

THE DEVELOPMENT OF TELEMEDICINE IN IMPROVING ACCESS TO HEALTH CARE IN REMOTE AND ISOLATED AREAS

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SUMMARY – Telemedicine is a relatively new way of clinical practice. It enables rapid access to remote medical expertise by means of telecommunication and information technologies, no matter where the patient or relevant expertise is located. The focus of the telemedicine project was to improve access to quality health services and to reduce the isolation of remote health care. Almost every clinical specialty has used telemedicine in some way, even though radiologists, cardiologists, dermatologists, and psychiatrists have been the clinical specialists most actively involved in telemedicine. In order to put the system to life in the isolated areas such as islands, it is necessary to keep the system functioning 24 hours a day. The need for consultations through telemedicine appears in real time, and not at an expected moment. With the development of a new information age telemedicine has been slowly incorporating into all aspects of medical practice.

Key words: Telemedicine – utilization; Quality Assurance health care; Primary health care; Technology assessment; Rural health; Croatia - island

Introduction

We are living in the information age. Computers have made inroads into almost all areas of medicine. Electronic transmission of patient information is becoming a significant part of our clinical practice. Telemedicine technology has been growing rapidly as a new way of medical practice. It has proliferated throughout the industrialized world, reflecting the convergence of scientific, technological, economic, and social factors.

History of Telemedicine

The practice of telemedicine may be dated to the early 1960s when the National Aeronautics and Space Administration (NASA) first put men in space. Demonstrating that physiological functions (heart rate, blood

pressure, respiration rate, and temperature) for astronauts in space could be monitored successfully by physicians on earth, NASA's scientists developed sophisticated biomedical applications¹. NASA's experience brought into sharp focus the parallel between the needs of an earth-bound physician trying to monitor, diagnose, and treat an astronaut in space and the needs of equally earth-bound physicians trying to diagnose or treat a patient in a remote location. The first interactive video link was established in 1964 between the Nebraska Psychiatric Institute in Omaha and the Norfolk State Hospital, 112 miles away. The first complete telemedicine system was installed in 1967, linking the medical station at Boston's Logan Airport to Massachusetts General Hospital². In 1985, a satellite network was put up to offer telemedicine services to remote areas of Queensland in Australia to improve access to medical care. In 1989, NASA conducted the first international telemedicine project, Space Bridge to Armenia, after a powerful earthquake had struck Armenia in December 1988. This

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project was extended to Russia to aid burn victims of a terrible train accident. After that this new form of medical practice caught attention of many professionals, agencies and governments because telemedicine was seen as a more cost-effective way of delivering medical and health care.

Definition of Telemedicine

Telemedicine means “distant care”. The prefix, from the Greek *telos*, implies distance. Telemedicine is a delivery of medical care when the patient and physician are in different physical locations. It uses information and telecommunications technology to transfer medical information in order to support diagnosis, therapy and education, and to provide and support health care when distance separates the participants³. It includes transfer of different kinds of information: basic patient information over computer networks, transfer of different kinds of images such as radiographs, computerized tomography (CT) scans, magnetic resonance imaging (MRI), ultrasound images, video images of endoscopic or other procedures, patient interviews and examinations, consultations with medical specialists, and medical educational activities.

The concept of telemedicine implies a variety of activities such as:

- teleassistance, where direct connection is established between the physician and a distant or isolated patient;
- telemonitoring, where the physician is being transferred information on a particular patient;
- teleconsultation, where the process of consultation is performed between the physician and a physician, or between physician and a patient;
- tele-expertise, which implies physician-to-physician consultation;
- video-conference, where a tele-expert provides consultation to physicians or patients;
- telesurgery, where a procedure is being performed with the assistance and guidance of an experienced surgeon; and
- tele-education, a possibility of acquiring medical knowledge.

Each of these activities is expected to improve the level of healthcare as well as the availability of physicians to every patient, at any place, and in the fastest and most efficient way⁴.

Considering the enormous role of telemedicine in current healthcare systems, it is of paramount importance to introduce telemedicine in practice. Telemedicine as a computer-based communication technology offers enormous potential for applications in medical practice and education. Telemedicine simplifies the exchange of medical and health information, knowledge, and education by bringing specialists and subspecialists to several different locations without travel. Patients get broader access to expertise and second opinions without travel. The technology offers not only the multidisciplinary care of patients but also allows for direct communication between various complementary and geographically distant consultants in different fields.

