Defining “telemedicine services” in the context of large-scale digitalization

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Abstract. The authors analyze the definitions of "telemedicine service" presented in domestic and foreign scientific publications, as well as on the official resources of various departments and healthcare organizations. It is revealed that there is a lack of research on this topic and the concept under study has a controversial nature. The authors carry out comprehensive testing of "telemedicine service" definition, adopted by the World Health Organization, for compliance with digitalization trends. In the course of the research, the incompleteness of the definition generally accepted at the international level was revealed. The authors propose their own interpretation of the "telemedicine service" concept, implying an individualized approach, the use of information and communication technologies in order to increase public health. There are also considered factors affecting the choice of this method of providing medical services, and determining the goals of application, including prevention, identification of causes, diagnosis and treatment of diseases.

1 Introduction

Over the past decades, the structure of the world economy has undergone a fundamental transformation. Changes in the nature of demand and the behavioral model of consumers contributed to the fact that the priority in the provision of services was the preservation of long-term relationships with the consumer, the identification of individual consumer preferences and, as a result, the customization of the production process. The digitalization process, due to the new realities of the market, has led to the transformation of the specific features of traditional services (intangibility, non-persistence, inconsistency of quality, inseparability from the source). The use of information and communication technologies contributes to an increase in the share of material elements in the service, since the prevailing part of information is stored on physical media (disks, flash drives, in the format of video, audio films, etc.) and is suitable for transportation. Some types of services (educational, medical, consulting, etc.) can be delivered to the consumer regardless of the distance; their receipt does not imply personal contact with the supplier, which, in turn, minimizes the subjective perception of the results of the service process. On the one hand, the information about the consumer accumulated and stored in the global network makes it possible to establish contact with each client, track his transactions and offer predictive personalized service. On the other hand, the use of services and virtual platforms for queuing leads to

standardization and scalability of services, increasing the throughput of the service organization's operating system.

It is generally recognized that digital transformation affects all spheres of the economy, society and industry, engages new technologies, investments and innovations, contributes to the creation of new products and services, markets and business models and, as a result, has a wide impact on society as a whole and is the foundation for fourth industrial revolution [1]. In the social sphere, digitalization simplifies processes and communication. From an economic point of view, it helps to improve the quality of goods and services while reducing costs. Moreover, value chains are being transformed, opening up new opportunities for increasing added value.

The use of digital technologies in medicine makes it possible to strengthen the healthcare system by providing additional access to medical services in remote regions, holding remote consultations of doctors, determining the need and urgency of hospitalization, repeated patient consultations, etc. Digitalization contributes to solving key healthcare issues in the world (increasing accessibility, improving the quality and cost efficiency) facing healthcare, as well as increasing the volume of remote delivery of medical services, including telemedicine.

A large number of scientific works are devoted to the comprehension of structural transformations in world economic practice and the analysis of trends separately. However, a number of issues, for example, in terms of the impact of global economic trends on the growth of human resources (namely, public health) as the main factor of global growth require further study. Moreover, the changing conditions, as well as the current state and ongoing reforms of the healthcare system both in Russia and in the world, are transforming approaches to the provision of medical services. The controversy is growing in relation to the concepts and categories used.

2 Materials and methods

Analysis of the relevance of the term "telemedicine service" required the study of various approaches to this phenomenon in domestic and foreign science, as well as identifying its compliance with modern economic trends, primarily digitalization.

At the initial stage of the development of telemedicine services, radio and telegraph became the main tools, which were used, first of all, in military medicine to solve organizational issues (evacuation of the wounded) and exchange medical statistical information. Nobel laureate Willem Einthoven (telecardiogram, 1905 - 1906) [2], Academician A.A. Vishnevsky (remote consultations, 1941 - 1945) [3], the founder of space biology and medicine V.I. Yazdovsky (bioradiotelemetry, 1948 - 1961) [4], American professor Jacob Gershon-Cohen (telegnosia, 1950 - 1951) [5], professor Albert Yutras (remote radio diagnostics, video-teleradio diagnostics, 1959) [6 ; 7] and others.

