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Telemedical Solutions -
Practical Approach in Bulgaria

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1. Introduction

The electronic communication network is an umbrella term, which generally is associated with computer and communication through modern information and communication technologies. These structures allow the workflow of data at different time and from different locations, using an e-mail address lists, electronic forums, online conferences, etc. The exchange of information over the Internet is a standard procedure, the main component of network communications and technological achievements, but this approach in the field of medicine and healthcare actually changes patients' lives!

Life in a network allows us to create virtual communities of various specialized organizations and entities working together on specific issues through the exchange of information. In essence, the Internet is a democratic, social and non-discriminatory information and technological environment, the ideal instrument for achieving common objectives which provide unpredictable opportunities for individual systems and experts.

Users of the World Wide Web in all its aspects and forms get more data, information, evidence, knowledge and experience through:

exchange of information substrates implementing technology tools and services to assist the communication process new automated methods of information processing conglomerates and statistical evaluation of any information products change in qualification - both for training and skills in technology assisted work.

By definition, telemedicine is a branch of medicine based on telecommunication and information technologies to ensure medical services and work as their main goal is quality care for all patients regardless of their location and social position.

Today the main priorities of medicine are: in economic terms - the financing of medical science and development of medical work to achieve higher efficiency; at international level - to what extent the poor and developing countries imitate the patterns of rich countries with expensive technologies and how to standardize and make consistent the information activities; in research plan - new technologies and sciences which serve medicine, how, in what dose, and appropriate application.

eHealth is strongly dependent on economic policy, infrastructure investment patterns and changes in health care facilities that provide opportunities to implement advanced technological solutions. Other fundamental factors are the pricing policy and legal framework and organization of this new kind of payments and services. There are no regulations and standards for the exchange of information and transfer of personal data

processing and storage. The staff is not well trained in terms of computer skills, which means investments in education and changes in the curricula of medical colleges and universities.

Business models and management approaches should first seek benefits for patient satisfaction by providing healthcare services through easier access. Professional communities must also be motivated by promotion and presentation of the advantages and benefits about:

- methods for data presentation;
- methods of access;
- methods for data integration;
- network services.

Notwithstanding increasingly aware of the role of IT in healthcare and global experience with proven benefits of eHealth, its introduction is associated with number of obstacles to overcome:

- Difficulty in converting these data - the necessity to integrate and digitize
- Standardization of medical records – personal information is stored from the patients, and on the other hand – locally, in the hospital. When all the participants are connected in the process of health care we will have continuous updates and a single database. Overall, this is a problem in any kind of systems, not just for medical ones.
- Confidentiality - in healthcare, this parameter refers both to the information stored on paper and data in electronic format
- Hardware limitations - the effective practice of an EHR system requires the presence of sufficient number of computers - desktops and notebooks in a hospital
- Inertia - Most large organizations have opposed the changes. The shocking transition to a new system in each institution should be made by the governing bodies. According to studies, introduction of the EHR system comes within the so-called 80/20 rule, i.e. - 80% of the work involves issues of managing change and only 20% work - technical issues

The standard medical practice, as such, exists from the Hippocrates times - face to face contact with a suffering patient, personal experience to suggest accurate treatment and legitimacy to the laws in Bulgaria are just some of the advantages and established standards of practice. On the other hand, paper documentation that is still the practice in our healthcare system, the possibility of intentional or accidental error, lack of sufficient practical experience in a particular case, present just some of the factors that describe the current status of our system as old-fashioned, unsatisfactory and risky for the health of the patient.

However, telemedicine is facing many other problems that lead to fear and reluctance from consumption of new working models. It requires modern standards of employment, security for the patient by several expert opinions, prevention and minimization of possibility of errors in the final diagnosis, the provision of care 7 days a week, 24 hours a day. Of course, the difficulties and obstacles in this scheme of work, which are related to the willingness of medical experts, placed in a competitive regime, the lack of ethical and legal frameworks that limit abuses and skills required to work with information technology are only a few of the barriers to implement that service.

In this chapter the standard medical practice will be discussed contrasting it with telemedical solutions and benefits based on deep investigation and SWOT analysis. The term telemedicine will be presented with 60 different definitions and comments, in

combination with a basic set of workstations for telemedical consultations. For the purposes of the investigation an inquiry model is realized, evaluating telemedical systems with 61 basic questions.

Tasks that we have pointed out in this chapter are to offer a short historical overview of telemedicine in Bulgaria, to demonstrate juxtapositions between different specialized terms as telemedicine, telemetry and telematics; to present one Bulgarian solution for telemedical services, to discuss the pros and cons from three different points of view – patients, doctors and hospital managers.

2. Investigation of telemedicine – SWOT analysis, confrontations, definitions

Health is the foundation of human life and therefore it must be supported by effective policies and actions in the country members of the European Community and worldwide. Article 152 of the EC Treaty requires "the development and implementation of all policies and actions to ensure a high level of protection of human health."

From January 1, 2007 provisions of EU regulations governing matters of social and health insurance are directly applicable in Bulgaria - in the context of the right of free movement of people within United Europe.

Bulgarian citizens who have continuous health insurance rights under Bulgarian law, if necessary, may use medical assistance in countries of the European Community.

eHealth challenges include developing common standards and interoperability of health products, systems and services at European level.

Given the recent accession of Bulgaria to the EU, it is an appropriate and timely investment in the development of eHealth in the country.

