

Developmental delays of healthcare in the digital economy

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Abstract. Currently, the driver of the development of socio-economic systems is their digital transformation. Information and communication technologies have significantly simplified a number of organizational and operational processes of companies in all sectors of the economy. In healthcare, ICTs have found their way into improving communication solutions. However, in general, the digital transformation of this area is much broader, and current trends, problems and prospects for its activation require additional scientific research. The study outlines promising directions for the development of the healthcare sector, based on the introduction of artificial intelligence, robotics, 3D printing and other end-to-end digital technologies. The trends examined in the course of the study made it possible to speak not only about promising directions for the introduction of key digital technologies in the healthcare sector, but also about the presence of a number of limitations. In particular, the activation of these processes in Russia is hindered by gaps in patent law and licensing. The article identifies possible management and regulatory decisions to overcome the existing limitations. The research results can be used as a theoretical basis for managing the development of the healthcare sector in the digital economy.

Today, digital transformation is one of the main drivers of economic growth. Digitalization covers all spheres of life, opening up huge benefits to government, citizens, and business. The digital economy was a reflection of the transition from the third industrial revolution to the fourth. In 2011, a special term for its designation appeared in Germany - Industry 4.0 - which means the transition to fully automated digital production. The study of new economic manifestations is of great interest, as it allows to increase the speed and quality of economic management, adjust the legal framework and rules for doing business, generate innovative products, services and services based on digital technologies.

The place of Russia against the global background of digitalization processes is illustrated by the World Ranking of Digital Competitiveness, compiled annually by the Swiss International Institute for Management and Development. The digital competitiveness rating is calculated for 63 countries of the world based on an analysis of 50 indicators that take into account the level of countries' readiness for digital transformation,

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the state of the regulatory environment, investments in R&D and education, the potential of digital technologies, capitalization of the IT industry, etc. In 2019, Russia took 40 -th position of the rating, having risen by 2 points over the year (table 1). The USA, Singapore, Sweden, Denmark and Switzerland are at the top of the rating. Among the BRICS countries, China has the best performance - 30th [4].

Table 1. Positions of the leading countries and Russia in the global ranking of digital competitiveness, 2019

Final ranks of the 2019 ranking, (2018)	Country	Index value, in %	Ranks of countries by the main components of the ranking		
			Knowledges	Technologies	Ready for the future
1 (3)	USA	100	4	3	2
2 (1)	Singapore	99,422	1	1	15
3 (2)	Sweden	97,453	7	5	3
4 (5)	Denmark	96,764	8	10	1
5 (8)	Switzerland	95,851	6	9	10
6 (10)	Norway	95,724	16	2	6
7 (4)	Finland	95,248	9	4	8
8 (9)	Canada	95,201	3	12	9
9 (6)	Netherlands	93,886	12	8	4
10 (10)	Great Britain	93,239	10	13	3
...
40(42)	Russia	65,207	24	43	51

In the modern world, end-to-end technologies of the digital economy are becoming more widespread, penetrating into all spheres of the life of society without exception [5, 6, 7]. The significant potential of their application in healthcare allows us to judge the growing role of digitalization in this matter. The prerequisites for digital transformation of the healthcare sector are becoming more evident. New technological solutions contribute to the effective transformation of methods and tools for diagnosis and treatment [2]. A special contribution to these processes is made by global informatization and mobility, thanks to which geographical restrictions in communication via the Internet, mobile devices and communication applications are overcome, which, among other things, largely contributes to the development of telemedicine [8].

In recent years, basic information technologies have been actively introduced in most medical institutions in the country. The current heightened epidemic risks associated with the COVID-19 pandemic are making adjustments to the scale and dynamics of healthcare digitalization. In this regard, it is digital technologies and solutions that can be applied to meet current challenges.

The importance of end-to-end technologies of the digital economy in the development of healthcare is also confirmed by world practice. More than 82% of healthcare business leaders reported that their AI divisions have already improved their operational and administrative workflows, according to a survey conducted by MIT Technology Review in conjunction with GE Healthcare. About 1000 specialists from the USA and Great Britain took part in the survey. Also, the final analytical report provides information that every 7 out of 10 healthcare organizations are already using or considering the use of artificial intelligence [1].

These companies point out that artificial intelligence:

- reduced the time spent on updating records and compiling reports (61% of respondents);
- freed up more time for consultation with patients (45%);
- freed up more time for operations (46%) [1].

Artificial intelligence and robotics are catalysts for transforming the healthcare industry. In world practice today, there is no doubt that artificial intelligence is a reliable mechanism in conditions of diagnostic uncertainties and can warn about anomalies that are subsequently interpreted by a person from a medical point of view and in terms of determining their clinical significance. Moreover, not long ago this state of affairs was considered absurd and unlikely. However, advances in artificial intelligence are positioning this class of technology as a powerful tool for improving clinical and operational efficiency. Artificial Intelligence enables everyone in the healthcare ecosystem to benefit from improved resource efficiency and diagnostics. Its application expands and enhances professional capabilities and provides the basis for more effective, personalized and cost-effective results [10 - 13].

Medical institutions in the United States and Europe are adopting a wide range of technologies and applications to achieve better healthcare outcomes, with a particular interest in EHR automation, medical imaging, diagnostics, and patient data and risk analysis. Within the framework of the study, the following trends were established (Figure 1) [1].

