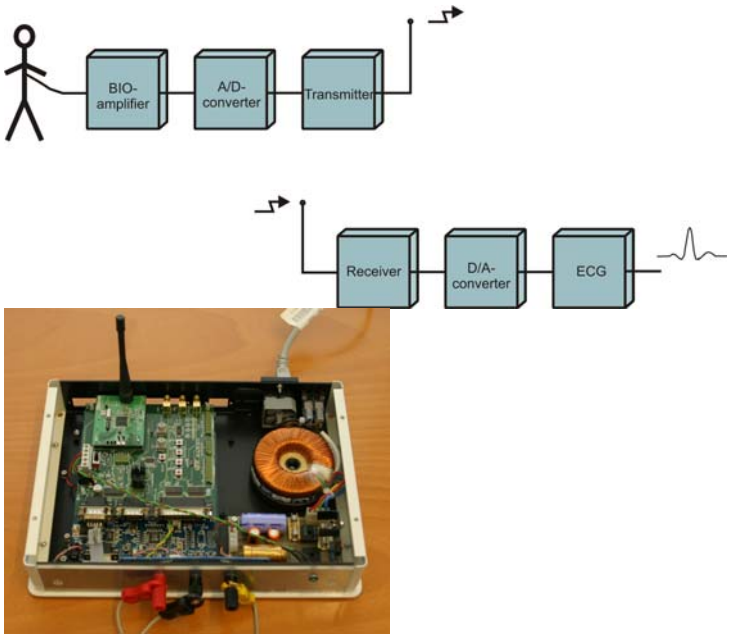
Keywords: Wireless, Telemedicine, ECG, Physiological measurements, Healthcare

Introduction

Even though wireless communications are becoming more widespread in everyday applications, the vast majority of examinations and physiological measurements carried out in hospitals utilise conventional cables and wires. The main goal of this study was to investigate wireless measurement and communications methods that could be used to replace the conventional cables of physiological measurements in healthcare. This study was carried out at the Telemedicine Laboratory of Tampere University of Technology and was funded by the national technology agency Tekes.

Methods

A wireless ECG [1] prototype was constructed as a testing platform. There are some wireless ECG products available on the market, but the main focus of this project was to test wireless links in general rather than bring a new wireless ECG unit to the market. Hence the construction of the prototype was designed to allow different types of rf-solutions to be tested. For this work a Chipcon CC1010 transceiver module was used. The module utilises ISM frequencies at 860 MHz band [2].



Picture 1. Block diagram of wireless ECG and receiver unit opened [4].

The preamplifier for the prototype was designed at Ragnar Granit Institute of Tampere University of Technology. Since the measured ECG signal was transmitted digitally to the receiver, a special D/A converter was constructed and added to the receiver. This allowed the system to be connected to ECG monitors commonly used in hospitals.

Signal level and impedance matching was done as well for the signal to be compatible with conventional ECG monitors.
Tests at Seinäjoki Central Hospital were carried out in the neurophysiology laboratory where conventional cable connected heart monitor was replaced with the wireless prototype during EEG examinations [3]. Healthcare professionals were interviewed after the tests and they were asked to note possible of abnormalities arising from this wireless connection. Tests in Central Hospital of Satakunta were conducted with ten orthopaedic patients [4].

Results

Several problem areas were revealed. A special electrode band on patients' chest was used which resulted in slightly different ECG waveforms compared to conventional electrode positioning. Although the bed-side monitors displayed the signal from the D/A converter, those monitors with more advanced signal detection and alarm functions interpreted the measured waveform incorrectly resulting in occasional incorrect heart-rate readings or arrhythmia alarms. The data transmission protocol of the prototype was quite sensitive to disturbances. 5 of the 20 tests carried out in Seinäjoki had some problems with the wireless link; typically the connection was lost in middle of the examination. In three cases connection recovered after a while. In some cases these problems were traced to physical shielding of the signal by other monitors at the bedside. The tests at Central Hospital of Satakunta showed also some disturbances of wireless link in four cases out of ten. Transmission reliability could be significantly improved with better protocols; the transmission protocol, frequency and signal strength used in this project were not sufficiently reliable for use in critical measurements.

Discussion

It is very challenging to implement wireless solutions in healthcare applications; it is not just the wireless link that has to be implemented, but also several other issues have to be taken into account. Users should also be briefed and trained carefully on the use of new technology.
Wireless links could bring some benefits to data transmission in health care, they can allow more flexible connectivity to other healthcare systems assuming that they have compatible wireless interfaces. Best application areas for wireless solutions are multi-channel measurement where several signals are transferred. Long term monitoring at home by wireless technology could also give some significant improvements compared to conventional recording.

Acknowlegements

The authors would like to acknowledge the support of TEKES and participating companies for funding the research project. We also want to thank Ragnar Granit Institute for their role in rf-link and bio amplifier design. Telecommunication Research Center of Tampere University of Technology in Pori is acknowledged for arranging one test environment. We also want to thank Central Hospital of Seinäjoki for their help in testing the wireless link.

References

[1] Hurst J W, Schlant R C, Rackley C E, Sonnenblick E H, Wenger N K. The Heart, 7th ed. McGrawHill, 1990. ISBN 0-07-031508-6.

[2] http://www.chipcon.com. Chipcon AS homepage.

[3] Heikkilä, H., Mäkelä, K., Sandell, S., Lepistö, R. Kliinisen Neurofysiologian Ohjekirja. Seinäjoki: Etelä-Pohjanmaan Sairaanhoitopiiri, 1999. 98

[4] Mänty H, Data Transmission in Healthcare. Tekes project report 2006; 65

A Preliminary Assessment of a Mobile Medical Information System

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Keywords: Mobile eHealth, mobile medical information system, system performance, information effectiveness, physicians in military services

Introduction

Mobile e-health services offer a solution for coping with healthcare challenges in the 21st century [1] [2]. A mobile medical information system was developed by the Finnish Medical Society, Duodecim in 2002. It is a set of medical information and knowledge databases which support physicians' medical practice by retrieving knowledge and information at the point of need at anytime/anyplace. It contains the EBMG (evidence-based medical guidelines) with Cochrane abstracts, the pharmacology dataset-Pharmaca Fennica with wireless update service for a complete drug (medicine) price list in Finland, ICD-10 (the international diagnosis code guide) in Finnish, the emergency guide issued by Meilahti hospital, a medical dictionary of over 57 000 terms and a comprehensive database over related addresses and contact information relevant to health care (pharmacies, hospitals, health care, etc.). The systems is also included a drug interaction database originally developed by the Karolinska Institute, Sweden. The system is built on an XML database and can be easily modified to work in most mobile devices, with different operating systems, *e.g.*, Symbian, Palm OS, and Windows CE. In Finland, the device most commonly used as a platform is the Nokia Communicator 9210, 9310 or 9500. Currently, the updates are delivered on memory cards. In the near future, the system will be able to update itself partly, or completely, through the wireless network. The system is designed for and used by physicians served in civilian medicine [3] [4]. Possible usage of it in military medicine is of the interest here.
In September 2005, with support from Pfizer Finland Ltd. and Duodecim Publications Ltd., thirty one physicians, undergoing their military training in the Finnish Defence Forces, were given a Nokia Communicator 9210 equipped with the mobile medical information system for free. These physicians were encouraged to use the system voluntarily during their military training. The training takes partly the form of normal classroom education, as well as, field training periods. The main objective of the training is to provide the Forces with officers who are knowledgeable in military medicine, especially, for combat and field situations[4].

Methods

In December 2005, after the physicians had used the system for a time of approximately three months, a survey was carried out. A research measurement assessing the two constructs—systems performance and information effectiveness— was adapted from Chang et al. [5][5], with changes in wording to make them appropriate for the mobile medical information system, and the (military) healthcare context. Both the constructs and sub constructs were measured using a five-point Likert-type scale, ranging from 1 (hardly at all) to 5 (to a great extent) with 0 indicating "not applicable". The descriptive

[4] More information can be found at www.mil.fi, [accessed 26.2.2006]
[5] Please check Chang et al. original article for the definitions and detailed description of the constructs.

statistics, frequencies and some central tendencies, were calculated from the 19 returned valuable answers.

Results

In general, the studied group is young (mean age = 24.95), male-dominated (18 males and 1 female), highly educated (1 M.D, 12 Lic.M., and 6 medical students), and familiar with the contents of the mobile medical information system. The results obtained from the survey showed that the physicians have positive perceptions regarding the performance of the medical system in their work, and in their military training.
Measures of system performance assess the quality aspects of the system and the various impacts that the system has on the physicians' work in general, and their military training in particular. The results are shown in Table 1. Measures of information effectiveness assess the quality of the information provided by the system, as well as, the effects of the information on the physicians (military service) work. The results are presented in Table 2.

Table 1. System Performance

Systems performance Valid N=19 (listwise)	Mean	S.D
Impact on job	3.27	0.56
Impact on external constituencies	3.16	0.71
Impact on internal processes	2.55	1.04
Impact on knowledge and learning	2.96	0.97
Systems Usage characteristics	3.83	0.49
Intrinsic systems quality	3.78	0.49
Construct average score	*3.28*	*0.42*

Table 2. Information Effectiveness

Information effectiveness Valid N=19 (listwise)	Mean	S.D.
Intrinsic quality of information	3.80	0.38
Contextual quality of information	4.07	0.48
Presentational quality of information	3.50	0.71
Accessibility of information	4.23	0.39
Reliability of information	3.92	0.69
Flexibility of information	3.62	0.43
Usefulness of information	3.49	0.36
Construct average score	*3.80*	*0.29*

Discussion

This paper aims to explore physicians' (in military service) assessment towards a mobile medical information system in terms of system performance and information effectiveness. By comparing the construct scores of the system performance (3.28) and of information effectiveness (3.80), it is easy to find that the mobile medical information system performed better in the domain of information effectiveness, than in the domain of system performance. The system can provide high quality of information for the physicians during their military service, and has various positive influences on their work in practice (Table 2). The nature of the physicians' military service work, in comparison with those in the civilian medicine, is characterised by working on the move and in field conditions, as well as, crucial emergence of contingencies in the battle line that necessitate a pragmatic and a quick reaction. Their information needs in any of

these situations might be difficult to satisfy without the adoption of mobile technology. This can explain why the physicians gave favourable assessments of the system in the terms of contextual quality and accessibility of information.

The mobile medical system performs well (Table 1), at least, to some extent. As a standalone mobile medical system, which functions at the individual level and serves as a knowledge database, it is obvious that the system can not have much impact on the internal processes of the physicians' military service work. The surprising negative impact on knowledge and learning may be due to the work context and training activities of the physicians during their military service. The training concentrates on handling patients in the front line, where the situations are usually time critical, and procedures tend to be of a similar nature: acute cases of wounded and seriously wounded, e.g., performing life saving emergency surgery in "mass production". Less acute cases, and attended to, acute cases are sent behind the front line for medical attention. The information needs in the front line are such that the physicians need to know the procedures by heart, assigning medicine doses, or looking to less than acute cases is not a priority. This type of work does not need databases and information systems. The negative assessments may also result from the fact that the mobile system lacks a focus on their military training contents; so far, the contents of the system are designed for the civilian medicine. The knowledge provided for military purposes is very limited in the current version of the system. Since the mobile system is to a great extent regarded as a complement rather than a competing tool, or a replacement for the PC-based Internet connected system [3], this might as well result in the less impact of the mobile system on the aspect of learning.

The study has given some insights for the system improvements for military purpose, especially on improving the system performance in the dimensions of its impact on internal processes and impact on knowledge and learning. Obviously, more content regarding the military medicine have to be included in the system. For examples, major trauma handling, pain relief, detoxication and cleansing of chemical/radiation injury in a combat situation; hygiene, epidemiology, prevention of infectious disease outbreaks while soldiers are living under rough conditions (in field and out of casern); and some peculiarities of "military health"-mass vaccinations, epidemiology, skin disease, and occupation safety/risk issues specific for military in casern/barracks. It also seems very crucial of potential integration of the system with soldiers' health data in order to increase its impact on internal processes, particularly in field situations.

Acknowlegements

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References

[1] Goldberg, S. and Wickramasinghe, N. 21st century healthcare – the wireless panacea. The 36th HICSS, January 6–9, 2003,Big Island, Hawaii.

[2] Wickramasinghe, N. and Misra, S.K. A wireless trust model for healthcare. International Journal of Electronic Healthcare, Vol. 1, No. 1, 2004,60–77

[3] Han, S. Understanding user adoption of mobile technology: focusing on physicians in Finland. Doctoral Dissertation, Turku Centre for Computer Sciences, Åbo Akademi University, second edition, June 2005.

[4] Harkke, V. Knowledge freedom for medical professionals-an evaluation study of a mobile information system for physicians in Finland. Doctoral Dissertation, Turku Centre for Computer Sciences, Åbo Akademi University, 2006.

[5] Chang, J. Cha-Jan. and King, W.R. Measuring the Performance of Information Systems: A Functional Scorecard. Journal of Management Information Systems, 2005 (22)1, 85-115.

Session C3
International Experiences

Thursday, August 31 2006

Aurora Hall

16:00-17:00

C3-1 **Ethiopia's Medical Challenges: Telemedicine as a Possible Solution**
Mengistu Kifle (*SWEDEN*)

C3-2 **Implementing Telemedicine in South Africa - "A South African Experience"**
J. B. Fortuin; *M. Molefi* (*SOUTH AFRICA*)

C3-3 **Finnish - Japanese Collaboration in the Field of Wellbeing Services and Technology for Elderly Care – Finnish Wellbeing Center- Project**
Sinikka Salo (*JAPAN*)

C3-4 **Baltic eHealth - Empowering Rural Areas in the Baltic Sea Region**
Nomeda Valeviciene (*LITHUANIA*)

Ethiopia's Medical Challenges: Telemedicine as a Possible Solution

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Keywords: Telemedicine, Ethiopia, Developing Countries, Information System

Introduction

Delivery of healthcare services presents many challenges for governments in developing countries. Some of these challenges include financial and human resources issues that might affect governments' ability to manage and transform scarce resources to meet healthcare needs [6]. In developing countries such as Ethiopia, health problems such HIV/AIDS and malaria, combined with high population growth rates, have increased the demand for the delivery of high-quality health services. Due to slow economic growth in developing countries, government agencies have not been able to fund healthcare sectors to adequately keep pace with rising costs [7,8]. For example, Sub-Saharan Africa, with 24% of the global burden of disease, has only 3% of the world's health workers and spends less than 1% of the world's health expenditure [7]. A combination of factors, such as brain drain is at the root of this severe shortage of skilled health professionals in the region. This has led to more than 65% of the region's countries unable to provide their populace with basic healthcare services. The shortage of health professionals in the region is further complicated by the concentrated locale of the specialists. For instance, according to the MOH-Ethiopia thirty of the thirty-eight radiologists are located in the country's capital city, Addis Ababa. In addition, Ethiopia's inadequate transportation infrastructure makes it even more difficult to provide healthcare services in remote, rural areas. Researchers and practitioners believe that telemedicine is and will continue to be one of the major answers to the medical woes of Ethiopia [2,7].

Given that telemedicine appears to one of several solutions to Ethiopia's medical challenges [2, 5], there are a couple of questions about telemedicine in Ethiopia that still linger. Therefore, in this paper, we attempt to address the following research questions:

a. What is the current state of telemedicine in Ethiopia?
b. What are some potential factors that could impact telemedicine diffusion in Ethiopia?

Methods

To address these questions, we pull together threads from varying case studies, review of existing literature, and on-site interviews with 22 personnel from functional and administrative areas including health professionals and stakeholders of the healthcare system in the country. In one way or another, these policy makers and health professionals are all involved with telemedicine implementation in Ethiopia and some of them were members of the National Telemedicine Coordinating Committee (NTCC). This paper is organized into three sections. Following this introduction, Section 2 discusses the growth and challenges of telemedicine diffusion in Ethiopia, followed by the learnt experiences and conclusion in Section 3.

Telemedicine Diffusion and Challenges

Ethiopia's health care system ranges from highly specialized urban academic centres to small health units throughout the country. Telemedicine is one form of technology that

may be part of the solution to a number of health care problems in the region. There are telemedicine initiatives in Ethiopia to connect 10 sites, implement low-cost technology and dial-up Internet connection. In this section, we present and discuss the telemedicine initiatives that help ease the current burden of healthcare services delivery in Ethiopia
The project was initiated in 2003 by giving training to 20 specialists and GPs. Among them about 20% of them were having access to computers and knowledge of Internet. Therefore the training includes basic computer application, FTP, Internet and WebPages browsing and practical application using medical scanner and digital cameras. Equipment are distributed and free Internet hours are given for 10 sites. It is found that 25% of the trained physicians only use the system. NTCC interviewed the physicians and found out that the key problem is lack of user-friendly option of the software and the time involved to send images. At the result organized a technical committee, which involves specialist and telemedicine expert to address the concerned issues by developing local software (Telemed-ETH) that includes dermatological and radiological consultation sheets and compression capacity without reduce the quality of image.

Telemedicine Practices

- *Teleradiology:* is mainly used for the purpose of securing second opinions from a specialist at the Black Lion Hospital in Addis Ababa [3,4]. The experts took x-ray pictures through various light intensities. Consultants and GPs' satisfaction shows that picture taken on the window light is the best quality. The outcome is significant because in rural areas with free background it is possible to get good quality x-ray pictures on white-sprayed windows using normal sunlight
- *Teledermatology:* it is suggested that to take two pictures, one shows the overall lesion which clearly shows the part of the body which the lesion exist, and the other is to use a magnifying adaptor which can clearly shows the type of the lesion to be able to be described as macular, vesicular etc.
- *Telepathology:* connects the Black Lion Hospital in Addis Ababa to the iPath server at the University of Basel, Switzerland. This telemedicine initiative is mainly used for second opinions in the central referral hospital using the ipath web based platform. In the practice it was able to see interesting cases, which can convince that, the importance of telemedicine in clinical practice. Among them here it is shown how telemedicine saves the young boys leg from being amputated and crippled. It is also gives a lesson that telemedicine helps the youngest practitioners and as in this case a very experienced professor of pathology used it successfully as a second opinion. [1].

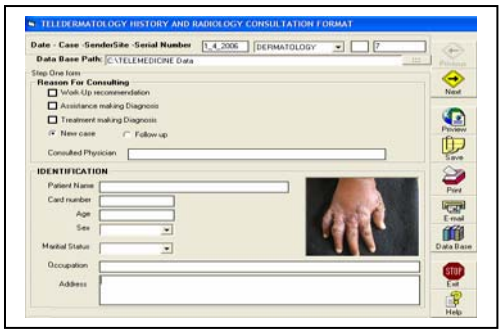

Figure 1: Telemed-ETH

Figure 2: - ipath platform

- *Teleeducation:* medical educations are required by newly established regional and teaching hospital in Awassa. Courses are prepared by well-established three medical school of the country and then broadcasted over broadband multimedia. Similar regional teaching hospitals well-equipped videoconference centre with

broadband multimedia set-up could follow courses and seminars organized by experts.

Challenges to Telemedicine Diffusion

Based on interviews with aforementioned telemedicine stakeholders Ethiopia faces the following challenges during implementation: lack of awareness by health professional because of the newness of the technology; lack of having local running budget and being donor dependent; commercial software not becoming local user-friendly; limitation of the international bandwidth; lack of coordination among the stakeholders; and only 20% of selected pilot hospitals were having access to computers and Internet.

Concluding Comments

Generally, Africa has been portrayed as a troubled continent with no hope for resurrection from its many gruelling socio-economic problems in general, and its medical nightmare in particular. Like most of the African countries Ethiopian people suffer from the shortage of specialties and healthcare delivery. However, this paper shows that steps are being taken to combat the many medical problems of the country through the adoption of telemedicine.

Lessons Learned

Based on the interviews it is learnt that: the cost of phone bills and Internet have to be budgeted from the health service and have to be planned a revolving fund for future service charge of specialty consultations; giving troubleshooting training to hospital technicians and assigning technicians when they are not avail; donated equipments need to addressee local equipment maintenance; refresher courses on telemedicine frequently have to be conducted; integration of medical informatics in medical curricula is necessary; and training of paramedical on telemedicine to help the busy medical practitioner or a specialist

Conclusion

It is clear that the telemedicine system itself cannot be the panacea for all specialists' problems of existing health care system. Even in the presence of a correct diagnosis, treatment facilities and drugs are still an issue and required to improve the current situation. Theses findings could have far-reaching consequences as the world looks to help this region's medical problems.

References

[1] I-path (2003) iPath Telemedicine Platform. Retrieved from http://telemed.ipath.ch/ipath/ (Current April, 15, 2006).

[2] Kifle, M., Solomon, A., Mbarika, V., and Okoli, C. (2004). Critical Success Factors for Telemedicine in Ethiopia Proceedings of the *15th Annual Information Resources Management Association International Conference*, New Orleans, LA.

[3] Kifle, M., Mbarika, V., & Datta, P. (2005). Telemedicine in Sub-Saharan Africa: The Case of Teleophthalmology in Ethiopia. *Journal of the American Society of Information Sciences and Technology*.

[4] Kifle, M and Shiferaw, F. (2006). Current Efforts of Telemedicine in Ethiopia. Presented at *ICT for Health*, Addis Ababa, 9 - 10 March 2006.

[5] Mbarika, V. (2004). Is Telemedicine the Panacea for Sub-Saharan Africa's Medical Nightmare? *Communications of the ACM*, 47(7), 21–24.

[6] Ethiopia Ministry of Health. (2006) *Health and Health Related Indicators*. Annual Report

[7] WHO (2006) World Health Report 2006.

[8] World Bank. (2001). World Development Indicator Retrieved from http://wwwint/whosis/country/indicatocfm?country=ETH (Current March 2005).

Implementing Telemedicine in South Africa "A South African Experience"

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Keywords: Telemedine; South Africa

Introduction

Until 1991, South African law divided the population into four major racial categories: Africans (black), whites, coloureds, and asians. Although this law has been abolished, many South Africans still view themselves and each other according to these categories. The post-apartheid Government of South Africa has made remarkable progress in consolidating the nation's peaceful transition to democracy. Programs to improve the delivery of essential social services to the majority of the, previously disadvantaged population are underway. Access to better opportunities in education and business are becoming more widespread. Nevertheless, transforming South Africa's society to remove the legacy of apartheid will be a long-term process requiring the sustained commitment of the leaders and people of the nation's disparate groups.

The vision of the National Department of Health, South Africa is a caring and humane society in which all South Africans have access to affordable, good quality health care. The South African Chief Directorate of Information Evaluation and Research, Department of Health (2001) stated that "the challenge for us lies in reaching all our people, especially in the rural areas and being mindful of not increasing the development gap between the 'haves and have-nots"

Kuntalp and Akar (2004) reported that people living in underserved areas struggle to access timely and quality medical care. Residents of these areas often have substandard access to speciality health care, primarily because specialist physicians are more likely to be located in urban areas of concentrated population. As a result, the patients living in rural areas have to travel to big cities where large and specialized medical complexes are located. Because of recent innovations in computing and telecommunications technology, many elements of medical practice can now be accomplished even when the patient and healthcare provider are geographically separated.

The Census (2001) reported that South Africa has a population of 44.8 million people, 43% of this population is living in rural areas. The highest percentage of persons in poverty is 63.3% in the Eastern Cape and access to electricity and water is the lowest in the Eastern Cape being 31.3%. Residents living in rural communities are confronted with significant inequities in access to health care compared with residents living in urban and suburban communities. Rural residents face a relative shortage of speciality and sub speciality physicians and show several inferior measures of health status (Marcin et al, 2004).

The information above has driven many health professionals to look at alternative solutions to delivering health care in South Africa. This has been an enormous challenge as there is a lack of human and physical resources. The aim of this study was to implement a workable telemedicine solution and use the outcomes to guide further research and development.

Methods

The study focused on rural clinics in one province of South Africa, Western Cape. Grabouw Community Health Centre provided information regarding the workflow of

the health facility, staff's experience of the current situation. In addition health professionals at the referrals hospitals were also interviewed. A time period of 4 weeks was spent at the clinic to make general observations.

Results

The observations revealed that Grabouw Community Health Centre (CHC) had running water, intermittent electricity, POTS connectivity, ISDN connectivity, the building exterior and interior was in a reasonably well maintained condition. The area surrounding the clinic included people from low socio economic group. However they were not the only clients using the facility it was also found that because Grabouw is renowned for it's fruit farming there were also plenty of clients from the more affluent groups using this facility since the health care options was extremely limited.

Grabouw CHC offered a range of services which included; (i) immunization; (ii) family planning; (iii) 24hr maternity unit; (iv) 24hr trauma unit; (v) fully stocked pharmacy; (vi) ARV treatment site; (vii) counseling and (viii) day clinic. The staff included 16 people this could be further subdivided into; 4 professional nurses, 5 nursing assistants, 2 part time medical doctors, 1 dentist, 1 dental assistant, 2 administrators and 1 cleaner. Total patient head count per day included 300 – 500 patients per day.

Approximately 10- 15 patients were referred on average per day to the hospital which is about 40 km away. Hottentots Holland Hospital does not provide a range of specialist services so often patients are referred to Tygerberg Academic Hospital that is about 100km away fro Grabouw CHC. The waiting period for referrals was approximately 3 weeks for chronics conditions. None of the staff were computer literate and 90% had not used a computer previously. When asked about telemedicine they were not aware of its capabilities and had not been exposed to telemedicine previously.

The workflow form the time the patient entered the clinic included: (i) drawing a existing folder or opening a new folder, if the patient is within the first 500 patients, if not the patient is turned away; (ii) folder is placed at the relevant section; (iii) the patient is seen by the health professional and exits the clinic after this unless required to collect medication at the pharmacy or referred to the specialist.

Discussion

Based on these result the first point of entry was to procure a simple low cost telemedicine workstation. The simplicity and flexibility should allow an inexperienced user to make use of the system with further increasing the workload or being too complicated. The system should also include a back up power supply to allow for power interruptions.

A search was done for a telemedicine workstation that allowed for these capabilities. We came up empty handed and to add to our problems the systems was costly and could not be remotely maintained and service / support would not be readily available.

University of Stellenbosch, Electrical and Electronic Engineering was approached to design and manufacture this product. The product was designed and implemented in Febraury 2005. The telemedicine workstation was well received and installed within a day. The key features of the telemedicine workstation included (i) no operating system interaction; (ii) integrated and intelligent video control; (iii) familiar consumer type user interface use and (iv) clinic adapted capturing. The system utilized ISDN connectivity.

The health professionals felt that the system was easy to use and was integrated adequately into the workflow. The training took approximately 15 minutes and for 3 sessions post training they required a trainer to facilitate them. The time to capture the cases took 10 minutes and the turn-around-time for response was approximately 1 day.

As noticed the videoconferencing option of the telemedicine workstation was not introduced as yet but this will occur in August 2006.
A good example of a success for telemedicine case is a 10 month old baby presenting with multiple abscess on the body. The child had previously been given antibiotics and ointment by a nurse. The child returned to the facility with high temperature and the multiple abscess had not been reduced. The consulting doctor was unsure about the cause of the abscess and the treatment option. The case was referred to 2 specialists and in the interim the patient was tested for HIV and any other disorders. The specialists had recommended that (i) patient be tested for HIV; (ii) administer intravenous antibiotics and (iii) that the abscess be lanced and referred to hospital for further observations. The telemedicine consultation possibly saved the life of young child and provided excellent care and support to the health professional.

Conclusion

Telemedicine has tremendous potential in a resource poor country like South Africa. Despite the lack of infrastructure and the limitation of funds to purchase such equipment the telemedicine workstation has demonstrated its ability to improve the quality of life and health care amongst South African citizens. Further investigation is required to determine the impact of this workstation on the health care quality and availability.

References

[1] Marcin, J.P., Ellis, J., Mawis, R., Nagrampa, E., Nesbitt, T.S., Dimand, R.J. (2004). Using telemedicine to provide pediatric subspeciality care to children with special health needs in underserved rural community. *Pediatrics,* 113 (1), 1- 6.

[2] Kuntalp, M., Akar, O. (2004). A simple low-cost Internet-based teleconsultation system that could effectively solve the health care access problems in underserved areas of developing countries. *Computer Methods and Programs in Biomedicine,* 75, 117 – 126.

Finnish - Japanese Collaboration in the Field of Wellbeing Services and Technology for Elderly Care Finnish Wellbeing Center- project

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Keywords: International collaboration, Welfare technology, Elderly care, Geriatric research

Introduction

In Sendai, Japan, an innovative, bilateral health care project for elderly care is underway. Jointly implemented by the Republic of Finland and the City of Sendai, the Finnish Wellbeing Center (FWBC) project has unique features that may enable it to serve as a model for cross-border cooperation in the Japanese welfare sector. The project is significant for a number of reasons, one of the most important being that it involves cooperation among private companies, universities and local governments in Finland and Japan for the development of health and welfare equipment. Joint efforts by companies in the two countries also serve to create and foster new fields of business. Moreover, the project provides a venue for research on new methods of elderly care that reflect Finland's skills and experience in the field. Japan and Finland are among the fastest ageing nations in the world. Japanese authorities and experts have taken a close look at the Finnish way to take care of ageing senior citizens. This interest has led to the idea of offering an entire Finnish concept for the care of older people for use in Japan. Essential to the Finnish care concept are rehabilitation and care services that promote and maintain independent living and physical functionality.

Methods

As a concrete result of the successful bilateral planning phase, an elderly care facility 'Sendan no Yakata Terve' was constructed in the City of Sendai. The facility is managed by Tohoku Welfare Corporation, a spin-off from Tohoku Welfare University. The functional concept is based on the Finnish "Sendai Sun" model, which emphasizes the dignity, autonomy and activity of senior citizens. The special nursing home for older persons provides integrated services and rehabilitative measures for its clients. The Center provides long-term care for 100 clients, short-term stay for 20 clients and a day service unit for 30 clients. Finnish welfare companies have provided a part of the necessary equipment. The building was opened in December 2004. In the close vicinity of the care facility, a Japanese-Finnish Research and Development Unit has been constructed. This Unit serves as a scientific research facility, technology development facility and business incubation facility in the field of ageing and related care services. The R&D Unit will encourage universities and other research and educational institutions as well as welfare industry companies to conduct joint R&D projects in the field. The building, which was inaugurated in March 2005, offers office rooms and co-design space for rent to suitable tenants. The functions of R&D Center are managed by Business Development Director of Finpro (Finland), and owned by the SIPO, Sendai City Industrial Promotion Organization (Japan).

Results

The first year of the R&D Unit has been very active. The project rooms are fully occupied, and several joint projects for future are under planning phase. The present R&D projects cover several areas in the field of scientific research as well as developing

new welfare technology, e.g. telemonitoring, eHealth and ubiquitous health care applications. There are projects on developing and localizing new wireless sensor technology, which analyses wellbeing of patients in beds. Another project is to measure the physical activity and control the safety and security of older persons living at home or home-like conditions. In the health care sector there is a research project for clinical laboratory test to detect gastric diseases. In addition, there are development projects on health care related IT software applications in medical imaging and contact center concept. Health and welfare information service integrated by CA-TV for older persons is under development. Several partners work on promotion of health and wellbeing by exercising and rehabilitation, and evaluating and monitoring effectiveness of those. Scientific research is done in collaboration with welfare universities and universities in economics about new service model for elderly care through network knowledge strategies. The R&D Unit has succeeded to provide support for the community by facilitating learning and networking opportunities for researchers, elderly care professionals and students as well as for governmental agencies and educational institutions. The opportunities for business development and incubation of new business ideas for welfare industries have been provided by the Unit.