According to the National Health Development Strategy 2008-2013 [50] the following are outlined as key priorities:

• Providing health services on-line;
• Implementation of electronic health cards.
• Implementation of personal electronic health records.
• Implementation of integrated software applications for processing and sharing information in real time, including: electronic directions, recipes, expert findings, laboratory and diagnostic data, etc.
• Development of complex integration models, working with external applications and systems.
• Creation of hospital information systems for electronic medical records.
• Construction of required infrastructure for normal functioning of healthcare system - networks that connect devices, and other devices.
• Construction of appropriate infrastructure for the deployment of telemedical applications.

eHealth, by definition, is a rapidly developing field where medical informatics, public health, supply of healthcare services and modern information and communication technologies interact. It features technology development for improvement of health services at local, regional and global levels.

The European Commission published in April the results of an Europe-wide survey on electronic services in healthcare (eHealth), which found that 87% of GPs use a computer, 48% have a broadband connection. Doctors in Europe store and send data electronically to patients, such as laboratory results.

According to the submitted study entitled "Evaluation of ICT use among General Practitioners in Europe" eHealth applications play a growing role in medical practice.

Advantages	Weaknesses
Needs of patients	respect, uncertainty and even fear of the unknown, arising from outdated entity, where medical informatics has no fixed place
access to care	lack of highly qualified specialists in the field of communication services
immediate assistance from specialist	lack of professional culture and teamwork with experts from other fields
24-hour coverage by a doctor for all hospitals	interactivity is achieved through a terminological language - communication strategies
Needs of specialists	
opportunity to communicate with all specialists in fields/community	
earlier medical intervention	
reduction illness time	
saves lives	
improved methods and treatment regimens	
medical advice and constant support at any time,	
at any place, any condition	
part of the digitalization of society and health care	
reform that reduces health inequalities	
construction of a modern technological infrastructure and information systems	
change of quality of medical work and training of experts in the most accessible way	
interactivity and good practices	
Opportunities	Impendences
improved access to the needy of health care qualitative improvement and effectiveness of diagnostic and therapeutic activity	lack of sufficient entrepreneurial spirit and motivation among professionals
benefits and satisfaction of patients and medical professionals	not popular business models of behavior and application of these services
Information Management	political management methods from the recent past, marked by different political motives
different communities - professional and patients	legislation
modernization of health policy	lack of regulations and pricing

Table 1. SWOT analysis of the Telemedicine as a new type of practice [48]

Standard medical practice		Telemedicine	
For	Against	For	Against
tradition of medical practice – changing with the generations		simultaneous operation of several organizations	costs for equipment
tested in time – fixed and accepted as routine practice		simplified and standardized process	knowledge of electronic standards and requirements
paper does not require any technology	risk of information loss	improved health services	new public nature of the profession
face-to-face contact	expenditure of financial and time resources to remote patients and their families	provision of care anytime, anywhere and by anyone	problems with persuasiveness and reliability
subjective – the record is done by one author	possible errors or omission	transfer of various data formats	Perceptions of staff to work with the new system
Law legitimacy	opportunity for abuse and manipulation of information	various forms of diagnostic techniques	competency requirements for more than narrow specialization
written responsibility, verified with personal signature	delay in time	consultation with multiple specialists together	competitive moment
results of communication with patients	poor results of aging assets	Provision of care 24 hours at home	ongoing commitment
		education from a distance in real time	Pricing - Who decides?
		human interaction - PC	PC equipment
		objectivity of opinions	ethical issues
		reduce professional isolation	Lack of political will to implement
		increased confidence by specialist	Institutional will
		providing the best experts in the field	prudence
		new working standards , fast and efficient , information transfer Real teamwork	lack of legal framework

Table 2. Standard medical practice vs telemedicine [48]

Basic applications of telemedicine in Bulgaria today are:
- Clinical telemedicine
- Military (and other specialized types of specializations) telemedicine
- Other health care information systems with various functions

- Remote training and retraining of experts and creation of new health concerns, consumer standards and mass cultural practices of users of these services, activities and expertise resident in the complex dynamics between health and disease.

Telemedical practice can be divided as follows:

1. technical devices for recording and transfer of data to the required distance
2. technologies, asisting medical decisions
3. experts to interpret the specialized information
4. agreement for real-time management of patient from a distance

The need for specialized information stems from the scope of work and medical practice relating to:

Key objectives of information systems in medicine are:

- projection and automation of entire information process to achieve the minimum possible risk of error
- improve and accelerate the selection of management decisions, planning and forecasting
- regulate information exchange in vertical and horizontal direction
- relief staff in its routine activities
- modification in the exchanging system with the environment - in this respect, telemedicine and computer networks are a genuine revolution in the filling and retransmission of data gathering and any kind of multimedia.

Key tasks that computer systems in medicine pursue:

- Unambiguous classification of information and processing of international standards that ensure objectivity, comparability and adaptation in operation modes and their possible use by other experts and classifiers - resources, statistics, diagnostics, certificate, health insurance, research and training
- Standardization of methods for retrieval of medical information and its carriers by type (computer file - Electronic Medical Record)
- Automation of processes input from various devices, technical and technological facilities and equipment (clinical and paraclinical)
- Coding and total control of information through design of menus, dialog with a PC, which guarantees the same standards
- Creation of databases for objects of local IP connections to other databases, with access to software, designed for different users

Telemedicine - method for remote consultations, personalized medicine by distance. Thus conceptual correlation value of the selected title in the enrichment of already developed or in designing new CIS adds additional feature that allows medical practice without physical contact, working from multiple different locations and at different time, repeatability and verifiability of decision processes and management choices of the source.

