

HISTORY OF THE DEVELOPMENT OF TELEMEDICINE AND BIOETHIC FACTORS OF ITS APPLICATION

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Abstract

This work comprehensively covers the history of telemedicine development, the technical, social, and scientific factors that influenced its formation, as well as bioethical issues arising in the application of telemedicine. The topic analyzes stages such as the emergence of telemedicine based on early information exchange systems, the development of communication technologies in the 20th century, and the expansion of modern digital medical platforms and mobile health services. Scientific works and practical applications highlight positive aspects of telemedicine, such as providing equal access to medical services for the population and offering quality medical advice to patients in remote areas. Additionally, bioethical factors in remote medical care are analyzed, including information security, personal data protection, informed consent, medical confidentiality, diagnostic accuracy, and the ethical responsibility of doctors.

According to the research findings, although telemedicine is utilized as a modern and effective method of providing medical services, issues such as adherence to ethical and legal norms, ensuring patient rights, and protecting medical information are of paramount importance in its implementation. This work serves to deeply illuminate the development of telemedicine and its bioethical aspects.

Keywords: Telemedicine, digital medicine, remote medical care, bioethics.

Telemedicine is a relatively new medical science. It involves the active use of computer and telecommunication technologies. Thanks to these modern advancements, specialists can improve the quality and convenience of patient diagnosis and treatment.

As early as the beginning of the 20th century, specialists sought to use communication channels for providing medical assistance. In 1905, a signal was transmitted through telephone lines in Sweden. Starting in 1922, specialists at the University of Gothenburg Hospital provided medical advice via radio to sailors at sea. The first teleconsultation for a patient with a psychiatric disorder was conducted in the USA in 1959. In the same year, the transmission of a lung fluorogram image was performed for the first time.

In the late 1950s and early 1960s, doctors in the USA and USSR were already attempting to transmit signals and images. Notably, during that time, telemedicine began to be used to support nuclear warships on autonomous voyages with the help of coastal medical services in the USA, USSR, Great Britain, and France. New technologies enabled the recording of cosmonauts' physiological indicators and the transmission of medical recommendations to orbit. During the flights of Yu.A. Gagarin and G.S. Titov, ECG and pneumogram were recorded on one and two chest leads. Later, technologies for obtaining seismocardiograms and methods and equipment for remotely recording physiological and biochemical parameters of the human body in

weightlessness were developed. This information was subsequently transmitted to Earth, and timely measures were taken to correct any abnormalities detected based on it.

In the 1960s and 1970s, scientists in the USSR actively worked on medical data transmission. At the A.V. Vishnevsky Institute of Surgery of the Russian Academy of Sciences, attempts were made to remotely diagnose congenital heart defects and other diseases using a computer (URAL-2). Telegraph lines provided communication for this apparatus with medical institutions in Yaroslavl, Vladivostok, and Khabarovsk. Simultaneously, notable work emerged on transmitting electrocardiograms to cardiology centers via telephone lines. Soviet systems "Volna" and "Salyut" were used for this purpose (Yanushkevichus Z.I., Khalfen E.Sh., Vinogradova T.S., Dovgalevsky P.Ya. and others).

In 1965, American cardiac surgeon M. DeBakey provided consultations on complex heart surgery performed in Switzerland via satellite communication channel. From the 1970s, US specialists transmitted data between medical centers in Arizona, Boston, and Canada using space communication technologies.

During the earthquake in Armenia (1988) and the gas explosion near Ufa (1989), telebridges (using audio, video, and fax communication) were established between disaster zones and US medical centers under the auspices of the Soviet-American Commission for Space Biology and Medicine. It should be noted that for a long time, the level of development in space biology and medicine in the USSR was significantly higher than in the USA. This was especially evident in the implementation of the joint Soyuz-Apollo project.

Specialists from Moscow clinics and US medical centers participated in teleconsultations and videoconferences. They consulted patients suffering from burns, mental illnesses, and various other ailments. During the 12-week period, a single international telebridge was attended by 247 Soviet (Armenian, Russian, Bashkir) and 175 American specialists. They examined 209 clinical cases from 20 medical fields. Within the framework of these conferences, significant changes were made to diagnostic and treatment processes using the latest technologies. New methods were introduced, and a large volume of medical information was shared. As a result of this work, diagnoses were changed in 33% of cases, additional diagnostic procedures were recommended in 46% of cases, treatment strategies were altered in 21% of cases, and new treatment methods were employed in 10% of cases. Norway became the pioneer in the active use of telecommunication technologies in medicine. Even today, there are many hard-to-reach areas in this country for traditional medical care. The second project was implemented in France - providing consultations to civilian and naval sailors. Today, telemedicine projects are available in many Western European countries. In the USA, new technologies are used ubiquitously for medical purposes. One of the largest medical centers in our country, conducting regular sessions with regions using modern technologies, is the Bakulev National Medical Research Center of Cardiovascular Surgery. It should be noted that the term "telemedicine" was introduced into practical use in 1974 by R. Mark (according to other sources, its author was Thomas Bird, who introduced it in 1970). This term encompasses many telecommunications and healthcare information methods. The system-forming principle of telemedicine, which has great bioethical significance, consists of the following: Its main focus is the patient who receives remote care using high-tech medical equipment and modern communication tools (particularly ISDN communication channels).

