

## TELEMEDICINE AND TELENEUROLOGY

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**SUMMARY** – Telemedicine is one of the most important and fastest developing branches of medical technology. The use of computer technology in medicine is a precondition for the development of infrastructure allowing for significant progress and better basis for team work. Over the past decades, the role of telemedicine has greatly expanded both worldwide and in Croatia. Its wide popularity has been supported by an ever growing number of projects revealing the possibilities and achievements of current medical technology. Employing telecommunication and computer technologies, telemedicine has opened way for remote diagnosis, therapy and follow-up of patients. Teleneurology has an important place in telemedicine. Neurology is a specialty the activities of which are closely linked to other specialties (radiology, neurosurgery, vascular surgery), thus the exchange of experience among various specialists being of utmost importance. A special role of teleneurology implies the possibility of connecting small hospitals with large centers and departments. In such a configuration, telemedicine would provide an opportunity for the initial assessment of the patient's condition, based on the contact with the physician of the patient himself, followed by appropriate triage decision and possible patient transfer from one to another center. In addition, this system would allow for the patient's clinical follow-up by physicians from small hospitals, at the same time serving as a sophisticated and inexpensive form of education (making use of the material from large centers, information exchange, etc.).

*Key words: Neurology, trends; Telemedicine, organization and administration*

### Introduction

Telemedicine is one of the most important and most rapidly evolving fields of medical technology. It employs telecommunication networks to transfer pictorial material, sound and text. The networks can also be used to transfer other information related to the patient and his/her condition. A special point of telemedicine is to connect doctors on islands with experts in hospitals, and to improve cooperation between specialized care and primary health care centers.

The medium utilized for data transfer varies and can involve multiple types of telecommunication technology

including Plain Old Telephone Systems (POTS), Integrated Services Digital Networks (ISDN), time division multiplexing systems using T-1 transmission signaling, Asynchronous Transfer Mode (ATM) methodologies, the Internet, intranets, satellites, and other assorted techniques. In fact, a telemedicine system can be as simple as a desktop computer connected to a medical reference source. On the other end of the spectrum, an example of an advanced telemedicine system may include robotic surgery<sup>1</sup>.

### Objects of Telemedicine

The objectives of telemedicine can be divided as follows:

- to reduce direct and indirect costs to health care sector and patients

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- to improve cooperation between specialized care and primary health care centers by moving services and expertise closer to citizens
- to promote the proficiency of physicians and other health care personnel by means of teleconsultation and video conference-based training
- to organize teleconferences and tele-education
- to provide at least the same level of clinical care to patients as by conventional technology
- to reduce waiting lists in specialized health care
- to improve and expedite consultations among different units of specialized health care in acute special cases (e.g., subspecialties in radiology and pathology, and in neurosurgery)

Telemedicine is utilized in many areas or specialties in health care such as cardiology, dermatology, home health care, oncology, pathology, psychiatry, radiology, and surgery<sup>1</sup>. Teleneurology has one of the most important roles in telemedicine. In their work, neurologists have to collaborate with many other specialists, e.g., radiologists, neurosurgeons, vascular surgeons, and others, and by teleneurology this cooperation is much easier and faster. Teleneurology also provides the best way for continuous education in neurology.

Perhaps one of the greatest benefits of telemedicine and teleneurology is their ability to bridge distance between geographically different locations. Until the recent advancement in telecommunication and computing, residents of rural and remote areas had to make do with substandard access to specialized medical care. Innovations in the field of telemedicine, however, have allowed for the breakdown of geographical boundaries<sup>2,3</sup>. With the shortage of radiologists and neurologists in rural areas, it is believed that telemedicine can provide less expensive and faster diagnosis than the more traditional courier service or itinerant specialists.

Several years ago, the Neuronet computer system was introduced at the University Department of Neurology, Sestre milosrdnice University Hospital. The purpose of the system was to connect all computers at the Department in a single network, and to connect Department with other Hospital departments (radiology, neurosurgery, vascular surgery, pathology, central laboratory) and with time to medical institutions all over Croatia.

The Neuronet has been developed through modules, so that at present the modules for patient personal data, personal and family history, outpatient visits, and clinical examinations are in function. When the patient presents to the neurological outpatient clinic, general data are en-

tered (name, address, occupation, age, sex, identification number, marital status), followed by data on personal and family history. The program contains Tenth Edition of the International Classification of Diseases with codes and diagnoses in Croatian and Latin.

Each visit has a code number, which corresponds to the number the patient is given when admitted to the hospital or just examined on outpatient basis. All data entered in the outpatient file are automatically transferred to the hospital file when the patient is hospitalized. The inpatient part of the program includes precise clinical and neurologic status. A very interesting part of the program are scales of illnesses (e.g., Glasgow Coma Score, Barthel Index, Scandinavian Stroke Scale, Rankin Scale, Hund and Hess Grading System for Subarachnoid Hemorrhage, NIH Stroke Scale). The physicians initially record the scale value, so the patient's condition can be monitored during hospitalization according to changes in the scale value. At the end of hospitalization, the patient is provided with a letter of discharge.