Telemedical functions aim to change the characteristics of medical work, which allow practice under evidence-based medicine, often described as a scientifically based medicine.

Defining the term telemedicine

Telemedical essence is a basic and fundamental type of service, a version of eHealth.

The variety of technological solutions in eHealth applications correspond to the following aspects:

- Tele-medicine / Tele-health
- Web Health Services
- I-medicine / I-health

- Cyber-medicine / Cyber-health
- Medicine online
- High-tech medicine
- Website and Portal

Telebridge in medicine and health [68]

1. Type of information (History of disease, video, X-rays, microscopic samples, data from literary analysis, etc.)
2. Transmitting medium (telephone line, satellite);Telemedicine is the main application area, where the following components are present:
1. Technology (measuring instruments, monitoring systems, channels of contact and communication video, workstations, databases, expert systems, etc.).
2. Medical education (distance education, computer workstation, and international inter-university educational programs)
3. Medical science
4. Library databases and knowledge systems
5. Social Medicine
6. Clinical Medicine
7. Health Policy
8. Management, law and of administration
9. Medical specific areas of knowledge (space biomedicine and ecomedicine, disaster, military telemedicine, etc.).
10. Interdisciplinary areas and activities, related to theoretical and applied aspects of human health.

The origin of the term telemedicine is a formation of two parts: "tele" in this phrase originates from the term "telematics" and added to the medical interpretation as a kind of modern medical science, practiced by means of telematics.

In it's contemporary sense, the actual concept of telemedicine exists since 1924. It appeared in the U.S. in Radio News article, the cover painted with a doctor who examines the patient and sends his results on the radio and the new chain scheme "Doctor on the radio. The first demonstration was made in 1951 at the World Fair in New York and in 1955 Dr. Albert Dzhutras began teleradiology practice in Montreal. In 1959 for the first time were transmitted diagnostic results between United States and Canada by coaxial cable.

Also, Cecil Whitson from the Institute of Psychiatry in Nebraska began the first courses in teleeducation and telepsichiatry. In Bulgaria, the theme is related to the development of aviation medicine and its basic methodology - aviation biotelemetry into a new mode - space medicine.

The term telemedicine was introduced into medical literature in 1974 by RGMark (Telemedicine system: the missing link between homes and hospital Mod.Nurs.Home-1974, N 32 (2). In the MEDLINE database there are previously published works which concerned the concepts of its place, role and possible development, without mentioning the term itself.

According to the Telemedicine Glossary [66]: "Telematics is the use of information and telecommunication technologies and services, usually in individual combinations to meet the specialized medical and consumer health needs and problems.

Telemedicine can be defined as a "system to expand and enhance the capabilities of medicine through electromagnetic field (EMF), suggesting a variety of information and management functions [67]."

For many, a commonly accepted definition is hard to designate, but there are several clear principles that are enshrined in the integrated multiple components of medical practice:

"The use of electronic information and communication technologies to deliver and maintain healthcare services, when distance separates the participants." [30] These technologies have applications in providing any care for the sick, education, research, administration and health care, overcoming distance and isolation [2]. Probably the most comprehensive is "Telemedicine covers everything from health, education, information and administrative services that can be transmitted at a distance via telecommunication technology." [40] "Telemedicine is a logical development of the first medical consultation by telephone, made at the beginning of XX century ". [41] Indeed, from a technical standpoint, it performs rational development and integration of informatics in medical practice.

"Telemedicine is the use of telecommunication technologies as a medium for delivery of medical services - diagnosis and patient care in locations that are remote from the supplier." This concept covers everything from the use of standard telephone service to high speed digital signals between computers, optics, satellites and other peripheral devices and software.

Another definition, that focuses more on the tools that telemedicine provides: "Telemedicine is based on the use of electronic communication and information technologies to provide or support clinical care from any distance." [1]

"Remote alternative medical practice - via telecommunications and video technologies, used for education, transmission of medical or other specialized data and its subsequent processing." [70]

According to the American Telemedicine Association: "The subject of telemedicine is transmission of medical information between remote points, where there are patients, doctors or other health care providers. It involves use of telecommunications to link diagnosis, treatment, advice and continuous training. [79]

In the next few specific definitions, the term is interpreted from a technical rather than a medical perspective, focusing on the means of transmission of information and methods of transmission:

"Telemedicine is the rapid provision of medical knowledge at a distance using telecommunications and information technologies, regardless patients location and the necessary information about his case. [18]

Section of medicine that deals with the remote control of the pilots health , astronauts, and then about a decade afterwards has become very famous and popular as telemedicine. [30]

"Telemedicine is one of the applied fields of medical science with systemic nature, which supposes combination of medical apparatus with telecommunications network equipment, software and specialists from several areas. [29]

"Unique variety of system applications of telecommunication technologies for medical purposes." [115]

"It is a combination of medical and technological systems implemented on the basis of computing and telecommunications, medical consultation, diagnosis and choice of therapeutic effects from distance and control of medical resources." [116]

"It is a system for delivery access to modern medical resources, a conglomerate of funds and complexes for potential realization of modern information and telecommunication technologies in medicine and healthcare, in harmony with the respective financial and legal certainty." [34]

"The tasks of research and development in the field of telemedicine are expressed in association between information and communication technology in a way that will provide services in health medicine and ability to systematically use the medical resources that are outside the local organization." [117]

A definition, which essentially illustrates this development, was published in 1990 in a paper in «Clinical Informatics in Medicine, Pathology and pediatricians»: "Telemedicine is the introduction of built-in Medical Information Systems (MIS) - new technological tools for data processing, now united as an entire technology systems for communication to create, distribute and store information products (data or knowledge) with minimal loss in order to carry out remedial and diagnostic activities, training and administration of patients in need in the right time and place. [18]

At http://ritmru.chat.ru/ [82], one of many sites, dedicated to the development of telemedicine in Russia, are published about 15 interpretive definitions of telemedicine from the most popular Russian authors.

