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TELEMEDICINE – EDUCATION AND PRACTICE

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ABSTRACT

Telemedicine is most commonly associated with a "long-distance" surgery in macro or micro dimensions. An example is a doctor operating on a patient who is in space or on a submarine, while he himself is in a telemedicine center found thousands of kilometers away [1]. The basis for telemedicine is the technological progress that we are observing in the last decade. Therefore, there is a need for cooperation between doctors and engineers in the fields of research, education and in offering medical services. Interdisciplinary character of telemedicine requires cooperation especially between medical and technical universities. The article presents already completed and just started telemedicine projects in Poland as a result of cooperation between Medical University of Gdansk and Gdansk University of Technology

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TELEMEDICINE

The term “telemedicine” describes two basic fields: “medicine” and “tele”, which is “at a distance”. This means that the simplest definition of telemedicine (according to Wikipedia: http://en.wikipedia.org) is describing it as “medicine at a distance”, which is a form of medicine and healthcare that combines elements of telecommunication, informatics and medicine. Telemedicine strongly depends on technology, therefore, its success in practice is determined by quality, efficiency and the cost of technology which is used. Professor F. Moohr from Leipzig, who is operating hearts with the use of remote-controlled robots, claims that the costs of such practice are very high. It can be mentioned as a curiosity that the professor’s first steps in medicine were in the Medical University of Gdansk.

Since over ten years telemedicine is being developed as part of research projects, first within the field of Health telematics and at present eHealth. Indisputably, in the area of European research, medical applications from the group eHealth have met with enormous interest. Research papers are predicting the directions of future implementations and possible practical uses. Telemedicine ideas are often ahead of current technological capabilities. However, in recent years, we have observed enormous developments in the informatics infrastructure and in cellular phone communication in Europe and in Poland. Well developed telecommunication infrastructure makes it possible, for practically everyone, to transmit basic data and medical signals, for instance ECG. It enables a constant growth of services, e.g. cardiologic telemonitoring. New technologies (for example UMTS) make it possible to develop and implement services, which can be practically used by both doctors and the patients. Apart from technological problems in the development of telemedicine there are other obstacles. Among them there are: incompatible law, ethical problems, financial problems (services cost refund) or even the psychological attitude of people (both of doctors and the patients).

However, it is certain that telemedicine will change the way doctors work. Today, we already have international agreements concerning offering teleconsultation services in medicine. An excellent illustration is teleradiology: radiology tests performed in one of the European countries are evaluated or consulted in Poland. Similar initiatives are found in the field of telepathology, teledermatology etc. Effectiveness of current telemedicine can also be illustrated by the following examples: development of technology for distance hearing test [2] (Prof. Czyzewski’s group from Gdansk University of Technology), cardiologic telemonitoring or a project of Polish cardiosurgery robot being developed in Zabrze [3].

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Telemedicine is especially suitable in travel medicine. Until recently, if a traveler is in the centre of a sea and a medical problem arose, it is a good luck if a general physician is on board, but typically there aren't any specialists available. Providing (specialized) medical assistance to ships at sea is probably one of the first practical applications of telemedicine [4,5,6]. Sea traveling time can be also fulfilled by distance learning activities. It this articles we present some medical, educational services useful for continuous education.

Telemedicine is associated particularly with modern science fields and research areas such as medical engineering, bioinformatics, medical informatics or biotechnology. Well-founded cooperation between Medical University of Gdansk and Gdansk University of Technology may be a source of further accomplishments, also in telemedicine.

TELEMEDICINE AND EDUCATION

An enormous progress in medical technology creates the need for constant education. Traditional Web-based solutions and distance learning methods can be useful [7]. Several systems were prepared for Polish users.

MedTech Service

One of results of cooperation is the MedTech teleeducational system – it is an educational and informative service called "Technology in Medicine", developed in the year 2000 [8]. It is dedicated to the use of electronics, telecommunication and informatics in acquiring, storing and processing medical data. Information presented in the service is in its manner introductory to the discussed topics. It can be the basis for technical education in various medical fields. The service was designed by a group of university teachers from the Biomedical Engineering Department of the Gdansk University of Technology (led by Prof. Antoni Nowakowski) and from the Medical University of Gdansk. The service contains more than 750 pages (A4) of information related to new technologies in medicine. The contents have been divided into 15 mutlimedia packages:

PACKAGE 1	Computer networks
PACKAGE 2	Technical standards in medicine
PACKAGE 3	Computer networks safety
PACKAGE 4	Information systems in medicine
PACKAGE 5	Roentgen systems
PACKAGE 6	Computer tomography technology

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PACKAGE 7	Nuclear Magnetic Resonance (NMR) technology
PACKAGE 8	Nuclear medicine technology
PACKAGE 9	Ultrasonography in medicine
PACKAGE 10	Electrocardiography
PACKAGE 11	Electroencephalography
PACKAGE 12	New medical diagnostic methods (EIT, thermography, magnetic methods etc.)
PACKAGE 13	Dictionary of technical terms in medicine
PACKAGE 14	Electromedical equipment safety
PACKAGE 15	Quality assurance and quality control in radiology and radiotherapy

The project was cofinanced by Stefan Batory Foundation as a part of "Internet for doctors" program. Results of the MedTech project were highly graded by a group of experts (doctors) chosen from the whole country by the foundation.

The continuously updated service is very interesting for health professionals. Around 5000 questions are registered in the service in one day. Over 100 000 users from all over the world have been copying the theme packages.

It is worth noting that the service is mentioned as implementation of "Telemedicine in education" in the following raport: E-HEALTH IN CENTRAL AND EAST EUROPEAN COUNTRIES, European Comission, DG Information Society, eHealth Unit, 2004.

