Telemedicine in Cardiology - Perspectives in Bosnia and Herzegovina

Nabil Naser¹, Salih Tandir²,
Edin Begic³

¹Polyclinic "Dr Nabil", Sarajevo, Sarajevo, Bosnia and Herzegovina

²Faculty of Medicine, University of Zenica, Zenica, Bosnia and Herzegovina

³Faculty of Medicine, Sarajevo School of Science and Technology, Sarajevo, Bosnia and Herzegovina

Corresponding author: assistant prof Nabil Naser, MD, PhD. Polyclinic "Dr. Nabil", Sarajevo, Sarajevo, Bosnia and Herzegovina. ORCID ID: <http://www.oecd.org/0000-0002-1278-8574>. E-mail: nabil@bih.net.ba

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ABSTRACT

Introduction: Aim of article was to present perspectives of telemedicine in the field of cardiology in Bosnia and Herzegovina. **Material and methods:** Article has descriptive character and present review of literature. **Results:** Information technology can have the application in the education of students, starting from basic medical sciences up to clinical subjects. Information technologies are used for ECG analysis, 24h ECG Holter monitoring, which detects different rhythm disorders. By developing software packages for electrocardiogram analysis, which can be divided and interpreted by mobile phones, and complete the whole of the patient in the ambulance, specialist, experienced specialists, or even consultations in various illnesses and cities. Image segmentation algorithms have significance in the quantization and diagnostics of anatomic and pathological structures, and 3D representation has an important role in education, topography and clinical anatomy, radiology, pathology, as well as in clinical cardiology itself, especially in the sphere of coronary arteries identification in the multislice computerized angiography of coronary arteries. Interactive video consultations with subspecialists from the state and the region in adult cardiology, adult interventional cardiology, cardiovascular surgery, pediatric invasive and non-invasive cardiology enable better access to heart specialists and subspecialist, accurate diagnosis, better treatment, reduction of mortality, and a significant reduction in costs. **Conclusion:** Telemedicine by slow steps in entering the soil of Bosnia and Herzegovina, but the potential exists. It is necessary to educate the medical staff, as well as to provide a tempting environment for software engineers. Investing in infrastructure and equipment is imperative, as well as a positive climate for its implementation.

Keywords: telemedicine, cardiology, software engineering.

1. INTRODUCTION

Today, it is almost unimaginable to operate, that is to provide quality health information and services and exchange information between health care providers without modern information technologies and links (1). Until recently, the communication took place completely in paper form, and large part of the effective working hours of healthcare workers was used to fill out forms, daily, monthly and other reports (1). Constant development of the technique has increased the success of diagnosing and treating patients, thus increasing the amount of data that the doctor needs to review in order to make a proper decision. This is aided by modern technology for automated medical data processing. Recently, there has been a synthesis of already existing telecommunication

systems and computers with modern medical equipment. One of the most famous services that represent the combination of everyday medical life and the latest technology is telemedicine (1). At EU level, the introduction of electronic healthcare means easier access to health services, regardless of geographic location, all due to innovative solution. E-health breaks down the existing barriers by enabling healthcare providers (public institutions, hospitals, etc.) from all member states to work together (1). It was necessary to wait almost half of century for the emergence of sophisticated devices based on electronics, which enabled the transmission of images of satisfactory quality. Although more sophisticated technologies, such as virtual reality, are still unacceptably expensive, the cost of other applications is steadily decreasing, so

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telemedicine services become available to people in more and more countries. Telemedicine services are of particular importance to remote and poorly developed regions, providing quality diagnostics and remote treatment (2). The idea of telemedicine is derived from several human needs, some of which are: The increase in the standard of living has led to an increasingly pronounced demands of health service users that the level and quality of each, including all medical services are equally distributed to the population.

Knowledge and experience is often concentrated in the heads of highly-specialized healthcare specialists, which number is very low compared to number of people worldwide living and working around the world. When providing medical services, a doctor often has the need to consult professional literature as well as consult with colleagues who are usually geographically distant and also have their daily schedules. The demand for more efficient work of medical doctors (number of patients during the working day) that is set by the administration is constantly present for several reasons (mostly economical), and every way to save time in the work is welcomed, especially if that leads to cost reduction (2). There are several definitions of telemedicine, some of which have been emphasized on the direct application of information technology (IT) to patient health, and some in the focus of the problem pose IT management and the issue of distance information transmission. Most people, including doctors themselves, under the term "telemedicine" include video conferencing, where experts are consulting, informing or educating (2). Telemedicine is more widely defined as the use of information technology for the transfer of medical services and information from one site to another. The World Health Organization has adopted the following definition: Telemedicine is a way to provide medical services, using telecommunication and information technologies, regardless of where geographically the healthcare provider, patient, medical information or equipment is located (2). The division derives from how telemedicine can be used, so that the following telemedicine services can be discussed:

- Teleconsultations (providing remote access to any medical specialists or information located in the electronic knowledge base);
- Telediagnosics (setting a patient's diagnosis by a doctor who has no direct contact with the patient and with the assistance of medical information,
- Telemonitoring (remote monitoring of physiological parameters of patients, most commonly in chronic patients who do not require permanent hospitalization);
- Telecare (therapy of patients outside the physical frames of a health institution);
- Telemedicine (education and training of medical staff outside their institution, remote access to databases through telecommunication channels,
- Telemedicine is a way of medical information transfer from one place to another, with the use of modern information and communication technologies, enabling provision of medical services regardless of the physical location of the doctor and patient.