"It is unity of telecommunications and information technologies for medical or health purposes. This must be done cost effectively by stimulating growth and usability of medical resources, which could be attainable through deployment of intellectual resources to establish information management systems." [118]

"The scope of telemedicine is to transmit medical information between distant points where patients, physicians and other providers of medical care and services are situated between medical establishment purposes: diagnosis, treatment, advice and continuous training." [1]

"Telemedicine is a system of agents, complexes and methods that realize the potential of modern information and telecommunication technologies in medicine and healthcare, in harmony with legal regulations, licensing rights and standards of work, corresponding to financial security." [66]

Distance is also cited as a major digitalization of medical services and activities and their intended transmission when it is necessary. This capability is achieved thanks to the unique connection principles of all participants in the therapeutic-diagnostic process.

To enrich the functional range of conversion, the process of medical and paramedical information would be used not only for treatment but also for training, organization, management, and control and business functions.

"Telemedicine is a system for accomplishment of remote medical expertise in any circumstances. It incorporates three main components: the domestic (and other non-clinical) registrations and care (the use of various types and quality biosensors) and centers for collection and analysis of received information, which work together." [73]

"It is not a tool that you buy to examine patients. It is important to remember that its impact is much greater than what we've seen when it introduces a new method and methodology in our work. This is the result of complex interaction of advanced technologies and human factors that would inevitably lead to social changes. The success of these changes and their usefulness is dependent on many different people - consumers and experts who work together. " [10]

This is the place to quote the original definition of Medical Informatics, Edward Shortliffe:

"Medical informatics is the study of rational ways for interpreting the patient's condition and its treatment approaches, which we define and develop over time; an examination of how medical knowledge is formed, distributed and applied." [62]

Telemetry	Telematics	Telemedicine
Use of telecommunications for automatically indicating radio beacons or recording measurements at a distance from the measuring apparatus. [107] Scientific method for measuring, registration and transport of medical data through communication tools. Transmission of data (i.e. registered and measured variables) - they can be measured and recorded manually and automatically	Refers to industry related to computers, interconnected via telecommunication devices and systems. This includes dial-up services to the Internet [108] Scientific method for data and / or information with selected communication tools. *Transmission of data and information with selected ICT*	Method for providing medical services, where distance is a critical factor. These services are performed by medical professionals, using information and communication technologies (ICT) for obtaining information needed for diagnosis, treatment and prevention. [95] Scientific specialty, which aims to realize the transportation of medical and health data and information through ICT between unlimited number of experts in real and / or another selected time/ experts. Automated or automatic transmission of data and information through ICT.
Scientific method, associated technology of automatic recording and transmission of data from a remote source to receiver. [103]	Combination of resources and services in computer science and telecommunications. [109]	Use of ICT the provision of medical care from a distance. [94]
Transmission at distance of measured values by radio or telephone coded amplitude, frequency, phase and pulse. The data are received and stored on a remote station. [92]	Technology that allows converting digital images to analog. [110]	Use of computers, Internet and other communication technologies to provide medical care to remote patients. [57]
Electronic device that carries specific data (measurements) to a remote receiver. Data are recorded electronically. [119]	Refers to the synthesis of various technologies, which generally are telecommunication technologies, computers, methods of data processing [111]	Telemedicine is not sub discipline of medical and therapeutic aids and surgical specialties. This concept includes the availability of telephone system, high-speed system for information transmitting through fibrooptics, satellites or

		combination of terrestrial and satellite communication technologies. [49]
Process of measuring quantities from a remote location, which is recorded and further processed by another one. [9]	Focal function between telecommunications and informatics (information science). [14]	Medical care at a distance - the images are transmitted, because patient and treating physician are not located at the same place. [76]
Computer-based monitoring and communication with remote objects. The term comes from the Greek tele = remote, and metron = measure. [120], [105]	Telecommunications and Informatics show the relationships between IT systems, digital data, etc. [107]	Integrated system for providing medical care using telecommunications and computer technology rather than direct contact between patient and doctor. [25]
System through which a signal is transmitted to a remote location in order to control the process, to perform specific functions and tasks. [25]	Realization of relationships between computer and information technologies. [41]	Provision of medical assistance to any point on the globe, using combination of communication technologies and medical expertise. [23]
Linkage, registered through specialized equipment using radio signals [95]	Wireless communication system designed for storage and dissemination of data. Applications: electronic systems in the industry, mobile phones, tracking vehicles and GPS systems, health and emergency assistance. [52]	Rapid provision of medical knowledge at a distance using telebridge and information technology, regardless of where the patient is located and where the information is needed. [109]
Technology, including wireless transmission of signals. The term is used to define the electronic technology, used for registration of several mechanical functions and sending process to a remote receiver.[32], [40]	Science for transmitting, receiving and storing information via telecommunication systems. [53]	Combination of medical information systems, fundamentally new means and methods of data processing technologies, integrated into a comprehensive system providing the creation, transmission and storage of information products - data and knowledge - in order to conduct therapeutic and adequate diagnostic measures, and perform the necessary

		training at the necessary time. [91]
Measurement of different electrical parameters by using feedback from a particular receptor device. In the T-level - the lowest level at which the signal stimulates the recipient and identify irritation. [35]	Integration of wireless communication technologies to create systems and monitoring devices. [54]	Method for remote assistance and exchange of specialized information on the basis of modern telecommunications technologies. [48]

Table 3. Comparison Telemetry / Telematics / Telemedicine [48]

Our definition of telemedicine is: Information network organization based on information and communication technology that connects medical experts together for medical care delivery from a distance.