Discussion

The objective of the Finnish Wellbeing Center (FWBC) venture in City of Sendai, Japan, was to build a welfare centre specialized in services for the aging population, functioning as the model unit for the Finnish elderly care concept in Japan. Essential to the Finnish care concept are rehabilitation and care services that promote and maintain independent living and physical functionality and using the latest welfare technology. By now, the Research & Development Unit of Sendai-Finland Wellbeing Center has grown to an expert institution widely acknowledged both in Japan and in Finland as well as in other countries. R&D Unit is an influential provider of new information and know-how in ageing and elderly care issues. This information and knowledge created by the Research & Development Unit of Sendai-Finland Wellbeing Center will serve as a solid basis for all decision-making for necessary future structural changes, as seen from the perspective of ageing societies. The principles of the Finnish elderly care concept are accepted in Japan, but the utilization of welfare technology has not been fully implemented yet. The Sendai-Finland Wellbeing Center serves an international centre for information related to aging and welfare technology, thus operating as a world wide site of representation of the Finnish elderly care model

Baltic eHealth - Empowering Rural Areas in the Baltic Sea Region

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Keywords: eHealth, Internet, networks, rural health care, cross-border.

Introduction

The fragmentation of healthcare caused by the many sectors, professions and extensive specialization can be counteracted positively by extensive use of digital services to provide seamless care for the individual patient. The digital support can secure the right information to be present anywhere at any time.
A project supported by the European Interreg III B programme, Baltic eHealth, aims at improving healthcare performance in rural areas of the Baltic Sea Region by providing access to specialist assessment – anywhere and anytime. The purpose of the project is to create an interoperable transnational infrastructure for eHealth and to illustrate that eHealth is an effective means of increasing the access for patients in rural areas to healthcare of high quality.

Methods

Internet-based healthcare networks are a step forward compared to first generation healthcare networks, which have been limited to pushing text-based messages between different systems. An Internet-based network can also "pull" data - and not only text but any digital data, for instance images and video sequences. The Internet-based networks can more effectively fulfill the vision of access to relevant data regardless of time and location.

Results

Although far from identical, the health delivery systems of Denmark, Norway and Sweden are similar. They also share a shortage of specialized health personnel. Furthermore, over the past ten years they have implemented an IT-strategy to increase efficiency in the delivery of healthcare services. Part of this strategy has been to build three national networks on top of the existing regional, secure and Internet-based healthcare networks. These national networks connect not only all hospitals in the three countries, but also a majority of the other stakeholders in the healthcare sector (GPs, private specialists, laboratories, homecare services etc.).
The main result of the Baltic eHealth project is the established Baltic Health Network (BHN), which connects not only all hospitals in Norway, Sweden and Denmark but also two hospitals in Lithuania and Estonia. The BHN has been operational since the summer 2005 and can be used for any eHealth purposes by any of the 200 participating hospitals. Modern telecommunication has a great potential for improving the quality of medical care in rural areas by making specialist knowledge and asssessments available for patients living even far away from the highly specialized medical centers. This is demonstrated in the project's two pilots.

In the eUltrasound pilot, the midwives in the rural areas of Västerbottan County, Sweden, are awaiting the establishment of the BHN to gain access to second opinion from specialists at the National Center for Foetal Medicine at the University Hospital of Trondheim, Norway. In the eRadiology pilot, the project attempts to overcome the

problem Denmark is facing concerning a lack of radiologists, which leads to vacant positions and discomfort for patients as they have to wait months for simple radiological examinations. The lack of radiologists is particularly noticeable at rural hospitals where up to a third of all positions may be vacant. To remedy the problem of lacking radiologists, X-rays taken at the Funen Hospital will be sent for description to a hospital in another country, which does not have a shortage of radiologists. The purpose of the eRadiology pilot is therefore to test if this type of solution between Funen Hospital and the radiological departments of Vilnius University Hospital and East-Tallinn Central Hospital. The pilot will investigate if the solution is technically, financially, culturally and linguistically feasible. If so, the goal of the pilot will be to develop a business plan that will bring the solution into daily production. The business plan will make the eRadiology service worthwhile to continue with for all involved parties on commercial terms after the project ends in 2007.

Discussion

The usage of a transnational network like the BHN brings about a number of critical questions. The most frequent ones are: Is it legal to send patient information between countries? How does a hospital get reimbursed if it delivers a second opinion to another hospital? How do we deal with cultural differences? What if the two collaborating health professionals do not speak the same language? These questions should be considered carefully before launching a cross-border collaboration. However, the answers to the questions are still very unclear and this is a barrier to the full-scale usage of the BHN. Few decision makers will initiate such projects if, for instance, the legal basis is unclear. The Baltic eHealth project will only be successful in persuading decision makers to use the BHN for transnational communication, if the project can give clear and unambiguous answers to the above questions. For this reason, the project will develop concrete guidelines on how to overcome legal, financial, cultural and linguistic barriers.

The BHN is the only cross-national healthcare network in Europe and removes a major technical barrier for cross-border collaboration between health professionals. The network and other results from the Baltic eHealth project such as best practises from the two pilots and guidelines on the removal of other barriers for eHealth are being made available to decision makers in the Baltic Sea Region and this will hopefully contribute to the large-scale usage of second opinion from available experts regardless of institutional, regional and even national borders. Once the usefulness of the BHN is documented in the Baltic Sea Region, the BHN will be a strong candidate for a universal European model for the next generation healthcare network.

Acknowlegements

Special thanks to the partners of the Baltic eHealth project – see: www.Baltic-eHealth.org. The Baltic eHealth project is co-financed under the EU BSR Interreg III B programme.

References

[1] htpp://www.Baltic-eHealth.org.

Session A4
Citizen Empowerment

Friday, September 1 2006

Helsinki Hall

10:00-11:30

A4-1 **Danes and Their Use of the Internet for Health Purposes**
Henning Voss (*DENMARK*)

A4-2 **Users' and Health Professionals' Opinions of the Hyvis Enquiry Service**
Virpi Jylhä; *Liisa Klemola*; *Kaija Saranto*; *Maija Paukkala* (*FINLAND*)

A4-3 **Formation of an Integrated Information Space Supporting the Disabled in Russia**
Victoria Stenina; *Alexander Shoshmin*; *Nataly Martynova*; *Yanina Besstrashnova* (*RUSSIAN FEDERATION*)

A4-4 **Development Process of a Citizen-centered Portal to Empower Patients in Psychiatric Care**
Maritta Välimäki; *Heli Hätönen*; *Tiina Jakobsson*; *Lauri Kuosmanen*; *Marita Koivunen*; *Anneli Pitkänen* (*FINLAND*)

A4-5 **Use of Web-based Health Counselling Service among Finnish University Students**
Johanna Castrén (*FINLAND*)

A4-6 **A Virtual Visit to the Hospital: Childbirth Clinic in Internet**
Maritta Korhonen; *Päivi Niiranen* (*FINLAND*)

Danes and their Use of the Internet for Health Purposes

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Keywords: Citizens, Internet, eHealth, Denmark, survey.

Introduction

Danes are among the most eager Internet users in Europe and computers with Internet-access can be found in more than four out of five Danish homes (1). Moreover, in the recent years a number of health and illness related websites and eServices have been introduced and Danes use them rather frequently (2). This development raises a number of questions: How are the existing services used? How many use them and who is the typical user? Which effects can we see from the use of health related websites and eServices? These and similar questions have previously been analysed in both Danish (see for instance 2, 3) and international studies (see for instance 4, 5). The Danish studies have however, been based on rather limited statistical material. In this abstract the mentioned questions are therefore discussed on the basis of a questionnaire with a quiet large number of respondents.

Methods

The data reported in this abstract is part of the *eHealth Trends* project, "WHO/ European survey on eHealth consumer trends", co-funded by the European Commission, programme of Community action in the field of Public Health (2003-2008). Seven countries participate in the project; lead partner in the project is the Norwegian Centre for Telemedicine (NST).
In Denmark the data collection was carried out by a polling agency via the telephone (both fixed- and mobile numbers) in October 2005. One thousand respondents between the age of 15 and 80 were selected using random stratification. Each interview took approximately 10 minutes to carry out. To monitor the trends in use of Internet for health and illness purposes the study will be repeated in the Spring of 2007.

Results

Sixty per cent of the Danes used the Internet to seek for health related information. This means that the percentage of Danes using the Internet for health purposes has grown from 20 % in 2000 (2) to 60 % in 2005 and this growth is primarily explained by an almost similar positive development in general access to the Internet.
The Internet is especially used for health related purposes by young people, by people with a high educational level, by women, by white collar workers, by people in bad health and by people with many children. Every fourth Dane experience that they feel calm or relieved after having read about illnesses on the Internet and this number is three times higher than people that get concerned. Three per cent say that they without prior contact to their medical doctor have changed their medication after having read information on the Internet. Eight per cent of the Danes have at one point been in contact with their doctor over the Internet, and if given the opportunity 58 per cent say they would read their own patient record online.

Discussion

For many Danes it is common practice to use the Internet for health related purposes. However, the position of the general practitioner as primary source for health related information is not threatened. The Danes use the Internet as supplement to their doctor

and a great deal – especially women – use Internet information to prepare for a consultation. To a larger degree the Danes seek solutions that make it possible for them to get online contact with the different players in the health care sector.

References

[1] Danmarks Statistik. Befolkningens brug af internet 2005. (The Populations' use of the Internet 2005.) Danmarks Statistik, 2005:30.

[2] Nielsen S, Eidner A, Dørup JG. Patienternes brug af internettet i danske praksis. (Patients' use of the Internet in Danish doctor's practices.) Ugeskr Læger 2005; 167: 2515-2518.

[3] Budtz S, Witt K. Consulting the Internet before visit to general practise. Patients' use of the Internet and other sources of health Information. Scand J Prim Health Care 2002; 20:174-6.

[4] Andreassen H., Sandaune AG, Gammon D et al. Use of Internet health services in Norway. Tidsskr Nor Laegeforen 2002; 122:1640-4.

[5] Masi CM, Suarez-Balcazar Y, Cassey MZ et.al. Internet Access and Empowerment – A Community-based Health Initiative. J Gen Intern Med 2003;18(7):525-30

Users' and Health Professionals' Opinions of the Hyvis Enquiry Service

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Keywords: eHealth, Internet services, Health services

Introduction

In Finland the number of Internet users has been growing rapidly and it has had an effect on delivering health care services1. According to Berry et al.2 the traditional office visit model used in health care does not benefit clients´ heterogeneous needs. Nowadays services should be delivered by offering multiple entry paths into the practise.2 Therefore new ways for accessing health services and information should be introduced. Internet-based services, like the Hyvis portal, are relevant options. Hyvis portal is a free Internet -based service for inhabitants of Etelä-Savo Hospital District that completes regional health services and promotes welfare of inhabitants by offering information about health and health care services. An enquiry service for users to consult a health care professional is included in the portal. Questions can be presented either in a public forum of the portal and everyone has access to information or in a private forum where access is secured and only the person who asks the question can read the answer. The aim of this study was to assess how the Hyvis Enquiry Service fulfils users' information needs by applying Choo`s information management model 3 and how the Hyvis Enquiry Service impacts on the use of health care services.

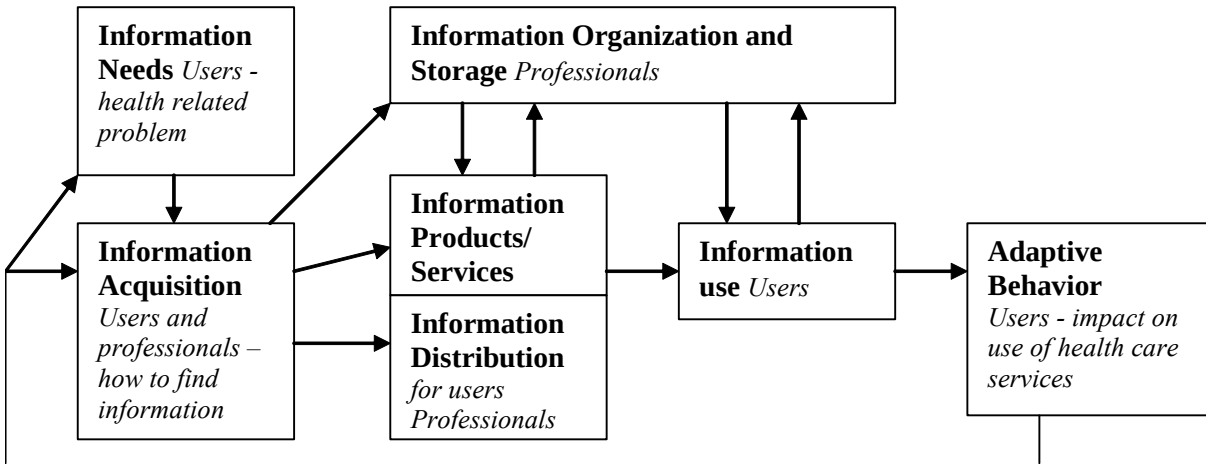

Figure 1. Applied Information Management Model[3]

Methods

A qualitative approach was used in this study and the data were collected through semi-structured interviews. Five users of the Hyvis-service and nine health care professionals were interviewed for this study. Professionals were interviewed in February 2006 and users were interviewed during March and April 2006. Six of the interviews were made on telephone. All the health care professionals, who answer to clients' questions via

Internet, were interviewed. The users of this service were asked to voluntary participate in the study by advertising the study on the front page of the Hyvis-portal. The themes of the interview were sent to interviewees in advance. This was done to ensure their awareness of the topics and they could prepare themselves adequately, but the answers would still be spontaneous. All the interviews were tape-recorded and the researcher also took notes. Interviews were typed up and the data was analysed by using inductive content analysis.

Results

The results of this study show that according to the health care professionals the enquiry service fulfils users' needs and users get specific information. Further, they think that the information is accurate for the question and is filtered by a health care professional. According to their opinion the enquiry service could reduce the use of health care services if inhabitants only knew the existence of the service better. Users wished for more specific answers. However, most users felt that they got the answer to their question. The enquiry service helped users to make decision whether to visit a doctor immediately or should they treat themselves. Users also wished that appointments for visits to health centre should be made via the Hyvis portal.

Discussion

The results of this study suggest that the Hyvis Enquiry Service benefits some inhabitants and users usually get the information they need. According to Choo´s applied information management model identification of information needs is vital as information needs are basis for information acquisition. When communication between inhabitants and professionals is based on typed text few threats for the identification of users' health-related needs exist, too. Firstly, health professionals can interpret questions in a different way than it was meant. This leads to that the user does not get the information needed. Secondly, users do not always give all necessary background information, which should be taken account in the answer. Accordingly information may not be appropriate and the user needs to contact health centre by phone and make an appointment. In that case users do not reach the level of information use and they do not change their behaviour like the goal of the service is. In addition, this study shows that due to these threats the enquiry service seems not to reduce the use of health care services at this moment. For users who do not need urgent help and do not want to spend time in a phone queue this will be a useful service model in the future in case that problems in identification of information needs are solved. According to this study one option could be structured questionnaires, which would help users to formulate their questions.

References

[1] Taavila A. Kuntien verkkopalvelut. Tampereen yliopiston tietoyhteiskunnan tutkimuskeskuksen työraportteja. Tampereen Yliopistopaino Oy; 2000.

[2] Berry L, Selders K & Wilder S. Innovations in Access to Care: A Patient-Centered Approach. Annals of Internal Medicine. 2003;139(7):568-74.

[3] Choo CW. Information management for the intelligent organization: The art of scanning the environment. 2nd edition. Medford (NJ): Information today; 1998.

Formation of an Integrated Information Space Supporting the Disabled in Russia

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Keywords: Electronic patient records, Medical-social expertise, Integrated information space

Introduction

By 2005 more than 14 millions of disabled people (about 10% citizens) were registered in Russia. More than 2000 federal state institutions of medical-social expertise (MSE) took part in their examining. These institutions are aimed to [1]:

- Provide rehabilitation and expert diagnostics in order to define rehabilitation potential, vital activity limitation, needs in social protection,
- Study reasons, factors and conditions influencing the beginning, development and outcome of disability, analysis of disability prevalence and structure.

Federal state institutions of MSE include the MSE Federal Bureau and main MSE bureaus (in every subject of the Russian Federation) that have branches – MSE bureaus in towns and in districts.

The information and reference system [2], [3] was developed for tasks of a federal state institution of MSE. It allows to computerize activity of these institutions at the municipal level or at the federal subject level and also to use separate workstations for specialists in authorities and in lower organizations at the federal subject level.

An electronic patient record in the integrated information-reference and analytical system for registration and rehabilitation of the disabled (the System) contains more than 300 parameters. The System includes 20-150 users. At present the System has been implemented in 14 subjects of Russia and its simplified single-user version designed for patient registration and reporting is used in about 60% of subjects of Russia.

Methods

Special corporate warehouses and appropriate analytical blocks allow monitoring and evaluating social programmes for the disabled and other socially vulnerable people. Using these technologies help to save and apply information accumulated earlier, update data bases structure, logical information relations etc. without modifying warehouse kernel. Workstations based on such warehouses provide the most flexible technology for data processing, paper and electronic documents circulation and nearly unlimited number of dictionaries and directories [3].During implementation of the System the appropriated technology was developed. This technology allows to provide complex computerization at MSE bureaus for several months including trainings programmers, specialists of MSE bureaus and technical managers.

This complicated System at the federal level needed a number of classifiers such as privileges classifier for the disabled, needs classifiers, services classifier etc. that allow all System components to work together. The System uses dozens of international, federal and local classifiers.

Results

As the System is based on using workstations by MSE specialists, implementation of it allows to solve all the problems which federal state institutions of MSE face with. State federal institutions of MSE define benefits for the disabled, i.e. implementation of this System helps to register and keep records of people who need in rehabilitation, validate individual programmes for the disabled and control their execution.
Besides that the opportunity to register most of socially vulnerable people not depending on examinations results has been appeared. All the data at every stage of examination are input into the integrated data base of a MSE bureau and united at the level of the main MSE bureau. In future a certain part of information can be transmitted to the level of the MSE Federal Bureau, where an integrated patient record or data about federal state institutions of MSE can be received by a special inquiry. This approach stimulates transfer activities of federal state institutions of MSE to a new quantity level.
Considerable economical effect also appears. This approach allows to develop information systems that are used as tools of social reforms and react to any innovations and changes in legislation. Implementations of the System result in the following:

1. creation and keeping united data base that contains all electronic patient records;
2. time reduction for preparing patient documents on 20-30% due to data validation, search by all parameters in a data base, preparation of documents during and after examination in a MSE bureau (about 10 documents per patient);
3. time reduction to 15 minutes (instead of 1 month of manual work) for preparing annual reports and standard statistical reports in a MSE bureau;
4. possibility of interaction with other information systems;
5. possibility of multivariate statistical analysis of disability, needs etc.

Discussion

To help the disabled to receive assistance from the state activities of state institutions and non-government organizations that use valid patient records needs coordination. These institutions and organizations should be united by an information system that supports their work within integrated information space [4]. Suggested System provides defining socially vulnerable people, evaluation of their needs and development of measures list to help these people and integration of data from different sources.

References

[1] О порядке организации и деятельности федеральных государственных учреждений медико-социальной экспертизы, Постановление Правительства Российской Федерации. N 805 (16 декабря, 2004) [On order of organization and activities for federal state institutions of medical-social expertise, Resolution by Government of the Russian Federation. Pub. L. No 805 (December 16, 2004)].

[2] Shoshmin A., Martynova N., Riabokon A. Rehabilitation information system for people with disabilities. New Technologies in Human Services 1999; 12 (1 & 2).

[3] Информационные технологии в сфере социальной защиты инвалидов. СПб: КопиСервис; 2002 [Information technologies in social protection of the disabled. St. Petersburg: CopyService; 2002].

[4] Martynova N.V., Shoshmin A.V., Strokova I.V. Organization of information space of rehabilitation of the invalids. Proceedings of the 7th International Conference Computers Helping People with Special Needs ICCHP; 2000 July; Karlsruhe, Germany.

Development Process of Citizen-Centered Portal to Empower Patients in Psychiatric Care

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Keywords: eHealth, Patient education, Psychiatric care

Introduction

Mental health problems are a national concern in Finland.[1] Particularly, patient with mental disorders may have problems understanding their illness and treatment.[2] Patients' willingness to follow through with treatment plan is related to their perception and understanding of illness.[3] Education has found to be an effective way to increase patients' awareness of their mental health problems,[4,5] ability to cope more effectively in daily life, compliance in treatment, reduction of relapse, or readmission rates.[6] Recent studies have shown that the Internet has shown promise in patient education when diverse illustration is needed.[7] Web sites seem to be a practical and promising intervention for preventing mental health problems as depression and anxiety to the general public. A randomized controlled trials in computerised interventions showed that computer-delivered interventions resulted improvement on the depression, anxiety, work, social adjustment or general psychopatology.[8]
A number of computer-based support systems or Internet-based self-help programs have been developed for various patient groups, but less systematically to patients with mental disorders. The overall goal of the study is to generate information on clinical outcomes and cost-effectiveness of information technology (ICT) use in mental health care as a part of patient education. In this paper, the development process of an interactive portal (Mieli.Net) to support patient's empowerment will be described.

Methods

The development process was carried out in ten phases.

Results

1) A survey for administrative personnel to ascertain the development needs for patient education was conducted. 2) A one-year patient satisfaction study. 3) The spheres of information rated important by mental patients discharged from psychiatric hospitals. 4) A literature review concerning patient's need for information. 5) The spheres of information for an Internet page prototype were formed based on meetings with expert groups and experts in the field of technology. 6) The content, structure, visual appearance and usability of a prototype of Internet pages were evaluated by clients in a patient association, nursing students, and nurses. Physiological tests were conducted to describe eye movement and use of the mouse connected with each set of Internet pages (nurses and nursing students). 7) The content of each information sphere was evaluated by clients in patient associations, psychiatrists and psychiatric nurses. 8) A multimedia applications developed together with clients were integrated into the Internet pages including voices with clients' life stories, pictures, figures etc. 9) Diary, peer-support, and eSupport systems were integrated into the portal application. 10) Evaluation process of portal usability as part of patient education is going on using a randomized controlled trial design with three fingers. Mieli.Net Portal is now being used in two psychiatric hospitals in Finland. So far 212 patients have been randomly allocated to one of the

three patient education groups: a) an experimental group (a portal is being used on the patient education programme); b) a control group (a patient education with written leaflets); c) patients with standard care (no special educational intervention developed for the study.

Discussion

To avoid alienation of mental patients and the introduction of more expensive technologies in health care without knowing the effects on staff and organisational performance, we should systematically test the relevance of IT in daily clinical practice on health services. Although laborious and time-consuming, it is useful to work in collaboration with consumers, health care staff, administrative personnel, technological experts, representatives of industry, and researchers to develop user-friendly information technology.

Based on a risk analysis of the project, a number of risks and limitations may occur. First, nurses may have negative perceptions of the benefits of information technology in the care of patients with mental problems, which may cause problems in implementing interactive portal into psychiatric hospitals' daily practice. Second, staff' lack of capacities and motivation to contribute to the practical arrangements of systematic patient education in psychiatric care. Third, a complicated recruitment process in research design resulting in high refusal rates. And last, patients' mental status which may cause high dropout rates.

Acknowlegements

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References

[1] Pirkoila S. & Sohlman B. (Eds.). Atlas of Mental Health. STAKES. Gummerus Kirjapaino Oy, Saarijärvi, 2005.

[2] Goldberg R, Gree-Paden L, Lehman A, Gold J. Correlates of insight in serious mental illness. J Nerv & Mental Disease 2001; 189 (3): 137-45.

[3] Perkins DO, Stroup TS, Lieberman JA. Psychotic disorder measures. In: Handbook of Psychiatric Measures. American Psychiatric Association, Washington, DC, 485-90, 2000.

[4] Perry A, Tarrier N, Morris R, Mc Carthy E, Limb K. Randomised controlled trial of efficacy of teaching patients with bipolar disorder to identify early symptoms of relapse and obtain treatment. British Medical Journal 1999; 318: 149-53.

[5] Turkington D, Kingdon DG, Turner T. 2002. Effectiveness of a brief cognitive behavioural intervention in the treatment of schizophrenia. Schizophrenia Research 2000; 53:14.

[6] Pekkala E, Merinder L. Psychoeducation for schizophrenia. In: The Cochrane

[7] Library, Issue 1, 2002. Oxford: Update Software, 2002.

[8] Enzenhofer M, Bludau H-B, Komm N, Wild B, Mueller K, Herzog W, Hochlehnert A. 2004. Improvement of the Educational Process by Computer-based Visualization of Procedures: Randomized Controlled Trial. Journal of Medical Internet Research 2004;6(2):e16.

[9] Christensen H, Griffiths KM, Korten A. Web-based cognitive behavior therapy: analysis of site usage and changes in depression and anxiety scores. Journal of Medical Internet Research 2002; 4(1):e3

Use of Web-based Health Counselling Service among Finnish University Students

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Keywords: Health counselling on the Internet, Student Health Care, University Students

Introduction

Among Finnish people of working age, young adults are the most active users of email and the Internet. University students use ICT even more actively than young adult population on the whole. The Finnish Student Health Service (FSHS) provides primary health care services to ca. 140,000 university students in Finland. Services includes also a web-based health counselling service through which general practitioners, nurses, and dental care professionals give instructions and advice on health and illnesses to anonymous students. The service free of charge covers following topics: sexual health, asthma and allergies, travelling medicine and vaccinations, oral health, and mental health. Our study was designed to examine factors that differentiate between users and non-users of a web-based health counselling service among Finnish university students.

Methods

This study was carried out made as a part of the "Student Health Survey 2004", a national mailing survey among Finnish undergraduate students aged 19-35 years. The population size was 101,805 and the study sample 5,030. The response rate was 63%. Statistical analyses were conducted using the χ^2 test.

Results

12% of respondents had used FSHS´ web-based health counselling service. Compared to non-users, users were more likely to be female (14% vs. 8%, $p<0.001$), and were studying in Helsinki area (18% vs. 9%, $p<0.001$). Compared to female non-users, female users reported more often >5 health cares visits in the past 12 months (11% vs. 7%, $p<0.001$). Compared to male non-users, male users had more frequently (30% vs. 20%, $p=0.019$) been diagnosed for asthma or allergies. There were no between group differences in self-reported global health status (excellent/good, only fair, or poor).

Discussion

Female gender, study residence in Helsinki area, higher numbers of health care visits, and diagnosed asthma or allergies were associated with the use of a web-based health counselling service. More research data are needed to evaluate the role of a web-based health counselling service as supplementing or substituting the traditional forms of health services

References

[1] Nurmela J, Sirkiä T. Muistio tietoyhteiskuntaohjelmalle suomalaisten tieto- ja viestintätekniikankäytöstä ja siihen suhtautumisesta marraskuussa 2005. Available from: http://www.tietoyhteiskuntaohjelma.fi/esittely/fi_FI/raportit_ja_selvitykset/_files/74706466515518450/default/ty-tilastotutkimus_05.

[2] Escoffery C, Miner KR, Adame DD, Butler S, McCormick L, Mendell E. Internet use for health information among college students. J.Am.Coll.Health 2005; 53(4):183-8.

[3] Umefjord G, Hamberg K, Malker H, Petersson G. The use of an Internet-based Ask the Doctor Service involving family physicians: evaluation by a web survey. Fam.Pract. 2006; 23(2):159-66.

A Virtual Visit to the Hospital: Childbirth Clinic on the Internet

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Keywords: maternity care, virtual organisation, information accessibility, empowerment, seamless care

Introduction

Technological development has created new possibilities for healthcare organizations to share information with patients; communication technology also enables patient empowerment and collaboration. Finland is among the pioneers in information and communication technology in the field of social and health care [1]. However, new technologically oriented working and learning environments of the Internet set heavy demands on the way these new environments are developed [2], [3]. In the Tutuks project we introduced a new welfare service for sharing information with the patients. The service has produced concrete results in empowering families by the use of modern technology in a very personal and emotional situation: childbirth.

Methods

In the Tutuks project the goal was to specify, design, implement and document a new tool and produce real time material for healthcare providers and customers. The primary target group of the service is families expecting a baby. The piloting partners were Kuopio University Hospital and the City of Kuopio. Through new health care services we are trying to develop information accessibility in the Pohjois-Savo region and to support seamless care and cooperation in service chain between organisations. We also want to evaluate the change process which starts in organisations through development of visible processes.

Maternity hospitals and mother–child clinics cooperate closely because they are both responsible for the care of the patients and together build a seamless service chain and co-operate to share the same good clinical practice. Our project encourages co-operation between different which was especially emphasized in building up the project group of professionals from the university hospital, primary health care and educational institutions.

More than 99% of Finnish women give birth in public hospitals. However, due to economic and organizational reasons prenatal training in hospitals has been reduced recently. Our starting point for the project was to promote a new way of health information. We also emphasized the importance of father in child birth; most information in the Internet is produced for mothers and concentrated on woman and child. The video material and pictures were produced together with families expecting a baby. Authentic material has also been reviewed by the families.

Results

In the Tutuks service we have combined relevant and authentic textual information with deeply emotional material, for example a video of an actual birth. All the information provided in the service has been checked by clinicians and nurses. Kuopio University hospital has agreed to maintain the service technically and keep the content updated.

The ‘thread’ running through the service is the map of different care paths. The interviews with professionals and panorama pictures of the rooms, and accurate

information combined with real situations presented in videos and photographs help the families to orientate to the childbirth as a significant and unique occasion. Moreover, the role of the professionals and organizational aspects are also presented.
We also evaluated the service with usability tests with parents, health care professionals and technical developers. The participants found the contents very useful and the implementation of the service very easy to use, but they also suggested some enhancements. The service is available to everyone on the Internet, www.synnytystutuksi.fi, and it will also be linked to the web-pages of cooperating healthcare providers.

Discussion

The critical factor in Internet information concerning healthcare consumers, functions and providers is the trustworthiness and accessibility of the service. However, healthcare information services should be user-friendly and user-centred. Ackerman [4] argues that three factors influence the adoption of information technology. Computer applications should be designed around the needs and working and communication patterns of users; technology should be easily accessible and well organized and users should posses a moderate level of self-confidence about their ability to use a specific technology. Use of information technology in health care requires certain abilities but also provides opportunities to learn and to acquire information.
In our project we have concentrated on two aspects: to give relevant information to families in their homes and to empower them as independent informed actors. The Tutuks service can also be used in the education of healthcare professionals, both in healthcare organisations and in educational institutions.