At present, the Neuronet connects only the wards of the University Department of Neurology. In the future, connections with other Hospital departments as well as with other hospitals are planned to be established. In this way, it will be possible to transfer electroencephalograms (EEG), color doppler flow images (CDFI), transcranial doppler images (TCD), computed tomography (CT) findings, electromyoneurography (EMNG) and other findings to remote locations.

## Barriers and Potential Solutions

While there obviously are many potential advantages and benefits associated with implementation of a telemedicine system or program, it has yet to become a commonplace practice in healthcare industry. Studies have revealed that the reason for this includes a number of barriers. These barriers are for the most part universal, and address issues such as licensure and liability, patient confidentiality and network security, physician reimbursement, lack of awareness among physicians and patients, concerns about cost-effectiveness, and technology that is difficult to use<sup>2</sup>.

Concerning licensure and liability, many physicians are apprehensive of providing teleconsultation due to the liability and malpractice potential involved. Since telemedicine often involves practicing medicine across state and/or international borders, questions concerning licensure

arise. Should the physician be licensed in the state where he or she is located, the state where the patient is being consulted, or both? Due to the lack of an unambiguous answer to this question, many opinions prevail.

Another issue that creates a barrier to widespread acceptance of telemedicine is the potential for a breach in patient confidentiality and network security. Proponents of telemedicine contend that this fear is merely a myth that is often overemphasized. Because there is an enormous amount of reference materials that pertain to the true risks and there is an abundance of security measures available to protect patient data, they feel that this fallacy can be overcome with the education of physicians, administrators and patients that patient data can be safely transmitted *via* electronic means. Some of the security measures available include physical security of the actual hardware and software components, access controls, firewalls, encryption, authentication, digital signatures, and time-stamps<sup>3</sup>.

Education is also crucial in the elimination of other barriers such as the lack of awareness among physicians and patients, concerns about cost-effectiveness and technology that is difficult to use. For instance, several studies have been conducted on cost-effectiveness of telemedicine programs. The overwhelming majority of these studies reveal that telemedicine is extremely cost-effective. As the cost of computing has dropped by 99.9% over the past three decades, it is believed that information technology today is "pervasive, easier than ever to use, and begging to be exploited"<sup>3,4</sup>. Coupling this decrease in the cost of computing with the case analyses explored in the aforementioned examples, it appears that the significant underlying barrier is truly a lack of education.

Perhaps the biggest barrier, in the view of physicians, is the lack of systemic reimbursement for telemedicine

services provided. Great strides have been taken to eliminate this barrier.

## Conclusion

All in all, telemedicine appears to have many benefits. It benefits both the healthcare sector and the patient. The ultimate benefactor of a telemedicine program is the patient, i.e. the patient is afforded more specialized treatment when normally isolated from these specialties, emergency treatment is available where previously it was not, and eventually the cost of treatment will decrease due to reduction in the cost incurred by the healthcare provider and/or facility. It appears that the appropriate strategy for making telemedicine a widespread reality, as opposed to a niche practice, is by standardizing and streamlining the reimbursement process, developing state and worldwide adherence to licensure issues, and education of the public, physicians, and the entire healthcare sector.

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## Sažetak

## TELEMEDICINA I TELENEUROLOGIJA

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Telemedicina je jedna od najvažnijih i najbrže razvijajućih grana unutar medicinske tehnologije. Upotreba informatičke tehnologije u medicini preduvjet je za stvaranje infrastrukture koja omogućuje velik napredak i bolju osnovu za timski rad. Posljednjih nekoliko godina značenje telemedicine poprimilo je velike razmjere, kako u svijetu tako i u našoj zemlji. Njezinoj popularnosti pridonosi sve više projekata u kojima se pokazalo kakve su mogućnosti i dosezi današnje medicinske tehnologije. Uporabom telekomunikacijskih i informatičkih tehnologija telemedicina omogućava dijagnostiku, liječenje i kliničko praćenje bolesnika. Teleneurologija ima istaknuto mjesto unutar telemedicine. Naime, neurologija je struka rad koje je usko povezan s drugim strukama (radiolozi, neurokirurzi, vaskularni kirurzi), te je razmjena iskustava između stručnjaka raznih profila neophodna. Posebno značenje teleneurologije je mogućnost povezivanja manjih bolnica s većim centrima i klinikama. U kontaktu s manjim centrima uloga telemedicine bila bi učiniti početnu hitnu procjenu stanja bolesnika na temelju kontakta s liječnikom ili bolesnikom, te nakon toga donijeti odluku o trijaži i mogućem prijevozu bolesnika iz jednoga u drugi centar. Usto, ovaj bi sustav omogućio liječnicima iz manjih medicinskih centara kliničko praćenje bolesnika, a ujedno bi poslužio kao suvremen i jeftin način izobrazbe (upotreba materijala iz većih centara, razmjena informacija itd.).

Ključne riječi: *Neurologija, trendovi, Telemedicina, organizacija i administriranje*