Progress in the informatics science leads to personalized care and prevention of diseases, in contrast to longer treatment episodes in the status "invalid". The patient plays a major role in automated systems and telemedical networks.

In detailed steps, telemedicine can be described as a combination of:

1. Specialized monitoring, care and support for the sick through the use of systems that enable access to expert advice and information, regardless of the places where the need and source of information are located.

2. Application of electronic information and communication technologies to offer medical care and support, in the case of distance between actors.

3. Delivery of healthcare where the distance factor is prevented from applying any medical and health methods through the use of information and telecommunication technologies such as the right to exchange information concerning diagnosis, treatment, prevention of diseases and injuries, research, further training, continuing education and health care interests that are related to health and its preservation.

4. Any activity, which is a manifestation of health care (including diagnosis, consultation or advice, treatment and monitoring) that normally exhibit a professional and a patient (or two professionals, if located at the different places) and it is implemented through exchange of information and communication technologies.

The mainstream media where the telemedical system functions is the Internet. There are versions of medium - telephone, webcasts, specialized hardware for videoconferencing systems, but as a general definition from 90s, web-space is the chief mediator and underlying factors for operation of telemedical systems.

What benefits should Internet suppose?

- Accessibility of each
- Efficiency
- Low cost
- Compliance
- Possibility of transmission of any data
- Opportunity to record videocommunication
- Relatively high literacy in a Web environment

Based on the international experience and tendencies, and reflecting the above advantages, it can be concluded that for the development of e-health and telemedicine in particular, the

necessary condition is an effective technology infrastructure (ICT) at each level in the health sector to ensure communication and transmission of information via the Internet.

Configuring the telemedical system

In Bulgarian medical hospitals, clinics and other private institutions have particular projects and implementations, which are not sponsored by the government. We have Leonardo Da Vinci in Pleven city, several solutions for the Military academy and few projects in medical hospitals. There are different projects in separate wards and departments, which often even are not popularized and published in the press and special journals.

The main stakeholders in Bulgarian healthcare system are the Parliament, the Ministry of Health, the NHIF and the Higher Medical Council. A number of other ministries own manage and finance their own health care facilities, including the Ministry of Defense, the Ministry of Internal Affairs and the Ministry of Transport. Private practice has expanded significantly, now including dental practices, pharmacies, physicians' surgeries, laboratories and outpatient clinics and polyclinics.

There have been advances in overall investment for the IT sector in Bulgaria as well as for IT in the healthcare system. In 2005, information and communication technology expenditure accounted for 3.77% of GDP and there were 59 personal computers (PCs) per 1000 inhabitants in 2004, compared to 47 in 2001.

Use of the Internet is also increasing. A recent survey conducted by the Alpha Research Agency found that 53% of adult Bulgarians used the Internet in 2010.

IT enjoys an ever-expanding application in outpatient care medical centres and in hospitals. Thanks to a financial donation from the World Bank, every GP now has a PC workstation and all PCs report in a digitalized format. In 2003, the Ministry of Health together with the Ministry of Finance and the NHIF countersigned the so-called "road map" setting forth the particulars of the coming incorporation of a diagnosis-related group (DRG) system within the reporting processes of hospitals. According to the "road map", and with the support of USAID and 3M Health Information Systems, a pilot project with 43 hospital beneficiaries was developed and implemented. 2004 marked the second year in which the relevant data necessary to calculate relative weights were collected. The National Centre for Health Informatics is also currently working on a project related to the introduction of uniform information standards within the health system under which in 2004–2005 all regional health care centers were updated with modern IT equipment.

The Health Card is one of the key technologies currently being developed and introduced in Bulgaria for health sector optimization, more efficient transactions between the health care institutions, more secure, flexible and transparent exchange of information, standardization of services and activities, and ensuring future interoperability with other European countries and healthcare systems. At the time of writing, there is no exact information about the dates for the launch of the system.

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A telemedical system is basic set of workstations connected to each other, designed to bridge the knowledge in clinical medicine and scientific tasks using telemedical procedures.

The simplest system is a telemedical link between patient and nurse through a telephone line - fixed or GSM. More complex systems include video surveillance and audio connection. They consist of high standard telephone lines, digital information technology, computers, peripheral equipment, satellite connection and software security. In dissertation "Telemedical functions of Medical Information System", published at http://eprints.nbu.bg/view/subjects/MET.html are discussed in details different solutions, schemes and configurations.

It is not yet known throughout the country form of telemedical connection between two hospitals that provide continuous contact of experts, available for patients, permitting remote consultations by sending some kind of standard tests and images.

Telemedical Information System (TIS) is by definition an information system implemented to provide telemedical services and has several components (attributes):

- Hospital Information System
- Electronic Health Record
- Systems for Image Processing
- Health Information Network
- Applications for support of distance learning

The purposes of a TIS can be determined:

- Registration of selected key information in the data source
- Provide a platform for automated processing of that information
- Communication platform for its transmission
- Provision of expert support with a choice of clinical decisions
- Ensuring confidentiality during transmission of patients` personal data
- Assisting the patients in managing their own health

For the Bulgarian healthcare system, as for every other too, there are strict requirements for healthcare delivery and payment organization. Before starting the practical work for development of software we have analyzed the hospital structure, working personnel, technology infrastructure – both, PC periphery and specialized medical apparatuses, etc. We have developed special Questionnaires for each user that was expected to work with the software.