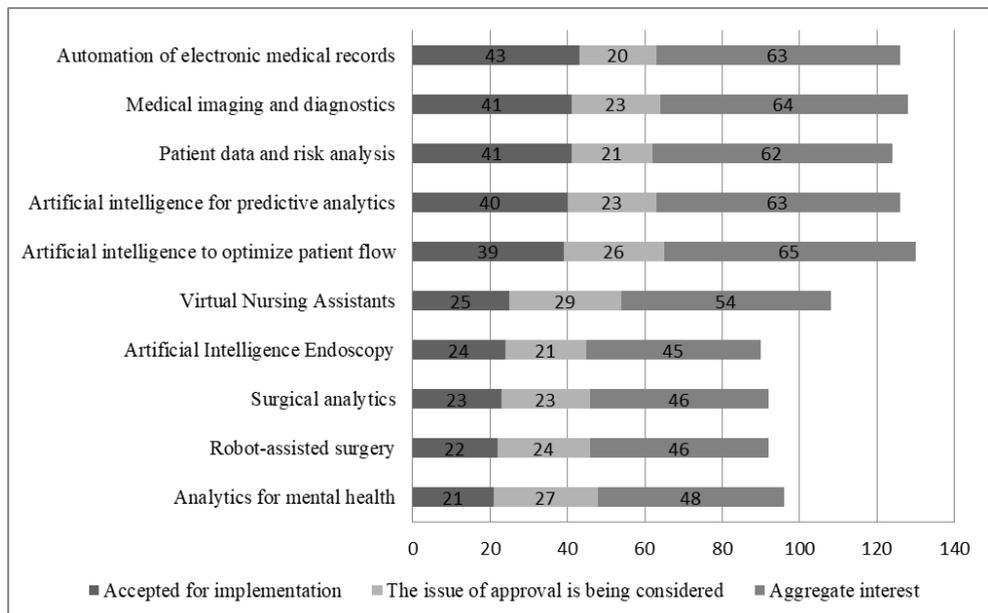


Fig. 1. The interest of foreign healthcare companies in digital technologies (in% of the total number of respondents) [1]

Almost two-thirds of the respondents surveyed indicate that such artificial intelligence-enabled tools are either used in their enterprises (41%) or are at the stage of considering implementation in practice (23%) [10].

The technological transformation of healthcare is undoubtedly a global trend. Scientists and developers are creating new solutions to improve accessibility, comfort and efficiency, and in the conditions of COVID-19 and safety, medical services. In this regard, the Russian practice of introducing end-to-end digital economy technologies into the healthcare sector

is of particular interest. The most promising of these are artificial intelligence technologies, robots and 3D printing.

During a pandemic, healthcare facilities are forced to resort to increased automation. Thus, specialized and repurposed disinfection robots can help with a shortage of personnel and in conditions of increased epidemic risks. An autonomous robot can deliver food and essentials to isolated patients, minimizing the risk of cross-contamination between people [9]. Testing for infection, as well as testing potential vaccines, is a massive task that can also be greatly simplified with automated systems.

In May 2020, a COVID-19 diagnostic system using artificial intelligence technologies began operating in Moscow. It was launched on the basis of a unified X-ray information center, where they previously studied the possibilities of using artificial intelligence for the timely detection of cancer. Now such a system will detect COVID-19 based on X-rays.

Sberbank provided the regions with free access to its experimental model of artificial intelligence to help doctors diagnose and treat COVID-19. Experts clarify that the artificial intelligence technologies involved in the model by computed tomography (CT) classify patients into infected and uninfected. In case of confirmation of infection, this technology allows you to determine the changes caused by the coronavirus and estimate their volume.

In addition, the Medsi network of clinics, together with the Third Opinion platform, launched a patient monitoring technology based on artificial intelligence. Botkin.AI, which presented artificial intelligence technology for detecting pneumonia and coronavirus, plans to integrate the development into medical institutions together with Mail.ru Cloud Solutions [3].

3D printing technologies, especially in demand during a pandemic, contribute to the digitalization of healthcare. However, it should be noted that the proposed options for the use of such technologies often lie outside the traditional system for the development and testing of medical solutions, which entails significant risks. In particular, the effectiveness of the use of 3D-printing products, as well as the possibility of their replication and maintenance of new equipment, has been poorly confirmed. Nevertheless, the unpredictable development of events with regard to COVID-19 may lead to the fact that it is medical respirators or ventilators, which are printed directly in a medical institution on a 3D printer, and will turn out to be a decisive factor in the fight against infection. The question arises of how to organize the certification of such products and how to respond to patent infringement in their manufacture based on 3D printing of original parts for medical equipment. If these and other obstacles are leveled, the world market may expect a sharp increase in the supply of simple and cheaper medical equipment, which will lead to a radical increase in the availability of high-tech medical care.

Thus, the trends discussed above allow us to speak not only about promising areas for the introduction of key digital technologies in the healthcare sector, but also about the presence of a number of limitations. First, MedTech companies are faced with a lack of certifications for 3D printed products and a significant portion of robotics. Secondly, in Russia there is no practice of using such technologies even in an experimental format, while abroad there are opportunities for their implementation, for example, in large hospitals and medical research centers. Thirdly, unauthorized 3D copies of medical equipment parts violate the patent rights of the original manufacturer. Fourth, the properties of 3D printed products are still unclear due to the lack of sufficient testing. All this taken together slows down the conduct of experiments with such products and their further introduction into the practice of medical institutions [9].

In conclusion, we note that in order to overcome the existing obstacles, the following management and regulatory decisions are required. Such solutions include reducing the time required for the creation, registration and clinical testing of tools and equipment for diagnostics, treatment and disinfection using end-to-end digital technologies (artificial

intelligence, robots, 3D printing, etc.). It is also necessary to promptly update the regulatory framework in order to accelerate the introduction of artificial intelligence technologies, robotics, 3D-printing, etc. into practice, which can be achieved by combining the efforts of regulatory and regulatory agencies and participants in the healthcare sector. Assistance in attracting external and increasing budgetary financing for the development of digital technologies in healthcare can play a significant role. These actions will significantly minimize the current restrictions on the implementation and development of digital technologies in the healthcare sector.

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