It is important to understand that telemedicine is a process rather than a technology. The telemedicine process has become increasingly feasible thanks to the ad-

vancement of technology, all in order to reduce costs (2). Telemedicine has been present in clinical medicine for the last 30 years, but has only started to develop significantly during the last 5 years. Electronic health (e-Health) applications are the base of telemedicine. They should be easy to use and the information they provide should be accurate. The quality of education should be improved so that the computer can provide healthcare workers with an optimal use of the e-Health strategy. This also implies improving the quality of education of computer users—a patient who needs knowledge to properly access health information. Also, another way to ensure the success of e-Health is to lower Internet access prices so that more people can access the health information network, especially people in developing countries. In addition, there is another important issue regarding the law and their adherence to the privacy and confidentiality of e-health users

2. AIM

The aim of this study is to present perspectives of Telemedicine development in the field of Cardiology in Bosnia and Herzegovina

3. MATERIAL AND METHODS

Article has descriptive character and present review of literature about Telemedicine in Cardiology.

4. TELEMEDICINE AND CARDIOLOGY

Telemedicine is a branch of e-health that uses communications networks for delivery of healthcare services and medical education from one geographical location to another (9).

E-Health applications should be easy to use and the information they provide should be accurate. The quality of education should be improved so that the computer can provide healthcare workers with an optimal use of the e-Health strategy. This also implies improving the quality of education of computer users—a patient who needs knowledge to properly access health information. Also, another way to ensure the success of e-Health is to lower Internet access prices so that more people can access the health information network, especially people in developing countries. In addition, there is another important issue regarding the law and their adherence to the privacy and confidentiality of e-health users. Cardiology has always been an attractive discipline in which a lot of resources has been invested, and as such has been a perfect ground for innovations. The use of telemedicine in cardiology is reflected in the following:

1. Information technology can have the application in the education of students, starting from basic medical sciences up to clinical subjects (3).

2. Information technologies are used for ECG analysis, 24h ECG Holter monitoring, which detects different rhythm disorders. By developing software packages for electrocardiogram analysis, which can be divided and interpreted by mobile phones (3), and complete the whole of the patient in the ambulance, specialist, experienced specialists, or even consultations in various illnesses and cities. Many, if not most, of hospitals (in the developed world) apply PACS technology

(Picture Archiving and Communication Systems). PACS is a contemporary, computer alternative for paper and film archives. It is an integrated system consisting of medical diagnostic devices, servers, workstations for data access, a computer network connecting system components, databases and interfaces to other systems (e.g. hospital and radiology information systems—HIS and RIS). The foundation of such a system on web technology allows data to be accessed from different locations within the medical facility as well as from remote locations outside of that institution. Thus, the system incorporates the functions of teleradiological services and systems for archiving, retrieval and review of medical recordings and patient's data. The implementation and analysis of the ECG can be shared through the aforementioned system (4). The software package has long been available with the stethoscopes.

3. Image segmentation algorithms have significance in the quantization and diagnostics of anatomic and pathological structures (5), and 3D representation has an important role in education, topography and clinical anatomy, radiology, pathology, as well as in clinical cardiology itself, especially in the sphere of coronary arteries identification in the multislice computerized angiography of coronary arteries (many free and commercial software packages have been developed that deal with the aforementioned topic).

4. Many mobile applications are available, even in the form of a mobile clinical decision support system, and enable the physician to diagnose the pathological condition alone. We should not forget about the many applications used in the fitness sphere, and which follow the cardiological parameters (6,7,8). Mobile applications are in the sphere of ECG diagnostics and interpretation, echocardiography, rhythm disturbance detection, patient value evaluation, risk assessment of specific diseases, titration of anticoagulant therapy, and in the training of specialists, both in noninvasive and invasive diagnostic methods. Mobile applications also provide patient training on a particular pathology and enable the patient to reach additional knowledge of the pharmacology of the substance, particularly pharmacodynamics and pharmacokinetics of the medicines. Alarms for taking the drug to the patient are of great benefit. Mobile applications that show the interaction of certain substances can be of a great assistance to physicians through all three levels of health care.