For the first time the term "telemedicine" was used in 1970 in the scientific work "Microwave transmission of chest radiographs" by Raymond Murphy, Doris Barber, Alice Broadhurst and Kenet Bird [8]. Scientists understood telemedicine services as "treatment at a distance". In 1972, Kenneth Bird describes how telemedicine can improve the health care system: "When interactive television is supplemented with diagnostic and monitoring tools, a telemedicine network is formed ... Telemedicine is a medical practice using interactive audio-video communication systems without the usual physical interaction of physicians. patient "[9].

In the 1980s and 90s. telemedicine services became an object of international relations, regulated by international organizations. In 1983, at the 35th World Medical Assembly, the Regulation on the Use of Computers in Medicine was approved, dedicated to the issues of safety and preservation of medical secrecy when using computer and information

technologies. In 1992, the 44th World Medical Assembly adopted the Regulation on Medical Examination, Telemedicine and Medical Ethics "[10]. WHO has recommended a number of ethical and organizational principles as key elements in establishing an effective telemedicine network or system. In 2005, WHO adopted a landmark document - Resolution WHA58.28 "E-health", regulating the use of telemedicine services on a global scale [11].

The evolution of the term "telemedicine service" is confirmed by a rich semantic field. It is represented by such concepts as "digital medicine", "mobile health", "mobile medicine", "e-health", "telepharmacy", "telemonitoring of patient's medical parameters", "Electronic Health Record (EHR)", etc. It is noteworthy that in different historical periods, the emergence of each of the listed synonyms of the concept of "telemedicine service" was determined by changes in the forms, methods and technologies implemented in Russian and foreign healthcare [12]. In the course of the 2007 study, 104 definitions of the term "telemedicine service" were identified [13].

The 1996 Institute of Medicine report "Telemedicine: A Guide to Evaluating Telecommunications for Health Care" provides the following definition: "Telemedicine services are a heterogeneous collection of clinical practices, technologies and organizational mechanisms" [14]. The Office of Health and Human Services (a department of the US Department of Health and Human Services) defines telemedicine as "the use of electronic, information and telecommunication technologies to support and promote remote clinical health care, patient education, and healthcare professionals" [15]. Based on the definition of the American Telemedicine Association, this phenomenon is the remote delivery of medical services and clinical information using telecommunication technologies and includes the transmission of medical information and clinical services using the Internet, wireless technologies, satellites, radio and telephones [16].

The head of the telemedicine project of the Portland Research Center, Nancy Brown, interpreted telemedicine as the use of telecommunications to provide medical information and services - "something between a simple discussion of a clinical case by two doctors over the phone and an interactive video consultation between medical centers in different countries using satellite technology [17]. American scientists John Craig and Victor Patterson defined the term as follows: the intersection of medicine, information and telecommunication technologies, influencing medical care [18]. A group of American researchers led by Margot Edmunds understands telemedicine as medical information that is transmitted from one site to another using electronic means, such as audiovisual and electronic instruments, in order to improve patient health [19].

In Russian science, large-scale studies of terminology in this industry have not been carried out. In most cases, the authors are guided by the definition of WHO [20; 21; 22]. WHAT, FOR EXAMPLE, RUSSIAN AUTHORS ARE GUIDED BY THIS DEFINITION. The World Health Organization understands telemedicine services as "the provision of health care services in an environment where distance is critical, by health professionals using information and communication technologies to exchange relevant information for the diagnosis, treatment and prevention of disease and injury, research and assessment, and for continuing education of health workers in the interests of improving the health of the population and the development of local communities "[23]. As defined by WHO, the characteristics of telemedicine services are:

- use of various types of information and communication technologies,
- overcoming geographical barriers with the establishment of communication between users located at a great distance from each other,
- the ultimate goal is to improve the health of the population,
- clinical support as a primary concern.

3 Results and discussion

In the course of the study, the authors tested the internationally accepted definition of telemedicine services for relevance.