After processing the inquiry results, our working team pointed out the following tasks:

- development of software for telemedicine purposes where the user should identify every single step with a digital signature – requirement from the Ministry of Health.
- development of web portal for popularization of the project
- assurance of the required technologies:
- Laptop with camera, microphone and audio system for every General Practioner (GP) in the municipalities
- Digital stethoscope and digital ECG apparatus for distance transmission of data
- Specialized videoconference software for communication between the users

- Professional hardware for videoconference rooms

Doctors use four types of forms – „Consulted", „Not checked", „Consulted but with necessity for more information" and „Returned forms with additional information". After starting a request for consultation there are the following types of fields:

Paraclinic examinations - Identical with the paper original: blood tests, patomorphologic, urine tests, image examinations (ECG, X-ray, Echocardiography, Velotest, Holter, Scanner, Mammography and etc.)

Unlimited number of uploads are allowed – both for the consulting and giving consultations experts; also zooming of the image to the original size.

User parameters that the system registers are name, action, host, ip address, day, month, year, hour, minutes and seconds. It allows filtering of any of the above mentioned parameters, Microsoft Excel export format of the references, chronology control.

The Administrator performs a connection between users and software developers, which is realized as an e-mail box with all the standard parameters.

The system has 69 different statistics.

1. *Doctor statistics* - From date to date; Number of required consultations; Number of accomplished consultations
2. *Hospital statistics*
- From date to date; Number of required consultations; Number of accomplished consultations
3. *References with export to Microsoft Word, Microsoft Excel and with graphical visualization:*
- Number of consultations per period
   - Filtering through start and end date, level of consultation
- Number of consultations with result 'hospitalization'
   - Filtering through starting and ending date, level of consultation
- Percentage distribution according to specialists
   - Filtering through start and end date, level of consultation and specialty
- Number of consultations with second consultation
   - Filtering through start and end date, level of consultation
- Percentage distribution of correspondence between working and final diagnoses
   - Filtering through start and end date, level of consultation
- Percentage distribution of final diagnoses according to disease types
   - Filtering through start and end date, level of consultation

4. One of the most important statistics is actually the chronology of the system and control of each activity of every person

We have accomplished 150 consultations and 2000 registered activities. Our purposes are to adopt the model and to implement it in 5 municipalities at first and afterwards in every municipality on Bulgarian territory.

What types of patients is this healthcare method intended for?

1. For patients with "no time" - particularly active and financially supported to seek maximum quality of service they want to vote and to participate in making "the second / other opinions.
2. For patients with "no option" - single adults and people with a bunch of diseases who are in a physical difficulty to contact a doctor.
3. For patients with "no contact conditions" - those who can not receive direct medical services due to any unique circumstances and large contingents of people (from living in remote locations to space flights and military operations).

4.   For patients like "I have the right of consultation" - prompted by the Constitution to regulate access to health care with the appropriate quality and prices should be clearly defined by the authors and be affordable for consumers.

Our software solution is implemented in 2 remote hospitals – Aeroclinic in Sofia and Municipal Hospital in the town of Svoge which is about 50 km far from the capital. According to the Personal Data Protection Law (PDPL) "processing of personal data" means any operation or set of actions that is made in respect of personal data by automatic or other means, such as collection, recording, organization, storage, adaptation or alteration, retrieval, consultation, use, disclosure by transmission, dissemination, making available, alignment or combination, blocking, erasure or destruction of data [37].

In remote consultation only initials of names, sex and age of patient are used.

The other protection method, covering the legitimacy of the diagnosis, is the electronic signature that the system requires to start working with.

Under Bulgarian law the electronic document signed with a valid digital signature is fully equivalent to the corresponding paper. The recipient of the electronic document does not need to possess a digital signature.

We have developed a representative analysis with 19 points that clearly shows the benefits form telemedicine.

Comparative analysis

In order to illustrate the merits, while outlining the challenges, facing the Bulgarian telemedicine, we will present a popular and close by construction, but far more extensive, solution - HEALTH OPTIMUM project.

This is European international project that involves 3 countries – Italy, Denmark and Spain. Italy participates with 6 neurosurgical telecounselling centers and Tele-laboratory; 1 telecounselling center and 1 tele-laboratory for Spain, and in Denmark – tele-diabetes center and tele-cardiology center.

The HEALTH OPTIMUM comprises the following services:

Tele-counselling - general hospital specialists/GP requests the opinion of the tertiary hospital specialists on a clinical case. The service can be provided according to various modalities:

-    Asynchronously (secure e-mail type interaction) - the requesting professional sends the query to the tertiary hospital specialists and waits for a reply. The maximum delay in replying to a query must have been agreed beforehand between the requester and the tertiary hospital. Both the request and the counsellor answer make use of standard forms, agreed among all the actors involved in the tele-counselling. Such forms must contain all the clinical and anamnesis information needed to provide a feedback through tele-counselling. Moreover such forms must be validated through digital signature according to EU and national regulations.

1.   Interactively (through videoconferencing facilities) - in this case the healthcare professionals can talk and see at each other, sharing information about the patient. This modality normally requires booking an appointment with the tertiary hospital specialist as in the case of a normal referral unless standby or emergency arrangements are in place between the requesting party and the tertiary hospital.