Acknowledgements

This paper is based on the Tutuks project, funded by the Regional Council of Pohjois-Savo, Kuopio University Hospital and municipalities in the Pohjois-Savo area, and on research in ZipIT-ojo project, funded by the National Technology Agency TEKES, the Finnish Work Environment Fund and Finnish software companies and health care organizations.

References

[1] Kouri P. & Kemppainen E. (2000). The implementation of security in distributed infant and maternity care. International Journal of Medical Informatics 60 (211–218). http://www.sciencedirect.com/science?_ob=MImg&_imagekey=B6T7S-422FH9Y-M-3&_cdi=5066&_user=1638579&_orig=search&_coverDate=11%2F01%2F2000&_qd=1&_sk=999399997&view=c&wchp=dGLbVlb-zSkzk&md5=c71e08cdb5effceddf750fdda354b719&ie=/sdarticle.pdf

[2] Cascio, W. F. (1999). Virtual workplaces: implications for organisational behaviour. In C. L. Cooper & D. M. Rousseau (Eds.) The virtual organisation, Chichester: John Wiley, 1-14.

[3] Mowshowitz A. (1997). Virtual organisation. Communications of the ACM, 40 (9). (30-37)

[4] Ackerman, M. (2000). The intellectual challenge of CSCW: The gap between social requirements and technical feasibility. Human-Computer Interaction, 15, 179-203.

Session B4
Evaluation and Security

Friday, September 1 2006

Terrace Hall

10:00-11:30

B4-1 **Economic Evaluation of Telemedicine in Finland**
Arto Ohinmaa[1]; *Marjukka Manninen*[2]
[1](*CANADA*); [2](*FINLAND*)

B4-2 **Measuring the Effectiveness of a Hospital Information System**
Andre Krull (*ESTONIA*)

B4-3 **Can eHealth Progress Be Measured?**
Päivi Hämäläinen; *Ilkka Winblad*; *Jarmo Reponen*; *Persephone Doupi*; *M Kangas* (*FINLAND*)

B4-4 **Improving Traceability of Functional Requirements to Information Needs and Applications in Healthcare**
Juha Mykkänen; *Irmeli Minkkinen*; *Assi Pöyhölä*; *Annamari Riekkinen* (*FINLAND*)

B4-5 **Registration Process in Health Care Public Key Environment**
Jarkko Majava; *Aapo Immonen* (*FINLAND*)

B4-6 **Prospects offered by VoIP Technology for Telephone Information Services in Primary Health Care: The Case of the Utajärvi and Vaala Health Centres**
Minna Heikkinen; *Harri Oinas-Kukkonen* (*FINLAND*)

Economic Evaluation of Telemedicine in Finland

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Keywords: Economic evaluation, review, assessment studies

Introduction

Telemedicine is a form of information and communication technology (ICT) where patient information (image, audio, or data) is transferred via telecommunication networks between two or more sites. The numbers of telemedicine and other ICT solutions in health care have increased rapidly during the last two decades. This increase of the new technologies has happened in a hope for improved productivity, cost-effectiveness, and cost savings. Telemedicine has also been expected to have other benefits, such as decreased waiting times, improved access to care and patient management processes, and learning/continuing education of the professionals. Since the investment costs on telemedicine equipment and networks are often high, economic evaluation of these technologies are needed to guide decision makers to do well informed decisions that base on good quality and usable economic data.

Methods

A literature review was made by Medline search in May 2005 to identify economic studies in telemedicine in Finland that either were theoretical evaluation framework studies or empirical studies with economic evaluation results. In addition we reviewed gray literature that includes research reports from telemedicine projects. Studies in Finnish, Swedish and English were included.

Results

Medline search found 18 Finnish telemedicine studies that included either economic analysis or evaluation framework. In addition 4 other reports and thesis were found to include economic analysis. The review found several studies that were made from the economic evaluation frameworks in telemedicine. In 1996 Finnish Office for Health Technology Assessment (FinOHTA) funded a health technology assessment (HTA) and economic evaluation study of telemedicine at the Northern Ostrobothnia Healthcare District (1). This study included the first Finnish framework for economic evaluation of telemedicine. This framework was later developed further and published in HTA agencies reports and in peer reviewed journal articles (2). As a benefit from this methodological work the number of Finnish telemedicine journal articles and reports that include a good quality economic evaluation is relatively high compared e.g. to some other Nordic countries (3,4).

The economic studies in telemedicine show that videoconferencing is cost saving in many specialties, if the number of patients is high enough and if the equipment is used also to other purposes, like continuing education and administration (2). In addition, the incremental costs to add a new specialty to utilize videoconferencing unit is relatively low, basically only tele-network expenses and variable personnel costs. If videoconferencing is used efficiently, it can make cost savings, improve access to care and cost effectiveness, and enhance patient care management among others.

From other telemedicine technologies teleradiology is possibly the most widely used in Finland and elsewhere in the world. The small teleradiological programs evaluations found in the review were not cost saving, mainly because their utilization rates were too

low to support the high investment costs to equipment (5). However, in higher utilization rates and in different technological and cooperative solutions teleradiology may become cost saving in many settings.

Discussion

Because the technology used in the telemedicine is increasing and changing rapidly, the need for new assessment studies in the field is increasing. In addition, methodological studies are needed to give guidance to researchers who are assessing new types of treatments including primary and secondary prevention that are very challenging assessment topics. One area, which would require more emphasis among health economists, is the changes in the productivity of health care due to increase of the telemedicine applications. Although some studies from the productivity area were found in the review, there is a need to increase that type of analysis in Finland and elsewhere. The conclusion of the review is that the status of economic studies in Finland has been relatively good. However, new economic studies are needed to provide updated information to policy makers about the new telemedicine technologies.

References

[1] Ohinmaa A, Reponen J, Koivukangas P, Haukipuro K, Mielonen M-L, Tuulonen A, et al. A model for the assessment of telemedicine and a plan for testing of the model within five specialities. FinOHTA Reports No. 5. Helsinki (Finland); 1997.

[2] Ohinmaa A, Hailey D, Roine R. Elements for assessment of telemedicine applications. International Journal of Technology Assessment in Health Care 2001;17 (2):190-202.

[3] Hailey D, Ohinmaa A, Roine R. Study quality and evidence of benefit in recent assessments of telemedicine. Journal of Telemedicine and Telecare 2004;10:318-324.

[4] Ohinmaa A, Nuutinen L, Reponen J, editors. Telelääketieteen arviointi Pohjois-Pohjanmaan sairaanhoitopiirissä *[Assessment of telemedicine in the Northern Ostrobothnia Hospital District]*. FinOHTA Reports No. 20. Helsinki (Finland); 2002.

[5] Ohinmaa A, Pietilä M. Telelääketieteen käytön arviointi: Case TELLAPPI II. *[Assessment of the use of telemedicine: Case TELLAPPI II]*. Lapin sairaanhoitopiirin julkaisuja, Raportti 2. Rovaniemi (Finland); 2000.

Full list of references in the review available from authors.

Measuring the Effectiveness of a Hospital Information System

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Keywords: eHealth, Health services, Evaluation

Introduction

The positive returns of e-health investments on implementing software for healthcare organizations have always been difficult to track as the gain is usually manifested through better service quality and fewer mistakes in the treatment process [1].
This presentation argues that regardless of improvements in service quality achieved by new software, it is also possible to create a model for calculating ROI (return on investment) by measuring personnel costs and the efficiency gain achieved by means of the new software.
In Estonia, most hospitals stick to their out-dated hospital information systems to keep their costs down on IT expenditure. However, by avoiding increased expenditure on modern information systems, the hospitals actually use their resources less effectively. The presentation shows how a modern hospital information system developed at Tartu University Clinics can help doctors and other users of the information system do their work more effectively and achieve higher ROI for the investments made.

Methods

A comparison of personnel (all personnel included) salary costs of the two largest hospitals in Estonia – Tartu University Clinics and North Estonia Regional Hospitals (24,9 and 21,7 million EUR respectively) [2,3] shows that one minute of an employee's working day costs approximately 7,5 Euro cents in Tartu and 6 in Tallinn. The rise in efficiency to compensate for a 0,5 million EUR IT spending (in Tartu, the IT budget in 2005 was around 0,86 million EUR) is approximately 9,6 minutes per working day. Thus, hospital information user's work at the current salary level needs to be 2 per cent more efficient to compensate for the investment.

Results

Tartu University Clinics started the development of a modern hospital information system eHL (electronic Patient Record) in the summer of 2003. By January 2006, the needed functionality was in place to start piloting the program in the Psychiatric Clinic of Tartu University Clinics. The following features can be identified in eHL which account for more efficient use of resources in the daily work of the information system users:

1. Less information to insert – there is automatic data transfer between epicrisis, anamnesis and journal which saves doctors' time
2. More information available to make decisions on – as the doctor can instantly access all sickness cases of a patient, the quality of decisions is better and decisions can be reached faster.
3. Integration with other systems – specific information is sent automatically to various registers as the information emerges, avoiding the need to re-enter the information several times.

4. Delegating documentation - the doctor can delegate the entry of patients' documentation to assistants or residents and approve the inserted information after overseeing.
5. Tracking of treatment costs – all services and treatments can be calculated down to the level of a single patient or sickness case, thus providing more accurate management information
6. Special documents – every structural unit can generate dynamic documents specific to their structural unit documenting only the information needed by a specific clinic, e.g. there can be any number of different anamneses among various structural units to be used in a single hospital information system.
7. Flexibility to change classification systems – e.g. if a classification system is changing from ICD-9 to ICD-10, it is easy to change the parameter from the web-based administration module.
8. Flexible system of rights and privileges – it is easy to grant or deny access to different users active in various structural units.

Objective measuring of efficiency gains is still under way in Tartu as the application has not been implemented in all Clinics, but it can already be stated that the ROI on eHL will be positive for Tartu University Clinics.

References

[1] O'Dell S, McGoldrick C. "Realizing positive returns from your e-health investments" Healthcare Finance Manager. 2001 Feb;55(2):50-5

[2] Annual report of Tartu University Clinics 2004

[3] Annual report of North Estonia Regional Hospital 2004

Can eHealth Progress be Measured?

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Keywords: eHealth, indicators, health care

Introduction

The need and interest to measure the progress of information society development emerged during the 1990´s when it was realized that deployment of ICT may have an effect on the productivity of societies. An approach based on the "readiness-intensity-impact" model has been developed by the OECD. This framework distinguishes three main stages of technology adaptation that can be followed by using indicators. (1).
A number of projects and initiatives have aimed at producing indicators which would allow measurement of progress of the Information Society in Europe. This work has studied several dimensions or areas of societal activities, health being one of them. The focus of projects like BISER, UNDERSTAND, BEEP and the Indicators for the Information Society in the Baltic Region has been regional, where as the project SIBIS had a national-level orientation (2-5). The study methodology adopted in these projects has been the population survey, as well as the extraction of relevant data from national and supra-national statistical services. The indicators developed through this approach can provide some information on the adoption of new technologies by citizens and to some extend businesses. However, detailed information that would capture the present state of progress in ICT adoption in health care service environments is still missing.
The Finnish national strategies towards the information society have emphasized the social and health care sector as one of the main targets. The number of general practitioners using electronic patient records (EPRs) has been used as an eEurope indicator. This indicator, however, has not been a sufficient measure for demonstrating progress in Finland for some time, since the usage level has been saturated. There is a need for new indicators for a better benchmarking of the situation in different areas of the country. FinnTelemedicum at the University of Oulu and Stakes (the Finnish National Research Centre for Welfare and Health) conducted a survey on the usage of information technology in health care in 2005 (6). Several questions in this survey were also included in a similar survey by FinnTelemedicum in late 2003 (7). Both surveys were done as an assignment of the Ministry of Social Affairs and Health and their main purpose was to gather information on the implementation level of national information society strategies. The usability of these measurements as indicators for implementation of ICT in health care will be discussed.

Methods

A structured web-based questionnaire was e-mailed both in 2003 and 2005 to all public health service providers in the hospital districts and health care centres. The questionnaire consisted of questions about the organization of the service provider, adoption of electronic patient records systems and different methods to transfer/exchange patient information between organisations during care processes. Also the implementation of different eServices for patients was asked for.

Results

Responses were obtained from all the hospital districts of Finland (100 %, n=21). It was possible to collect the information on the number of GP´s using EPRs from all health

care centres in Finland (n=252), while the response rate for other questions was 71 %. The results of 2003 and 2005 on EPR usage, e-Referrals and e-Discharge letters, sending and receiving laboratory results and x-rays and also video consultations are presented in Table 1.

Table 1. Prevalence of different measures of ICT adoption in Finnish health care for 2003 and 2005

Measure	Practice Setting	2003	2005
EPR in use*	secondary care	13/21	20/21
	primary care	94 %	96 %
e-Referral & e-Discharge letter	secondary care receiving	10/21	16/21
	primary care sending	24 %	44 %
sending/receiving laboratory results	secondary care	10/21	19/21
	primary care	38 %	62 %
sending/receiving digital pictures(x-ray)	secondary care	13/21	18/21
	primary care	8 %	29 %
Video consultations in use	secondary care	7/21	10/21
	primary care	13 %**	12 %**

* in 2001, 8/21 in secondary care and in primary care 83 %
**21 health centres in 2003 (n=155) and in 2005 (n = 179)

Discussion

The adoption of EPRs in everyday practice is high in Finland. This was first achieved in general practice and has now been realized in hospitals as well. Therefore, this measure will not provide considerable new data on adoption of ICT applications. With other measures like e-Referrals and e-Discharge letters, change can still be measured. When indicators for the adoption of ICT are developed it seems that the measures are usable only during the transition from the phase of readiness, to full intensity of usage. As development proceeds, the need to create new indicators arises. It is also important to note that the full evaluation of the impact of the change can only be undertaken after full intensity of usage has been reached. In this way an indicator can also show the right time to begin looking for possible efficiency gains (or losses). The usability of the Finnish indicators (with the exception of EPR adoption) has not yet been tested in international comparisons. The selection of indicators suitable for measuring different phases of eHealth development progress internationally requires joint testing in interested countries.

References

[1] Clayton T. Information Society: From Statistical Measurement to Policy Assessment. Statistics, Knowledge and Policy. Key Indicators to Inform Decision Making. OECD 2005.

[2] BISER - Statistical Indicators for Benchmarking the progress of European regions in the emerging Information Society. Project website available at: http://www.biser-eu.com/

[3] BEEP - Best eEurope Practices. Project website available at: http://www.beep-eu.org/

[4] UNDERSTAND - European Regions UNDERway towards STANDard indicators for benchmarking Information Society. Project website available at: http://www.understand-eu.net/

[5] SIBIS - Statistical Indicators Benchmarking the Information Society. Project website available at: http://www.empirica.biz/sibis/about/about.htm

[6] Winblad I, Hämäläinen P, Reponen J, Kangas M. Preliminary results, FinnTelemedicum -Stakes eHealth survey. Univ. of Oulu and Stakes, Unpublished interim results, 2006.

[7] Kiviaho I, Winblad I, Reponen J. Terveydenhuollon toimintaprosesseja ja asiointia tukevat atk-sovellukset Suomessa. Osaavien keskusten verkoston julkaisuja 8/2004.

Improving Traceability of Functional Requirements to Information Needs and Applications in Healthcare

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Keywords: process remodeling, requirements, health information systems, integration, eHealth

Introduction: traceability in HIS development

One of the central development areas in requirements engineering is to narrow the gap between requirements elicitation in the application domain and analysis and specification techniques [1] to assure the appropriateness of solutions to the work of end users. This need has also been identified in health information systems (HIS), but requires many types of traceability in information systems development (ISD): traceability of actions to activity system, traceability of information to different actors, and traceability of information processing acts to work processes. This abstract discusses generic features of information systems in systems development chain from description of information and activities in organizations to requirement specifications and further to design decisions of applications. The results are recommendations to improve traceability especially in the development of health information systems, which are discussed in relation to ISD.

Methods: traceability in ISD chain from two directions

Traceability of requirements means the ability to describe and follow the life cycle of requirement specifications *both backwards and forwards* [2]: the documented requirements must be traceable both to the goals and needs in the organizational environment and to the designs and implementations of the applications. This abstract discusses traceability in an *ISD value chain*, which initiates from the understanding of target domain and its contexts (domain analysis), proceeds to the specification of goals and requirements (requirements specification) and further to the design of software solutions (design). However, we do not consider the most detailed technology design aspects in this abstract. In particular, we approach the requirements specification and modeling from two directions: activity analysis and specification of open application interoperability solutions. We also use the generic classification of *functional aspects of information systems* by Iivari [3]: *structure* (which informational parts and entities the system includes), *function* (which kind of tasks and operations are performed using the system), and *behavior* (when and using what kind of interactions the system performs its tasks). Each aspect has different features in different phases of ISD value chain from activity analysis through requirements to software design.

The recommendations presented in this abstract are result from conceptual development based on the literature [1, 2, 4, 5] and authors' experience and studies on the field of HIS development: component-based software development, interface specifications, standardization and activity-based development [6]. In addition, previous studies about requirement specifications, models for solution specifications and domain analysis are used. The recommendations have been incorporated in the current projects of the authors and are discussed in the light of preliminary results from their application.

Results: four recommendations to improve traceability

As the ISD value chain proceeds, accuracy of functional aspects is increased and abstraction level is lowered. Traceability can be improved by linking the descriptions of different aspects in different phases of the chain and by ensuring common understanding of the target state. We recommend four activities to improve this traceability in HIS.

In different phasese of the ISD chain, different modeling artifacts are typically produced. Traceability of requirements can be improved by *developing traceability between models of different aspects and phases*. Figure 1 outlines a modeling chain to support this.

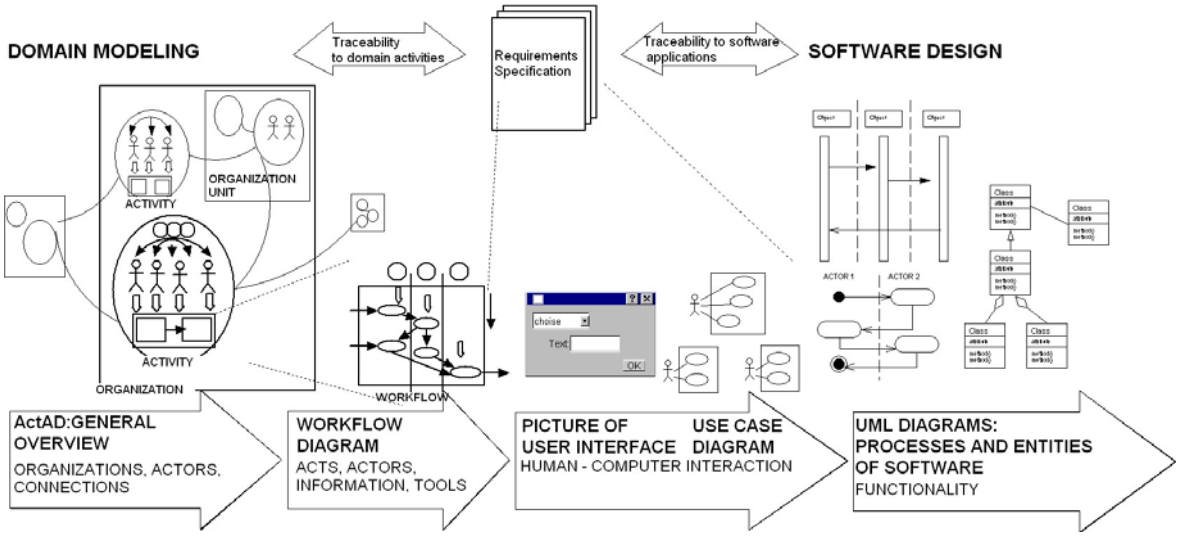

Figure 1. Modeling chain supporting traceability

Any single model does not cover the entire chain from domain analysis through requirements to the solution design. However, we suggest that especially *traceability of information entities and elements* is central in modeling efforts through the chain, especially in information-intensive domains such as healthcare.

Use case descriptions and other common analysis and design techniques fail to provide an accurate and holistic view of the activities supported by the system. However, *illustrations of the user interface* provide a clear way to link different phases and to increase common understanding between experts of different disciplines. Existing process models can also be complemented with user interface pictures to visualize solutions to the end users and to promote user acceptance, which is crucial in healthcare IT projects.

It can also be observed that despite available recommendations and guidelines, requirements are not documented accurately, atomically or unambiguously. In practice, traceability would be improved by merely *documenting and referencing requirements accurately and consistently*. Good requirement specifications are concrete, verifiable, attainable using available resources, atomic and concise [1].

Discussion: implications to the ISD chain

Assuring consistent model transformations and traceability requires evaluation of different analysis and modeling methods to assure usability, adequacy and accuracy of methods to be utilized. Our experience from activity-based domain analysis, requirements documentation and solution specification highlights some traceability implications.

In *activity-based domain analysis*, central elements include actors, tools, work processes (linked activities), outcomes, and practices for work, coordination and communication. We have used a *three-level approach* in activity-driven requirements engineering. The levels include: 1. overview of networked work activities (organizations, work activities, information entities, stakeholders and relationships between them), 2. work processes and information management (including actors and information needs mapped to the processes), 3. detailed acts and tools (information processing acts, software, use cases, user interfaces). ActAD framework [4] is used as guideline how to structure and describe activities. The upper level description serves as a map where lower level descriptions are traced and reflected. This supports traceability and is useful in describing both current and target state of domain especially in healthcare, where few processes are automated, and IT applications are linked to multi-professional communication and collaboration.

In relation to *requirements specifications*, challenges include consistent understandability of the requirements for developers and healthcare stakeholders (different professional groups, information management), and adequate accuracy to base design to the requirements. Furthermore, careful documentation of requirements is challenging in rapid and evolutionary software development processes.

Solution design includes detailed definition of functional (information and functionality) and architectural aspects (parts, connections, interactions and development principles) in software. Structure and information are commonly defined as parameters, elements and information models. Functions are seen in message types, operations, inputs processed into outputs, and capabilities of the user interface. Behavioral aspects are present in events, data communications, message passing and invocation relationships, and user interface design of software applications. Traceability can be improved, if previous phases produce consistent basis for reference and support is available to base design decisions on them.

In relation to the discussed implications, we are performing studies to assess and improve traceability and "requirements for good requirements" in model-centric development approaches: MDA (Model-driven architecture), HDF (HL7 Development Framework) and business process modeling using definition languages and notations BPEL and BPMN.

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References

[1] Nuseibeh B, Easterbrook S. Requirements Engineering: A Roadmap. In: Finkelstein A, editor. The Future of Software Engineering. ACM and IEEE Computer Society Press; 2000. p. 35-46.

[2] Gotel O, Finkelstein A. An Analysis of the Requirements Traceability Problem. Proceedings of International Conference on Requirements Engineering. IEEE CS Press; 1994. p. 94-101.

[3] Iivari J. Object-oriented information systems analysis: A framework for object identification. In: Shriver BD, editor. Proceedings of the Twenty-Fourth Annual Hawaii International Conference on Systems Sciences, Vol. II. IEEE Computer Society Press; 1994. p. 205-218.

[4] Korpela M, Soriyan HA, Olufokunbi KC. Activity Analysis as a Method for Information Systems Development: General Introduction and Experiments from Nigeria and Finland. Scandinavian Journal of Information Systems. 2000;12:191-210.

[5] Hooks I. 1993. Writing good requirements. Proceedings of the Third International Symposium of the INCOSE - Volume 2, 1993.

[6] Mykkänen J, Porrasmaa J, Korpela M, Häkkinen H, Toivanen M, Tuomainen M, Häyrinen K, Rannanheimo J. Integration Models in Health Information Systems: Experiences from the PlugIT project. In: Fieschi M, Coiera E, Li Y-C, eds. Medinfo 2004. p. 1219-1222. Amsterdam: IOS, 2004.

Registration Process in Health Care Public Key Environment

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Keywords: Public Key Infrastructure, Registration Autihority, Telemedicine, Health services

Introduction

The need to comply with legislative and regulatory requirements has become more evident in resent years as health care services have started change several processes to digital world. In PKI (Public Key Infrastructure) this need to comply all legislatives is more important than in several other IT environments, PKI-environment is build around several different services. Usually people are putting lot effort on creating secure Certificate Authority service, as they should. In many cases, people have left other services with too little focus. One of those most important parts of working PKI environment is life cycle of certificates [1]. This method combines digital certificates, cryptography and certificate authorisation establishing complete data security architecture [2]. In the wider definition of PKI, verification and registration of the users and as well as CPS, Certification practise statement, PKI policies the core the PKI. In order to provide reliable services and solutions for end-users, user environments for verification have to be created. Also smart cards for end-users, the organisation producing the cards, the production process with verification mechanisms, software for end-users and the verification of servers and the crypto programmes should be included [3]. Registration of Health care personel is one of most complicated issue in PKI-enviroment. Registration has to be builded in a way that it doesn't affect any operations inside personels daily work. This means, that fully centralized registration is realistically impossible to attain. In cases when user doesn't for a reason or another have access to their own certificate, sustainable methods to overcome this problem have to be well planned.

Methods

Once utilizing digital services in health care, there are several services which need to be carefully planned, ex. OCSP (Online Certificate Status Protocol), CRL(Certificate Revocation List), X.500 and obviously one of most important part which is always facing the compliment of all different legislatives, the registration authority service [4].
When building scheme for registration authority there are several issues witch has to be taken account. Most important question is; how to build registration authority scheme so that it will be secure, but most important is that how to build it to be most usable in short coming future also.
When starting to plan registration authority scheme organization has to think about the future, so that once implemented investment will be there for several years to come.
When thinking about user registration in most traditional way; user comes to one centralized registration centers and shows his physical ID, based on this information the Registration Authority (RA) officer then inputs all necessary user information to registration authority client and sends those for certification to certification authority. After these steps RA officer can then create smart card for user [5].
To confront these problems, an organization has to know its architechture both physical and logical. Full mapping of all operations which include usage of certificates has to be

created. Problems cased by user losing his certificates has to be evaluted, how will it affect to user if he needs to wait for new certificates even for weeks.

Results

There are some problems in traditional model which has to be confronted already in planning phase. What will happen if registration central is located about 1000km away from the user. One have to resolve this problem by creating several different registration centers, mainly because we have to take account of future, some users will always lose their smart cards or some of them will get broken.
Will the centralized solution work if organization will in a future see need for internal certificates (ex. Cross boarder alliance); one can resolve this problem several different ways, implementation of sub-ca systems, this will enable local organization to create own certification policies. Obviously one can also create centralized policies and use centralized Certificate Authority (CA), but still use local RA client with local RA Officers, but in this scenario one has to take account about local need also in centralized policies [6].
Implementation phase of newly acquired PKI is high work effort. All users will need the certificates. How long it will take if the RA officer has to manually input all existing user in RA database? One can confront this problem by creating automated batch processes which will load all necessary user information from previous employee databases. Even the whole creation of certificates in implementation can be automated; and of course it should be.

Discussion

This as important as it is to place registration there where the old user is, is also the fact that organization will acquire new employees. Those will need to be certified and identified, in large organization this will be daily operation and one will encounter several work processes which has to be constructed around it; one can easily ease this work load of registration centre by creating web-services for registration phase, new employees information is inserted in PKI systems where ever they start their jobs. Needed information is then sent to registration center where user has to go to pick up his new smart card, and of course user has to present his physical ID in this phase.
Centralized system will also confront huge problems in environment which uses high amount of temporary employees; these users don't necessary need all the same certificates as regular employees, it will became necessity to create local certificates, maybe just for usage of system login.
Scheme for building working registration environment doesn't answer only about usability and security question, but instead one of most important effects of it is the downsizing of costs; this can be most efficiently added to planning phase and with right implementation organization will save money in usage phase of the system.

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References

[1] Nash A. Duane W. Celica J. Brink D. 2001 "PKI- Implementing and Managing E -security." Osborne / MCGraw-Hill, California, USA.

[2] Martikainen, M. 2000, ' Terveydenhuollon sähköisen asioinnin liiketoimintamahdollisuudet tietoliikenneoperaattorille.' Helsingin kauppakorkeakoulu, johtamisen laitos.

[3] Kerttula, E. 2000. 'Tietoverkkojen tietoturva.' Oy Edita Ab, Helsinki.

[4] Adams, C. Lloyd, S. 1999 ”Understanding Public-Key Infrastructure” Macmillan Technical Publishing. Indianapolis, USA.
[5] Spanhi, S. Weber, P. 2002 ”Secure exchange of medical data: requirements and solutions” Surjan (edit.) ” Health data in the information society. Proceedings of MIE2002) IOS press, Amsterdam.
[6] Housley R, Polk T. 2001. ' Planning for PKI ' Wiley Computer Publishing, New York, USA .

Prospects Offered by VoIP Technology for Telephone Information Services in Primary Health Care: The Case of the Utajärvi and Vaala Health Centres

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Keywords: VoIP, Primary health care, Health centre, Telephone information services

Introduction

The primary health care services provided by the Finnish health centres currently face many challenges, with increasing demands, an ageing population and shrinking financial and staffing resources. Patients must by law be able to receive contact a primary health care professional immediately by phone, and voice over IP (VoIP) technology offers prospects of improving this access to care. One of the key ideas of VoIP is that voice mail may be treated in a similar manner to email. Technically, the voice is transported in packets over the Internet network. In designing VoIP telephone services, the public switched telephone network (PSTN) needs to be addressed as well (Wang & Hu 2004). A specific IP telephone, which is a modern video phone (Ahuja & Ensor 2004), or a so-called 'softphone', a workstation with telephone software, may be used in place of a conventional phone. This softphone can be connected with applications such as Web browsers and net meeting systems (Davidson & Peters 2002, 324). Teams can potentially achieve better cooperation through VoIP regardless of physical distance (from a few metres to thousands of kilometres).

Methods

The general motive for this research was to study how telephone information services in Finnish primary health care may be improved, in particular with VoIP technology. A software system for managing phone calls based on a fast regional community network and VoIP technology has been under development for the social and health services of the municipalities of Vaala and Utajärvi in Northern Finland. The aim is that it should be cost-efficient and tailored to the needs of the health centres. There were two questions to be investigated: What are the current problems affecting telephone information services at the Utajärvi and Vaala health centres, and how can their telephone information services be improved using VoIP technology? This research is an exploratory case study aimed at creating new insights for theorizing IT benefits. The data were gathered by means of theme interviews conducted at the Utajärvi and Vaala health centres with four experienced nurses who had participated in developing the telephone information services and focused on current problems with these services and the assumed benefits of VoIP technology. In order to verify the results the assumed benefits were compared with findings in previous research.