Types of Technology

Telemedicine covers a range of technologies, including telephone, radio, facsimile, modem and video, and uses various terrestrial and space-based (satellite) transmission media. Two different kinds of technology make up most of the telemedicine applications in use today⁵. The first, called store and forward, is used for transferring digital images from one location to another. A digital image is taken using a digital camera (“stored”) and then sent (“forwarded”) by computer to another location. This is typically used for non-emergency situations, when a diagnosis or consultation may be made in the next 24-48 hours and sent back. The other technology, two-way interactive television, is used when a “face to face” consultation is necessary. The patient and physician are at the originating site. The specialist is at the referral site, most often at an urban medical center. Videoconferencing equipment at both locations allows for a “real-time” consultation to take place.

Applications of Telemedicine

Almost every clinical specialty has used telemedicine in some way, although some have used it more than others. Radiologists, for example, have embraced the technology on a large scale. Cardiologists, dermatologists, and psychiatrists have been the clinical specialists most actively involved in telemedicine.

Radiology. Teleradiology systems electronically transmit radiographic images and consultative text from one site to another. With the transmission of images to the radiologist, he is able to provide prompt interpretation of radiological images. The immediate availability

of image data leads to early intervention and improved patient treatment⁶.

Cardiology. At present, telemedicine is applied in cardiology at several levels. First is the traditional patient-doctor relationship but at a distance. The patient in a remote center is equipped with easy-to-use devices that can transmit relevant diagnostic data *via* telephone or Internet to the physician's computer. Second, telemedicine can be applied for consultations among medical experts similar to those in other medical branches. Third, telecardiology has found application within hospital information systems (HIS) open to external users *via* Internet⁷.

Dermatology. Dermatologic services are improved through the extension of the clinical expertise of metropolitan dermatologists to rural providers and patients and through enhancements in the diagnostic abilities of primary-care physicians⁸.

Psychiatry. Telemedicine is one of the possibilities of providing mental health care in the primary care environment, meaning the well-known and close environment in which the patient lives. The application of the telepsychiatric model is especially efficacious in consultative interventions, education, diagnostic procedure and therapeutic models.

Neurology. "Telestroke" model. Stroke is the first cause of disability and it can be treated by using recombinant tissue plasminogen activator (rt-PA), but only in the first three hours after the onset of symptoms. These facts have encouraged the University Department of Neurology, Sestre milosrdnice University Hospital, the Reference Center for Neurovascular Disorders of the Ministry of Health of the Republic of Croatia, to connect different university departments of neurology at hospitals all over Croatia into a unique information network that will enable transfer of all data on stroke patients. The Telestroke model enables providing the best possible medical care for stroke patients in every part of Croatia, transmission and exchange of patient data between different centers, and online consultation of specialists and subspecialists⁹.

Emergency. The opportunity to provide teleconsultation in an emergency is one of the most valuable achievements of telemedicine. Depending on the health problem and the patient condition, a specialist consultant may help the general practitioner by giving his advice how to provide complete care to the patient.

Education. Tele-education is defined as the use of telecommunications technology to deliver education from a distance. The aims of tele-educational activities are:

1. medical education of professionals,
2. education of patients and public about health matters, and
3. enabling people for active learning using new technologies.

Telecommunications and the rapid advances of computer-based systems such as virtual reality, multimedia and the Internet give the educators an option to provide effective instruction.

Telemedicine in Croatia. The first steps of telemedicine in Croatia were made in the mid-1980s when an electrocardiogram was for the first time transmitted from a remote patient to the Department of Cardiovascular Diseases in Zagreb by ordinary telephone communications. The signal was translated into its graphic equivalent and commented by the cardiologist. The modest technology of the time could not make possible bilateral simultaneous transmission of the image and the sound. The true progress could be achieved after the development of ISDN network and establishment of the governmental agency, Croatian Academic and Research Network (CARNet) in 1991/1992, during the Independence War. In 1993, a national telepathology system was established between Zagreb and remote hospital centers. It was followed in 1995 by a program for monitoring diabetic patients throughout the country. The next year a program for cardiac electrostimulation by telecommunication was presented, and in 1998 the national programs of teleradiology and teleneurosurgery were in full function. In the same year the Academy of Medical Sciences of Croatia organized a scientific conference on the achievements of the Croatian telemedicine with the aim to stimulate cooperation between the primary health care level and higher levels of the structure. Three years later real successes have been achieved in connecting some islands with the central institutions. Throughout that period, numerous tele-educational programs were developed in large medical centers¹⁰.