1. Use of information and communication technologies for the exchange of necessary information. Historically, telemedicine services have used the most innovative technological solutions for their time. At the present stage of development, the provision of this type of service involves the use of the following technologies:

- communication infrastructure - networks (including wireless), network equipment, video conferencing and telephony;
- computing infrastructure - servers, storage and backup systems, data processing centers, computers, mobile devices, office equipment;
- system-wide software - operating systems, database management systems, communication and computing infrastructure management;
- application software for automated systems;
- analytical systems for modeling, decision support (medical decisions), reporting and data presentation [24].

2. Additional access to medical services. In the generally accepted definition, distance is considered as a critical factor. During the first telesurgical operation (endoscopic cholecystectomy) in 2001, the patient was in Strasbourg (France), and the operating surgeon was in New York (USA) at a distance of about 7000 km [25]. The recorded delay was 135 milliseconds, this indicator did not affect the quality and process of the surgical operation at all. The duration of the intervention was 45 minutes. Discharge was made 48 hours later, and complete recovery occurred within standard terms [26]. According to the authors, additional access to medical services can also be achieved through temporary (for example, during emergencies) and financial (in the case of using expensive equipment) factors. Often, all three factors are critical in deciding whether to provide telemedicine services.

3. Improving the health of the population through the diagnosis, treatment and prevention of diseases and injuries. In this definition, the main focus is shifted from prevention and identification of the causes of the disease to diagnosis and treatment. However, there is no doubt that telemedicine services contribute to the enhancement of public health. Long-term studies prove their effectiveness. In the 1970s, NASA implemented the Integrated Medical and Behavioral Laboratory Measurement System project to provide medical care in hard-to-reach areas using telecommunications and satellite communications. It was found that telemedicine consultations were either critical or important and useful for the treatment of patients in 86.3–97% of cases (for video conferencing - 78.3%). Technical efficiency was characterized as acceptable in 85% of cases [27].

4. Clinical support is the main task of telemedicine services. In this case, the telemedicine services market does not act as an independent unit, but as an autonomous part of health care, the harmonious functioning of which contributes to improving the quality of medical services and strengthening the health care system. The words of the founder of telemedicine Kenet Byrd prove this thesis: “Telemedicine depends on the doctor and their special abilities. It is not a substitute for it, nor is it an alternative to a doctor. In fact, telemedicine increases the efficiency of a specialist and expands their ability to be at the very center of medical activity” [28]. One of the founders of Russian telemedicine L.V. Chireikin also assumed the use of telemedicine services as a link in the health care system: “It goes without saying that remote consultations can never replace the real communication of an experienced doctor with patients ... Remote clinical consultations, if properly organized, are effective not only at the hospital, but, which is especially important, and at the pre-hospital stage” [29].

5. The official definition formulated by WHO does not take into account the individual characteristics and needs of the patient and does not imply a customized approach.

Undertaking an integrated theoretical approach to the study of the telemedicine services market, the authors proposed the following definition: a strictly individualized set of measures involving the use of information and communication technologies for the prevention, identification of causes, diagnosis and treatment of the disease in order to increase public health in conditions when distance, time and finance is critical.

Thus, the telemedicine services market is the leading direction for the use of information and communication technologies in healthcare, combining complex technologies associated with the receipt, visualization, transmission, search and storage of medical information. The development of remote diagnostics and medical care, as well as the processes of serviceization and digitalization, determine the evolution of the conceptual apparatus.

4 Conclusions

1. The study identified trends in the digitalization of the services market: transformation of the specific features of traditional services, diversification of the market using information technologies, providing additional access to services while reducing costs and improving quality, strengthening the social sphere.
2. The analysis of scientific literature revealed the controversial nature of the concept of "telemedicine service" used: information and communication technologies for the needs of medicine; medical information, health care services.
3. Testing of the definition generally accepted at the international level revealed its incompleteness: it does not take into account time and financial factors; overlooks the contribution of the phenomenon to the prevention and identification of the causes of the disease; does not imply a customized approach.
4. The authors propose their definition of telemedicine service, with account of the digitalization processes in the social sphere.