Results

The case study revealed three main challenges regarding telephone information services in primary health care: People do not always succeed in contacting their health centre immediately by phone, the peak time for incoming calls is in the morning, particular Monday mornings, and there is pressure to reduce people's need to see a general practitioner by improving and increasing telephone information services. The case study revealed the following points concerning telephone information service systems based on VoIP technology:

1. They consist not only of VoIP technology but also of software systems built on top of it. In fact, some of these systems may also be used without VoIP technology. The general public is often confused over the key concepts, e.g. what is an outcome of VoIP technology and what results from the information system that utilizes it in combination with another technology.
2. They can help people to contact a health centre immediately by phone when they need to do so, and VoIP can make it easier to manage and route incoming calls, as they can be treated as computer files that can be moved with a mouse to ring in another place or on another person's phone. They may also be routed to other health centres that are connected to the regional community network.
3. They may also improve handling of the caller's actual problem by phone without any need to see a general practitioner. This can be achieved by more effective communication and consultancy between professionals at a single health centre or between the health centres connected to a regional community network. More effective communication and consultancy may include better information on each other's presence and the exchanging of still pictures and video, voice and other data simultaneously and in real time over the data network. Nurses have better possibilities to consult a practitioner or another nurse in a difficult case during a phone call.

There are some technical problems commonly found during the development of VoIP services. For instance the possibility of tapping the VoIP calls must be eliminated by addressing the security of VoIP networks. Delay, packet loss or jitter in the data networks may influence the quality of the speech. However, VoIP calls can be better guaranteed with the quality of service (QoS) functions. In addition, a consistent procedure for locating emergency VoIP calls has to be developed. Finally, VoIP-based wireless local area networks (WLAN) are still experiencing functional problems. As a whole, VoIP services have been developed just about 10 years so that little has been reported about the practical problems related to systems based on it.

Discussion

A citizen's access to primary health care services can be improved to a considerable extent by providing high-quality information services. Many of the current problems can be resolved with better designing of these systems. Contemporary technologies such as VoIP can make the daily work of physicians, nurses and other health care professionals easier or allow new ways of working. The case study revealed that health care professionals connected by a regional community network and IP telephones can collaboratively realize some of the potential benefits of VoIP technology. Future research still needs to be carried out, however, into the actual benefits of VoIP technology and systems built on top of it. The effect of the findings of this research on the actual VoIP system development should be later evaluated.

References

[1] Ahuja SR, Ensor JR. VoIP: What is it good for? ACM Queue. 2004;2(6):48-55.
[2] Davidson J, Peters J. Voice over IP. Helsinki: Edita Prima; 2002.
[3] Wang R, Hu X. VoIP development in China. IEEE Computer. 2004;37(9):30-37.

Session A5
Organisational Change

Friday, September 1 2006

Helsinki Hall

13:00-14:30

A5-1 **Legal Challenges of Cross Border eHealth Services**
Leif Erik Nohr (*NORWAY*)

A5-2 **A Process View on eHealth: Research Agenda**
Kari Jalonen; *Nora Ekroos* (*FINLAND*)

A5-3 **Telemedicine as a Tool in Organisational Changes**
Peder Jest (*DENMARK*)

A5-4 **Addressing Project Management Issues into the Implementation of Hospital Information System - Project team perspective**
Maija Valta; *Kaija Saranto*; *Anneli Ensio*; *Hannu Valtonen* (*FINLAND*)

A5-5 **The Suitability of Common Facilities of Apartment Buildings to Rehabilitation and Supporting Services of the Elderly**
Laura Sorri (*FINLAND*)

A5-6 **Hospital Simulation System for Collaborative Department Planning**
Noriyuki Takano (*FINLAND*)

Legal Challenges of Cross Border eHealth Services

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Introduction

By means of information- and communication technologies (ICT) one has the possibility to offer and provide health care services across national borders to an extent and in a way not seen before. These possibilities can serve both patients, doctors and institutions (hospitals), and can be a tool for access of quality services, sharing of competence, education, second opinion, etc, etc.
The project Baltic eHealth [1] aim at utilising these possibilities and to use them as a means to counteract migration from rural areas, based on a presumption that access to health care and quality of services are relevant factors in a migration process.
In the project, the health networks of Denmark, Sweden and Norway have been interconnected and in addition the East Tallin Central Hospital of Tallin, Estonia and the Vilnius University Hospital Santariskiu Klinikos, Vilnius, Lithuania been connected to the networks. The network provides services within the fields of ultrasound and radiology.
An important part of the project has been to work with possible barriers for implementation of cross border services. This work has been centered on technological, organizational, economical and legal issues. The result of this work is a document of guidelines and checklists of these issues, where this presentation deals with the legal aspects.

Methods

A legal advisory group was established within the project with participation from all participating countries. Members of this group actively took part in discussions at several meetings and workshops with the purpose of identifying the most crucial legal issues and discuss how these should be dealt with as perceived or actual barriers.
In addition, members of the group analyzed a number of legal issues in relation to their
The group produced a first report on identified legal issues of the Baltic eHealth project and this report in turn became the basis for the main deliverable of checklists and guidelines.

Results

The early study identified the following issues as most important and as the ones that are most likely to represent barriers for implementation and development of cross-border telemedicine services:

1- Issues concerning privacy, confidentiality and Information Security
2- Responsibility issues
3- Licensing issues
4- Issues concerning Patients' Rights
5- Consent issues
6- Payment/reimbursement issues
7- Contract issues

The report on identified legal issues discussed these matters to some depth and tried to analyze how they were, or could be, dealt with under the different legislations represented by the participating countries in the project.

Furthermore, the work continued towards creating checklists and/or guidelines based on the findings of this report. Guidelines were prepared within the following subjects: Responsibility, licensing, patients' rights (including consent) and contracts.
The purpose of these guidelines and checklists are to serve as reference material for the services in the project as well as establishing a list of relevant points to consider for other – similar – projects and for further expansion of this project. Corresponding guidelines/checklists have been produced with relation to technological-, organizational-, and economical issues.
The full report where all guidelines are included will be published later this year (2006) on the project website.

Discussion

In addition to the challenge different legal systems represent in cross-border telemedicine/eHealth services and projects, it is in fact a challenge to sort out – identify – the legal issues and to what extent these are real barriers. In this project, our basis was that laws and regulations should be considered as frameworks, not as barriers at the outset. On the other hand, one cannot ignore specific and real barriers when they emerge, especially when these are barriers that seem unreasonable. To some extent, legislative barriers occur as a result of an outdated and "static" legislation being challenged by new technologies and new ways of working and thinking.
Furthermore, the work on legal issues in this project addressed some of the challenges and difficulties of making guidelines and checklists like the ones we set out to make. Questions concerning "anchoring" and legitimacy need to be dealt with.
This presentation will give an overview of the work done on legal issues in the Baltic eHealth project and will hopefully show that many of these issues and solutions have a more general relevance for cross-border services and projects.

References

[1] www.baltic-ehealth.org

A Process View on ehealth: Research Agenda

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Keywords: eHealth, Process efficiency, Primary care, change management

Introduction

System innovations are needed in Western health care systems. New technological solutions have been actively tested, and there is a strong belief in the positive effects of new technology to health care systems [1]. However, the scientific research within the area is still quite incomplete.

The "eHealth II" research project described here focuses on eHealth, which is defined [2] as the use of information and communication technology, especially the internet, to improve or enable health and health care. The study aims at developing technological and process know-how on eHealth issues in Finland, and at creating concrete evidence to test the potential benefits of eHealth for productivity of the care process, patients' and professionals' views on the quality of service and access to care. The research concentrates on eHealth functions involving secure patient-provider communication.

The research develops pilots and measures eHealth systems for supporting primary care processes in Finland. These systems are developed in cooperation with three partner organizations and a network of technology and healthcare providers. The systems aim at improving the availability of healthcare services, customer satisfaction, and efficiency of the service production system.

The objective is to describe the effective application of eHealth systems to Finnish primary care by applying best eHealth practices to the studied three care processes. These experiences are used to gain insight into the implementation of eHealth services in the Finnish environment in general. The research will look into the value added by eHealth, its effects on health care organizations and their productivity. The user experiences and technological constraints on applications will also be mapped.

Methods

The research implements a multiple case study methodology. Development projects are made in cooperation with two public primary health care providers, and a foundation that is specialized in student health care. The research concentrates on the diabetes care processes of the public health care providers, and the physical examination process of the student health care foundation.

The research studies the effect of the development of care processes on the productivity of the care process and resource use. Productivity of the care process is viewed from an industrial management point of view, analyzing the time needed in each phase and the value added. Peltokorpi et al. suggest that in health care the categorization should be divided into three major groups: diagnostic and care time, administrative time and waiting time [3]. The process point of view and time based management can also be applied to e-Health research [4]. The efficiency of care processes is viewed from a similar frame of reference, comparing the services provided with the resources needed to provide them.

The research has started with an interview study and a quantitative analysis of process data in order to model and understand the care processes under the scope. Based on the analysis, the nature of the processes along the continuum standard – routine – non-routine is identified [5]. The applicability of eHealth to these subprocesses is then evaluated, using as criteria the current working methods, needed resources and the

efficiency of the care process. After the evaluation, a new care process is constructed and piloted. Finally, the two care processes are compared and the developed model is benchmarked with European and U.S. best practice systems.

Results

Internet and electronic solutions create grounds for system innovation, but the components that make eHealth systems productive have to be identified in order to understand their benefits.
The research will demonstrate the effects eHealth solutions have on efficiency and customer satisfaction in the care process, as well as on accessibility of care and disease management. The research will result in a model for the implementation of eHealth systems in Finnish primary care, focusing on the factors influencing its success.

Discussion

Untangling the effects of eHealth technology on a health care organization is a very broad social, technological and managerial question. The authors believe that the answer is of utmost importance for the development of Western health care systems.
The ongoing research project will produce an analysis of the features of eHealth systems that are relevant and productive in the Finnish primary health care system. The research will aid healthcare organizations in the recognition of routine and standard processes suitable for eHealth solutions and in achieving a fit between these solutions and the care processes of which they form a part.

Acknowledgements

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References

[4] Pagliari C, Sloan D, Gregor P, Sullivan F, Detmer D, Kahan JP, Oortwijn W, MacGillivray S. What Is eHealth (4): A Scoping Exercise to Map the Field. J Med Internet Res. 2005; 7(1):e9

[5] Eng T. The e-Health Landscape – a terrain map of emerging information and communication technologies in health and health care. www.rwjf.org. 2001.

[6] Peltokorpi A., Kujala J.: Application of Time Based Management in the Improvement of Patient Process Efficiency. First Conference of the POMS College of Service Operations: Operations Management in Services: Theory and Practice, Columbia University, New York, US, 3-4th December 2004.

[7] Ilvonen K, Ekroos N, Kujala J. Internet and Browser based system effects on preliminary care process. Helsinki University of Technology; HEMA-Institute. 2006.

[8] Lillrank P, Liukko M. Standard, routine and non-routine processes in health care. Int J Health Care Qual Assur Inc Leadersh Health Serv. 2004; 17(1):39-46.

Telemedicine as a Tool in Organisational Changes

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Keywords: Quality, patients pathway, chronic diseases, telemedicine, strategic planning

Introduction

The global aim of managing a hospital system is to accomplish "the patient principle": at any time to offer the patient, and equal to all patients, the most competent treatment in accordance with national and international recommendations and to perform this under the given resources. This demands solutions of some difficult problems:
- Medical events/quality must be registered and documented
- The resources of the physicians must be used appropriately
- Extended demands to secure the patient pathway are mandatory
- The increasing number of patients with chronic diseases needs special attention

An important tool in these procedures is the use of telemedicine, not only as a medical tool. Used in the strategic planning telemedicine can support the organisational and cultural changes, which are needed in solving the implications mentioned.

Methods

In a regional hospital consisting of one big and four smaller entities and containing 4 medical departments with different geographic locations (one in a small island with only ferry connections), the managing board wished to merge the departments into 1 department. The main purpose was to give patients equal access to medical services, to meet the regular quality demands, to utilize the physicians appropriately through recruitment problems and finally to optimize the patients pathway with special consideration to the increasing number of patients with chronic diseases.
Structural changes of course were necessary. The medical departments were combined in one with one medical management. The telemedicine methods used were: telecardiology with mobile ECG and ultrasonic investigations, teleendocrinology with mobile blood glucose evaluations and retinal screenings in diabetics, telealcohol treatment, teleCOLD with mobile lung function tests. On line and off line consultations were used. The Electronic Health Record was an important pivotal point in the consultations. The telemedicine connections were between the stationary admission department and the outpatient clinics, the island hospital, some of the general practitioners and the centre for alcohol abuse treatment. Projects with connection to the patient at their home addresses are in progress.

Results

The new medical department consists of one acute and stationary admission ward with 123 beds in the central hospital (10.000 admissions/year), 3 outpatient clinics (50.000 visits/year) and consultant obligations at the island hospital (200-500 patients/year). All combined with telemedicine connections. The staff is diminished (number of employees) and the productivity has improved (cost effectiveness evaluations).
The acceptance (measured by questionnaires, number of political objections, number of articles in local newspapers)of the changes among patients, doctors, politicians and the public was greater than expected and that usual, caused by the wider offer of specialized medical services ex. through the telemedicine methods now available. New ways of covering the patient pathway tighter were elucidated during the telemedicine

cooperation with general practitioners, the centre of alcohol abuse treatment and the patients at home.

Conclusion

Telemedicine tools are a usable cofactor in reaching strategic goals concerning effective structural and organisational changes in hospitals with geographic distances. But it is an important tool too in reaching a tighter control with the patient pathway and in cooperation and coordination in treatment of patients with chronic diseases. Medical managers at every level must enforce their knowledge of these tools and consider the influence on the strategic planning.

Addressing the Project Management Issues into the Implementation of Hospital Information System - Project team perspective

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Keywords: Project management, Health information system, Implementation, Evaluation

Leadership and change management are important factors in eHealth projects. Project management is the process of planning, organizing and controlling projects. [1] The purpose of the project management is to predict as many organisational dilemmas as possible and ensure successful organisational-change projects. There are some essential characteristics of projects that differentiate them from other organisational-change activities: goal-orientated activities with very specific objectives, co-orientated inter-related activities across functional barriers, finite duration activities that have clearly defined start and end points and projects are all unique. [2]

Compared with the traditional hierarchical and bureaucratic "command and control" leadership the project management approach offers much strength. It is action and result oriented and provides a single point of contact between project leader, project staff, management and stakeholders. On one hand project management can foster a synergistic and creative "we" atmosphere because it brings together a multidisciplinary team focused on achieving a shared goal. On the other hand project management requires effective leadership. As its best it can promote effective personal work habits and management skills especially in planning and controlling techniques. [3]

Project management has a crucial role in the implementation of new technology in health care. A good manager must typically process a blend of technical experience and managerial knowledge. [4] In general, the most common reasons for project failure are poor project planning, a weak business case and a lack of top management, involvement and support. Other reasons are unproven technology, poor education or unrealistic schedules. [5] It is argued that every project takes twice as long, costs twice as much and delivers half of what was promised. [4] Furthermore, implementation of new technology in health care is much more than a technical process and involves issues concerning organizational culture, professional values, work practices, change management and effective leadership. [6-9] Due to these challenges, healthcare is possibly one of the most complex environments, which makes the project management extremely demanding and can lead to the failure of the whole project. [10, 11]

The purpose of this study was to evaluate project management and project teamwork issues from the point of view of project team members.

This study is a case study. It is a part of the broader research process where implementation of the Hospital Information System (HIS) was evaluated from different point of view in Hospital District of Helsinki and Uusimaa. For this study project team members [N=14] were interviewed in the end of 2005 and in the beginning of 2006. Eleven of these members participated in the project team of Helsinki University Hospital. One of them was the project manager of the hospital project team and the other ten members had other different roles in the project. Three other members worked in the project team of Helsinki University Hospital Information Management. One of them was the project manager of the whole project and two other members worked mainly as trainers in the project.

The interviews were carried out by theme interviews. Based on the previous research the themes concerned with project planning, management, communication, co-operation between project team and end-users, resources and evaluation of project work. In addition to these themes features of successful implementation were examined. The results were analysed with content analysis.

Results

The findings of this study indicate that project planning is a very crucial stage in the HIS implementation process. In this case the multidisciplinary project team regarded as a good point. Due to many different wards, professionals and cultures in the hospital it is important that the project team consists of many different occupational groups. Also available amount of personnel resources regarded as sufficiency. Despite of some long sick leaves the project ran to time. However some of the project team members, especially the part-time workers, had difficulties to share their time and roles between the project activities and actual job. The project manager of the whole project was regarded as skilled and supportive person. Overall the atmosphere of the project team was regarded as highly positive and motivating.

In this project some of the project team members thought that they recruited too late and they didn't have enough time to orientate themselves on their responsibilities and roles. The duties of each project team member were not carefully enough delineated. Some of the members didn't know what they were expected to do in the project. Moreover, many of the members mentioned that they didn't have earlier experience in project working and they would have needed more familiarizing with the project work methods. Some of the project team members compared the beginning of the project with jumping to the moving train.

Despite of some difficulties in early stage of the project and hard schedule the project went on with the plan. However the team members considered necessary that during the implementation basic hospital activities should have been reduced. The project team members had noticed many cultural features affecting to the project and the implementation process. Many barriers between different clinicians and professionals were found. It was regarded important that project team members were familiar with these features and were able to handle the problems if necessary. Overall the project team was concerned about end-users and their well-being. Characteristics of the successful HIS implementation were defined by project team members for example as follows:

"End-users are satisfied with new technology"
"Technology makes easier their work"
"Calm atmosphere on the wards"
"The end-users have enough support and help when needed"

Discussion

The results of this study ensure previous studies that further education in project work and project management is needed in health care organisations. All the project team members should be recruited before the project starts. They should be motivated to work at the project. Furthermore, different occupational groups and clinical areas should be represented in a project team. The responsibilities of each project team member should be clearly defined. In addition, the team members should be relieved of their basic duties during the implementation project and sufficient personnel resources should be ensured.

The project manager has a significant role concerning the successful implementation of HIS. Supportive, encouraging and target-oriented manager is needed during the whole

implementation process. It is important that the project manager has much experience and expertise in both health care and implementation processes. [4]
The implementation of HIS is most of all the socio-technical process. To ensure the successful project in the hospital the right persons and project manager has to be chosen in time. Furthermore, at least some basic project management training needs to be provided.

References

[1] Häyrinen K, Saranto K. Successful Health Information System Implementation. In: Khosrow-Pour M, editor. Encyclopedia of Information Science and Technology.USA: Information Resources Management Association, Idea Group Reference.; 2004. p. 2678-2683.

[2] Whitehead D. Project management and action research: two sides of the same coin? J.Health.Organ.Manag. 2005; 19 (6):519-531.

[3] Loo R. Project management: a core competency for professional nurses and nurse managers. J.Nurses Staff Dev. 2003 Jul-Aug; 19 (4):187-93; discussion 194.

[4] Lorenzi NM, Riley RT. Organizational issues = change. International-Journal-of-Medical-Informatics 2003; 69 (2-3):197.

[5] Whittaker B. What went wrong? Unsuccessful information technology projects. Information-Management-&-Computer-Security 1999; 7 (1):23.

[6] Lorenzi NM, Riley RT. Organizational Aspects of Health Informatics. New York: Springler-Verlag; 1995.

[7] Lorenzi NM, Riley RT. Managing change: an overview. J.Am.Med.Inform.Assoc. 2000 Mar-Apr; 7 (2):116-124.

[8] Berg M. Implementing information systems in health care organizations: myths and challenges. Int.J.Med.Inform. 2001 Dec; 64 (2-3):143-156.

[9] Kaplan B, Shaw NT. People, Organizational, and Social Issues: Evaluation as an exemplar. Yearbook of Medical Informatics 2002:91-102.

[10] Jayasuriya R, Southon G. Information technology management. In: Hovenga E, Kidd M, Cesnik B, editors. Health informatics: an overview. Churchill Livingstone. ed. China.; 1998. p. 291-302.

[11] Van Der Meijden, M.J., Tange HJ, Troost J, Hasman A. Determinants of success of inpatient clinical information systems: a literature review. J.Am.Med.Inform.Assoc. 2003 May-Jun; 10 (3):235-243.

The Suitability of Common Facilities of Apartment Buildings to Rehabilitation and Supporting Services of the Elderly

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Keywords: apartment buildings, common facilities, rehabilitation, elderly

Introduction

Amount of elderly people is increasing rapidly in Finland. In 2004 the amount of Finnish population ageing 65 years or older was 15.8 % and by year 2020 is expected to grow up to 22 %. Approximately 94 % of people over 65 years of age are living in ordinary dwellings. The seniors want to live in their own dwellings as long as possible and be supported by services needed when their coping starts to weaken. The attention should be paid to the quality of the housing and suitability for the elderly, because the sufficient housing and independent coping in everyday routines increase quality of life and decrease need of supporting services and pressure to apply in institutional care. The housing stock is renewing slowly, with the speed a bit more than one percentage a year. Adequate volume of dwellings suitable to the elderly can not be realized only by new construction production. Therefore the developing the existing housing stock and surrounding to suit also to the needs of the elderly is necessary.
The research is focused on apartment buildings built between 1950's and 1980s'. This age distribution of the apartment buildings has been chosen, because they make up significant proportion of Finnish apartment housing stock, during their construction legislation hasn't required suitability to handicapped and they have reached the age when renovation and repairing is needed. Same time with the renovation alterations needed are easy to realize. This research is focused in existing apartment houses situated in population centers and developing them to suit better to needs of the elderly. The aim is accessible built milieu, which supports autonomy and independent living. Also the aim of the study was to discover the unused resources of apartment buildings.
The research will be continued in new project "Smart Living Environment for Senior Citizen (SESC)". The aim is to produce smart everyday environment, which supports the living in own home and familiar living surroundings among the other people with different ages.

Methods

The method used in the research is case study. The cases studied were ten apartment houses representing well the chosen age distribution. There were also technical condition analyses available of the cases. Criteria for evaluating the suitability of apartment houses to the needs of the elderly were established for this research. Evaluation concerned also common facilities and unused resources like unused spaces and coverage in the houses.

Results

Three of the case apartment houses were built in 1950's, three in 1960's, two in 1970's and two in 1980's. The houses were located in Oulu and Kajaani.
There were plenty of unused or partly unused spaces in apartment houses built in 1950's and 1960's. In all of those houses the old central heating system with boilers still

existed. Usually the fuel compartments were also unused or partly unused. These form a significant resource for new use. In apartment houses built in 1970´s there were largest variety of common facilities. A new feature compared to older houses was common assembly rooms. In houses built in 1980´s there were less common facilities than in older houses because of higher standard of equipment in the apartments. Evaluation of common facilities revealed poor maintenance and developing of them.
According to earlier study quite a little attention is paid to the common facilities by the elderly inhabitants. Some of the interviewed didn't even know what kind of common facilities there was in their houses. The assembly rooms were least used. On the other hand some considered common facilities as an important venue of social contacts.

Discussion

The rooms of common facilities have a large potential to serve in use like as space for mobile and small scale rehabilitation and supporting services, and self care. They are near the inhabitants, potential users. Elderly people aren't willing or able to leave very far from their apartments. Indoor connection is an advantage during snowy and icy period. The same space can't only serve users from the very same house, but also users living in same quarter. The same devices and same personnel can serve more people located in common spaces than located in separate apartments. Contacts with other people in addition to reasonable action increase social wellbeing.
The research was part of the Future Senior Living –research project. The research project is joint project of Department of Architecture of University of Oulu, Department of Nursing Science of University of Tampere, Future Home Institute of University of Industrial Arts, VTT State Technical Research Centre and Automation Technology Laboratory of Helsinki University of Technology. The main financier of the project has been Tekes Finnish Technology Agency.

References

[1] Sorri L. 1950-1980-lukujen asuinkerrostalojen soveltuvuus senioriasumiseen. Oulun yliopiston arkkitehtuurin osaston julkaisuja A 35. (in press)

[2] Sorri L. Vanhusten asuntojen perusparannustarve Oulussa. Haastattelututkimus. Diplomityö, Oulun yliopisto, arkkitehtuurin osasto. Oulu. 2001.

Hospital Simulation System for Collaborative Department Planning

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Keywords: Healthcare, Management, Simulation, Web application

Introduction

The purpose of the present project is to develop an information system for healthcare staff and managers to better understand their entire organization in multiple senses such as resource, budget, workflow and management rule/habit, and to exhange their ideas.

Methods

Preceding works in this field, e.g. [1, 2], have concentrated mostly on standalone simulations. The present work emphasizes share and collaborations of users in network environment. It is a co-development project by technical developer, Tampere University of Technology, and users (e.g. healthcare staff), making software solution for the interest possesed by each organization of users (Figure 1).

Figure 1. Project model

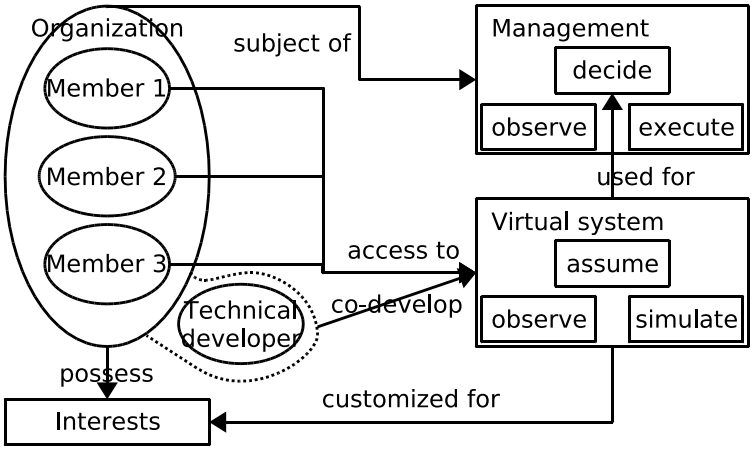
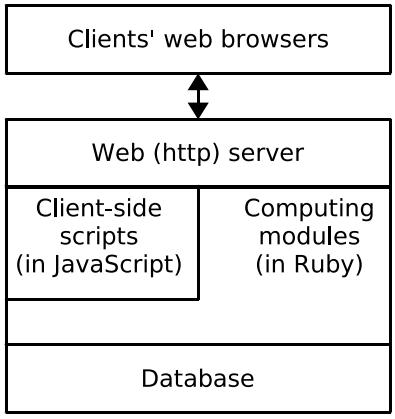


Figure 2. System components



The products are based on database, web server, server-side computing modules and client-side (web page-embedded) scripts (Figure 2), all exploiting open standards and/or open source software. The database has resource and workflow data, the resource including staff, equipment and places. The server-side modules and user interface dynamics can be customized for the organization's business logic and habits.

Results

Since 2005 [3] three case studies, all with Seinäjoki Central Hospital, have been conducted. They have yet to be evaluated by the staff and administrations. The first case was a modelling of the department of clinical neurophysiology. The system finds resources for each testing procedure and calculates the running cost (Figure 3).
In the second case a dialysis unit planing sheet was produced (Figure 4). The sheet describes reasons for choosing the numbers of nurses and dialysis machines, and treatment service hours, automatically calculating them as a user changes assumptions.
The third case, with the pediatric allergy unit, has started for department revision planning.

Figure 3. Resource overview and cost calculation page (left) and work flow parameter input page (right)

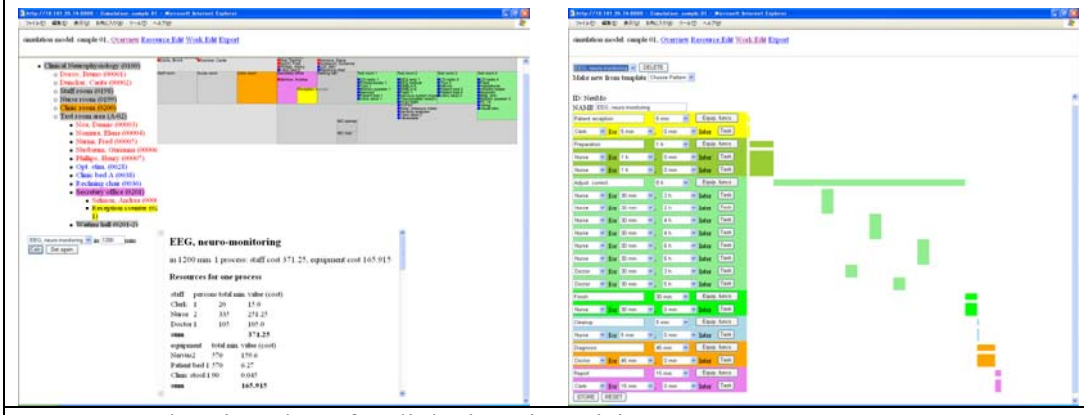
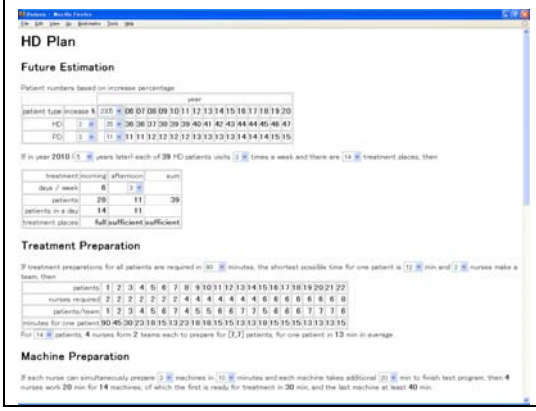


Figure 4. Planning sheet for dialysis unit revision.



Discussion

The hurdle for all involved to make access to organization planning should be low. However, such activities including simulation may not be healthcare workers' primary job and learning and examining IT tools for business planning could cause an extra workload. In the co-development style the users know what is being made and how to operate it during the development. Through the series of developments, the technical developer continuously develops base technologies and collects solution know-how.

Acknowledgements

The technical developer (authors) is sponsored by Finnish Funding Agency for Technology and Innovation (TEKES) and Seinäjoki Central Hospital in the ProViisikko Program.

References

[1] C. R. Harrell and V. Lange, Healthcare Simulation and Optimization Using MedModel. Proc. Winter Simulation Conf., 2001; 233-38.

[2] Arena, Rockwell Software, PA, USA.

[3] Takano N. and K. Mäkelä, A New Hospital Workflow and Resource Management and Simulation System. Proc. 5th Int'l Workshop on Biosignal Interpretation 2005; 191-2.

Session B5
eHealth and Healthcare Systems and Structures II

Friday, September 1 2006

Terrace Hall

13:00-14:30

B5-1 **Telestroke - Telemedicine in Thrombolytic Therapy of Acute Ischemic Stroke**
Risto O. Roine (*FINLAND*)

B5-2 **Telemedicine Programmes in Extremadura (Spain) and Alentejo (Portugal)**
Luis Goncalves[1]; *Claudio Peláez*[2]; *Ana Nogales*[2]
[1](*PORTUGAL*); [2](*SPAIN*)

B5-3 **Analysis of Communication Breakdowns for eHealth Systems Design**
Svetlena Taneva[1]; *Philippe Palanque*[2] ; *Sandra Basnyat*[2]; *Marco Winckler*[2]; *Effie Law*[1] [1](*SWITZERLAND*); [2](*FRANCE*)

B5-4 **Management of ICT-based Service Development: A Challenge for Evolving Social and Health Care eServices**
Hannele Hyppönen (*FINLAND*)

B5-5 **Ultrasonic Diagnostic Applications for Ophthalmological eHealth Subsystem**
Skaidra Kurapkiene; *Arunas Lukosevicius*; *Alvydas Paunksnis* (*LITHUANIA*)

Telemedicine Programmes in Extremadura (Spain) and Alentejo (Portugal)

Luís Gonçalves[1], Claudio Pelaez Veja[2], Ana Nogales[2]
[1] Telemedicine in Alentejo (Portugal), [2] Telemedicine in Extremadura (Spain)

Introduction

In Extremadura the Telemedicine appears as an answer that our responsible political and health services people in charge found due to specific characteristics, different situations on the geographic, demographic, and social fields of our area. The main reason is to reduce the distance between health services and patients, avoiding unnecessary dislocations, giving faster answer and support to those who work and live on distant areas.
Extremadura has an extension of 41 634 Km^2 and a population of 1 071 000, and geographic dispersion of 25,7p/km^2, with a high percentage of old people that lives in rural areas.