N. Brown (head of the telemedicine project at the Portland Research Center in Oregon) defines telemedicine as a "middle ground" between using telecommunications to provide medical information and services, a simple telephone discussion of a clinical case by two doctors, and an interactive video conference-consultation between medical centers in different countries using satellite communication. However, this is a somewhat simplified understanding of the modern capabilities of telemedicine. The WHO introduced a slightly broader definition of telemedicine in 1997: "Activities, services, and systems related to the provision of remote medical care through information and communication technologies, aimed at promoting healthcare development, conducting epidemiological surveillance and providing medical assistance, as well as training, management, and scientific research in the field of medicine."

The level of development of communication systems and computer technology determines the success of telemedicine projects. New technologies allow for storing any image on a computer, preparing it for transmission, sending it over communication channels (including in real-time) to any distance, receiving and decoding it without loss of quality, and presenting it to experts for joint discussion of the problem.

Modern advancements in telemedicine are attributed not only to the emergence of analog but also digital information transmission channels, and the widespread adoption of global network connections. However, many substantive, informational, methodological, organizational, technical, financial-economic, and bioethical issues remain unresolved.

According to several experts, telemedicine is primarily a highly effective remote diagnostic tool. Nevertheless, it can be successfully applied in other areas as well. Network technologies enable documented transmission of medical histories when transferring patients between clinics, rapid resolution of issues related to advanced training of doctors (conducting licensed training courses remotely), and more.

Currently, the WHO is developing the concept of creating a global telecommunications network in medicine. This includes the electronic exchange of scientific documents and data, their rapid retrieval through telecommunication networks, conducting video conferences, remote discussions and meetings, electronic voting of medical specialists on key medical issues, and more.

International medical telecommunications networks are actively developing. For instance, the Satellife system is used to transmit medical information and train personnel in developing countries. "Planet Heres" is a WHO-created system used for scientific telecommunications, scientific expertise, and coordination of scientific programs. More than 70 international telemedicine projects are centrally funded in the European Union. For example, the HECTOR project is used for emergency care needs, while the HOMER-D project is utilized for treating patients at home. Their main goal is to develop methods for registering and formalizing medical data, preparing them for transmission and reception. Data compression algorithms and standard forms of data exchange at both the source data level (images, signals, etc.) and medical history level are being created and tested. Automated workstations are being developed for specialists in various fields (ultrasound diagnostics, computed tomography, radiology, biochemistry, etc.). In some cases, these projects are structured and qualitatively coordinated (for example, ITHACA, STAR). Today, there are over 250 telemedicine projects worldwide. Based on their characteristics, they can be categorized into clinical, educational, informational, and analytical types. According

to geographical distribution, they are divided into local (within one institution, 27%), regional (40%), national (16%), and international (17%). Most of them are multi-purpose, and almost half (48%) are related to education. In 25% of projects, modern information transmission channels are used for management and administrative needs. In 23% of cases, they are used to provide medical services to populations in rural and remote areas.

It is evident that telemedicine depends on the pace of development of the global Internet network (especially the new direction - the intelligent Internet). However, due to technical specifications (maximum possible speed and volume of transmitted data), its capabilities are limited from a telemedicine perspective. Furthermore, the Internet is an open network, and the transfer of patients' medical information and its public discussion is unacceptable from legal and bioethical standpoints. The implementation of strict protection for medical data is necessary to comply with the rule of bioethical confidentiality.

Today, the use of telecommunications in medicine (and meeting various information needs of specialists and healthcare institutions) is developing in two main directions: through the open Internet and through closed corporate networks in the form of telemedicine itself or parts of existing networks allocated for teleconsultation time in "point-to-point" or "point-to-multipoint" modes. This meets the bioethical requirements for information transmission (primarily radiographs, tomograms, microphotographs, etc.). A necessary condition is the development, implementation, and adherence to standards for obtaining and presenting medical images (X-ray radiological, microscopic, color reproduction of skin manifestations of diseases) in compliance with bioethical laws.

