

Digital technologies in healthcare: achievements and prospects

Ter-Akopov G.N.

Pyatigorsk Medical and Pharmaceutical Institute –
branch of Volgograd State Medical University
Department of Economics and Organization of Health
and Medicine
Pyatigorsk, Russia
nnn_05@mail.ru

Kosinova N.N.

Volgograd State Medical University
Department of Economics and Management
Volgograd, Russia
nnn_05@mail.ru

Knyazev S.A.

Volgograd State Medical University
Department of Economics and Management
Volgograd, Russia
sergey-cknyazev@mail.ru

Abstract — Digital technologies is one of the priorities in the development of the healthcare sector worldwide, this market is increasing by a quarter every year. The process can provide a breakthrough in the availability and quality of services without increasing health care costs. Therefore the development of digital medicine is carried out with the active participation of the state. Russia is not an exception. In Russia, several information-analytical projects of noticeable global scale are already being introduced.

In the near future, fundamentally new ways of development may emerge in the healthcare sector: digitalization of medical data, use of mobile devices to monitor and transmit medical indicators online, developing cloud services providing their storage and processing, introducing artificial intelligence to help doctors quickly take the right decisions.

The article considers digital technologies in healthcare as a complex of financial, economic, technical, social, organizational, production business processes that can affect the quality of medical services, the performance of the state guarantees program of medical care, and ultimately, the quality of life of citizens and the implementation of the state strategic plans as a whole.

The authors provide analysis of the implementation of digital technologies in health care and assert that digital health technologies are successfully implemented in the Russian Federation, and make appropriate generalizations and conclusions.

Keywords — digital economy, digitalization of health care, telemedicine, artificial intelligence, electronic medical records, human resources, quality of medical services.

I. INTRODUCTION

The development of the digital economy is inseparable from the development of human capital and the improvement of the quality of life, where health care is one of the foundation stone. If the trend of distance education in our country has already developed, then it is only planned in the sphere of health care. If a person is faced with a choice - no

medical care for objective reasons or help provided remotely via telemedicine, he will obviously choose the remote option, even if it is non-standard and unusual.

Ensuring the availability of medical care is impossible without the widespread use of digital technologies to solve the problems of reference and information support for making medical decisions, including by means of providing rapid access to complete and accurate information about the patient's health, the implementation of automated procedures to verify compliance with the selected treatment standards of medical care, checking the correctness of prescribing drugs, receiving remote medical consultations by persons suffering from chronic diseases, require constant monitoring, operational professional interaction of doctors and pharmacists. Especially all this is relevant, taking into account the area of the Russian Federation and the distance between individual settlements.

The aim of the research is to study the achievements and prospects for the development of digital technologies in health care in the Russian Federation and their impact on the quality of medical services provided to the population and the effectiveness of public health management.

II. MATERIALS AND METHODS (MODEL)

Empirical and complex economic analysis methods were used in the process of achieving the goal of the research.

III. RESULTS AND DISCUSSION

A. Legal regulation of digital health in the Russian Federation

Any economy of the future is a digital (electronic) economy and there can be no other economy. Accordingly, this is understood in our country and an attempt is being made to move to a new level, to look at the next planning horizon. If the previous version of the "Information Society" was viewed

more as a reduction of digital inequality, as the infiltration of information technologies into various spheres, including social and cultural, and as infrastructure development, then the new option focuses on the development and diversification of the economy, competitive access to the international market, creating new jobs and even new markets.

The Decree of the Government of the Russian Federation dated July 28, 2017 No. 1632-p adopted the Digital Economy of the Russian Federation Program[1], which defined the goal of moving to a qualitatively new level of using information and telecommunication technologies in all spheres of social and economic activity.

The program establishes for the period up to 2025 8 areas of work, the implementation of which should in principle indicate the achievement of the goals and objectives for the development of the Russian digital economy, including:

- a) *Government regulation;*
- b) *Information infrastructure;*
- c) *Research and development;*
- d) *Personnel and education;*
- e) *Information security;*
- f) *Public administration;*
- g) *Smart city;*
- h) *Digital Healthcare.*

We are interested in the Digital Healthcare Program. The program justification says:

"The health systems of Russia and practically all, both developed and developing countries of the world, have encountered systemic problems. Most of the existing health systems were created 100-200 years ago in other socio-social and economic conditions. In addition, there was a jump in the development of high-tech medical wearable means of monitoring physiological parameters, as well as implantable medical devices and remote monitoring devices. They require not just modernization, but the creation of new innovative digital health systems based on new technologies and management methods that meet modern conditions.