References

1. A New Industrial Strategy for Europe. Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions, Brussels, 2 (2020)
2. W. Einthoven, Le Telecardiogramme, Archives Internationales Physiologie, **IV**, 132 (1906)
3. A.A. Vishnevsky, Diary of a Surgeon. The Great Patriotic War 1941-1945 (1970)
4. I. Akulinchev, N. Aghajnyan, Technology-Youth, **9**, 25 (1962)
5. J. Gershon-Cohen, A.G. Cooley, Telognosis, Radiology, **55(4)**, 582 (1950)
6. A. Jutras, Teleroentgen Diagnosis by Means of Video-Tape Recording, Am J Roentgenol Radium Ther Nucl Med, **82**, 1099 (1959)
7. A. Jutras, Union Med Can, **88**, 1215 (1959)
8. R.L. Murphy, D. Barber, A. Broadhurst, K.T. Bird, Am Rev Respir Dis, **102**, 771 (1970)
9. K.T. Bird, Chest, **3(61)**, 204 (1972)
10. A.V. Vladzimirskiy, Telemedicine, Digital Printing House, Donetsk, 50-51 (2011)
11. World Health Organization, <https://apps.who.int/> (2021)
12. R.N. Shepel, A.V. Kutcher, T.V. Vakhovskaya, O. M. Drapkina, Emergency Cardiology and Cardiovascular Risks, **3(2)**, 766 (2019)
13. S.P. Sood, Studies in Health Technology and Informatics, **130**, 257 (2007)

14. Telemedicine: A Guide to Assessing Telecommunications in Health Care, Institute of Medicine (US) Committee on Evaluating Clinical Applications of Telemedicine, Field MJ, editor, Washington (DC): National Academies Press (US), 34 (1996)
15. Health Resources & Services Administration, <https://www.hrsa.gov/> (2021)
16. The American Telemedicine Association, About Telemedicine, Higher Logic, <http://www.americantelemed.org/> (2021)
17. N. Brown, A Brief History of Telemedicine, Telemedicine Information Exchange, **105**, 833 (1995)
18. J. Craig, V. Patterson, Journal of Telemedicine and Telecare, **11(1)**, 3 (2005)
19. M. Edmunds, R. Tuckson, J. Lewis, B. Atchinson, K. Rheuban, The Journal for Electronic Health Data and Methods, **5(2)**, 1303 (2017)
20. V. D. Zakiev, E.V. Zorin, V.R. Mustafina, I.A. Gimaev, Materials of the XII International Scientific and Practical Conference of Students and Young Medical Scientists, May 18, 2018, Tver, 393 (2018)
21. V.F. Fedorov, V.L. Joiner, Implementation Prospects, Physician and Information Technology, **2**, 36 (2020)
22. P.V. Mikov, E.A. Bryleva, Bulletin of the Perm Institute of the Federal Penitentiary Service of Russia, **2(37)**, 53 (2020)
23. WHO, A Health Telematics Policy in Support of WHO's Health-For-All Strategy for Global Health Development: Report of the WHO Group Consultation on Health Telematics, 11-16 December, Geneva, 1997, Geneva, World Health Organization (1998)
24. O.E. Karpov, M.N. Zamyatin, D.V. Shishkanov, S.A. Subbotin, P.S. Dyachenko, Bulletin of the National Medical-Surgical Center named after N.I. Pirogova, **3**, 7 (2018)
25. A.V. Vladzimirskiy, Telemedicine, Digital Printing House, Donetsk, 58 (2011)
26. J. Marescaux, J. Leroy, M. Gagner, F. Rubino, D. Mutter, M. Vix, Nature, **413**, 379 (2001)
27. Starpahe Systems Report, 1, 2, Operational Performance, Lockheed Misseles & Space Company (1977)
28. K.T. Bird, Chest, **3(61)**, 204 (1972)
29. L.V. Chireikin, P. Ya. Dovgalevsky, *Remote Diagnostic Cardiological Centers*, St. Petersburg: 16