TELEMEDICAL CONSULTATIONS ARE ALSO CARRIED OUT USING THE INTERNET (IP CONNECTION). HOWEVER, DURING THE DISCUSSION, VIDEO IMAGES OF PATIENTS, DOCTORS, CONSULTANTS, AND OTHER VIDEO MATERIALS ARE NOT BROADCAST. DURING THE PROCESS, THE EXCHANGE OF STATIC GRAPHIC MATERIALS TAKES PLACE, WHICH CAN BE MODIFIED (DRAWING ON THEM, MARKING PROBLEM AREAS). FOR THIS PURPOSE, A SHARED WHITEBOARD IN NETMEETING MODE IS USED. THE CONSULTATION IS CONDUCTED IN AUDIO DATA TRANSMISSION MODE. THIS APPROACH NOT ONLY MEETS MODERN TECHNOLOGICAL CAPABILITIES BUT ALSO ALIGNS WITH THE PRINCIPLES OF BIOETHICS. USING THESE MODERN TECHNOLOGIES, THE MOSCOW RESEARCH INSTITUTE OF PEDIATRICS AND PEDIATRIC SURGERY OF THE RUSSIAN MINISTRY OF HEALTH, TOGETHER WITH THE RUSSIAN COMPANY "WEBMEDIA SERVICES," THE RUSSIAN MINISTRY OF EMERGENCY SITUATIONS' "ZASHITA" VSMK AND "CENTROSPAS," PROVIDED REMOTE ASSISTANCE TO INJURED CHILDREN IN A HOSPITAL IN CHECHNYA, UTILIZING THE CAPABILITIES OF THE "HELIOSNET" COMBINED ACCESS SYSTEM. THE CAPABILITIES OF THE INTERNET AND TELECOMMUNICATION TECHNOLOGIES ARE WIDELY USED IN MEDICINE. THUS, A SAMPLE SURVEY OF 400 AMERICAN DOCTORS CONDUCTED IN MARCH 2001 SHOWED THE FOLLOWING RESULTS: 356 (89%) OF SPECIALISTS ENHANCE THEIR KNOWLEDGE BASE USING THE INTERNET AND USE IT FOR REMOTE COMMUNICATION WITH THEIR PATIENTS. THE WORLD WIDE WEB ALLOWS DOCTORS TO OBTAIN ADDITIONAL SCIENTIFIC AND PRACTICAL INFORMATION ABOUT DISEASES ENCOUNTERED IN THEIR PRACTICE AND TO SELECT NECESSARY MEDICATIONS. BY 1999, 15,000 WEBSITES IN VARIOUS FIELDS OF MEDICINE WERE REGISTERED ON THE INTERNET; CURRENTLY, THEIR NUMBER HAS REACHED 300,000. ON SUCH SITES, ONE CAN FIND REVIEWS, IMAGES, AND MEDICAL INFORMATION. DOCTORS USE THE INTERNET TO

DISCUSS AND SEEK ADVICE IN COMPLEX CASES. HOWEVER, ONE SHOULD NOT FORGET THE PRINCIPLES AND RULES OF BIOETHICS. AN ACTIVE POSITION IN THIS AREA IS HELD BY THE TELEMEDICINE CENTER AT CENTRAL CLINICAL HOSPITAL NO. 1 OF JSC "RJD," WHICH REGULARLY CONDUCTS VIDEO CONFERENCES AND CONSULTATIONS ON CARDIOLOGY, UROLOGY, AND NEUROLOGY. TODAY, IT IS BECOMING CLEAR THAT TELEMEDICINE, TOGETHER WITH INTERNET TECHNOLOGIES, CAN ENABLE MORE RATIONAL USE OF THE SCIENTIFIC AND PRACTICAL POTENTIAL OF MEDICINE AND HEALTHCARE. HOWEVER, MANY SPECIALISTS APPROACH IT CAUTIOUSLY DUE TO THE IMPOSSIBILITY OF ESTABLISHING DIRECT CONTACT WITH PATIENTS, WHICH IS VERY IMPORTANT FROM A BIOETHICAL STANDPOINT. THE INTELLECTUAL FOUNDATION OF TELEMEDICINE TECHNOLOGIES IS THE HL7 MEDICAL KNOWLEDGE STANDARD. WITH ITS HELP, IT IS POSSIBLE TO TRANSMIT LARGE VOLUMES OF DATA AND IMPROVE THE QUALITY AND DIVERSITY OF INFORMATION.

THE TASK OF TELEMEDICINE IS TO TRANSLATE MEANINGS. HOWEVER, THERE IS A RISK OF SYSTEM DEGRADATION, WHICH COULD RESULT IN THE SESSION TURNING INTO A ROUTINE TELECONFERENCE WHERE THE PRINCIPLES AND RULES OF TRADITIONAL BIOETHICS ARE NOT OBSERVED AT ALL. AT THE SAME TIME, THE PHENOMENON OF TELEMEDICINE IS OF INTEREST TO THE HISTORY OF MEDICINE AND BIOETHICS. A MORE DETAILED DESCRIPTION OF THE PROBLEMATIC ASPECTS OF THIS PROMISING AREA OF A DOCTOR'S PRACTICAL ACTIVITY IS REQUIRED.

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