A new model of the health care system should be created and begin to function in parallel with the existing system, gradually intercepting its functions. Such an approach minimizes the loss of the transition period and will provide the population with quality medical care during the transition period. The new model focuses on preventive medicine and a personalized approach. The creation of a new health care model is based on the development of so-called "digital" medicine, which allows collecting and processing, including remotely, large amounts of data at the population level to make informed optimal strategic decisions and identify new directions of development"[2].

According to the content of the Program, the implementation of Digital Healthcare should lead to the following:

- citizens are provided with timely, necessary and high-quality medical care using digital medical services by doctors, patients, healthcare managers of all levels and forms of ownership;
- affordable, convenient, efficient and high-quality medical services help to increase the average life expectancy

of the population of the Russian Federation to 76 years, increase the active and working age of citizens up to 5-6 years after reaching the retirement age.

The expected results of the implementation of the Digital Healthcare program are:

- a) *Citizens of the Russian Federation will be provided with affordable medical care at the place of demand that meets the criteria for timeliness, personalization, prevention, manufacturability and safety.*
- b) *The productivity and efficiency of using material, human, informational and other resources and data in the provision of medical services will be improved (by 2025 by no less than 30%), while maintaining the quality of medical care for all patients in accordance with regulatory documents of the Ministry of Health of Russia .*
- c) *An ecosystem of digital health will be created in Russia through the transfer of innovative solutions to medical organizations and the support of domestic start-up companies in this area.*

To achieve these goals, it is necessary to create a regulatory environment conducive to the development of digital health, including:

1. The state regulation system formation of digital health.
2. Development of measures system of state support for digital health care, including encouraging the transition of medical organizations to the formation, use and processing of legally relevant electronic medical and organizational documents, the use of digital health services.
3. Ensuring the citizens of the Russian Federation of continuity and quality of medical care by providing medical personnel involved in the process of providing medical care, and the patient access to legally relevant electronic medical information located in the EHR USHIS (subject to the consent of patients to the processing of medical information in electronic form), despite the form of the medical organization ownership providing medical care
4. Procedure determination for providing medical care using registered medical equipment designed to provide medical care using digital health care and interacting with it support systems for making medical decisions.

B. Foreign and domestic experience in the implementation of digital technologies in health care

Digital technologies is one of the priorities in the development of the healthcare sector worldwide, this market is increasing by a quarter every year. The process can provide a breakthrough in the availability and quality of services without increasing health care costs. Therefore the development of digital medicine is carried out with the active participation of the state. Russia is not an exception. In Russia, several information-analytical projects of noticeable global scale are already being introduced.

The volume of the global digital medicine market, according to Global Market Insights, reached \$ 51.3 billion last year. By 2024, it is expected to grow more than twice - up to \$ 116 billion [3].

At the center of health in the XXI century there are data -

electronic health records (EHR), which digitally collect all data on the state of human health from the moment of his birth. Today, EHRs are already used in 94% of US hospitals. The centralized medical record system should appear in the European Union in 2020. A unified state healthcare system is being created in Russia. At the same time, its local segments exist and successfully operate in many regions of our country today. For example, in Moscow all state city polyclinics are connected to the Unified Medical Information System (UMIS).

Another component of digital medicine is carrying medical sensors that will transmit data online about the physiological body parameters and human activities. Their wide distribution will not only encourage people to lead a healthy lifestyle, but also provide the ability to remotely monitor the health status of patients. In the future, this approach should significantly reduce the number of visitors to medical organizations.

In the near future, wearable devices can become not only a means of diagnosing a condition. They will be able to make their own decisions about the need for medical intervention. So, in the Seoul State University (South Korea), a patch has been developed that can not only measure the level of glucose in the blood, but also, if necessary, give the patient an insulin injection. A similar device was also created for patients with Parkinson's disease.

Telemedicine will solve the problem of quality and efficiency of medical care, especially for citizens living in places remote from large medical centers, as well as for chronic patients, patients undergoing rehabilitation, and age patients who need constant monitoring. The law on telemedicine, signed in July 2017 [4], introduced changes to a number of legal acts regulating the use of IT-technologies in the health sector, and legally enshrined the concept of "telemedicine technologies" designed to provide remote communication of doctors and patients. With their help, it is also possible to significantly reduce the number of patient visits to the hospital - after all, part of the doctor's recommendations can be obtained without leaving home.