The Telemedicine Developing Project

It started on the year 2002 with realization of a pilot project that connects a rural health centre with a Hospital, giving TeleConsultations in 4 different medical specialities (radiology, cardiology, dermatology and surgery). The results confirm the viability of the project. During the year of 2003 we increase up to 18 rural primary health cares, distributed among 8 areas of this region and their 11 reference hospitals.
The results of Teleconsultation activities 2003-2005
The activities started on September of 2003, when the installation of 29 platforms of Telemedicine ended, after giving the necessary training for their management.
The below numbers reflects the differential from who have been made online and those who have been made off-line:

	Online	Off-line
2003	560	209
2004	3723	680
2005	4216	733

	Dermat.	Rx	C.M.A.	Cardiol.	Trama.	Neurol.
2003	415	209	114	22	---	---
2004	1947	680	750	116	474	237
2005	2120	733	539	173	778	308

Data of the "Extremaño Model" of Telemedicine

1- The TeleConsultation activity will occur during usual hours between 8:00 am and 15:00 pm from Monday thought Friday, not having the necessity to increase the work timetable, but just make some adjustment to the schedule.
2- There was no need to contract new employees. There was a readjustment of an employee's schedule (most probably a nurse) to arrange for technical coordination.

This model divides the activities of the primary care team to be less stressful.
3- The specialists participate on a voluntary basis and without extra payment (the consultation agenda was established during the usual hours of work). In most

cases we try that all staff participates to make sure that all consultations can be done.

4- Since 2005 each area as to accomplish some objective that reflects the variable productivity of all the participative teams.
5- The Teleconsultations are mainly done in real time, online, synchronic mode. Although they need a better dedication and organization that increase the relation doctor – patient, avoiding the lost of contact between them. This way, people that are against telemedicine have fewer arguments to fight this type of medicine.
6- All patients of the health care centre have both possibilities: the classic way on the teleconsultation – most of them end up choosing the second way when the specialist as any doubts of diagnostic, he sends a previous evaluation and priority, if necessary.
7- This technological tool allows the e-learning with the advantage of not loosing time with dislocations and hours of work lost with no cost, previous planning of the e-learning as a normal activity. In the last year there have been more than 100 session of e-learning.

Conclusions

1. The Teleconsultations have done some changes in the way of work of the health professional's area with some doubts in the beginning, mostly by the lack of knowledge of the new technology and the void on legal aspects.
2. The good acceptation from the patients is reflected on the questionnaires done.
3. Any specialty benefits with this tool being valid on their selection, priority consultation and check up.
4. For the health professionals this is a very valorous training opportunity.

Telemedicine in Alentejo (Portugal)

Introduction

The Telemedicine Program to the Alentejo Region, stands to the same basic ideas as in Extremadura. It improves significantly the access of the patients to the specialized health care in the region, that has the extension of 23 683 Km^2 and has 461 637 in habitants.

Program Development

It started in 2000 with a pilot project in dermatology involving the Hospitals of Évora and Elvas. It was expended slowly through today, being now evolved 10 Health Care Centres and 4 Regional Hospitals.

Operative Program

Teleconsultation (between an health care centre and a regional hospital).
It is previously settled according the health care centres with the referral regional hospital (Telemedicine units of the Beja, Elvas and Évora Hospitals).
The consultation is always online with the presence of the general practitioner, and the hospital specialist with the support of an executive "officer" that writes down the date of registration, the prescription and the follow-up.
The specialities involved in Teleconsultation are: cardiology, dermatology, neurology, physiatrist, paediatrics, surgery, internal medicine, diabetes, traumatology, general, paediatrics surgery, gastroenterology and radiology (between health centres and reference hospitals) and pathology, paediatrics cardiology, medical genetics, oncology

and neuropathology (between regional hospitals and central reference hospitals in Lisbon).

Statistics of the Teleconsultations

Year	Number of teleconsultations
2002	2 914
2003	6 414
2004	8 608
2005	10 481

The Teleconsultations are online except the RX that is off-line.

The obtained benefits are:
The improvement of the patient's information
The increase of the access to the medical speciality consultation
Drastic decrease of waiting time for a consultation
Reduction of the consultation time
Quickness of the patient follow-up
Specific training of the GP's
Reduction of the transportation costs
Low cost of telecommunications
Reduction of expenses associated to the hospital
Social cost reduction related to patients, with less absenteeism, and no need of accompanying persons with payment of food or lodgement
Significant increase of patient's satisfaction

The authors gives details about saving costs with the introduction of teleconsultation in the health system, about payments to the involved professionals and still announces the technological changes of the program to the current year of 2006.

Analysis of Communication Breakdowns for eHealth Systems Design

Svetlena Taneva [1], Philippe Palanque [2], Sandra Basnyat [2], Marco Winckler [2], Effie Law [1]
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Keywords: cooperation, medical error

Introduction

Safety-critical fields such as Air Traffic Control address safety during the design stage by applying task-modeling techniques, and human error prediction of knowledge-based, skill-based and rule-based mistakes and lapses [3]. However, the cooperative nature of the activity is not the primary focus in these approaches. Rather, it is the behavioral or cognitive errors that occur.

Medical services are cooperative activities that involve a number of participants (e.g. physician, nurse, technologist, pharmacist, etc.) who work towards a common goal of providing healthcare. Clinical activity is not only a highly cooperative process, but also safety-critical, collaborative, distributed over time and space, and characterized by high complexity and coordination demands. Communication enables the cooperation, collaboration, and coordination processes [1], and eHealth technology mediates these processes. What, then, are the implications of a communication breakdown?

Technology represents the backbone of the healthcare process. However, it is medical professionals who assume responsibility for the failures of technology [2]. The discussion of human factors in medicine centers on accreditation, licensure, a posteriori analysis of accidents, and decision-making. We propose an adverse-event minded design method for eHealth applications that considers the error-prone nature of the distributed computer-supported medical work process. We model potential breakdowns, afforded by the medium, the task, and the workflow. Our method can account for potential failures and suggest design and workflow solutions to prevent accidents, a priori.

Methods

Medical activity is built on the premises of cooperation, coordination and collaboration. These, in turn, are a function of the success of communication among actors. We propose to expand the focus of design methodology for eHealth systems to consider the processes of joint activity by exploring potential communication breakdowns – interaction fragments between people and/or systems that generate unintended deviations from the activity's trajectory towards a goal. We identify five levels of potential communication failures that produce adverse outcomes in eHealth applications: medium/technology, semantic, coordination, cooperation, and collaboration. The set of interaction configuration scenarios for such failures is: person-to-person, person-to-system-to-person (system-as-mediator), person-to-system, and system-to-system. Our design approach consists of the following steps:

1. Construction of a task model for each participant, a system-side interaction model, and a cooperative activity model (which combines all the other models)
2. Human error analysis
3. Identification of potential communication breakdown hotspots

- breakdowns at five levels of analysis: medium/technology, semantic, coordination, cooperation, and collaboration

- the influence of temporal relations
- the influence of the interaction and space configuration scenario

4. Mapping of predicted failure to anticipated adverse outcomes
5. Design and/or workflow solutions; suggest redundancy where needed in order to make the process robust and fault tolerant

The method emphasizes the importance of considering the limitations of the intended communication modality (voice, digital, analog, face-to-face, synchronous, etc.) as preconditions to communication failure. Further, an eHealth system is seen as a communication contributor, similar to human participants in the joint activity (no intelligence is attributed to the system though).

Results and Discussion

We applied our method to a typical telemetry monitoring activity scenario, and our breakdowns analyses predicted a great number of potential adverse events. For example, in the abbreviated task model shown in Figure 1, we predict a communication failure between the telemetry monitoring system used to send a page to the physician and the hospital paging system. The associated adverse outcome could be that the physician receives a delayed page. The delay time could, in the worst case, result in a life-threatening or fatal outcome for a patient in serious condition. One proposed solution to this potential risky situation is the utilization of a backup/redundant communication channel between the nurse and the physician.

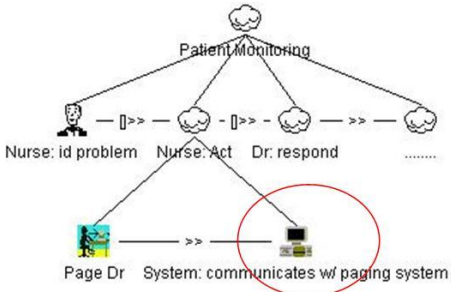

Figure 1: Patient Monitoring task model (abbreviated)

Following our analyses, we looked at the adverse events associated with an existing telemetry patient monitoring system made by a major manufacturer and currently used in a number of hospitals in North America. Over the last thirty months, 19 out of 21 reports about this system submitted to the U.S. Food and Drug Administration MAUDE database are associated with communication breakdowns in one of the levels we propose; 89% of the breakdowns resulted in a life-threatening situation or death. Over half of these failures were predicted by our method.

We argue that the current state of medical processes is impossible without the technology that enables the majority of domain communication and coordination. Thus, technology is a vital participant in joint activity. Anticipating failure in communication patterns – among humans and systems – can lead to design solutions, which prevent fatalities. The goal is to make eHealth applications safer, starting at the design stage.

References

[1] Clark HH. Using language. New York: Cambridge University Press; 1996.

[2] Bogner MS, editor. Human error in medicine. Hillsdale, NJ: Lawrence Erlbaum Associates; 1994.

[3] Fields R, Paternò F, Santoro C, Tahmassebi S. Comparing design options for allocating communication media in cooperative safety-critical contexts: a method and a case study. ACM Trans. Comput.-Hum. Interact. 1999; 6 (4): 370-398.

Management of ICT-based Service Development: A Challenge for Evolving Social and Health Care e-services

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Keywords: eHealth, service innovation, management, evaluation, sociology of technology

Introduction

For nearly two decades most western countries have looked to IT to improve both efficiency and quality of health care. Early expectations of the health care and IT as "a match made in heaven" have during the 20-year engagement turned into long "wait of the marriage to happen" [1]. Review of literature on ICT in social and health care service development revealed, that there were surprisingly few articles focusing on service development with IT. Implementation of IT has also seldom resulted in expected improvements of services. Review of literature on ICT design and management revealed that there are some promising tools for co-construction of technology and its use, but also critique on poor adoption of these tools in practice [e.g. 2; 3]. The outcome has been, that transition to IT in health has been technology led, with little attention paid to service or work process change. [4, see also 5 and 1.]

New theoretical tools to understand and support co-evolution of technology, its users and use practices have been presented in the field of sociology of technology and activity theory. Sociology of technology focuses on co-evolution of social and technical [6; 7], activity theory on evolution of institutional activity as an open, multi-voiced system where change in one element has impact on others [8]. These tools have been applied also in some analyses of health care IT e.g. by McLaughlin [9] and Gregory [5]. These tools were tested in a study of an IT project to see, what can be learned about co-development of health care service and IT. [4.]

Methods

A case study method was implemented to study the dynamics of change. As a case an EU-project (1994-1998) was selected, where innovation-award winning e-services for home care had been developed and implemented 2 years prior to data collection. Following research questions were set using the theoretical framework:

1) Which (and whose) problems triggered the e-services development?
2) How and by whom were the objects of the development defined and shaped?
3) How did the established technology-based services function and meet the needs of different stakeholders?

Data consisted of project documents, interviews of key stakeholders in development and production of services and ethnographic observation of use of the technology-based service from viewpoint of different stakeholders.

With help of the theoretical tools, a model for co-development of services and technology was produced to explain successes and challenges met in different phases of the project. To study transferability of the model, it was implemented in evaluation of the national e-prescription piloting (2002-2006) in Finland with similar research questions. Data has consisted of stakeholder interviews, pre-and post implementation observation of prescription process, questionnaires and literature review. Project documents and ethnographic participatory observation were used to study the development process.

Results

Case I illustrated the ill fate of a technology-implementation project, pointing to three main reasons for failure, which could be extracted with help of the model:
1) The institutional activity systems of core actors in the service provision network were not studied as basis of the needs, interests and possibilities of development of eServices
2) The objects of development were defined by technology providers. eServices with novel work processes were not taken as an object for development. Change in services and work was technology-led (they were adjusted to fit the implemented technology)
3) Due to 1 and 2, some of the key institutions did not experience added value from IT. Clients were dissatisfied with the e-service. The development ended when external financing ceased. None of the technical applications remained in use 2 years after the project had ended.
In Case II, the created model was applied as a basis for multidisciplinary framework in evaluating an ongoing e-prescribing project [10]. It helped to reveal a project initiated and led by governmental actors and regulators with good acknowledgement of existing legislation and standards, but not yet taking adequately into account the contexts of intended use, needs and interests of service providers and clients. It also revealed a project concentrating on technology, with too little emphasis on construction of new service models or end user needs. It helped to extract recommendations for organising and focussing of work in order to design the use (work processes and innovative new service models) to bring added value from technology to the key stakeholders.
Management of eService development proved problematic in both cases. In Case II, there has been a possibility to influence the project. The project, however, has not been able to benefit from the feedback to the fullest extent due to the project model not being designed flexible enough to be redirected on basis of evaluation results. This indicates towards a need to build multidisciplinary, constructive assessment as integral part of eHealth projects from project planning to established use of new service models [cf. 4, also 11].

Acknowlegements

The author would like to acknowledge the support of STAKES and the Academy of Finland for funding of the research project (Case I) and the Ministry of Social affairs and Health for funding of the evaluation project (Case II).

References

[1] Clancy, C.Health Information Technology, Quality of Care and Evidence-based Medicine: An Interlinked Triad. Annual Symposium, American Medical Informatics Association, Washington, D.C., October 25, 2005. http://www.ahrq.gov/news/sp102505.htm (27.3.2006)

[2] Wood, L. E. (ed.) User interface design. Bridging the gap from user requirements to design. Boca Raton, Florida: CRC Press LLC; 1998

[3] Orlikowski, W. J. The duality of technology: rethinking the concept of technology in organizations. Organization Science 3 (3); 1992, p. 398–427.

[4] Hyppönen, H. Tekniikka kehittyy, kehittyvätkö palvelut? (Technology develops, what about services?) PhD Dissertation, tutkimuksia 134. Helsinki, Stakes; 2004.

[5] Gregory, J. (2000). Sorcerer's apprentice: Creating the electronic health record, re-inventing medical records and patient care. PhD Dissertation, Department of Communication. San Diego, La Jolla, CA: University of California. http://heim.ifi.uio.no/~judithg/phd_mstrx.pdf (29.1.2004).

[6] Callon, M. The sociology of an actor-network: The case of the electric vehicle. In: M. Callon, J. Law & A. Rip, Editors. Mapping the dynamics of science and technology. Sociology of science in the real world. London: The MacMillan Press;1986 , p. 19–34.

[7] Bijker, W. E., Hughes, T. P. & Pinch, T. J. Editors. The social construction of technological systems. New directions in the sociology and history of technology. Cambridge, MA: The MIT Press; 1987.

[8] Engeström, Y. Learning by expanding: an activity-theoretical approach to developmental work research. Helsinki:Orienta-konsultit; 1987.

[9] McLaughlin, J., Rosen, P., Skinner, D. & Webster, A. Valuing technology. Organisations, culture and change. London: Routledge; 1999

[10] Hyppönen, H., Salmivalli, L., Nykänen, P., Ruotsalainen, P. Pajukoski, M. Testing a theoretical framework for interdisciplinary IS evaluation: The case of Finnish Electronic Prescription. Int. Journal of Healthcare Technology and Management (IJHTM) (In Print)

[11] Ammenwerth, E., Brender, J., Nykänen, P., Prokosh, H., Rigby, M., Talmon, J. Visions and strategies to improve evaluation of health information systems. Reflections and lessons based on the HIS-EVAL workshop in Innsbruck. Int. Journal of Medical Informatics (IJMI) 73; 2004, p479-491.

Ultrasonic Diagnostic Applications for Ophthalmological eHealth Subsystem

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Keywords: eHealth, ophthalmic ultrasound, teleophthalmology

Introduction

The extraction of knowledge from medical information is very important tendency in eHealth development. The amount of information increases constantly. It has to be concentrated in valuable knowledge which is useful in medical decision making and developing electronic patient's health information. Properly developing eHealth system creates the unique possibility to collect and integrate medical knowledge.

Methods

The main objectives (Fig. 1):

- To create and evaluate processing methods of informative ophthalmic ultrasonic diagnostics signals;
- To estimate the relation between ultrasonic parameters and biochemical and biomechanical characteristics of eye tissue for clinical decision support;
- To develop the ophthalmological eHealth subsystem using informative data of ultrasonic ophthalmological diagnostic signals and images, telemedicine technologies and networks.

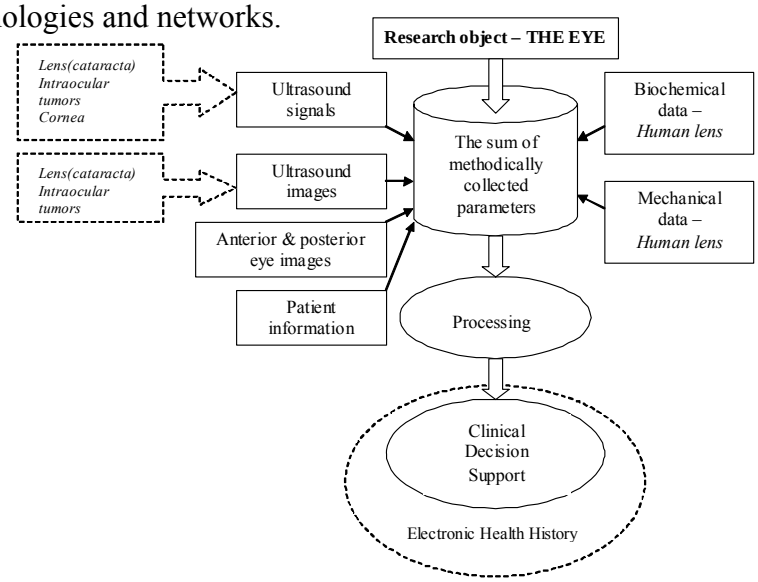

Fig. 1. The scheme of assessment and integration of ophthalmological diagnostic data.

Results

A functional teleophthalmological system for collection and processing of informative ophthalmological diagnostic parameters has been created (Fig. 2). This is an input for developing of the ophthalmological eHealth subsystem, using appropriate telemedicine technologies, forming ophthalmic records from the beggining: creation of methods for collection of information, saving of information, development and improvement of informative processing methods and algorythms.

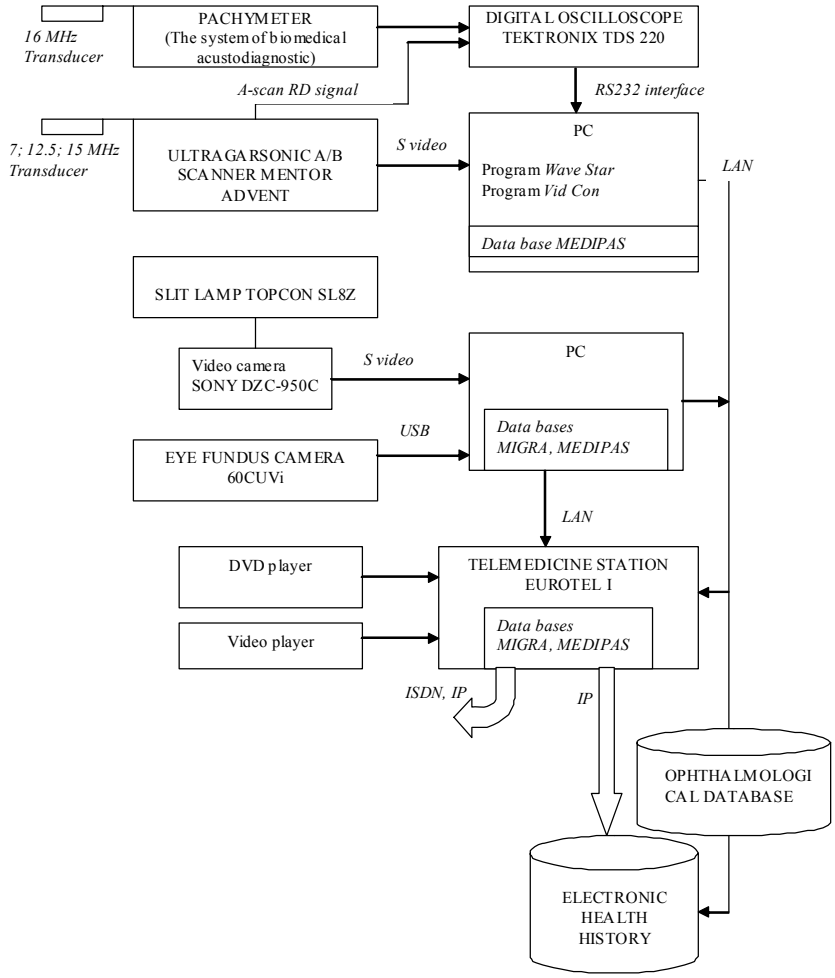

Figure. 2. The teleophthalmological system.

Discussion

Realization of operative teleophthalmological system is complicated task. It is very important to adapt medical diagnostic equipment, receiving, saving and processing of medical information and network for getting correct, high quality diagnostic results.

Acknowledgements

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References

[1] Ackerman M, Craft R, Ferrante F, Kratz M, Mandil S, Sapci H. Telemedicine Technology. Telemedicine Journal and e-Health 2002; 8(1):71-78.

[2] Carson ER, Cramp DG, Morgan A, Roudsari AV. Clinical decision support, systems methodology, and telemedicine: their role in the management of chronic disease. Information Technology in Biomedicine 1998; 2(2):80–88.

[3] Paunksnis A, Barzdziukas V, Kurapkiene S. E-Ophthalmology for clinical decision support. Biomedizinische Technik 2005; 50(1):1472-1473.

[4] Paunksnis A, Barzdžiukas V, Kurapkienė S, Dzemyda G, Jegelevičius D. The use of information technologies for diagnosis in ophthalmology. Telemedicine and eHealth Forum, The Royal Society of Medicine 2005:26.

[5] Marozas V, Gelžinis A, Lukoševičius A, Severgardh P, Kurapkienė S, Paunksnis A. The method to achieve online telemedicine capabilities using general purpose videoconferencing software. European Journal of Medicine Research 2002 :47.

Poster Presentations
Session A

Thursday, August 31 2006

Terrace Hall

13:15 14:00

P-01 **Challenges and Problems in Using a Specialised Health Care Information System (Sis)**
Tarja Suominen; Marianne Maass, Paula Asikainen, Ilmari Rostila, Tiina Mäenpää (*FINLAND*)

P-02 **Improving Reporting Practices from a Nurse's Point Of View**
Airi Elovaara; Anja Kettunen (*FINLAND*)

P-03 **Data Base Of Clinical Cases: Object-Oriented Technologies for Data Management**
Vita Miseviciute; *Martynas Speckauskas, Alvydas Paunksnis, Arunas Lukosevicius* (*LITHUANIA*)

P-04 **Preparedness of Ambulances in Finland for Wireless Data Exchange with Hospitals and Health Centres**
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P-05 **Wilho – A New Concept of Wireless Management of Healthcare Processes**
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P-07 **Safety Culture in Teleradiology**
Antti Servomaa; *Anja Kettunen*; *Antti Niemi* (*FINLAND*)

P-08 **The Advantages of Distributed, Totally Automated Laboratory Service. A Technical Solution Based on Liquid Micro Processor Technology**
Raino Saarela, N.H. Kaartinen (*FINLAND)*

P-09 **e-Services in Clinical Laboratory Environment - A Case Study from Vaasa Hospital District**
Matti Mäkelä; *Arja Tuomaala*; *Anna-Kaisa Rainio* (*FINLAND*)

P-10 **Improving Patient Follow-up**
Kari Haukipuro; *Maria Kääriäinen* (*FINLAND*)

P-11 **Health Information Management in Self-Care Project**
Niko Männikkö (*FINLAND*)

Challenges and Problems in Using a Specialised Health Care Information System (SIS)

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Keywords: SIS, benefit, usefulness, organization climate, culture

Introduction

Recently, there has been consensus about the necessity to ensure simultaneous availability of all patient data in order to benefit from the full potentials of telemedicine. As a consequence, the idea of an Electronic Patient Record (EPR) has emerged, in which all data from various departmental databases are available timely, when needed. This implies that interoperability between different systems is required (Xu et al., 2000). Functional EPRs embrace all departmental sources of patient information. In this scenario, the EPR is a similar system to the analogue patient record.

EPRs include access to patient demographic-, appointment-, laboratory- and imaging databases. The focus of Information System (IS) is on providing patient-friendly, effective and efficient services. EPRs allow information to be sent instantaneously available in different health care units. Consequently, earlier diagnoses are possible, thus allowing immediate treatment decisions. In some medical conditions this is crucial. Regardless of the location of the patient medical expertise become available, which increase patient democracy, and the quality of care. Patients need not to be transported where the need expertise is, but their imaging results are transmitted via networks.

There are several objectives in this study project:

1) The purpose is to describe the usability of the SIS from the viewpoint of health care professionals

2) There purpose is to find out the origins and consequences of organizational culture and climate in different health care and human services context before and after implementation of technology (atj)

3) The purpose is to evaluate benefits of the use of a Specialised Health Care Information System (SIS) in certain patient groups. This is achieved by describing the work processes related to the treatment of patients before and after the adoption of the SIS.

It is evident that patients suffering from chronic diseases may avoid temporary drawbacks or definitive worsening of the disease with adequate disease management. Monitoring of the disease and prompt interventions are tools for disease management. Any diagnostic information is crucial in order to provide timely and adequate care. The scarce health care resources may be redirected to other meaningful tasks, than repeated unnecessary appointments, phone calls or re-examinations.

The results of this project help us to see more clearly the challenges of the management of social and health care organizations implementing new technology and evidenced based practices. This project increases our understanding about the origins of organizational cultures and climates, promoting attainment of preferable outcomes it will strengthen much needed knowledge-base for developing social and health care management.

Methods

So far, as one research method Human Inquiry was used, in order to carry out the criteria based evaluation of the quality of the information system. In 2005 a survey was

conducted in one health centre. The survey consisted of a semi-structured thematic interview, activity analysis, and time and motion studies. The focus of the survey was to observe the physicians ward, in order to obtain real life information about the flow of the patients appointment and data flow. The scope was to discern situations in which patient care was accelerated or hindered due to availability or lack of diagnostic information.
The survey included a semi-structured 90 minutes long thematic interview with the treating physician. Also, activity analysis was performed regarding 20 diabetic patients' clinical appointment, belonging to a follow-up program. Time and motion study was used, in order to determine crucial work processes. A modelling software (QPR Finland Ltd.) was used to draw flow charts. Activity was described as it was pursued before the health centre had access to the SIS, and after the health had gained access to the SIS.

Results

The preliminary results indicated that the overall disease management may improve in patient care. This might hinder the worsening of the disease and thus lead to considerable cost savings.

Discussion

Further investigation is justified in order to refine the work processes and further eliminate the hindering aspects.

Acknowledgements

Authors would like to acknowledge the support of the implementation project (Salpahanke) for funding of the research project.

References

Xu Y., Sauquet D., Zapletal E., Lemaitre D., Degoulet, P., "Integration of medical applications: the 'mediator service' of the SynEx platform", *International Journal of Medical Informatics*, 2000, 58-59: 157-166.

Improving Reporting Practices from a Nurse's Point of View

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Keywords: activity system, systems introduction, information system, organizational change, reporting practices

Introduction

Electronic patient record is an important part of patient safety in health care. Information systems in the field of social welfare and health care have made a rapid progress. Simultaneously with the introduction of more and more advanced systems, the organisation shall be prepared for changes in the work of the users and the entire health care activity. [1] Improving the quality of health care is considered to be the most essential area to be developed. This study was carried out as a part of a quality development project [2], Kirjaa ja raportoi - Register and Report, in the Division of Internal Medicine at Oulu University Hospital.

Methods

The purpose of this study was to investigate the needs for developing patient reporting and the education of it, as well as the support given by supervision when introducing the information system as a part of work practice. The target group of the study was the nurses in the Division of Internal Medicine at Oulu University Hospital. The study was carried out as a qualitative participatory research. The data was collected by a preliminary questionnaire in October 2004, by theme interview in December 2004, and by an evaluation questionnaire in May 2005. The data was analysed by using the grounded theory.

Results

The data showed a need for developing reporting practices. Mastering registration without big problems requires good skills with computers and that needs a lot of well planned education, which is shown also in other studies [3]. As there is a lack of a common registration practice, finding information about former treatments on computerised patient records takes time, and thus causes difficulties in the continuity of a patient's care. Occasional problems with information systems slow down the registration of information about patients or information retrieval. On the wards, the system of oral reports on patients will be maintained, but it will be further elaborated.
In order to meet the needs for development, a degree programme based on NET technology was established. Though it was piloted only partly, the results encouraged to continue to develop the programme.[4]

Discussion

Networkbased education offers new possibilities also to the staff in hospitals new way to learn in open learning environments. The benefit of such education is that one can study when ever. [5] This study focuses on improving reporting practices from purely a nurse's point of view. Besides nurses, many other professionals are involved in patient reporting, thus the findings of this study will be invalid for wide generalisation of reporting practices. It is important to motivate and support the staff especially when

starting with new practices and programs. Reorganisation of own workflow is very important.

Referencies

[1] Saranto, K. Von Fieandt, N., Klami, P., Luostarinen, J. Sulonen, H., Nissilä, L. (toim.) 2002. Terveydenhuollon ja varhaiskasvatuksen henkilöstön tieto- ja viestintätekniikan koulutuksen sekä työelämän osaamistarpeiden kartoitus. Stakes, 29/2002. Osoitteessa www.stakes.fi/verkkojulk/pdf/Aiheita29-2002.pdf. Luettu 19.5.2005.

[2] Karasti, H. 2001. Increasing sensitivity towards everyday work practice in system design. Department of Information Processing Science, University of Oulu. Acta Universitatis Ouluensis A 362, Oulu University Press.

[3] Laine, R. 2003. Henkilökunnan kokemuksia tietojärjestelmän käyttöönotosta ja käytettävyydestä. Pro gradu –tutkielma. Terveyshallinnon ja –talouden laitos. Kuopion yliopisto.