Despite the expansion of telemedicine, the volume of patients receiving services that use the technology remains relatively low¹¹. In part, this reflects the lack of a consistent coverage and payment policy and concerns about licensure, liability, and other issues.

Discussion

Telemedicine is a relatively new way of clinical practice. The focus of the telemedicine project was to improve access to quality health services and to reduce the isolation of remote health care. It is important to remember that telemedicine and its technology is fast changing and still in early development stages. It requires flexibility and creativity to respond to its challenge. Telemedicine improves access to health care in remote areas by reducing the need for patients or doctors to travel; by improving contacts between the professional staff involved it produces educational benefits (continuing medical education) for them and reduces professional isolation; by improving communication between the periphery and hospitals, telemedicine facilitates higher quality medicine; and finally, telemedicine may be cheaper than conventional practice, although relevant studies are only just starting to appear.

In order to utilize the potentials of telemedicine, its integration with traditional health care is crucial. Up to now, telemedicine in general has not had much effect on the medical practice, structure and organization of health care.

The introduction of telemedicine should, according to Wooton (1996), be guided by the principles of:

- evidence based practice
- appropriate risk management
- proved cost effectiveness
- maintenance of equity in provision of health care
- partnership between patients and professionals in future developments¹².

Telemedicine has many benefits. One of the benefits of telemedicine is cost saving, because information is less expensive to transport than people are. Other benefits include immediate access to medical expertise regardless of location, and more timely diagnoses and treatments than would otherwise be possible. Despite all of the benefits that one can get by accepting telemedicine as a new way of clinical practice, there is an unresolved debate about whether telemedicine represents a change in the process of medical care or merely a change in access to services. It permits a wide range of services to be provided from a distance.

There are some critical questions about the telemedicine practice that should be asked. First is the question of liability and malpractice. Liability for practicing telemedicine can be divided into three basic categories:

low level liability for information dissemination and patient education *via* electronic devices, moderate level liability for the practice of consultation and communication of medical advice over electronic media, and high level liability for the actual practice of medicine, diagnosis, and treatment of patients on the Internet. The technology utilized by telemedicine also poses a malpractice risk for telemedicine practitioners. When a physician fails to use a piece of equipment he will be liable for the harm caused to the patient. Because telemedicine is so dependent on technology, telemedicine practitioners run the risk of being held liable for malpractice if that technology fails, even though the liability for technology failure should be shared among all involved parties, including the technology manufacturer. Although no cases of telemedicine malpractice have been reported, the potential nevertheless exists.

Second is the issue of confidentiality. The present system of medical records is already insecure, but there are additional concerns about the ability of electronic medical record systems to maintain an adequate level of security. In general, electronic records are more secure than paper-based charts, although a possible breach of security may mean that more unauthorized persons can obtain access to confidential data¹³.

Third is the question of ethics. An informed consent provided by the patient and confidentiality of his medical data belong to fundamental rights of the patient and basic principles in a telemedicine procedure. The entire telemedicine team should be fully aware of the potential loss of data or their unintentional transfer to those not to be involved in the procedure, and should therefore continuously take all measures available for patient data protection.

A question that remains to examine at the end is whether telemedicine technologies will be beneficial to remote communities in the long-run through the provision of specialty care that would otherwise not be available, or will they result in reduced access and availability of care because specialists are no longer visiting these communities to provide care?

In 1996, Wooton wrote: "*Telemedicine will do for health care what the personal computer has done for the office. Or so its proponents believe. Its opponents believe that it represents a threat to the doctor-patient relationship and is an intrinsically unsafe way of practicing medicine. What is more, they suspect that its costs vastly exceed its benefits and that it is yet another example of "toys for the boys"*"¹².