2.   Virtual referral - general hospital specialists or exceptionally a General Practitioner carries out a virtual referral with the tertiary hospital specialist while the patient is in his/her clinic. This service normally requires booking an appointment with the tertiary hospital specialist as in the case of a normal referral unless standby or emergency

arrangements are in place between the requesting party and the tertiary hospital. Notification services

- This family of services will notify the referring medical doctor (general hospital specialist or GP) about relevant events concerning the evolution inside the tertiary hospital of the patient they have referred. Three types of events requiring notification have already been identified in a previous eTEN project (C³ - Comprehensive Continuous Care): Notification of Admission; Notification of Transfer and Notification of Discharge (this includes death as one of the possible reasons for discharge).

Before	After
Transport to hospital	Instant Consultation
Using an expert	Using more experts
Paper archive	Electronic data base + paper archives
Losses in transmission of data and research	Digitized archive of record with 2 seats
More costs to the patient / relatives	Less cost to the patient / relatives
Multiple visits	Number of visits
Expenditure of time for specialist	Only if necessary
Healthcare in hospital	Healthcare at home
Isolation of experts	Improving relations in expert community
Charge for the hospital:	Only if necessary
- For professionals	Only if necessary
- Transport	Only if necessary
- Time	Only if necessary
- Technology	Off with long-term returns
Loss of time for patient	Only if necessary
Limited disease prevention	Disease prevention
Patient access to specialists at the local level	Patient access to specialists at national level
Need for direct contact with national specialists	Remote specialist consultation at national level
Limited free time	Increase the creative work

Table 4. Before/after implementation of telemedical software analysis [48]

Shared clinical records - a referring general hospital specialist and tertiary hospital specialists will have access to the same set of patients clinical records during a virtual referral or during the entire stay of the patient in a tertiary hospital. This allows the referring specialist not to lose touch with his/her patient.

Tele-laboratory - it allows to carry out tests which are usually executed inside a clinical laboratory practically in any place thanks to portable analysis equipment which can be checked remotely, data transmission and a PKI infrastructure which guarantee the authenticity the confidentiality and the legal value of the data transmitted. [122]

Throughout Bulgaria is not yet known form of telemedical scheme between two hospital units that provide continuous contact between the experts, available for patients and permits remote consultations by sending any kind of standard tests and imaging, as parts of the DH (disease history) treated.

TELECONSULT is organized as follows:

- Main software desktop solution, divided according to the operational level into three main parts– three different management modules that are developed according to the requirements and necessary functions for each participant in the telemedical process.
- Audio and video streaming through specialized software.
- Video communication through newly developed application with individual virtual rooms, locked and password protected meetings.

With this integral solution is performed the ability to verify whether a receiving physician presents; if the receiving system is able to process the transmitted files and whether the receiving system has approved all prior files. Each patient is identified only with age, sex and physical conditions, in order to keep the patients privacy and confidentiality.

Expert's module is designed and conformable to the specific telemedical consultation characteristics – each variant of consultation: required, consulted, not checked and with request for more information, is differentiate with its own color. The system checks every 30 seconds about newly arrived requests for consultations, and ensures sound and visual signalization to attract the expert's attention.

The operator's module is the main coordinator in the system, where the Operator manages the expeditiousness of the process of giving consultation, and in case delay of 24 hours, the system allows redirecting the form according to the available specialists. In case of few requirements for the same specific condition consultations arrive at the same moment, the system distributes through the available specialists in the corresponding specialty.

The Administrator performs functional connection between users and software developers, which is realized with system mailbox. He has the authorization to make any kind of statistics for anybody at any time.

Administrator's panel is developed in order to assure the correct performance of the processes, committing full access to every single user parameter that the system registers: name, activity, host, ip address, day, month, year, hour, minutes and seconds. The system allows filtering of any of the above mentioned parameters, Word & Excel export of the references, chronology control, and graphical representations in bars. Statistical basis is organized in 69 different sections. In order to prove the usability and benefits from telemedical investments, there are two statistics about percentage of application for a medical expert and for a hospital.

The comparative analysis is developed on the base of published and accessible documents for both projects.

The asterix indicates that the value of the first 4 parameters is doubled, because of their importance and significance to the realization of telemedical solutions. The rest: are also important, but required for any kind of software solution.

Teleconsult performs videoconsultaions through specialized software, Health optimum states that the interactive form of consulation is done through video-conferencing facilities, where the healthcare professionals can talk and see each other and thus share information about the patient.

Teleconsult doesn't have Telelaboratory, Health Optimum develops four

In Bulgarian practice still it is not familiar as a working model the HL7 standard, while Spain, Denmark and Italy investigate efforts.

DICOM is not implemented and used in Teleconsult, in contrast to Health Optimum.

IDC 10 is introduced in both system as working coding system.

By Notification services we mean services, ensuring that the experts attention would be kept and he would be able easily to asses the situation. In Teleconsult there are 4 types of consultations: Required, Consulted, Not checked and With request for more information, while in Health Optimum are performed as follows: Notification of Admission; Notification of Transfer and Notification of Discharge.

Email connection is with 2 points for both softwares, because Teleconsult has internal email system within the software solution. It doesn't perform, for example – patient-doctor connection. Health Optimum, on the other site organizes secure e-mail type interaction - the requesting professional sends the query to the tertiary hospital specialists and waits for a reply.

Exchange of files and records is well organized in Teleconsult, because it allows sending and receiving any kind and format of documents. Health Optimum experts have access to patients' clinical records in a single data repository.