[4] Elovaara A (2005) Raportointikäytäntöjen kehittäminen. Esimerkkinä Oulun yliopistosairaalan sisätautien tulosyksikkö. Pro gradu tutkielma. Oulun yliopisto

[5] Tella, S.,Nurminen, O., Oksanen, U., Vahtivuori, S. (toim.) 2001. Verkko-opetuksen teoriaa ja käytäntöä. Helsingin yliopisto. Opettajainkoulutuslaitos. Vantaan täydennyskoulutuslaitos. Helsinki: Hakapaino.

Data Base of Clinical Cases: Object-oriented Technologies for Data Management

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Keywords: eHealth, information system, object-oriented data base, object-oriented technology

Introduction

Modern diagnostic equipment for processing electronic data is widely used in telemedicine centers. It is convenient for easy data access. But the Information System (IS) is needed for storing, retrieving and transmissing this evolving and semantic data. Thus, health care centers are able to collect large libraries of different clinical cases and perform data mining.
Firstly, we performed an experiment with two most known database management technologies to test their level of suitability to such kind of system; secondly, we developed a tool for data collecting, processing and transmissing. Our study target is ophthalmology because it is a convenient field for telemedicine as the images of the eye play the most important role for diagnoses. We developed a system that stores ophthalmologic data developed in object-oriented technologies. This IS also accepts the eHealth services [1].

Methods

Experimenting with Data Base Management Systems

Experiment [2] dealt with an evolving data problem. A scenario with expanded user capabilities was created. The new data containing images and parameters were to be added in the system. To accomplish this requirement we had to make changes in all system components. To show the flexibility of Object-Oriented Data Base Management Systems (OODBMS), we created a similar Rational Data Base (RDB) model to Object-Oriented Data Base (OODB) classes and compared the changes to be made. A number of advantages of OODBMS were observed during this experiment, the most important being:

- possibility to store and retrieve data with the same statement;
- absence of necessity to create extra fields between tables, because of the references the OODBMS uses;
- absence of duplicated data;
- more flexible storage of multimedia data.

System architecture and implementation

Due to the advantages of OODBMS, OODBMS db4o [3] and Microsoft .NET programming environment [4] were used to develop the system (2005-2006). The architecture of the system is presented in figure 1.
The system is based on three-layer architecture. The OODMS is set in the remote

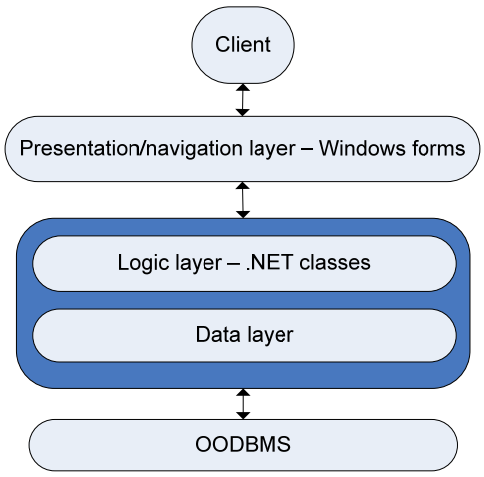

Figure 1. Architecture of implemented IS

server, and the system is installed and launched on every computer as a separate program.

Results

The system has possibilities of storing Electronic Health Record (EHR) information as well as the unlimited amount of research images. Ophthalmologic data mainly consists of a variety of different examination images and their covering information. The images of examinations, included in the IS, are:

- view of anterior and posterior segments of the eye;
- fluorescent angiography pictures;
- ultrasound B-scan pictures.

IS also contains extended possibilities of multidimensional data mining. The system was tested using the data obtained during patients' examinations in the Telemedicine Center of Kaunas University of Medicine [5].

Discussion

Work with different technologies and concepts leads to a better quality of developed products, including software. The latter can able to work with different data types, to ensure compatibility and flexibility. The demands of medical data users are changing continuously. However, with the help of the above mentioned technologies developed IS encompasses a number of areas of teleophthalmology: it provides access to eye specialists in rural or remote areas; it is capable of collecting all the necessary information about the patient in one unit and establishing a library of clinical cases; it is suitable for linking and sharing diverse medical resources; it can be used in distance learning and continuing education [6]. Also, the system has increased possibilities of data storing, retrieving and exchanging as well as multidimensional data mining. The IS developed could be a part of national eHealth system.

References

[1] Lukosevicius A. eHealth Services: Classified Benefits, Functionalities and Users. Biomedical Engineering 2005; 224-231.

[2] Miseviciute V. Research of Medical Data Information System, which Uses Object-Oriented Technologies. Master thesis 2006; 9-20, 56-58.

[3] OODBMS db4o. URL: http://www.db4o.com/.

[4] Microsoft .Net. URL: http://www.microsoft.com/net.

[5] Telemedicine center of Kaunas University of Medicine. URL: http://tmc.kmu.lt.

[6] Yogesan K., Kumar S. Teleofthalmology. Springer 2006; 4.

Preparedness of Ambulances in Finland for Wireless Data Exchange with Hospitals and Health Centres

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Keywords: emergency transportation, information technology

Introduction

In Finland, municipalities are responsible for organising the emergency transportation. In most cases it is organized by purchasing the service from private providers but the service may also be provided by municipal employees themselves. The total number of ambulances of each provider depends on the size of the municipality. The median population of a Finnish municipality is about 6000 inhabitants, thus one provider typically has 1 – 3 ambulances and a total of 4 -6 employees for the task. The educational background of the employees corresponds usually to that of a nurse or a practical nurse accomplished by courses of emergency care. The ambulance unit has to have at least a driver and one educated employee. The County Administrative Boards are responsible for the supervision and the practical supervision is usually done by the medical director of a health care centre. The main partners working in cooperation with the emergency transportation provider are the health care centres and the emergency wards in secondary/tertiary care hospitals.

The Government Decision-in Principle on Securing the Future of Health Care in Finland highlights effectiveness, productivity and quality of services. In emergency transportation the accomplishment of these objectives is challenged by long transportation times due to long distances. Especially in the scarcely populated northern part of Finland the distances from remote villages to the emergency wards in secondary/tertiary hospitals can be over 500 km, which for a patient means 7 – 8 hours ride in an ambulance. Even the distance to the nearest on-call physician can be 100 km or more.

It is not unusual for the staff of an emergency transportation vehicle to have a need to consult a physician during the transportation. Traditionally this has been done by mobile phones or radios. There are, however, needs for more versatile information exchange between ambulances and hospitals or health centres.

In order to find out the current preparedness for multimedia messaging between ambulances and the units of emergency care FinnTelemedicum at the University of Oulu and Stakes (National Research Centre for Welfare and Health) conducted a survey during the last quarter of 2005. The study is a part of an extensive survey on the usage of information technology in the health care of our country which has been done as an assignment of the Ministry of Social Affairs and Health [1].

Methods

A structured web-based questionnaire was e-mailed to all ambulance service providers that were listed in the register of Sairaankuljetusliitto (Union for transportation of patients) [2]. The list was accomplishes by inquiries made to health centres. If the register did not include an e-mail address, a paper version of the questionnaire was mailed with a reply envelopment. The questionnaire consisted of questions about the organization of the service provider, wireless equipment (other than the mobile phone), electronic documentation, and opinions on collaboration and education. According to the register there are 208 private business enterprises in Finland for transportation of

patients and in addition there are 80 public providers (municipal fire departments, health centres), and 25 providers owned by NGO´s like the Finnish Red Cross. The questionnaires was e-mailed or mailed to all the 218 service providers maintaining explicitly emergency transportation by ambulances and whose contact information could be obtained. These included 185 private enterprises, 30 providers in municipalities or health centres and three NGO´s.

Results

The overall response rate was 62 % (n= 135), 58 % (n= 107) for private business enterprises, 87% (n= 26) for public providers and 66% (n=2) for the rest. The median number of ambulances maintained by each responders was two (range 1 – 21). Most responders had a GPS locator and equipment for wireless transferring of ECGs. Minority had preparedness for data transmission for other purposes (table 1).

Table 1. Prevalence of wireless equipment (mobile phones excluded) for information exchange in ambulances (N = 130) by purpose of use

Equipment	Available % (n)	Not available % (n)	Missing % (n)
Electrocardiogram	89 (115)	12 (15)	0 (0)
Patient history and status in text mode	22 (29)	76 (99)	2 (2)
Other vital patient data *	39 (50)	59 (77)	2 (3)
Other data exchange**	16 (21)	75 (98)	9 (11)
GPS locator	62 (80)	37 (48)	2 (2)

*blood pressure, pulse, oxygen saturation, **fax, etc

The recording of patient data was completely digital in two (2 %), both digital and manual in 44 (34 %), and exclusively manual in 84 (65 %) among the 130 providers who responded. Most responders regarded collaboration with hospitals and health centres in planning, implementing and usage of information technology as insufficient. This was the case also for education and training (table 2).

Table 2. The opinions of ambulance providers on collaboration in planning, implementing and usage of information technology and on education concerned

	Sufficient	**Insufficient**	**Can't say**	**Missing data**
Collaboration	21% (27)	62 % (81)	14 % (18)	3 % (4)
Education	14 % (18)	56 % (73)	29% (37)	2 % (2)

Discussion

The response rate of the survey was not high but it was enough to give a conception of the topic. Most of the ambulances can transfer digital ECGs and locate themselves, but a minority had preparedness for data exchange for other purposes. First results of the wider study show that lack of preparedness may be wider on the side of the health care units receiving the information. These can be discussed in more detail later. There seems to be need for improving collaboration with ambulance service purchasers and in education on the topic of information and communication technology.

References

[1] FinnTelemedicum, Stakes: Manuscript to be published in June 2006
[2] http://www.sairaankuljetusliitto.fi/

Wilho – a New Concept of Wireless Management of Healthcare Processes

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Keywords: wireless network, wireless applications, wireless integration, wireless hospital

Introduction

Globally, Finland is a leader in the development of data networks and wireless technology. The strong development of technology in recent years has introduced new opportunities for enhancing hospital process. Finland's healthcare system is going through great technological changes and search for new solutions. Wilho was created when high-tech companies, researchers and service providers in Oulu began developing wireless hospital technology and operation models. The objective was to create a plan for a wireless hospital aimed at boosting the care of patients for domestic as well as export markets. Thus was born the Wilho Consortium and the Wilho Program [1], whose key objective is to make the internal processes of a hospital more efficient by wireless solutions. Partners of the Wilho Consortium (Oulu University Hospital, ODL Health Oy, University of Oulu and Whealth Oy) started an initial survey in 2003. Now the Wilho Program is proceeding as four Wilho Projects in the participating hospitals, university and company.

The Wilho Concept

The Wilho Concept can be divided into three parts: wireless network, wireless applications and integration, which combines the first two.

The heart of the concept of a wireless hospital is the **wireless network** itself, which can be connected to data systems as well as the various applications of the hospital processes. In the direction of data systems, the wireless network can be seen through standardized data transmission protocols, and in the direction of the applications with standardized RF interfaces. The WLAN base stations (Wireless Local Area Network) connect wireless devices to the fixed infrastructure network. Room-specific base stations can be based on ZigBee [2] or UWB (Ultra Wideband) [3, 4] technology and they link measuring and location data elsewhere on the data network. UWB technology uses a frequency range of 3.1-10.6 GHz at low power levels, which enables data transfer of up to 600 Mb/s in a small coverage area. In tracking and data transmission, either WLAN or UWB technology is used depending on the application and its requirements.

Integration in the Wilho Concept means 1) wireless support for the top level of hospital management (e.g. strategy planning and cost accounting), 2) wireless support for hospital information systems and 3) wireless integration of medical, clinical and diagnostic data. One of the main goals of the Wilho Program is the enhancement and streamlining of the internal processes of hospitals. When care progresses more quickly, the amount of labour required for caring an individual patient is reduced and there is enough time to perform essential working phases. Our vision is to develop an Enterprise Resource Planning (ERP) system for hospitals supported by wireless logistics.

Wireless applications mean 1) wireless tracking of patients, staff, equipment and materials i.e. wireless logistics for the optimization and management of clinical workflow, 2) continuous wireless monitoring of the vital parameters of patients, 3) continuous wireless connection to optimal specialists and 4) wireless access to all

medical and clinical data needed. Wireless networks make data available in real time in follow-up care locations as soon as the patient arrives. Wireless networks and applications also enable the continuous, unbroken monitoring of a patient's condition. UWB technology is able to localize with a precision of a few centimeters. The precision of current WLAN tracking methods is a few meters.

Benefits of using wireless technology in hospitals

Wireless technologies are assumed to provide unique and novel ways to optimize and enhance hospital processes. By using an electronic patient record and wireless communication medical doctors can save 15 % of their time [5] and nurses over 10 %. In addition, wireless technology saves time in ordering medicine and other supplies. According to our studies, in one ward (26 beds) 13 hours are spent for ordering and 21.5 hours for handling of deliveries. In surgical departments ordering and handling of deliveries may take up to 167 hours per week and 147 hours per week, respectively. Use of wireless technologies together with electronic patient records will really create huge savings on the hospital level.

References

[1] Wilho – Healthcare process management supported by wireless technology [homepage on the Internet], 2006 [cited 2006 Apr 19]. Available from: http://www.wilho.net

[2] ZigBee™ Alliance [homepage on the Internet], 2006 [cited 2006 Apr 19]. Available from: http://www.zigbee.org

[3] UWB Forum [homepage on the Internet], 2006 [cited 2006 Apr 19]. Available from: http://www.uwbforum.org

[4] WiMedia™ Alliance [homepage on the Internet], 2006 [cited 2006 Apr 19]. Available from: http://www.wimedia.org

[5] Comparative study of a Finnish and a UK district hospital's doctors' time spending patterns. Unpublished research report, C-Quest Partners Oy, 2006.

PACS-systems and the Realization of the Patient Data Protection

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Keywords: data protection, eHealth, telemedicine

Introduction

The aim of this study [1] was to examine different methods of realization patient's confidentiality when digital x-ray pictures are transferred between health care organizations. The other objective for the research was to find out optimal means to fulfil the patient's data protection. Moreover, the purpose also was to find out the personal opinions and competency of the staff corresponding to the PACS-system (PACS: picture archiving and communications system). It was also important to find out the knowledge level of the above-mentioned persons about the data protection legislation in Finland.

Methods

The disclosure of the patient records, the follow logs, consultations, managing the registration and data protection politics were asked from the persons in charge with open ended question in the first part of this study. The answers were analyzed with deductive content analysis. The structured questionnaire for the second part was created on the grounds of those results. The questionnaire was sent to (N=56) PACS-responsibles (profession radiographer) and other professionals who disclose x-ray pictures. The analysis was made with SPSS for Windows by using per cent distribution and frequency distribution, crosstabulation, χ^2-test, Fisher's exact test and Contingency Coefficient.

Results

In this study 57% of the respondents were PACS-responsibles, 39% radiographers and 4% clerks. 85% of the respondents had received data protection education in departments weekly meeting or in 1-2 hours lecture, 7% hadn't received any education. When the x-ray picture was disclosed to the other health care organization, 49% of the respondents didn't know whether the consent of the patient existed, but this became evident. The consent was stored in 55% of the cases only in paper form with the patient record (fig.1). Access into the other registration's PACS archive was possible to 41% of the respondents and 86% of them also used this opportunity. In this study 50% of the PACS-RIS-systems consisted with Agfa Gevaert's and Commit's systems, the rest were Tamro's, Effica's and Tietoenator's systems and different combinations. 71% of the respondents considered the data protection legislature in Finland is too tight to fulfil with the present technique, but 51% thought that the realization of the patients data protection was possible to fulfil by performing different accounts.

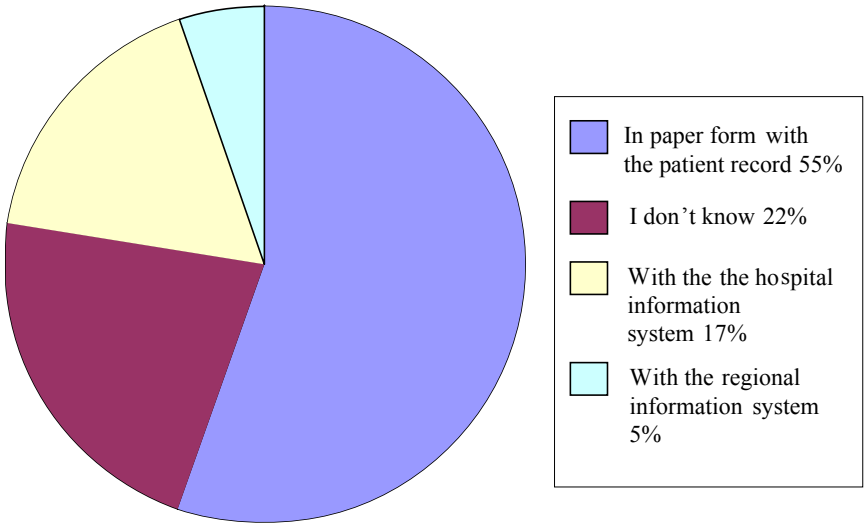

Figure 1. The location of the patient's consent.

Discussion

The consent of the patient for x-ray picture disclosure was usually only in paper form and therefore difficult to verify. In the health care organizations there are opinions that the patient has given the consent if not particularly denied it. This point of view is contrary to Finnish legislation [2,3,4]. Also, the x-ray picture was regarded as a part of the doctor's referral. The common custom to find out the patient's consent was to verify it from the context. The consent was seldom possible to verify from hospital information system. However, the professionals consider that patient's right to data protection is important, but the realization of it is difficult due to the complications with the flow of information. It was obvious that the professionals are waiting for the regional information systems to solve this problem.

Conclusions.

1. The disclosure routines in health care organisations have to be build to follow the Finnish data protection legislature.
2. The staff corresponding to the PACS-system needs more data protection education.
3. It is hypothetical that the upcoming national or the regional information system will solve the difficulties to realize patients consent.

References

1. Järvinen PE. PACS-systems and the realization of the patient data protection [master's thesis]. Department of Nursing and Health Administration; University of Oulu; Finland; 2006.
2. Act on the Status and Rights of Patients, Pub. L. No. 785/1992, 13.3§ (August 17, 1992)
3. Personal Data Act, Pub. L. No. 523/1999, 12.1§ (April 22, 1999)
4. Ylipartanen A. Tietosuoja Terveydenhuollossa. Potilaan asema ja oikeudet henkilötietojen käsittelyssä. 2th ed. Pieksämäki: RT-Print Oy; 2004.

Safety Culture in Teleradiology

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Introduction

There are a lot of advantages in the use of teleradiology in a sparsely populated country, where facilities are located widely around the country. The telemedicine network and the personnel and equipment resources of a central hospital enable remote monitoring of technical and clinical quality assurance (QA) of digital imaging in health centres and local hospitals. The changing process from conventional to digital radiological system must be planned carefully to reach a strong commitment to use the system in a proper, safe and effective way. Doctors and nursing staff are usually satisfied to the filmless radiology because that means faster patient care[1]. The quality of images seems to be good enough on the monitors for reporting and quality assurance both in radiological departments and in physicians' office.

Radiographer's role is changing because they are now more responsible for the quality than earlier. The image quality is strongly depending on the radiation dose; more dose gives less noise and better image quality. It is also possible to manipulate images and have better image quality – or not. It is possible to lose low contrast details or produce artefacts, which are not real. Digital imaging is an advantage but there are also some gaps; e.g. there is no more under or over exposed x-rays. The quality of the x-ray is almost always better with higher dose and that's why it is easy to give higher doses [9].

Safety culture has been applied in nuclear power plants [3] and industry [10] for a number of years The latest demand of the safety culture in the medical radiation provides well educated staff and continuous education all the time [2]. Safety culture can be recognized as a factor affecting and strengthening radiation safety and -protection in the use of medical radiation in the long run [4].

Methods

Safety culture covers all the factors, which have effect on radiation safety. Digital imaging and teleradiology provide methods to process the image, to transfer it through the network, to archive and report it. Current radiation protection legislation set new requirements for radiation safety, quality assurance (QA), image quality and patient radiation dose and education and training of the staff. Patient doses in different x-ray examination have been collected for years. Quality assurance of radiological equipments was done well with the conventional imaging system. With digital imaging receptors there is no national recommendations how to produce QA. Finland has more than 220 health centres providing x-ray facilities. Many health centres are small locating in remote areas without any radiologist or physicist. The medical doctor is responsible for the radiation safety.

In 2003 the images assessed in the Oulu University Hospital (OUH) consisted of 10 real consecutive patient cases, which presented a wide range of typical lumbar spine images from teenagers with normal bone density to elderly patients suffering from osteoporosis. The digital images were taken at the primary health care centre with a Fuji CR-system, and transferred to the university hospital in a native DICOM format. So there was no degradation of the image quality during the transfer and no error due to scanning of films. The test measured both the real imaging and positioning quality at the primary health care centre and the monitor/software image quality at the university hospital.

Image display was made with a Sectra IDS4 imaging workstation with three monitors, one colour monitor and two high-brightness black and white monitors. [5]

Results

Wide teleradiology practice in Finland has shown many advantages and possibilities in radiology. The studies in this review focused on radiation dose with digital image receptors, QA of workstations and activities of radiation safety officers. The QA of the image quality of workstations were made about in the half of the x-ray departments of university and central hospitals. [5] Regulatory and organizational environment and worker and work/technology characteristics were the main factors affecting the safety culture of safety officers in medical radiology. Radiation protection legislation requires that quality assurance is carried out in all x-ray departments. National and international QA programmers (AAPN, NEMA) for work stations are already available [6]. The latest studies show that with digital image receptors it is possible to achieve lower patient doses but there is also possibility that the doses increase if there is no continuous quality assurance programs [8,9, 11].

Discussion

Teleradiology provides many-sided possibilities besides to make diagnosis also to improve the technical and clinical QA through the digital network. It offers also way to educate the staff in rural areas and provide continuous feedback to radiographers of the image quality and dose and to doctors of there reporting. It is important to reach the image quality high enough with dose required in every health center and hospital. Good enough image quality means less retakes when the x-rays are sent to central hospitals. It's important because the latest studies show that all harms of radiation is not yet known [7] and there are some patient groups who are exposed often since one's birth e.g. premature infants [8]. The radiation safety officers need clarification in their organizational position, declaration of their tasks, more power in decision-making, education and increased cooperation with other parties to provide an effective safety culture [4]. National (or international implemented to Finish legislation) guidelines for QA of the imaging receptors should be given. Quality assurance should be part of every day work in all radiological departments. Safety culture is a new concept to provide safe, high quality and

References

[1] Reponen J, Kettunen A, Tapanainen E, Ervasti J & Joensuu J (2006)
From conventional to digital archive; education process of the clinical staff. Electronic poster in ECR 2006.
[2] ST-ohje 1.1 (2005) Säteilytoiminnan turvallisuus perusteet.Edita Prima oy. Helsinki.
[3] IAEA. International Atomic Energy Agency 1991. Safety Culture . A Report by International Nuclear Safety Advisory Group, Safety Series No. 75-INSAG-4 IAEA,Vienna
[4] Servomaa A, Holopainen M (2005) Turvallisuuskulttuuri kehitystekijänä säteilysuojelussa lääketieteellisessä säteilyn käytössä. Suomen Lääkärilehti 2005 (2481-2484)
[5] Servomaa A, Reponen J, Kettunen A, Kylmäniemi K (2002) Quality assurance in health centres utilizing telemedicine network, EuroPACS 2002. Proceedings of the 20th EuroPACS annual meeting Oulu, Finland
[6] Annala H, Reponen J, Kettunen A, Niemi A, Servomaa A (2004) Quality assurance in workstations of x-ray departments in Finland EUROPACS-MIR 2004 Trieste.2004
[7] Hall P, Adami H-O, et al, Effect of low doses in ionizing radiation in infancy of cognitive function in adulthood: Swedish population based cohort study. Brit. J. Med. 2004 (328-330)
[8] Kettunen A, Radiation dose and radiation risk to foetuses and newborns during x-ray examinations.STUK-A204 Säteilyturvakeskus 2004
[9] Kettunen A, Servomaa A (2003) The effect of image receptor change on radiation exposure to patients in the intensive care units. W. Paile (ed) Radiation protection in the 2000s – Theory and practice. Nordic

Society for Radiation Protection. Proceedings of the XIII ordinary meeting, Turku August 25-29,2002, 316-319
[10] Simola, A (2005) Turvallisuuden johtaminen esimiestyönä, Tapaustutkimus pitkäkestoisen kehittämishankkeen läpiviennistä teräksen jatkojalostustehtaassa. University of Oulu Work Science, University of Oulu
[11] International Commission on Radiological Protection 93 (2004) Managing patient doses in digital radiology. Annals of the ICRP Vol. 33 .

The Advantages of Distributed, Totally Automated Laboratory Service. A Technical Solution Based on Liquid Micro Processor Technology.

Kaartinen, N.H.; Saarela, R.

In health care branch ICT (Information and Communication Technology) began to change existing processes. Result is what we call Telemedicine. Until now telemedicine has been restricted to physical phenomena.

In-Vitro-Diagnosis (IVD), a chemical information process, performed in clinical laboratories, has a central role in present evidence based medicine. IVD is indirectly determining the cost of healthcare by a much higher portion than its direct 2-10 percent fraction. IVD is widely used only in USA, in EU and in Japan. The present trend in conventional IVD is to reduce cost by concentrating testing operations to central laboratories, requires a well working sample transport logistics, what is not available in less developed countries. Part of the problem is the minor role of ICT in IVD, whereby true automation and cost reduction has not taken place. In fact laboratory analysers are like small mechanical factories, supplied by bioanalysts for reagents, for disposables, for sample materials, for calibrators and for control sera.

The only fast growing diagnostic segment is Point-Of-Care-Testing (POCT). It challenges the conventional laboratories by speeding up the process. POCT, at it's best, gives some cost savings, but brings up certain problems: quality control of the results and ICT integration of the devices.

TeleChemistry (TC) is a new technology, based on a Liquid Micro Processor (LMP) core, transforming and packaging expensive off-line laboratory biochemical and medical testing to an on-line ICT-based quality test data production. TC enables practically anywhere a turnkey, distributed, real time chemical testing service with an infinitely small running costs/test.

A comparison made between a laboratory testing and a leading POCT testing known as I-STAT, is here extended to include the planned TC service, with focus on cost savings. Excluding the same, unavoidable sampling costs, TC is superior over I-STAT by a factor of ten. There are other features increasing the value of TC service to customers: a very short traceability of calibration with subsequent high accuracy, a wide flexibility in pricing versus volume, built-in connectivity and integration to automated infrastructure, free, customised test selection.

In more general terms, TC means a sharp cost reduction and a sharp volume increase of chemical testing also in other biochemical and chemical fields, like chemical process control, environmental monitoring, food processing, human and pet well-being etc. The present IPR protection and a clear pathway for a technological development and for a further IPR-protection, e.g. into a handheld personal diagnostic and chemical testing business, offer a long term profitable new business outlook.

e-Services in Clinical Laboratory Environment - A Case Study from Vaasa Hospital District

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Keywords: eHealth, Processes, Electronic identity, laboratory

Introduction

Heath care patients act more and more like a consumers and require more efficient services. Resourcing these services and growing demands is a huge challenge when public health care struggles with resourcing issues even today. Situation will be even more challenging in 10 years when big age groups retire.
Electronic services, fully functioning and integrated services and seamless data transfer may help us with future resourcing issues. Electronic health records (EHR) are starting to get common, but we are not able to collect all benefits before different IT-systems are integrated to each other. Next step will be bringing the patient as a part of administrative process.
This abstract and final presentation will share the outcomes of Vaasa hospital district's "Pro Viisikko" project.

Methods

Project group carried out a quantitative survey to laboratory patients in two laboratories in Vaasa. Survey measured current state of service process in laboratory and patients willingness to use electronic services when booking a time to laboratories. Implementation of survey lasted one week and 852 patients out of 1188 (71,5%) answered. Project group also created basis for electronic interaction between heath care professionals and patients.

Results

Survey pointed out that 27% of all patients are willing to book time to laboratory using Internet. 50% of all patients are willing to book time using telephone, which can be arranged using call-centers. Typical user for laboratory's e-Services would be 20-39 years old person that uses laboratory services few times a year.
Project group noticed that biggest issues when implementing electronic services in health care are related to patient's electronic identity and secure communication. Finnish Population Register Centre offers services and tools for using an electronic identity in web-services. Electronic identity has been granted for 100 000 persons in Finland [1]. In ideal case, patient's booking information could be connected to EHR and laboratory results could be routed back to patient. It became obvious that such functionality can not be implemented and the technology that could be used to identify patients, is not common enough.

Discussion

According to our questionnaires and preliminary experiences we can say that patients are ready for well executed electronic services, however lack of commonly used electronic identity has become a bottleneck. A true integration to information systems that consist any critical data can not be done without believable electronic identity. To achieve full patient satisfaction and true benefits, we will need multi-channel solutions to communicate with patients and to identify them.

Acknowlegements

Authors would like to acknowledge the support of the Finnish Funding Agency for Technology and Innovation (TEKES) for funding of the project.

References

[1] www.fineid.fi [homepage on the Internet]. Helsinki: Population Register Centre, Available from: http://www.fineid.fi/vrk/fineid/home.nsf/pages/4C8F3A95FF0AE93FC2257054002DAA1C

Improving Patient Follow-up

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Keywords: Outcome and Process Assessment, Information Systems, feedback

Introduction

The objective of healthcare is successful results of treatment. However, little information about the effectiveness of treatment is available, because healthcare productivity instruments take no account of the results of treatment. Assessment of end results is difficult due to the short duration of each visit at the hospital. Therefore, follow-up information about treatment and its effectiveness is critically important.
Improving Patient Follow-up and Patient Controls is a project set up by the Finnish Ministry of Social Affairs and Health and goes under the National Health Project. The project is administered by Northern Ostrobothnia Hospital District. The Patient Feedback system (CPF) is technically implemented by Coronaria Feedback Ltd. Five hospitals (Oulu, Oulaskangas, Raahe, Central Ostrobothnia and North Karelia) and one health centre (Ruukki) are involved in this project. The project is funded by the participating municipalities and the Finnish state.
The purpose of the project is assessing the effectiveness of treatment/operation and further improving treatment methods through use of a patient follow-up. Answers are sought to the following questions: 1) What kind of information can be collected through patient follow-up and 2) What are the effects of using patient follow-up?

Methods

The project studies the spreading of hospital infections both at Oulu University Hospital and at the Central Hospital of North Karelia. At Oulu University Hospital, the project is also studying children's recovery after a surgery and their satisfaction towards the treatment, evaluating the applicability of treatment follow-up to long-term neurological illnesses, and studying the compliance of nasal CPAP treatment for sleep apnoea patients. At the Central Hospital of Central Ostrobothnia, Raahe and Oulaskangas the studies focus on recovery from operations. At Ruukki Health Centre, the project studies the effect of patient follow-up on patients' living habits among the patients belonging to type 2 diabetes risk group.
Information is collected by means of a structured questionnaire that is specifically constructed for this project. Each clinic specifies the criteria for selection of the target group from the patients of day surgery, infectious diseases, epilepsy, nasal CPAP and type 2 diabetes risk group. The questionnaire is sent to the target group at set intervals by SMS text messages or by e-mails. The information can also be collected by phone interviews. The information is automatically stored at the clinic in the database of the CPF server. Descriptive statistical analysis is run on the results using the CPF analysis tool.