5. Telemedicine has its significance in detecting and treating acute conditions in cardiology. It has enabled the training of personnel in the treatment of acute conditions in cardiology, and already many certification courses of survival are handled through this system.

6. Multimodal presentations of cardiovascular procedures are already in use.

7. E-health represents the use of information-communication technologies to meet the health needs of citizens, patients, health professionals and healthcare institutions. An electronic health system (or health information system) is an information and management system that supports the health care process as a whole. E-card is a systematic collection of electronic information on

the health of a single patient or population, which is kept for easier access to information, treatment calculations, disease screening, and reduced need for manual administration. The E-card itself provides a more accurate diagnosis, as well as treatment through certain segments of the health care system. E-recipe is a substitute for a classical recipe issued by doctors. The advantage is reflected in reduced administration costs and possible problems arising from classical doctor prescriptions. E-referral is sent electronically from the doctor to the laboratory with the indicated analyzes and the receipt of these results. E-Health Card is a multifunctional smartcard that is being developed as a replacement for a classic paper health card that can easily make changes to the insured person as well as adding information about electronic receptions, laboratory M-health shortened to mobile healthcare is the term used in medical practice and public health services through mobile devices.

8. Interactive video consultations with subspecialists from the state and the region in adult cardiology, adult interventional cardiology, cardiovascular surgery, pediatric invasive and non-invasive cardiology enable better access to heart specialists and subspecialist, accurate diagnosis, better treatment, reduction of mortality, and a significant reduction in costs.

9. The term home surveillance monitoring is part of the future, if not even the present, of cardiology.

10. Video consultation between physicians for the treatment of patients with subspecialist character impose as an imperative.

11. Monitoring of a patient under specific diagnosis and at home-care is also a great benefit to the physicians as well.

12. Titration of therapies for many cardiovascular diseases and simultaneous monitoring of vital parameters (with additional cardiological parameters) of patients under home conditions for whom specific therapy is applied may lead to a significant increase in the treatment success. Titration of certain pharmacological agents is sometimes avoided, and patients are treated with another, less-expensive drug due to lack of hospital bed and long-term stay. Video monitoring of patients and doctors in specialist institutions would certainly contribute to the treatment of certain cardiovascular pathologies.

13. Data collection at Cloud Servers would allow access to data from many locations, which would be of great importance for hereditary diseases as well as for illnesses of subspecialist nature.

5. TELEMEDICINE AND CARDIOLOGY IN BOSNIA AND HERZEGOVINA

Bosnia and Herzegovina can follow the development of telemedicine as well as the use of information technologies in cardiology itself. The development of mobile applications, the development of various software solutions, and the development of software systems and communication networks require interaction between experts and electrical and medical professionals, additional medical education, the enthusiasm of software developers, as well as presenting biomed-

icine and medical informatics to younger generations as a prospective branch to make good progress as well as financial stability. Investment in infrastructure is essential (supply of medical centers with new generation equipment). Currently, the individuals and enthusiasts dealing with telemedicine through the prism of mobile applications and PACS systems, but this is still the beginning. It should be borne in mind that there is evident potential in this area.

6. PROBLEM SOLVING

It seems quite clear that e-Health is more than just technological development. According to G. Eysenbach: "E-Health is an emerging field, encompassing medical informatics, public health, relating to health services and information delivered or enhanced over the Internet and related technologies. In a broader sense, the term features not only technical development, but also state of mind, thinking, attitude, global thinking, to improve health care locally, region- ally as well as around the world, using information and communication technology".

In 2004, the European Commission adopted a plan for the introduction of e-Health services, on the basis of which the member states need to have elaborate national strategies by 2010. A possible problem for the use of telemedicine or information technology itself in medicine is primarily related to poor quality of software solutions and poor connectivity, with inadequate software maintenance. Reliability and availability is a key issue, as many of these systems can be critical life-supporting systems (10). If these two traits are confirmed, the use of telemedicine is well justified and necessary (11).

Other issues are related to ethical questions, which can nevertheless compromise the patient. However, the protection of personal data as well as the relationship between a doctor and a patient is a two-way street. There is a need for the development of numerous ethical bodies, as well as supervision agencies, which would validate and provide a certificate of authenticity as to basic mobile applications, as well as large software solutions. Everything that is used directly in practice must pass through some form of research, in order to issue a certificate of use, which may again be a problem.

7. CONCLUSION

Telemedicine by slow steps in entering the soil of Bosnia and Herzegovina, but the potential exists (12-23). It is necessary to educate the medical staff, as well as to provide a tempting environment for software engineers. Investing in infrastructure and equipment is imperative, as well as a positive climate for the its implementation.

With all the other benefits that modern biomedical disciplines provide to scientists, experts, and ordinary practitioners in organizing and performing healthcare practices today, we have the undoubtedly the greatest benefit of using modern information technology.

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