PKI infrastructure in Teleconsult is represented with digital signature – requirement of Bulgarian law, the system requires authenticity of medical specialist – the private key is connected to his unique ID number, when any action is performed by him in Teleconsult. In Health Optimum data transmission and a PKI infrastructure guarantee the authenticity, confidentiality and legal value of the transmitted data.

Emergency arrangements is a parameter, that ensures fast reaction from the system itself, when there is an urgent situation. Teleconsult guarantees express actions, which include light and signal alarms. Health Optimum performs asynchronous services through secure e-mail type interaction, where the maximum delay in replying to a query must have been agreed beforehand between the requester and the tertiary hospital.

Clinical anamnesis information is presented through introduction of concrete data from the patient's record. In Health Optimum – the experts have access to the whole patient's record from a centered repository.

Multilingual interface – Teleconsult is developed into Bulgarian and English, while Health Optimum is a three different countries product

Both systems get 2 points for System verifications. Teleconsult consultation forms have obligate fields, which filled incorrect, do not allow sending the request.

Teleconsult executes 69 different references and system statistics.

Archive is well organized in Teleconsult with high level of security and RAID 5.

Level of introducement – Teleconsult is a national project within 2 hospitals, while Health Optimum is an international development.

Specialists on call use the company network with a private ADSL (or ISDN) – both software solutions ensure that parameter.

Teleconsult can perform GPRS connection, but at the current moment this feature is not specifically developed. Tele-laboratory makes use of the existing company network for

connections to elderly homes and a GPRS or similar connection with mobile POCT devices for use in home assistance.

HIS connection with the telemedical module has 4 points for Teleconsult, because actually it is pat of a HIS. Health Optimum works within a hospital institutions but it is not clearly stated that it is part of a HIS.

Teleconsult has 4 points for Open system, because it is organized easily to update and expand.

Multifunctional system. We haven`t found data about System statistics, Archive and Open system for HEALTH OPTIMUM.

The maximum result of the 23 parameters analysis is 84. HEALTH OPTIMUM is with 77% accomplishment, while Teleconsult is with 68%. The system allows unlimited number of participants, but to the current moment different legal limits and obstacles do not allow spreading.

Comparative analysis

System / Parameter	TELECONSULT	Health Opitmum
Videoconference connection *	4	2
Telelaboratory *	0	4
HL7 *	0	3
DICOM *	0	4
IDC 10	4	4
Notification services	3	4
Email connection	2	2
Exchange of files and records	3	2
PKI infrastructure	3	4
Emergency arrangements	4	2
Clinical anamnesis information	3	4
Multilingual interface	3	4
System verifications	2	2
System statistics	3	No data
Archive	3	No data
Level of introduction	National	International
ADSL connection	4	4
GPRS connection	1	2
HIS connection with the telemedicine module	4	3
Open system	4	No data
Multifunctional system	4	2
	58	65

Legend: 0 - missing; 1 - bad organization;   2 - exists; 3 - good organization; 4 - excellent organization

3. Conclusion

eHealth and its practical application options are necessary, inevitable part of electronization of society. This requires not only investing in technology, but also to think about training and qualifications of medical experts to offer it as an important and effective version of healthcare services.

The results of the surveys from three different points of view – patients, doctors and hospital managers, confirmed the usefulness of such a decision. More than 4/5 of patients find it satisfactory and do not worry about the lack of physical contact with the treating expert. Physicians reported their positive attitude about this contemporary method of work, supporting it in about 90%. Of course, our findings are based on a limited number of statistical observations.

Clearly recognized is the natural caution and even fear when introducing a new practicing method - both for the quality of provisioning methodology and technology, either for data protection and natural tendency towards tradition of natural communication, we believe that we have made the first step. There are no registered complaints and mistakes; the intake is a natural and good feedback. It is important to indicate the originality of presented telemedical system - in our country there is lack of experience, no attitudes, limited research and publications.

On these grounds we can determine Teleconsult as an example of High-tech medicine. Patients should have personal respect and a culture of their own health management - to seek and comply personal medical and health data and information. Clinical approbation and subsequent implementation show that more than 60% of consulted patients are reallocated after hospitalization for teleconsultation and in over 25% there is a positive effect on hospitalized with a result – reduce of their hospital stay. In more than 10% of cases is demonstrated complete consistency between the views of consultants.

4. Acknowledgment

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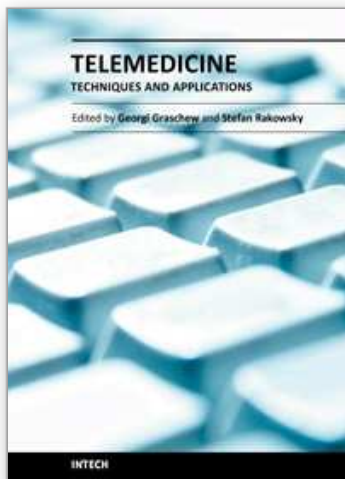
Telemedicine Techniques and Applications

Edited by Prof. Georgi Graschew

ISBN 978-953-307-354-5

Hard cover, 514 pages

Publisher InTech

Published online 20, June, 2011

Published in print edition June, 2011

Telemedicine is a rapidly evolving field as new technologies are implemented for example for the development of wireless sensors, quality data transmission. Using the Internet applications such as counseling, clinical consultation support and home care monitoring and management are more and more realized, which improves access to high level medical care in underserved areas. The 23 chapters of this book present manifold examples of telemedicine treating both theoretical and practical foundations and application scenarios.

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