Results

This project has provided information e.g. about hospital infections, operation/treatment effects, compliance of nasal CPAP treatment as well as the development needs in post-operation patient education and patient feedback. For type 2 diabetes risk patients the results will show if patient education has short-term effects on the patient's living habits and if patient follow-up could efficiently improve patient's living habits.

This project has contributed especially in systematic patient follow-up process, in treatment quality improvement and in the introduction of new technological solutions. In addition, some follow-up visits of nasal CPAP patients have been eliminated using the patient follow-up. As a new way of working, the systematic patient follow-up has changed working culture and has required adapting and giving up on old ways substituting real patient follow-up.

Discussion

The follow-up information about treatment and its effectiveness can be collected using the CPF. However, the adaptation of the health professionals to new ways in working culture takes its time.

Acknowledgements

Authors would like to acknowledge the support of the Ministry of the Social Affairs and Health for funding of the development project.

Health Information Management in Self-Care Project

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Keywords: Information Management, Information Services, Health, Technology.

Introduction

Information technology and communications technology give opportunities for promoting health, equality and welfare among the population. Technological systems also offer possibilities to address present and future challenges in social welfare and public health care services. Improved possibilities to control and process information enable citizens to choose from a broader range of lifestyles services. Information technology solutions can reduce demand for other services. People's ability to manage on their own can be supported and improved by transmitting information and services through the web.
The starting point in the Self-Care Project is to develop and support the position and responsibility of municipalities' inhabitants as the users of health services. The objective of the project is to build services through which people can obtain information on health services and health regardless of time and place.

Methods

The purpose of this sub-project is to create new innovations, and information and concrete applicability data for a Self-Care service publication system. Sub-project seeks to develop technologies and methods through which it is possible to produce high-quality health information that matches the customer's needs. In addition, the information offered to users should be of the kind that can be adopted easily. The aim is to create a whole that can be adopted and interpreted easily and in which the origins of all information can be tracked.
Already existing, generally accepted databases and publication channels are combined in content production. In addition, new, innovative methods are created in the project for use in information management, quality monitoring and publishing. An attempt is made to pay attention to quality matters at all levels of information publishing.

Results

The research and development work results in a self-care service package, which supports the traditional production of services in the public health sector. As a result of the sub-project discussed in this report, a model is created for the production and publication of health information. In addition to controlling contents, new methods are devised that facilitate the control, further development and maintenance of the information. The various project functions together form a cooperation network through which multisector collaboration can be enhanced between public and private sector service providers. As a result of the research and development work, a new operations model is generated that can be transferred to and utilised in other environments.

Discussion

The information technology has the potential to be a powerful resource for meeting some of the public's health information needs. However, this requires that these new technologies present well-organized and accurate information in a way that is understandable. Research is needed on how the public's use of the health information

technologies, complements, or complicates patient physician communication and on how patients and health professionals can make better use of this resource. In addition much work needs to be done in the area of organizing health and medical information so that it is easier to find, relevant, and ready to be used, ever for people with a low level of health literacy.

References

[1] The Information Society Council's report 2005. Towards a Networked Finland.

[2] Indicators of accuracy on consumer health information on the internet: A Study of Indicators Relating to Information for Managing Fever in Children in the Home. Fallis D, Fricke M. J Am med inform Assoc 2002 Jan-feb 9:73-9.

Poster Presentations
Session B

Friday, September 1 2006

Terrace Hall

12:15 - 13:00

P-12 **Involving Elderly with the Technology Design Process**
Eeva Leinonen; Minna Isomursu; Petri Pulli (FINLAND)

P-13 **Videoconferencing in Child and Adolescent Psychiatry in Finland – An Inadequately Exploited Resource**
Lilli Pesämaa, Hanna Ebeling, Marja-Leena Kuusimäki, Ilkka Winblad, Matti Isohanni, Irma Moilanen (FINLAND)

P-14 **Smoking Cessation on the Internet in European Union Countries**
Ellen Tuomaala,Kristiina Patja (FINLAND)

P-15 **Telemedicine Cockpit for "Plug and Play" Telemedicine with Singe Action Control of Presentation And Communication**
Takashi Tsukasa, M.Mori, K.Hori, T.Kuroda, H.Yoshihara

P-16 **Intelligent Robotics in Physiotherapy**
Tonny Jæger Pedersen; Birgitte Ebbe Mathiesen, Peder Jest, Niels Erik Pedersen, Hanne Hansen, Lars Hulbæk, Thomas Klitbo, Henrik Hautop Lund(DENMARK)

P-17 **A New Software for ECG Monitoring System**
Liudas Gargasas; Alfonsas Vainoras; Rimtautas Ruseckas; Ruta Jurkoniene; Vidmantas Jurkonis; Vytenis Miskinis (LITHUANIA)

P-18 **Monitoring of Cardiac Output by Means of Chest Impedance Signal Morphology Analysis**
Mindaugas Tamosiunas, *Andrius Macas, Giedre Baksyte, Algimantas Krisciukaitis, Julija Brazdzionyte* (*LITHUANIA*)

P-19 **Evaluation of Systolic Arterial Blood Pressure from ECG**
Kristina Berskiene; *Alfonsas Vainoras*; *Liudas Gargasas*; *Zenonas Navickas* (*LITHUANIA*)

P-20 **Investigation of Cardiac Autonomic Regulation Efficiency by Means of Combined Heart Rate Variability and ECG P-Wave Morphology Analysis**
Algimantas Krisciukaitis (*LITHUANIA*)

P-21 **Eye Fundus Image Processing for eHealth Diagnostic System**
D. Jegelevicius, V. Barzdziukas, M. Patasius, V. Marozas, A. Lukosevicius (LITHUANIA)

P-22 **Parameterisation of the Normal Eye Fundus Images**
Valerijus Barzdziukas; *Alvydas Paunksnis*; *Ugne Elinauskaite*; *Laura Zubaite*; *Darius Jegelevicius*; *Martynas Patasius* (*LITHUANIA*)

P-23 **Visualization and Analysis of the Eye Fundus Parameters**
Gintautas Dzemyda; *Jolita Bernataviciene*; *Olga Kurasova*; *Virginijus Marcinkevicius*; *Vydunas Saltenis*; *Vytautas Tiesis* (*LITHUANIA*)

Involving elderly with the technology design process

Eeva Leinonen; Minna Isomursu; Petri Pulli

Keywords: participatory design, gerontechnology, design probes

Information systems and technologies are expected to play an important role in enabling the ageing to live well and independently in their own homes. Smart environments have a potential to support a versatile participation of the elderly in the activities of society and to use independently social and health services. Most people agree that it is important to get ageing people and their carers involved with the development process of new technology. However, there are just few studies of their successful involvement. It has been shown that the elderly do not know all the possibilities of and often are not amenable to new technologies. This can severely limit their willingness and ability to contribute actively to a discussion of their needs and requirements.

In the future the elderly will have better education, more money to use and they will be more technology oriented than elderly today. We argue that opportunities for successful technology adoption could be found in technology that support active live of elderly. Finding the possibilities for adopting technology that have the highest value for their users Isomursu et al. (2005) argue that the methods used for involving users into the design process should be selected and tuned according to the specific characters of the user group in question. Different methods work best for different cases (Isomursu et al 2005).

The SESC (Smart Living Environment for Senior Citizens) project rises to this challenge by studying the needs of elderly for identifying possibilities for adopting and developing technology. This multidisciplinary research, including specialists from architecture, community planning, clinical medicine, medical technology, telehealthcare and information processing is funded Academy of Finland 2006-2009. The project aims to examine the needs and possibilities of technology for supporting the elderly in their everyday life. This paper summarizes experiences presented in the literature from involving elderly users with the technology design.

The most traditional methods for involving users into the design process include questionnaire surveys and interviews. These can be used in covering lots of users and for quantitative analysis. However, design process often seeks for more detailed, fine grained understanding of the needs of the target group, which is often achieved by observations and other contextual inquiry methods. Group methods can be used for facilitating social aspects that elicit information about user needs.

Experiences indicate that questionnaire surveys with older people are most successful when personally administered by the researchers in interview, observation or group situations (Eisma et al. 2004). This of course makes it more difficult to use questionnaires for large scale surveys. Group methods include both discussion and action intensive methods. Several studies (e.g. Lines and Hone 2002 and Eisma et al. 2004) report difficulties in keeping the discussion intensive focus group of elderly focused on the subject of discussion. In conclusion, they noticed that the most functional focus group is when it comprises at most three elderly people (a number also recommended by Inglis et al. 2002) and is structured so that the elderly are able to pay attention on the main task while in-depth information is available. Action intensive methods, such as bodystorming (Oulasvirta et al. 2003) and hands-on sessions (Eisma et al. 2003) have been used for familiarizing with activities and technology. The role of the elderly can be more than being an information source – elderly can also act as

design partners in interaction with the designers. Eisma et al (2003) have examined the concept of mutual inspiration to facilitate the active role of elderly.

Most techniques used for including users in the design process separate collection of user data from the actual potential usage situation, i.e. the everyday life of the elderly. Tools called "probes" can be used for collecting user data from real-life contexts. Probes can be any kind of tools that are actively or passively used by the users to collect data or design ideas from the users. They can be, for example, postcards or diaries (Gaver et al. 1999), or they can be technological devices, such as video messaging systems (Hutchinson et al. 2003). We aim at exploring the possibilities of photographing device that will be integrated in glasses and the compressed photograph data will be wirelessly downloaded to server for later analysis. Based on aposteriori analysis done in co-operation with the subjects, it is expected that the daily processes of persons in the target group can be identified, understood, classisfied and modeled. We expect that the panoramic snapshot approach can also be utilised to develop a memory prothesis type functionality. Memory prothesis combined to process support and weekly calendar can provide a major contribution for the smart living environment which is our overall objective. Details of technical approach are available in another research paper (Zheng et al. 2006)

Involvement of the users early in the design process is highly recommended and valuable, as the designers seldom represent the user group themselves and they cannot thoroughly understand the needs and requirements of the future users. We believe that there clearly is space and need for more research and experimentation to get elderly actively involved in the technology design process.

References:

Eisma, R., Dickinson, A., Goodman, J, Mival, O, Syme, A, Tiwari, L. Mutual Inspiration in the Development of New Technology for Older People. Proceedings of Include conference; 2003, London.

Eisma, R., Dickinson, A., Goodman, J., Syme, A., Tiwari, L., Newel, A. Early user involvement in the development of Information Technology-related products for older people, Proceedings of Univ Access Inf Soc; 2004; 3: p. 131-40.

Gaver B, Dunne T, Pacentil E. Design: Cultural probes. Interaction. 1999; 6, 1:21-9.

Hutchinson H., Mackay W., Westerlund B., Bederson B.B., Druin A., Plaisant C. et al. Technology Probes: Inspiring Design for and with Families. Proceedings of CHI Conference; 2003 Apr 5-10; Ft. Lauderdale, USA.

Inglis, E., Szymkowiak, A., Gregor, P., Newell, A., Hine, N., Shah, P. et al. Issues surrounding the user-centered development of a new interactive memory aid, In: Keates S, Langdon P, Clarkson PJ, Robinson P (eds) Universal access and assistive technology. Springer; 2002.

Isomursu P., Isomursu M., and Leinonen E. User Involvement of Different Target Groups in a Mobile Context. Proceedings of European Advances Consumer Research Conference; 2005.

Lines, L. and Hone, K.S. Research Methods for Older Adults. Proceedings of British HCI Conference; 2002. London. Springer.

Oulasvirta A, Kurvinen E, Kankainen T. Understanding contexts by being there: case studies in bodystorming. Personal and Ubiquitous Computing. 2003; 125-34.

Zheng X, Pulli, P., Sironen, M., Towards Smart Living Environment for Senior Citizens. Submitted to Wireless World Research Forum 26-28 April 2006, Shanghai, China.

Videoconferencing in Child and Adolescent Psychiatry in Finland – an Inadequately Exploited Resource

Lilli Pesämaa[1], Hanna Ebeling[1], Marja-Leena Kuusimäki [2], Ilkka Winblad [3], Matti Isohanni [2], Irma Moilanen[1]

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Keywords: videoconferencing, child and adolescent psychiatry

Introduction

The purpose of this study was to assess the current role of videoconferencing and the purposes for which it has been used in child and adolescent psychiatry in Finland, to evaluate users' experiences of videoconferencing and to elicit the plans for its further use. Finnish epidemiological surveys have revealed psychiatric disorders in 14-22 % of primary school pupils aged 8-9 years1. According to some estimates, children's mental health problems are increasing in Finland2. The number of children placed outside home or taken into custody has been increasing3. More than half of the children in child welfare institutions would need psychiatric help4, but never get it, even though they may have undergone examinations and been provided care plans in specialised health care before the placement. Children with psychic disorders did not recover when placed in child welfare institutions5. Specialised nursing resources are not adequate to meet the need for help, either, and pressure keeps building up in the child welfare services operating under the auspices of the social welfare sector3. The inadequate resources and fragmentary structure of the service system as well as the presence of numerous small and administratively uncoordinated units with scant staff resources have resulted in problems that reduce the availability of services and impair their quality. The distances between the primary and specialised health care organisations may also be long, which diminishes the availability of child and adolescent psychiatry services in sparsely populated areas.

The utilisation of rapidly developing information and communication technologies has been a focal concern in the national health care strategies and action programmes since the 1990s. The national health project for 20026 underlines the need to restructure operating practices, to increase efficiency and productivity, to enhance equal availability of services, to ensure access to treatment and to guarantee high quality of services and high-standard expertise of health care staff. Apart from nationally defined goals, the development of electronic health care services has also been discussed in the European Commission e2005 Guidelines, which recommend that the EU member states should be able, by the end of 2005, to provide health services and health consultations to the other member states via telematic connections7.

Methods

A 16-item questionnaire concerning the use of videoconferencing was sent to all providers of child and adolescent psychiatry services in specialised health care in Finland in 21 hospital districts. The responses to the open-ended questions were classified by two authors (L.P and I.W.), who first established categories independently based on five respondents' responses. After that, they negotiated for consensus concerning the final categories to be used in the analysis of responses.

Results

Videoconferencing has been utilised in child and adolescent psychiatry for an average of 3-4 years. Videoconferencing has been used in clinical work, distance education, mentoring, administration and research. Use of videoconferencing was reported by 16 of the 21 hospital districts. Videoconferencing was used for clinical work in 12 and for distance education in another 12 hospital districts. Two districts used videoconferencing for clinical work weekly and six districts monthly. Three districts used videoconferencing for distance education weekly and five districts monthly. Two districts used videoconferencing for supervision weekly and four districts monthly.

Discussion

Two thirds of Finnish hospital districts (16/21) and every fourth of health centers8 have telematic connections and the equipment needed for videoconferencing in child and adolescent psychiatry. Although the workers' experiences of and attitudes towards videoconferencing are favourable, this method is not widely used in child and adolescent psychiatry.

Although there is a pressing need for the adoption of new therapeutic methods, the opportunities of information technology are rarely used in child and adolescent psychiatry. Functional equipment and remote connections are already available for child and adolescent psychiatry, and the adoption of technical equipment into use would not be a major investment. Ultimately, we are dealing with administrative policies and choices, which will determine whether services will be available in response to the patient's need or locality.

Acknowledgements

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References

1 Almqvist F, Puura K, Kumpulainen K et al. Psychiatric disorders in 8-9-year old children based on a diagnostic interview with the parents. European Child & Adolescent Psychiatry 1999;8:17-28

2 Pönkkö M, Ebeling H, Taanila A, Linna S, Moilanen I. Psychiatric disorders of children and adolescent – a growing problem at school. International Journal of Circumpolar Health 2002;61:6-16

3 Ministry of Social Affairs and Health, Finland. National project to secure the future of health care. Access to health care and waiting list management. Memorandums of the Ministry of Social Affairs and health 2003:33. Helsinki 2004

4 Hukkanen R. Psychosocial problems of children placed in children's homes. Turun yliopiston julkaisusarja, sarja D. 2002. Väitöskirja

5 Anttonen S. Sijoitettu lapsi/nuori – vailla tarvitsemaansa psykiatrista hoitoa. Etelä-Savon sairaanhoitopiirin julkaisuja nro 33. 2002

6 Decision in principle by the council of state on securing the future of health care. Brochures of the Ministry of social Affairs and Health 2002: 6 eng. http://www.terveyshanke.fi/eng.pdf

7 e-Health – making healthcare better for European citizens: An action plan for a European e-Healh Area, COM (2004) 356 final, April 30th (2004.
http://europa.eu.int/information_society/doc/qualif/health/COM_2004_0356_F_EN_ACTE

8 Winblad I et al. 2006. According a new research. (will be published this year)

Smoking cessation on the Internet in European Union countries

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Keywords: Smoking cessation, Internet, European Union

Introduction

In recent years, new smoking cessation websites have been launched in European countries to support existing telephone s
ervices. However, information on these services has been scarce and unsystematic. Therefore a research and development project for the development of the quality processes of cessation websites has been launched by the European Network of Quitlines.

Project objectives and tasks to reach the objectives have been stated as follows:
I An overview and in-depth analysis of web-cessation services in the area of EU
The objectives are reached through fulfilling the following tasks and methods:

- collecting general information on web-cessation in the area of EU
- collecting information and accomplishing a more detailed analysis with web-cessation services in countries having most experience with web-cessation, those like the Netherlands, the UK, Sweden and Denmark.

II Creating a network of experts in order to support the quality definition
This objective is reached through:

- tracing the most suitable experts in the EU countries
- networking service providers and web-cessation experts
- providing settings for discussion by organizing expert meetings

III Quality work for smoking cessation websites

- defining best practices and high quality standards for web-cessation services
- creating tools and guides for practical work

IV General objectives of health promotion and equality of health
The objective is reached through:

- developing web-cessation as a medium of public health and health promotion
- finding common areas with other eHealth questions
- developing internet as a medium for equal health promotion

Methods

The project was launched by service identification in EU countries – by the first round of data collection. In order to identify current available services, the members of European Network of Quitlines (ENQ) were asked to point the existing service either for adults or for adolescence or both. In principle not commercial Web sites were included in the collection.
After the first round of data collection, more detailed questionnaire was developed in order to collect more detailed information from EU countries hosting web cessation services. During the second round of data collection, it was distributed through e-mail and web (Globalink).

In addition, an evaluation tool has been developed for cessation websites. There have been two necessary levels of quality systems when creating an evaluation tool. First, the general eHealth quality certification systems had to be taken into account, as they have been originally created to the use of all health-related websites. On the other hand, smoking cessation websites needed their own, specific evaluation criteria with specific issues on smoking, tobacco and cessation. The combination of the previous has served in identifying key criteria and issues for the evaluation tool.

Results

Out of 28 ENQ member countries participating to the survey 11 countries were still without a smoking cessation website in 2005. In addition, web-based cessation services were somewhat unequally distributed on the European continent. In western and northern Europe there were web smoking cessation services in abundance. On the contrary, in eastern and southern Europe, there was undersupply of cessation websites or the websites were under development, for instance in Estonia, Lithuania, Spain or Portugal.

There is lot of variation of smoking cessation websites in the EU region. There are smoking cessation websites which form their own entity or they can compose only one part of the larger health promotion site. There are also different types of smoking cessation websites. The variation also causes difficulties in the comparison, evaluation and quality control of the websites.

A developed evaluation tool for smoking cessation websites is meant to improve the quality of smoking cessation websites. It is meant to support practical planning and need assessment, complementing or improving existing functions, developing new functions or constructing completely new websites. The tool is meant for self-evaluation. It includes evaluative questions and checklists and both general and detailed elements

Discussion

First, new websites should be founded on the areas and in languages they are lacking. In order to further utilize internet as a tool for smoking cessation in the EU region it would be important to have a smoking cessation website available in every main national languages in Europe, and also in bigger minority languages. Nevertheless, it is not obligatory to have a smoking cessation website in every country, as some countries having common languages can take advantage of each others' websites.

Second, strengthening of service providers' networks would be necessary. That would be needed in order to exchange experiences in website construction and development, but also in order to negotiate on appropriate specialization of the websites. Third, more research and development work is needed in order to optimize the quality of the websites and to maximize the use of them. However, some prerequisites for further development work exist already. The definition of minimal and optimal requirements for a smoking cessation website, contents and services included would be necessary.

Telemedicine Cockpit for "Plug & Play" Telemedicine with Single Action Control of Presentation and Communication

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Keywords: Telemedicine, Multi-Modal Interface, Application level QoS control

Introduction

Shortage of public healthcare funds and global mobility of the public generals are common international problems in healthcare. This indicates telemedicine as a possible solution. Although many trials succeeded to enable telemedicine over information networks, most of them require long period of time to setup the information environment and engineer for on-the-fly support to fit communication methods to requirements of medical doctors and limitations of the information network. Some of the foregoing telemedicine systems are even performed on a special purpose network instead of the Internet in order to avoid the on-the-fly adjustment by securing quality of network. To boost up usage of telemedicine under various conditions, telemedicine supporting information systems (telemedicine systems) should be ”Plug and Play”. At least, freeing users from on-the-fly adjustment is essential.
To be ”Plug & Play, a telemedicine system needs to handle various types of multi-media data and to shape them to fit into the limitations of the information system although the quality of information network is generally quite unstable. Moreover, the system needs to handle presentations of the various data although requirements of the clinicians vary along the progress of medical treatment and surgery, and the meaning of ”high quality” depends on each media. Thus, to produce flexible framework of application level quality of service (QoS) control is essential for establishing a potential telemedicine system.
On the other hand, a telemedicine system should not disturb clinicians to determine emerging requirements to the system during the clinical process. Thus, to produce an intuitive interface is also essential for establishing a useful telemedicine system.
To realize ”Plug & Play” telemedicine, the authors designed new telemedicine system named ”telemedicine cockpit” consists of flexible application level QoS control framework and clinicians' interface based on the proposed QoS framework [1]. This paper presents a mechanism enabling clinicians to control the QoS and presentation of information by single hand gestures, and reports results of evaluation of the prototype from human computer interaction (HCI) point of view.

Methods

The telemedicine cockpit consists of three parts; presentation control, QoS control, and input interface.
The presentation control part arranges various medical data on display consisting of small screens close to a doctor and a large-scale screen on the background. Required medical data is lined up as a catalogue on the large-scale screen, and selected media displayed on the small screens. This arrangement enables the clinicians to keep an eye

on the data most often required (important data), such as view of surgical field, in the centre of the his/her view, and other related data, such as biomedical signals in the surroundings (reference data). As the cockpit arranges information regarding the human cognitive mechanism, a clinician in the cockpit can obtain required data at a single glance, and easily map required reference data based on position of the data among the catalogues.

The QoS control part manages transmission of all data. The important data is transmitted in maximum quality, and the reference data is transmitted in minimum required quality under the limitation of bandwidth as shown in [2].

The input interface part lets the user to select important data from the presented catalogue intuitively. The telemedicine cockpit introduces ”put that there” interface [3], understood as one of the most intuitive interface metaphor for information systems. As the presentation control part already arranges data visually, ”put that there” metaphor is quite suitable for the cockpit. Additionally, as the context of selection of the catalogue is quite clearly understood as ”put selected (important) data into central display”, the system does not have a need for ”there” function, that is, the system can ignore time series of motion.

Once a certain catalogue is selected, the input interface notifies the selection to the other parts. The presentation part arranges the selected catalogue into the centre display, and the QoS control part sets a higher priority for the catalogue. This mechanism can control the communication and presentation of the catalogues through a single intuitive gesture.

Results

To confirm that the proposed interface simplifies HCI in the telemedicine cockpit, a prototype was evaluated. Subjects were asked to operate a master-slave robot through the telemedicine cockpit via a local area network. During the operation, subjects needed to tele-operate the pointer of the slave to a practice target as accurately as possible. Three MPEG-2 video streams were presented; two of them were short distance views of the practice target, and the third was a long distance view of the slave robot. The subjects had to switch between the video streams using the proposed method, which was found effective.

Discussion

This paper presents ”Telemedicine Cockpit” which enables users to browse all the required information at a glance and to obtain the most required information into the centre of the view at maximal quality by a single intuitive hand gesture. The experiment showed that the method successfully simplifies catalogue management during an operation, and, at least, frees the operation from on-the-fly adjustment. The authors are developing QoS for various media, such as sound stream from stethoscopes for auscultation in addition to video and voice streams required for interview or operation of the slave robot. As the need of ”high quality” depends on the types of media or even the clinical context, further collaboration with clinicians is required in order to define preferred levels of quality. Continuous research on level of quality of the media should result in definition of an interface that realizes "Plug&Play" telemedicine in the near future.

References

[1] Hori K.et. al. Surgical Cockpit System-Standardization of Integrated Information Support System in Telemedicine. Medical Informatics. 2001; 21(5):333-340
[2] Mori M.et. al. Application Level QoS Control for Telemedicine System. The 13th Annual Medicine Meets Virtual Realty Conference. 2005; 163
[3] Bolt R A.et. al. Put That There:Voice and Gerture at Graphics Interface. Computer Graphics. 1980; 14(3):262-270

Intelligent Robotics in Physiotherapy

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Abstract

A successful rehabilitation is the result of a confident cooperation between the patient and the physiotherapist. In the effort to motivate the patient in both shorter and longer term, the physiotherapist has to make the treatment both meaningful and interactive.
Tools that have the possibilities to support these goals are needed.
Aiming at this the Therapy-department at Counsil Hospital of Funen (Sygehus Fyn), wondered if the tools of intelligent robotics could give us the possibilities to support these goals.
That was why collaboration was started up with the Mærsk Institute – University of Southern Denmark, Centre for Health Telematics and Entertainment Robotics, who has experiences from developing an intelligent robot technology for playgrounds.
The purpose was to transform the fundamental principles from the intelligent playground into intelligent robotic technology in rehabilitation, in the attempt to support the rehabilitation-goals mentioned above.
This exiting collaboration, where experts from two completely different professional worlds have gone together, has shown that it is possible together, through e.g. brainstorming and professional feedback, to develop an unique new rehabilitation tool.
The intelligent robotic rehabilitation tool is in this spring (2006) developed to make it possible to challenge the patients balance, coordination, condition and weight bearing, all adjusted to the individual level of performance.
The tool consists of an intelligent surface, which can sense the patient's physical movements and react upon these with light and sound. The patterns of aimed movements can be adjusted to the individual patient, either automatically by the intelligent robot technology or manually by the physiotherapist. To motivate the patient it should be possible to make relevant movements, e.g. a tennis player can get a feedback that makes him move like in a tennis game, or he could "play" against another patient.
Another goal is that the tool will allow the physiotherapists to estimate and document the effects of the rehabilitation.
We hope that it will be possible, in the late summer (2006), to bring up some experiences about this new intelligent robotic rehabilitation-tool.

A New Software for ECG Monitoring System

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Keywords: Electrocardiogram, Monitoring, Software, Hardware

Introduction

ECG monitoring is a valuable tool for investigation of cardiovascular system [1-4], and many ECG monitoring systems (ECGMS) have been developed at the last two decades. Appearance of new technologies and programming means creates possibilities for improving the hardware and software of ECGMS. The aim of this work was the development of software of ECGMS with extended possibilities of ECG data analysis and application.

Methods

The ECG recorder (PicoMed GmbH.) is small in size with complete 16 bit risk processor, containing adjustable filters, amplifiers, 32 MB or more memory for stored patient data and it has scope for simultaneous recording of 2 channels up to 72 hours. ECG recorder is equipped with a Bluetooth module. The developed PC software embraces the point to multipoint Bluetooth technology, and this feature permits to perform online ECG monitoring control up to 6 patients in the real time. Developed software of ECGMS consists of program modules designed for data input, identification of ECG complexes, measurements of parameters, classification, displaying, editing, printing of results, saving and searching in database. The system of statements includes the conclusions about the main disturbances of heart rhythm. The display of analyzed data is accomplished in several modes: the tables of various parameters, trends of parameters integrated events presentation and verbal interpretation of detected events. The database is based on standard GDT and ODBC interfaces and enables an easy connection to existing networks.

Results

The pilot testing of developed software was accomplished on data from standard MIT database, containing 50 ECG samples with different heart rhythm and conduction disturbances. At this stage of investigation the accuracy of software was assessed. For this purpose the expert-cardiologist overlooked the ECG records and computer analysis results. An expert concluded, that localization of QRS complex was detected correctly in 99.5percent of cases, the duration of QRS complex was measured with accuracy of 90percent, the classification of QRS complexes was performed with accuracy of 90.4percent and diagnostic classification – with accuracy of 87.6percent. It is necessary to stress, that all episodes of ventricular tachycardia (five episodes in two patient records) have been detected by developed software of ECGMS. In the next stage of testing some features of hardware and software of ECGMS - the convenience for user (patient and physician) and quality of recorded signal have been assessed. For this purpose the real 100 ECG records of males and females (age – from 1.5 to 75 years) have been made: 40 patients with cardiovascular diseases, 50 coworkers of Kaunas Institute of Cardiology, 5 children and 5 sportsmen. The experts reviewed ECG records of 100 investigated persons, computer statements and determined the reasons of erroneous statements. The reason of 95percent mistakes were the various type noises in

the ECG, such as jump of baseline, which occur due to increase of polarizing current in the contact skin-electrode, sudden decrease of QRS amplitude due to increased the resistance in contact skin-electrode. The erroneous statements due to fails of programs consisted 5percent.

Discussion

The developed software creates possibility to monitor and analyze online the ECGs of 6 patients with one PC, and this feature cannot be found on other existing ECGMS. It is obvious, that modern ECGMS must carry trough the extended analysis of statistic and spectral characteristics of heart rhythm. The heart rhythm analysis is performed by developed software according to the recommendations of European Society of Cardiology [5], and various characteristics of heart rhythm - Puancare diagrams, distributions of parameters during monitoring are evaluated. This feature is also uncommon for existing ECGMS. Flexible and small in size ECG recorder extended application of ECG monitoring for such situations as underwater sport activities, swimming, diving, mountain climbing, examination of pediatric and geriatric population. Extended database was created on state-of-the-art-technology, and it includes all recorded ECG, results of analysis and data about patient, physician, place and type of recording. The testing results of developed software (recognition accuracy – 99.5percent; cycle classification accuracy – 90.4percent; diagnostic classification accuracy – 87,6percent) imply, that performance of programs is comparable with such of existing ECGMS. Finally, the developed software enables to receive the large amount of needed data and present them in convenient and informative for user mode.

Acknowledgments

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References

[1] Papaloukas C, Fotiadis DI, Likas A, Michaelis L. A rule based technique for the automated detection of ischemic episodes from long duration ECG. J.Medical & Biological Engineering & Computing, Proceedings of the European Medical & Biological Engineering Conference, 1999,Nov.4-7, Part 1; 728-9.