Big data is another technology that can be used both to improve the quality of diagnosis and treatment, and in the development of new drugs. The more widely distributed medical gadgets will receive, the more information will be accumulated in the medical data storage. And its processing opens up truly endless opportunities for healthcare to identify patterns, trends, and develop new treatments.

Artificial Intelligence (AI) in health care can become an indispensable tool to support medical decision making. The most well-known solution in this area — the IBM Watson system — based on analysis of vast data amounts, such as recent scientific advances, expert opinions, and the patient's medical history, helps the doctor most accurately diagnose and prescribe the optimal treatment. Today, IBM Watson is used in hospitals in Japan, China, the United States, several European countries and, according to statistics, increases the likelihood of making a correct diagnosis by 40% [5].

AI systems are quite widely used in oncology, where they allow us to isolate a tumor and healthy tissues in a medical image, as well as to evaluate how effectively the therapy was carried out on patients. AI also helps to detect a number of diseases in the early stages, such as blood poisoning, for

example.

The technologies of virtual and augmented reality have already proven themselves well both in the process of rendering medical aid, for example, in surgery, and in the course of rehabilitating patients after surgery. They also find application in the process of training and professional development of medical workers.

For example, today the VeinViewer device has become quite widespread, which projects an image of the veins onto the human body and helps to determine the most accurate injection site. Several European hospitals have already begun to test augmented reality glasses. The surgeon who puts them on not only sees the operation, but also receives detailed information about its course, which allows him to correct his actions. And in Switzerland, the Mindmaze – VR solution technology has been developed, which helps restore movement coordination of people who have suffered a stroke.

Robots are increasingly used in healthcare. Hundreds of clinics around the world, including about 20 in Russia, are already performing endoscopic surgery with the help of a robot surgeon Da Vinci. The doctor at the console sees the surgical site in 3D with multiple magnification and uses special joysticks to control the surgical instruments.

In addition, robots can be useful in the training of doctors. There is also a simulation center in the medical cluster of the Skolkovo Innovation Center, where domestic-made robots are presented, where you can learn to fight stroke, laparoscopic and endoscopic operations, gastroscopy, and much more.

3D printing is another technology in the near future that can radically change health care. Printed on the 3D-printer models of the joints, dental implants, etc., as closely as possible correspond to the individual characteristics of each individual patient. Thus, in the British Institute of Regenerative Medicine Wake Forest has successfully grown 30 different types of cells and organs, as well as cartilage and bone, including ears and noses.

Among the technologies that in the near future should fundamentally change medicine, making it "smarter", not to mention the blockchain. It will allow medical institutions to combine their existing data, and thus increase the efficiency of their use, while ensuring accessibility and, at the same time, security.

Digitalization of health care, including the improvement of information technology support for the medical and pharmaceutical organizations activities, health workers, students of medical and pharmaceutical universities, should ultimately increase the efficiency of management in the field of health care.

C. Problems impeding the information technology implementation in healthcare

Today, digital healthcare tools are being actively developed in Russia, its implementation into clinical practice will ultimately increase the life expectancy of the country's residents. Meanwhile this process is slow.

We highlight the following problems that prevent the introduction of information technology in medicine:

1. In the sphere of legislation, the process of adaptation to new technological realities is just beginning. In 2017, the

government adopted a telemedicine bill that will allow to provide remote medical care - to hold consultations, consult, monitor the health of patients at a distance, write out electronic prescriptions and certificates. The law application has been tested in a number of “pilot” regions, and will now be implemented throughout the country.

Polyclinics and hospitals, in which telemedicine offices appeared, note that this service greatly simplifies the lives of both patients and doctors. For discussing tests, closing a sick-list, or adjusting a treatment, one does not have to make an appointment with a doctor and come to an appointment. For this kind of services, there is enough remotedoctor reception.

The advantages of telemedicine are obvious both to professionals and ordinary people, but the picture, where all areas of medicine are covered by telecommunication technologies, still seems to be utopian.

This happens because:

- firstly, there are not enough specialists in narrow areas who can advise everyone;
- secondly, broadband Internet is not distributed throughout the country. The parliamentarians want to make an initiative on the full coverage of the Internet throughout the territory of the Russian Federation, in order to fulfill the law has become easier.