Ryzyko Service

Another diagnostic educational service is a program for evaluation of cardiovascular risk factors and the risk of cardiovascular death. It can be found on the web page www.ryzyko.amg.gda.pl. After entering the required data, recommendations for basic risk factors modification are automatically generated.

Currently, there are more than 30 000 registered web page entries. The user is given recommendations in a graphic form. The medical community asked us to describe management algorithms according to the calculated risk. The program contains also a didactical part. It enables the Internet user to observe the influence of his risk factors modification on his risk level.

There is ongoing work on further expanding the service by adding, among others, visualization of risk distribution according to geographical localization.

KNOW Project

Cooperation between universities of the Pomeranian Region – Gdansk University of Technology, Medical University of Gdansk, the University of Gdansk and Gdynia Maritime University – made it possible to create inter-university Educational Platform. The project was called KNOW – distance learning that supports raising professional

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qualifications. In the year 2005 financing was obtained from the European Social Fund, Integrated Regional Development Operational Program (ZPORR). Within the project, courses using the technology of distance learning were designed and carried out, among others: "Ethics of an organization", "Treatment of chronic pain for family doctors", "Radiological diagnostics".

Within the platform, it is possible to access many courses and training sessions (connected both to the KNOW project and to other projects, for instance MedTech).

There is an interesting course offered within the project KNOW, which is called "Ethics of an organization". Many participants of this course are management professionals in health care. The content of the course was organized and designed by Michal Wrzesinski, Ph.D (Australia) and a group from the Medical University of Gdansk (Prof. Janina Suchorzewska, M.D. and Dr Marta Michowska, M.D.). During the course there was a videoconference with a teacher from Australia.

The course "Radiological diagnostics" (coordinated by Prof. Michal Studniarek, M.D., Dr Joanna Zielonko, M.D.) is prepared based on interactive environment which enables to learn radiological anatomy using set of images with indicted regions of interest. There is a great interest in the course "Treatment of chronic pain for family doctors", prepared by Prof. Janusz Siebert, M.D., Dr Zenobia Czuszynska, M.D., and Dr Marek Suchorzewski, M.D. Course is divided into ten learning modules and covers different practical aspects of treatment of chronic pain.

All participants of the first course received certificates of course completion and diplomas.

The second course using distance learning technique will be completed by the end of 2006. This does not mean, however, that the cooperation will end. Further tools aiding teleeducation and teleconsultations are being developed. The following belong to them: interactive medical document project (web page editor together with radiological data files DICOM and other digital medical data files), image content based search system, etc.

A new quality in electronic medicine constitute the elements of an epidemiologic diagnostic system included in the projects ordered by the Health Care Informatization Center. These are: "System of dispersed medical data acquisition and data warehousing" – a project which has been realized and implemented (test phase) and "Use of artificial neural networks in analysis of open database acquired from the population of family doctors' patients". Both tasks are performed together by the Medical University of Gdansk and Gdansk University of Technology.

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TELEMEDICINE FOR A FAMILY DOCTOR

In the Pomeranian Voivodship there are over 1000 doctors practicing primary care as family physicians. The doctors' offices are dispersed up to 180 km from the academic center.

This population reports the need for a system including:

1. the so-called rapid information system,
2. rapid medical consultation system (consultation with a doctor),
3. integrated educational system,
4. integrated laboratory diagnostics system.

These four elements are covered by the term telemedicine. Therefore, a form of realization with the use of telemedicine is indicated. What aids accomplishing this task is tight cooperation between the Medical University of Gdansk and Gdansk University of Technology. An interuniversity research center has been created, which consits of:

- Department of Biomedical Engineering, Gdansk University of Technology
- Department of Machine Construction and Exploitation, Gdansk University of Technology
- Department of Family Medicine, Medical University of Gdansk
- implementation unit

Proposal for the creation of a common field of study has been submitted.

At present, a new project is being developed: "Complex medical diagnostics system in prevention and monitoring diseases of patients in the Pomeranian region". The goal of this project is to start cooperation between a group of family doctors in the Pomeranian Voivodship and highly specialized medical laboratories, rapid diagnosis centers and consultations with the Medical University of Gdansk.

This project will involve, among others, evaluation of logistic and informatic communication necessary for basic and specialized medical laboratory diagnostics.

In the first stage, the project assumes cooperation of family doctors with specialized laboratories of ACML. The general rule is to obtain basic tests at the Point of Care Testing (POCT) which is a local laboratory organized in a family doctor's office. Essential laboratory and informatic equipment will be provided for the offices as a part of POCT project. Specialized testing would cover full laboratory diagnostics profile. The project will include a system of consultations of the family doctor with representatives of the various medical disciplines.

The cooperation leads to development of first informatic tools:

- dispersed system of education, consultation and experience exchange in the field of family medicine,

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- system of ordering tests and exchanging laboratory test data,
- dedicated communicator for sending text, email and sms'es,
- ECG teleconsultation system,
- system for gathering and exchanging medical images.

As a result of project realization and implementation of the complex medical diagnostics system an improvement can be assumed in:

- clinical supervision of patients,
- monitoring of chronic disease treatment,
- therapy control,
- patient-doctor relationship,
- medical decision making,
- promptness of diagnostics,
- patient health and satisfaction,
- patient access to specialized tests,
- family doctor satisfaction,
- decreasing costs.

CONCLUSION

The basis for today's data exchange techniques is digital technology. Digital technology enables to produce almost all medical data in digital form and send it using digital communication methods far away to/from ship on sea or space ship. Further research is required to improve methods of digital, medical data acquisition and secure exchange.

As part of cooperation between the Medical University of Gdansk and Gdansk University of Technology many common telemedicine projects have been realized. It is not possible to mention all of them in this short article. Naturally, this excellent cooperation will continue to grow with the benefit to both universities and the community of the Pomeranian Region.

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