[2] Pardo Y, Merz CNB, Paul-Labrador M, Velasquez I, Gotdiener JS, Kop WJ et al. Heart rate variability reproducibility and stability using commercially available equipment in coronary artery disease with daily life myocardial ischemia. Am J Cardiol 1996; 78:866-70.

[3] Johanson P, Rossberg J, Dellborg M. Continuos ST monitoring: A bedside instrument? A report from the assessment of the safety of a new thrombolytic (ASSENT 2) ST monitoring substudy. Am Heart J 2001; 142:58-62.

[4] Baszko A, Ochotny R, Klaszyk K, Popiel M., Straburzynska-Migaj E, Cieslinski A, et al.. Correlation of ST- segment depression during ambulatory electrocardiographic monitoring with myocardial perfusion and left ventricular function. Am J Cardiol 2001; 87:959-63.

[5] Heart rate variability. Standards of measurement, physiological interpretation, and clinical use. Task force of the European Society of cardiology and the North American Society of Pacing and Electrocardiology. Am J Cardiol 1996:78:866-70.

Monitoring of Cardiac Output by Means of Chest Impedance Signal Morphology Analysis

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Keywords: Impedance cardiogram, Cardiac output, Principal component analysis

Introduction

Monitoring of central hemodynamics during acute phase of myocardial infarction is of crucial importance. Cardiac output is one of the core parameters in assessing the status of the patient in such cases. Impedance cardiography (ICG) has been introduced by Sramek in the 1960's as a simple and non-invasive measurement of cardiac output which is used till nowadays. However, measured data in some cases remain controversial. This is highly expressed in states causing low cardiac output syndrome cardiogenic shock, severe arrhythmias as well as in healthy obese patients [2]. The search of optimal methods and grounding the indications for the monitoring of central hemodynamics led to introduction of invasive methods for evaluation of hemodynamics into clinical practice in 1970. The method of thermo dilution, using Swan–Ganz catheters became a "gold standard" for the evaluation of hemodynamic changes. However, possibility of complications during invasive method application and their influence on the outcome of a patient's heath caused new wave of investigations the aim of which was improvement of non-invasive methods of evaluation of cardiac output like ICG. Genesis of ICG signal is explained as impedance variations determined by varying blood volume in main chest vessels during various phases of heart cycles. Another important factor is respiratory movements when physical parameters of chest (amount of air in lungs, resistance of the alveoli to the blood flow etc.) are changing. These two processes cause signal components with different frequency parameters. First derivative of the ICG signal obtained in most cases by means of special registering hardware mainly reflects blood volume variation in lungs and is usually used for central hemodynamics evaluation. Comparison of cardiac output estimates in acute phase of myocardial infarction obtained using first derivative of ICG with thermo dilution data revealed substantial errors of such evaluation. The aim of our study was elaboration of reliable method for estimation of ICG parameters quantitatively reflecting central hemodynamics.

Methods

Simultaneous recordings of thermo dilution data using Swan-Ganz catheter and chest impedance signal together with 1 chest lead of ECG was performed during 24h follow up of the patients in acute phase of myocardial infarction (Permission of Kaunas Region Ethics Committee for Biomedical Research Nr. 169/2004). Chest impedance and ECG signals were registered using "HeartLab" system [1]. Method for decomposition of ICG signal, based on combined analysis of ICG and ECG signals [2] was used to calculate two components of ICG signal: one reflecting respiratory movements, another - blood flow in lungs and major vessels of the chest. Structural analysis of the blood flow reflecting signal was used to form three sets of fragments of it reflecting major phases of respiratory movements (inhalation, exhalation, medium state). Principle component analysis (PCA) was used for evaluation of shape changes in all three sets of signals in regard to the changing clinical status of the patient and quantitative estimates obtained

by means of thermo dilution electrode. PCA transforms the original data set into a new set of vectors (the principal components) which are uncorrelated and involve information represented by several correlated variables in the original set. The vectors are the optimal basis functions we used for signal decomposition. Coefficients of these basis functions calculated for every cardiocycle were parameters for evaluation signal shape changes.

Results

Variety of the shapes of the ICG component reflecting blood flow during various phases of respiratory movement is presented in fig.1(left). In cases when cardiac output estimated by means of 1st derivative of ICG showed high correlation with thermo dilution data, coefficients of up to 4 basis functions in all sets of signals showed high correlation too. In complicated clinical cases (patients in cardiogenic shock, severe tacharrhythmias) ICG derivative method failed. At least one of coefficients of basis functions calculated from inhalation phase signals showed good correlation with thermo dilution data (Fig.1 right).

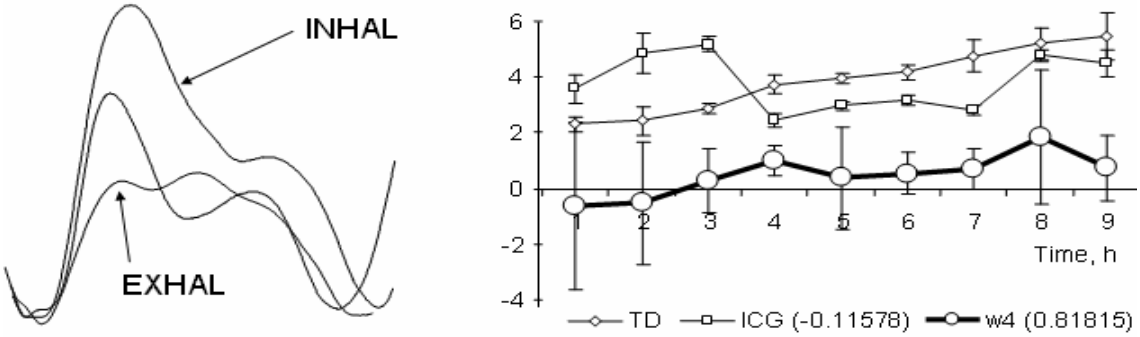

Fig.1. Variety of shapes of blood flow reflecting impedance signal during various phases of breathing (left). Cardiac output: TD- thermo dilution data; ICG- derivative of impedance signal method, w4- coefficient of 4th basis function of decomposed signal.

Discussion

Parameters obtained using our method give only relational but quantitative estimates of central hemodynamics, what in many cases could be of great importance. Our investigations showed that breathing have substantial impact on ICG signal shape and analysis should performed in regard to breathing phases.

Acknowlegements

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References

[1] Drėgūnas K., E.Povilonis. Cardiac output and hemodynamic monitoring system “Heartlab”. "Biomedical engineering" (Proc.Int.Conf.), Kaunas 1999, p.100-105.

[2] Kriščiukaitis A., M.Tamošiunas, A.Macas, G.Bakšytė, J.Braždžionytė Complex analysis of 24h simultaneous ECG and Chest Impedance Signal Recordings. "Biomedical engineering" (Proc.Int.Conf.), Kaunas 2004, p.49-52.

Evaluation of Systolic Arterial Blood Pressure from ECG

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Keywords: Systolic arterial blood pressure, Functional state, Bicycle ergometry, Double product

Introduction

Human organism adaptation peculiarities and opportunities to physical load is an actual task of physiology, sports and clinical medicine. The solution of this task is tight-knit to human functional state evaluation. In clinical practice the most popular method of functional state complex evaluation is the bicycle ergometry [1]. The reaction of the investigative person to bicycle ergometry is complicated and complex, inclusive the functions of different human organism systems. The adaptation to physical is tight- knit to changes of the systolic arterial blood pressure. It is simply measurable value at rest, but sometimes even impossible to do it during physical activity [2,3]. The aim of this study was to investigate the possibility to evaluate the systolic arterial blood pressure during physical activity by ECG parameters – heart rate and JT interval.

Methods

A model of human functional state evaluation during physical activity was applied [4]. For evaluation of systolic blood pressure calculations the data of 10 women (age average 34±3,6 years), who 3 time per week participated in healthiness aerobics exercise was taken. The investigation of cardiovascular system reactions was performed by ECG analysis system "Kaunas – Load", developed at the Institute of Cardiology, Kaunas University of Medicine [1].The standard stress test method of provocative incremental bicycle ergometry was used. The bicycle ergometry was started from 50 W power, increasing the power every minute by 25 W. The test was performed two times during one month. We used these functional indexes at rest and in each level of load (N): the heart rate (HR), the systolic arterial blood pressure(S), JT interval. For the evaluation of S we applied the double product (DP): $DP = HR \cdot S \cdot 10\text{-}2$ and analyzed the functional relation between it and JT interval during physical load. This relation we postulated by hyperbolic ($N>50W$) and linear functions ($N\leq 50W$): ,where a,b,k,m – real numbers [5].

The approximation was made by the least squares method for each person individually [5]. For the evaluation of S we used the parameters a,b,k,m from the first test and the new data HR and JT interval observed during next test: . For the accuracy of evaluation we compared the calculated systolic blood pressure value with observed value and counted the relative percentage error. We used one sided Student's t – test (probability of error 0,05) to prove, that the accuracy of evaluation is no less than 85%.

Results

The relation between double product and JT interval during physical load was approximated by hyperbolic and linear function by least square method. The relative percentage error of approximation was less than 5% for all investigated persons. In figure 1 the example of real and approximated DP(JT) for one women is given.

Figure 1. The relation between DP and JT

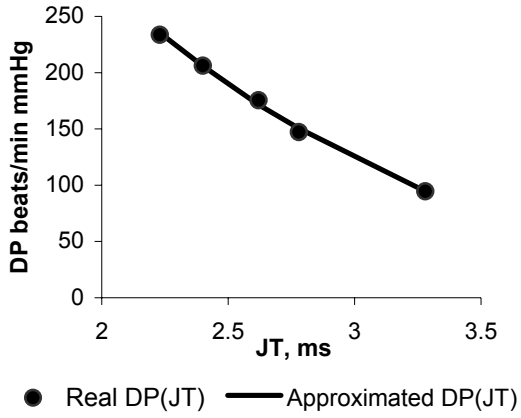
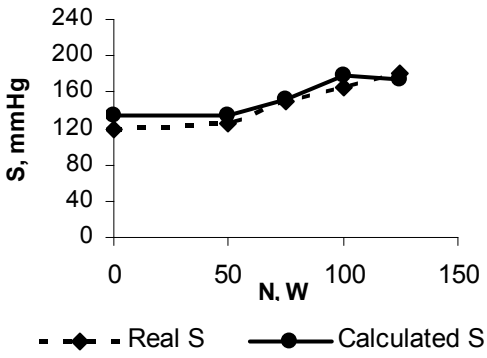


Figure 2. Real and calculated S



During the first test we calculated parameters a, b, k, m. During next test we calculated the systolic blood pressure. We estimated that the accuracy of S prediction could exceed range of 90%, if the person's functional state is stable and both tests are performed in short time (1 - 2 months). Prediction example for one woman is given in figure 2. We checked that relative percentage error of S was less than 15% ($t = -1{,}873$, $p<0{,}001$) for all persons.

Discussion

The functional relation between double product and JT interval showed the possibility to evaluate the systolic arterial blood pressure using HR and JT. According to age, gender and functional state of investigated persons it is possible to evaluate the systolic blood pressure with more than 85% accuracy. The given methodology allows to evaluate the systolic blood pressure during physical load, when conventional measurement is impossible, whereas the ECG is recorded.

Acknowlegements

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References

[1] Vainoras A, Gargasas L, Jarusevicius G, et. al. The bicycle ergometry and the possibility of complex evaluation.Lithuanian Journal of Cardiology, 1999, 6(4): 760-763.

[2] Braam R.L, Thien T. Home blood pressure measurement with oscillometric upper-arm devices. Neth J Med 2003; 61(10): 307-312.

[3] Palatini P. Blood pressures behavior during physical activity. J Sports Med 1998; 5(6): 353-374.

[4] Poderys J. The basics of the Kinesiology – Training book. Kaunas, 2004: 189 -206.

[5] Berskiene K, Aseriskyte A, Sedekerskiene V, et.al. The relation between systolic arterial blood pressure and ECG parameters. Biomedical Engineering: Proceedings of International Conference, Kaunas, 2004: 23-27.

Investigation of Cardiac Autonomic Regulation Efficiency by Means of Combined Heart Rate Variability and ECG P-Wave Morphology Analysis

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Keywords: Sympathetic/parasympathetic control of heart activity, P wave, Principal component analysis

Introduction

Activity of the heart is controlled by autonomous nervous system. This control is a result of permanent concurrence between sympathetic and parasympathetic nerve systems. Chronic fatigue syndrome, various tachycardias are caused by disturbances of this regulation. Orthostatic test is used to evoke misbalance of activity of sympathetic/parasympathetic systems for diagnostical reasons. Changes in parasympathetic activity usually are related with ECG P wave shape changes, which occur due to the migration of heart electrical excitation start point (pacemaker) in sinoatrial node or even outside of it [1]. It is also observed as non-smooth, specific changes of RR intervals [2]. However, changes of RR intervals could be caused by sympathetic or other mechanisms participating in the control process. Therefore combined investigation of RR interval and ECG P wave morphology changes during evoked sympathetic/parasympathetic misbalance could reveal valuable information about status of autonomous heart activity control of patient.

Methods

Twelve lead ECG signal recordings of various age (20 – 71 years) patients (n=53) who underwent clinical tests including orthostatic test were used for investigations. Control group recordings were made from healthy patients (n=20) in age of 21+/-2 years. Other recordings were made from patients (n=33) in age between 45 and 71 years, part of them (n=17) underwent cancellation of atrial fibrillation. Twelve bit 500 Hz rate sampling was used for ECG recordings. Structural analysis of ECG was performed in aim to detect reference points (peak points of R waves) for RR interval measurement and extraction of P wave zone (140 ms interval starting from 150 ms before R wave). The P wave zone samples (70 samples from each lead) consequently formed an array of 840 parameters representing shape of P wave during one cardio cycle. Every recording consisted of 350 cardio cycles. Two dimensional arrays (840 x 350) of parameters were representing shapes of P waves during one orthostatic test. Reduction in dimensionality and forming of an optimal set of parameters for P wave shape representation was done by means of the principal component analysis (PCA), the method which enables to retain the highest possible degree of variation present in the original set [3]. PCA transforms the original data set into a new set of vectors (the principal components) which are uncorrelated and involve information represented by several correlated variables in the original set. The vectors (the principal components) are the optimal basis functions to be used for signal decomposition. First 10 principal components were used for decomposition of array of P wave samples of every cardio cycle. Coefficients of these basis functions were used as optimal estimates of P wave shape changes.

Results

In all recordings orthostatic test was reflected by specific changes of RR intervals (Fig.1 left). These changes showed visual correlation with changes of coefficients of first 5 basis functions (principal components) used for P wave decomposition (Fig.1 right). Variety of P wave shapes in 12 leads is presented in the centre of Fig.1. Comparison of quantitative estimates of RR interval changes and P wave shape changes revealed differences between age groups. More significant P wave shape changes for the same RR interval changes observed for patients who had atrial fibrillation. Less significant P wave shape changes observed for the patients who underwent cancellation of atrial fibrillation.

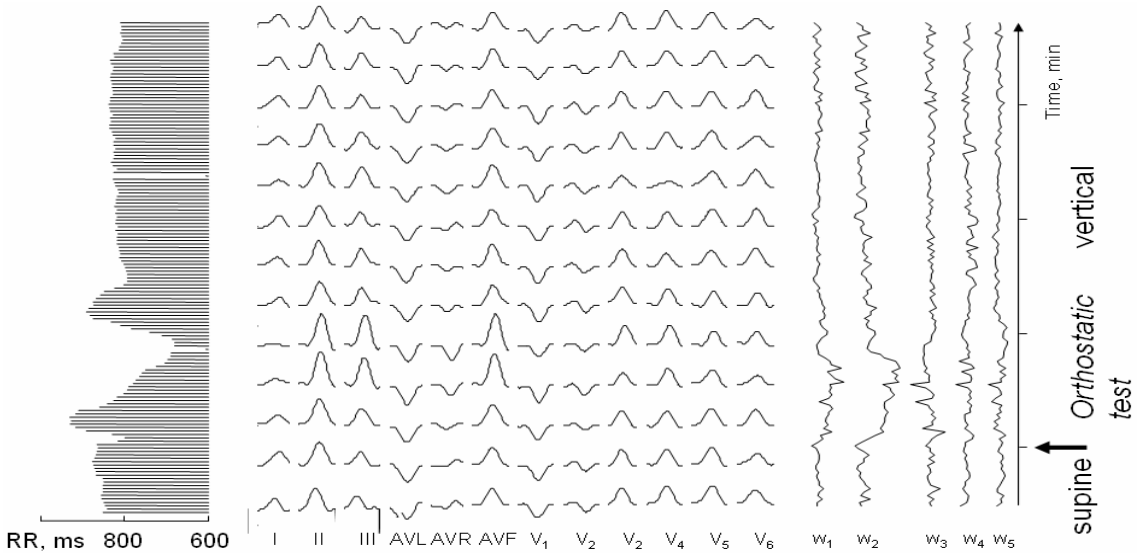

Figure 1. RR intervals, P wave variety in 12 ECG leads and values of first 5 coefficients of optimal basis functions calculated using PCA during orthostatic test.

Discussion

PCA, involving information represented by several correlated variables from original parameters set into one, concentrates variation of parameters and allows to construct an optimal quantitative estimate for morphology changes. Quantitative estimates obtained by our method comply with the age and/or pathology related trends in sympathetic/parasympathetic heart activity control reported by several authors.

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References

[1] Adomonis VM, Bredikis JJ, Bukauskas FF, Lukoshiavichius KK, Mutskus KS. [Transposition of the pacemaker in the right atrium during stimulation of the vagus nerve in the dog] Biull Eksp Biol Med. 1987 Apr;103(4):387-90. Russian.

[2] Kodama I, Boyett MR, Suzuki R, Honjo H, Toyama J. Regional differences in the response of the isolated sino-atrial node of the rabbit to vagal stimulation. J Physiol. 1996 Sep 15;495 (Pt 3):785-801.

[3] Jollife I.T., Principal component analysis (Second edition), (Springer New York, 2002) (ISBN 0-378-95442-2).

Eye Fundus Image Processing for eHealth Diagnostic System

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Keywords: eHealth, Image processing, Health services, Evaluation

Introduction

Combination of information technologies and signal processing techniques into Web based services for health system can help better diagnose diseases and even acquire new clinical knowledge [1, 2]. Web based tools give more flexibility for developers and for medical practitioners: compatibility for different computer platforms, better service and response to needs, better access using available Internet connection. Web based tools can be used in effective way combining them with signal and data processing tools such as Matlab (*The Mathworks, Inc.*). This synthesis can give flexible result, especially in system development phase.

Eye fundus images are very complicated medical diagnostic images requiring good experience from ophthalmologists to interpret them. Under project "Information technologies for human health – clinical decision support" ("IT Health") supported by Lithuanian State Science and Studies Foundation, tools and services for eye fundus image analysis have been developed. In this thesis we present eye fundus image processing framework developed for web services based on signal processing and interactive image analysis tools.

Methods

Automatic and interactive image processing algorithms were developed for the analysis of digital images of eye bottom (fundus). Algorithms are used for the extraction of quantitative and qualitative parameters for further analysis by multidimensional data processing tools. Framework of eye fundus image analysis consists of:

- estimation of the quality of eye fundus image;
- localisation of main landmarks of eye bottom (optic nerve head, macula and vasculature tree);
- segmentation of optic nerve head and vessels;
- calculation of quantitative parameters of segmented objects.

Analysis and parameterization of image is done by combining both automatic and interactive tools. This is necessary due to the big variety of eye fundus structures and pathologies. Interactive tools also are used by experts to build image analysis results for the reference for the evaluation of automatic algorithms. This is very important in initial phase of implementation of image analysis tools.

Results

For the development of image processing algorithms Matlab (*The Mathworks, Inc.*) programming environment was used. Complete framework for eye fundus image processing was implemented in eHealth diagnostic system using Web technologies: Web server, PHP, Java applets and COM objects compiled from Matlab image processing scripts.

Achieved results are:

- list of diagnostic parameters for description of eye fundus image features
- sequence of eye fundus image analysis steps
- algorithms for the evaluation of quality of eye fundus images
- algorithms of locating landmarks of eye fundus image: optic nerve disk, macula region
- algorithms of optic nerve disk segmentation and parameterisation
- algorithms for vessel segmentation: tracking and diameter measurement

Optic nerve disk is described by approximated ellipse parameters, theirs ratios, specific length, area and thickness parameters and also by ophthalmologists evaluations. Eye fundus vessels are described by specific coefficients estimating their tortuosity [3]. These parameters then are forwarded for processing with data analysis algorithms.

Discussion

Framework for eye fundus image analysis based on signal processing, interactive tools and web services was build to support ophthalmologist's decisions.
The advantages of such Web based eHealth service solution are: easy to use and access for the user, easy to test and improve for the developers. Web based system is easy to maintenance as it has only one application common for every user and guarantees user access to the last and most updated versions.
We believe that proposed framework of development, implementation and testing of e-health services could be used in other medical specialties what are using images as dermatology, neurology, ultrasound echoscopy and others.

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References

[1] Perner P. Image mining: issues, framework, a generic tool and its application to medical-image diagnosis. Eng Appl of Art Intell. 2002; 15: 205–216.

[2] Jegelevicius D, Marozas V, Lukosevicius A, Patasius M. Web Based Health Services and Clinical Decision Support. In: Duplaga M, Zielinsky K, Ingram D, editors. Transformation of Healthcare with Information Technologies, series Studies in Health Technology. IOS Press; 2004; Vol. 105: 27-37.

[3] Patasius M, Marozas V, Lukosevicius A, Jegelevicius D. Evaluation of tortuosity of eye blood vessels using the integral of square of derivative of curvature. EMBEC'05: the 3rd European Medical and Biological Engineering Conference: IFMBE European Conference on Biomedical Engineering, 2005 November 20 – 25, Prague. Vol. 11. P. 1–4.

Parameterisation of the Normal Eye Fundus Images

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Keywords: eHealth, Ophthalmology, Image processing

Introduction

Ophthalmoscopic evaluation of the eye fundus changes still remains one of the main diagnostic methods in ophthalmology. Photography of the eye fundus helps in documentation and follow-up of the development of the eye disease. Evaluation of the eye fundus images is complicated because of variety of the anatomical structures and possible changes in case of eye diseases and requires good experience from the expert.
One of the ways in which the modern information technologies can help better diagnosis in ophthalmology is the eye fundus image processing with parametrisation of the main anatomical structures of the eye fundus.
Under the project "Information technologies for human health – clinical decision support (IT-Health) the tool for parameterisation of the main eye fundus structures in fundus images has been developed [1, 2]. In this thesis we present first results of the implementation of the tool and parameters of the main structures in healthy eyes.
The main objective of this study was to determine parameters of the main structures in eye fundus images for healthy, emmetropic ("normal") eyes.

Materials and methods

Eye fundus images of the 19 healthy, 22-23 years old volunteers (38 eyes) evaluated. (permission of the Bioethics center of Kaunas University of Medicine 2006.02.05 BC-MSMF-63) All volunteers had a normal visual acuity - 1.0, (Sneelen) and emmetropic refraction. Fundus photography made in Telemedicine Center of Kaunas University of Medicine, fundus camera Canon CF-60UV*i* has been used, 60° angle, 6.3 Mpixels images taken.
Image processing was made in Biomedical Engineering Institute of Kaunas University of Technology, using existing telemedicine network and new eHealth diagnostic system [1, 2, 3]. Perimeter, short and long axis, eccentricity of ellipse, vertical and horizontal diameter, area of the optic nerve disc (OND), diameters and 4 specific coefficients, estimating tortuosity (arc/chord ratio and 3 different coefficients, using integral of square of derivative of curvature – ISDC) for retinal vessels: superior temporal retinal artery (STRA), inferior temporal retinal artery (ITRA), superior temporal retinal vein (STRV) and inferior temporal retinal vein (ITRV) have been measured.

Results

The main eye fundus parameters, measured in 38 fundus images are shown in Table 1, the main parameters of the retinal vessel tortuosity – in Table 2.

Table 1. Parameters of the normal structures of the eye fundus

No.	Structure	Average	SD
1.	Horizontal diameter of the OND (mm)	1.822	0.134
2.	Vertical diameter of the OND (mm)	2.042	0.150
3.	Ellipse short axis of the OND (mm)	1.807	0.133
4.	Ellipse long axis of the OND (mm)	2.062	0.157
5.	Ellipse excentricity (mm)	0.465	0.098
6.	Area of the OND (mm²)	2.937	0.409
7.	Perimeter of the OND (mm)	12.170	0.836
8.	Diameter of the STRA (mm)	0.128	0.011
9.	Diameter of the ITRA (mm)	0.131	0.010
10.	Diameter of the STRV (mm)	0.157	0.013
11.	Diameter of the ITRV (mm)	0.163	0.013

Table 2. Parameters, estimating retinal vessel tortuosity

No.	Vessel	Average ± SD			
		Arc/chord ratio	Coefficient 1 (10^{-5})	Coefficient 2	Coefficient 3 (10^{-6})
1.	STRA	1.054±0.038	1.502±1.213	0.019±0.012	4.036±2.499
2.	ITRA	1.058±0.053	1.502±1.201	0.019±0.017	3.711±2.475
3.	STRV	1.062±0.040	1.287±0.867	0.016±0.011	3.435±2.100
4.	ITRV	1.091±0.061	1.209±0.676	0.015±0.009	3.309±1.682

Calculation of the normal parameters and determination of normal relationship between the main structures in emmetropic eye fundus is the beginning of implementation of eHealth system into the ophthalmological practice.

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References

[1] Jegelevicius D, Marozas V, Lukosevicius A, Patasius M Web Based Health Services and Clinical Decision Support. In: Duplaga M, Zielinsky K, Ingram D, editors. Transformation of Healthcare with Information Technologies, series Studies in Health Technology. IOS Press; 2004; Vol. 105: 27-37.

[2] Patasius M, Marozas V, Lukosevicius A, Jegelevicius D. Evaluation of tortuosity of eye blood vessels using the integral of square of derivative of curvature. EMBEC'05: the 3rd European Medical and Biological Engineering Conference: IFMBE European Conference on Biomedical Engineering, 2005 November 20 – 25, Prague. Vol. 11. P. 1–4.

[3] Jegelevicius D, Barzdziukas V, Ulickiene R. Identification of the optic nerve disc boundary in eye fundus optical images. Biomedical engineering: Proceedings of international conference; 2005 October 27-28; Kaunas University of Technology, Lithuania. Kaunas: Technologija; 2005. P. 51-56.

Visualization and analysis of the eye fundus parameters

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Keywords: eHealth, ophthalmology, parameterisation of eye fundus, visualization

Introduction

In this research, the ophthalmologic data are analysed visually by using the integrated combination of the self-organizing neural network (SOM) [3] with the Sammon's-type multidimensional scaling [1, 2]. The target of analysis is to observe and evaluate visually how the numerical parameters of the optic nerve disc of eye are inter-correlated, whether they form characteristic groups, and whether it is possible to simplify the system of chosen parameters.

Methods

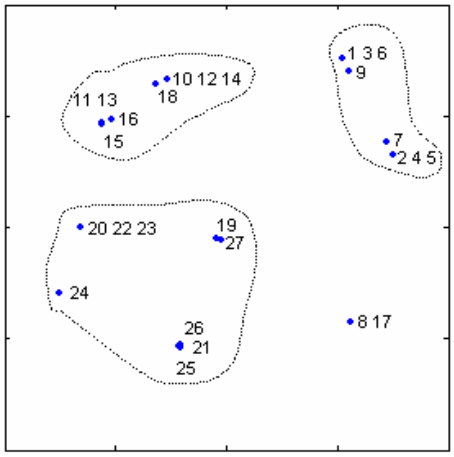
The images of fundus of eyes are analysed. 27 parameters of the fundus of eyes are measured: (a) parameters of optic nerve disc (OND): major axis of OND ellipse (1), minor axis (2), semimajor axis (3), semiminor axis (4), horizontal diameter (5), vertical diameter (6), area (7), eccentricity (8), and perimeter (9); (b) parameters of excavation (EKS) (excavation is a degenerated part of OND): major axis of EKS ellipse (10), minor axis (11), semimajor axis (12), semiminor axis (13), horizontal diameter (14), vertical diameter (15), area (16), eccentricity (17), and perimeter (18); (c) ratios between various OND, EKS, NRK parameters (neuroretinal rim (NRK) is an OND part that is not degenerated): ratio of EKS and OND horizontal diameters (19), ratio of EKS and OND vertical diameters (20), NRK area (21), ratio of NRK and OND areas (22), ratio of EKS and OND (23); (d) thickness of NRK parts: inferior disc sector (24), superior disc sector (25), nasal disc sector (26) and temporal disc sector (27). The correlation matrix of 27 parameters is calculated on a basis of 138 patients with healthy eyes or damaged by glaucoma and myopia. From the correlation matrix, a system of multidimensional vectors is restored using the method proposed in [1]. In a result, 27 27-dimensional vectors are obtained: one vector corresponds to one parameter. These vectors were visualized and decisions were made on a basis of the visualization results. The integrated combination of the SOM and Sammon's mapping [2] is used. Sammon's mapping is quite a common tool for the multidimensional data visualization. The SOM is able not only to visualize the multidimensional data, but also to cluster them. It presents the results in the form of some table. However, the table does not answer the question, how much the 27-dimensional vectors, corresponding to the neighboring cells of table, are close in the multidimensional space. The integrated combination gives the answer. In the integrated mapping, the multidimensional data are projected onto a plane by using Sammon's mapping, taking into account the learning flow of the SOM.

Results

Figure 1a shows the distribution of parameters on the SOM table, and Figure 1b presents their distribution on the plane.

1 3 6		10 12 14	18	16	11 13
9					15
7		27	19		
2 4 5					20 22 23
		21	25		
8 17		26			24

a)



b)

Figure 1. Distribution of parameters: (a) on the SOM [6x6], (b) on the plane.

Discussion

The research indicates that the parameters form some clusters. The parameters 1-7, 9 of the optic nerve discs (OND) form a separate cluster. In this cluster we can see two subclusters {1,3,6,9} and {2,4,5,7}. Parameters of excavation (EKS) 10-16,18 make a separate cluster, too. Parameters 8 and 17 (OND and EKS ellipse eccentricity) form a separate cluster. Parameters 19-27 (ratios between OND and EKS ellipse parameters, and neuroretinal rim parameters) also try to form a cluster. Here we also observe some subclusters. It allows to reduce the number of the parameters: to take representatives from each cluster. The results cannot serve directly for assistance in clinical decisions, however they will be used in developing a computerized tool for eye disease diagnosis.

Acknowlegements

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References

[1] Dzemyda G. Visualization of a set of parameters characterized by their correlation matrix. Computational Statistics and Data Analysis 2001; 36 (10), 15-30.

[2] Dzemyda G., Kurasova O. Heuristic approach for minimizing the projection error in the integrated mapping. European Journal of Operational Research 2006; 171: 859-878.

[3] Kohonen T. Self-organizing Maps, 3rd ed., Springer Series in information Sciences, 30, Springer–Verlag, 2001.