What kind of development of remote consultations can we talk about if people who most need help live in places where they only saw a glimpse of the Internet.

2. Another problem is related to the technological factor, namely the insufficient level of integration into a single network and the lack of connections to high-speed Internet networks both among doctors and patients. In Russia, the advanced projects in the field of digitalization of the healthcare sector are two information platforms:

- Unified State Healthcare Information System (USHIS). It will connect the information systems of all medical organizations and specialized departments, will allow to maintain unified electronic medical records and registers of persons with certain diseases. Medical information systems have been already introduced in 83 regions, where electronic health records of 46 million patients are maintained, there is an opportunity for an electronic doctor appointment, etc. This year, in a pilot mode, personal account “My Health” was launched on the portal of public services.
- The Unified Medical Information and Analytical System of Moscow (UMIAS), which has been operating since 2012. The number of portal users exceeds 9 million patients and 10 thousand medical workers. On the portal, you can make an appointment, get a referral for an examination, issue a sick-list and a medical card. 97% of recipes issued in Moscow are electronic. Moscow is the only metropolis in which all clinics are combined into a single system [6].

The connection of all state medical organizations to USHIS is planned for 2025. At the same time, the project implementation to eliminate digital inequality, which involves connecting to the Internet of residents of rural, remote and hard-to-reach areas, is still faced with objective difficulties in

financing [7].

3. The state is just beginning to develop education and professional retraining, taking into account the digitalization of health care.

In 2016 on the basis of the First MSMU named after I.M.Sechenov the country's first Department of information and Internet technologies in medicine was established. It is planned to open similar departments in other universities [8].

At PFUR, fourth and fifth year students learn how to prepare, conduct and document video consultations, organize remote master classes, and also broadcast operations and diagnostic procedures. And the exam is taken in the form of a business game, during which they are divided “by role” - they become participants and patients of the telemedicine consultations and conduct them in conditions as close as possible to the real ones.

However, today the telemedicine technologies development is in dire need of those under whose leadership these young doctors will work. Health care providers need to know both the capabilities of this innovative tool and its limitations. Without studying the basics of telemedicine by health care managers, the equipment of telemedicine centers will lie on the balance of medical organizations with dead weight.

4. The development of digital health is associated with innovation. About 50 digital health projects are represented in the Skolkovo Technopark in two clusters - IT and the biomedical technology cluster. Among these projects, 16 innovative teams leading development in the field of artificial intelligence, 5 teams create expert systems, 8 teams develop medical sensors and remote monitoring systems, 15 teams create various instruments for integrated patient management [9].

Projects such as Third Opinion, Botkin AI, Doc +, Ritmer, UNIM, FtizisBioMed can become leading in the emerging digital health care market and achieve capitalization in excess of \$ 1 billion. In the three to four years perspective, the capitalization of telemedicine companies in our country will reach \$ 30–40 million, and they will be comparable in scale to the federal network of medical clinics. For the successful implementation of these projects, it is necessary to attract private capital using the public-private partnership mechanism [10].

IV. CONCLUSION

Based on analysis we can draw the following conclusions:

1. Digital healthcare technologies are a real salvation for Russia, with its vast territories and remote settlements. These technologies help save time to specialists and patients, as well as assist people from remote areas where doctors cannot reach simply physically.

2. The question of how quickly digital technologies will penetrate the medical market has become central to the discussion of the digital health program. Optimistic forecast is by 2025. In segments where there is effective demand, primarily in private medicine, this will happen rather quickly. Mass medicine will take this path objectively slowly.

3. Key areas of digital medicine development in the short term are:

- Introduction of electronic medical records.
- Development of the “connected patient” concept –the condition monitoring and medical services provision with the help of embedded intelligent devices.

- Telemedicine.

4. Main advantages of healthcare digitalization are:

- Financial - cost savings by reducing patient contact with doctors and modernizing the organizational delivery system.
- Social - increased availability of quality medical care.
- Professional - improving the quality of services by reducing the number of medical errors, the development of predictive medicine, improving the effectiveness of clinical research.

The main achievements and prospects of digital technologies in healthcare are highlighted in the article, the problems and, most importantly, the ways to solve them, will ensure the availability of all types of medical care and activate the processes of wide and rapid introduction of the latest diagnostic and treatment technologies into medical practice.

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