In order to prevent telemedicine from becoming “toys for the boys”, and in order to put the system to life in isolated areas such as islands, it is necessary to keep the system functioning 24 hours a day. The need for consultations through telemedicine appears in real time, and not at an expected moment. Accordingly, the consulting institutions should provide the lists of contact numbers and specialists responsible for consultations. These lists should be available to end users of telemedicine, who must be educated for its use. The issues of significant importance are the payments for telecommunication services, consultants and technical support. Telemedicine could be the first step towards the integration of healthcare system of isolated areas as a functional unit in a wider healthcare system.

References

1. BASHUR R, LOVETT J. Assessment of telemedicine: results of the initial experience. *Aviat Space Environ Med* 1977;48:65-70.
2. MURPHY RIH, BIRD KT. Telediagnosis: a new community health resource. *Am J Public Health* 1974;64:113-9.
3. FIELD MJ. Telemedicine: a guide to assessing telecommunications in health care. Washington, DC: National Academy Press; 1996.
4. ORLIĆ D. Ethics and telemedicine. In: KLAPAN I, ČIKEŠ I, eds. *Telemedicine*. Zagreb: Telemedicine Association Zagreb; 2005, p. 3-7.
5. PEREDNIA DA, ALLEN A. Telemedicine technology and clinical applications. *JAMA* 1995;273:483-8.
6. BATNITZKY S, ROSENTHAL SJ, SIEGEL EL, WETZEL LH *et al.* Teleradiology: an assessment. *Radiology* 1990;177:11-7.
7. ŠESTO M, BATINIĆ Z, TRBOVIĆ A. Telemedicine in cardiology. In: KLAPAN I, ČIKEŠ I, eds. *Telemedicine*. Zagreb: Telemedicine Association Zagreb; 2005. p. 264-70.
8. PEREDNIA DA, BROWN NA. Teledermatology: one application of telemedicine. *Bull Med Libr Assoc* 1995;83:42-7.
9. DEMARIN V. Teleneurology. In: KLAPAN I, ČIKEŠ I, eds. *Telemedicine*. Zagreb: Telemedicine Association Zagreb; 2005, p. 256-9.
10. RICHTER B. Kratka povijest razvitka telemedicine u Hrvatskoj. In: KURJAK A, RICHTER B, eds. *Telemedicina u Hrvatskoj. Dostignuća i daljnji razvitak*. Zagreb: Akademija medicinskih znanosti Hrvatske; 2001, p. 31-41.
11. SANDERS JH, BASHSHUR RL. Challenges to the implementation of telemedicine. *Telemed J* 1995;1:115-23.
12. WOOTON R. Telemedicine: a cautious welcome. *BMJ* 1996; 313:1375-7.
13. GILBERT F. How to minimize the risk of disclosure of patient information used in telemedicine. *Telemed J* 1995;1:91-4.

Sažetak

RAZVOJ TELEMEDICINE U PROMICANJU ZDRAVSTVENE SKRBI U UDALJENIM I IZOLIRANIM PODRUČJIMA

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Telemedicina je relativno nov način iskorištenja saznanja i resursa kliničke medicine. Omogućava brz pristup specijalistima putem telekomunikacijskih i informatičkih tehnologija, bez obzira gdje se bolesnik ili specijalist nalazi. Cilj joj je unaprijediti zdravstvenu skrb i smanjiti zdravstvenu izoliranost udaljenih područja. Gotovo je svaka grana kliničke medicine prihvatila telemedicinu, iako je ona ponajviše uključena u radiologiju, kardiologiju, dermatologiju i psihijatriju. Da bi sustav zaživio u izoliranim područjima kao što su otoci neophodno je da bude u funkciji 24 sata na dan, jer se potreba za konzultacijom putem telemedicine događa u stvarnom, a ne u zadanom vremenu. S razvojem novog informatičkog doba telemedicina će polako zauzimati sve važnije mjesto u svakom vidu kliničke medicine.

Ključne riječi: *Telemedicina – iskorištenje; Zdravstvena skrb osigurane kvalitete; Primarna zdravstvena skrb; Procjena tehnologije; Zdravlje u seoskoj sredini; Hrvatska – otok*