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DOI: <https://doi.org/10.32782/2224-6282/191-10>**Oliinyk Mariia**

PhD in Economics,

National Economic University named after Vadym Hetman

ORCID: <https://orcid.org/0000-0002-5700-1296>**Kozak Vadym**

PhD in Economics, Professor,

National Economic University named after Vadym Hetman

ORCID: <https://orcid.org/0000-0002-6136-6239>**Zarytska Nataliya**

PhD in Economics, Associate Professor,

National Economic University named after Vadym Hetman

ORCID: <https://orcid.org/0009-0009-7668-2347>**Олійник М.О., Козак В.Г., Зарицька Н.С.**

Київський національний економічний університет імені Вадима Гетьмана

## STRUCTURAL MODERNIZATION OF THE GLOBAL HEALTH CARE SYSTEM

Nowadays, both diversified channels of medical care for patients in remote mode, as well as extensive telemedical networks and systems of exchange of specialized medical information between all participants in the process of public reproduction of medical services at the national and supranational levels are actively being formed. As a result, we are all witnessing the development in global coordinates of a multi-level integrated system of a digital ecosystem of health care, which is based on digital technologies, forms qualitatively new channels of value creation for consumers of medical services and ensures deep convergent interaction of all key subjects of the medical care system citizens – from doctors, patients, health care institutions and states to health insurance companies, intergovernmental and non-governmental international organizations, business communities, etc. In view of this, there is every reason to claim that the qualitatively new business models of the digital health care system implemented in a fragmented manner in the conditions of digitalization will already in the next decade accumulate a powerful institutional and technological resource for "undermining" traditional business models of medical care with their departure from the narrowed format of the primary link of medical services to deep penetration into all links of the value chain formed in health care, and therefore – the formation of sustainable cash flows for producers of medical services. The purpose of the article is to reveal conceptual approaches to the systematic implementation in global coordinates of the key priority of digital health – the formation of values for patients in an ethical, safe, reliable, fair and sustainable way, while fully complying with such principles of providing medical services as: its transparency, safety and accessibility to broad segments of the population, scalability of medical care and its regularity, digital compatibility of structural components of the digital ecosystem, and strict confidentiality of medical information.

**Key words:** digital medicine, global medical sector, digitization, business models of medical care, digitalization of medicine, telemedicine networks, digital health.

**JEL classification:** L15, F00, F01, F60

## СТРУКТУРНА МОДЕРНІЗАЦІЯ ГЛОБАЛЬНОЇ СИСТЕМИ ОХОРОНИ ЗДОРОВ'Я

На сьогодні активно формуються як диверсифіковані канали медичного обслуговування пацієнтів у дистанційному режимі, так і розгалужені телемедичні мережі і системи обміну спеціалізованою медичною інформацією між усіма учасниками процесу суспільного відтворення медичних послуг на національному і наднаціональному рівнях. У результаті всі ми є свідками розбудови у глобальних координатах багаторівневої інтегрованої системи цифрової екосистеми охорони здоров'я, яка базується на діджитал-технологіях, формує якісно нові канали створення цінності для споживачів медичних послуг та забезпечує глибоку конвергентну взаємодію усіх ключових суб'єктів системи медичного обслуговування громадян – від лікарів, пацієнтів, закладів охорони здоров'я і держав до компаній з медичного страхування, міжурядових і неурядових міжнародних організацій, бізнес-спільнот тощо. У системних процесах глобальної цифрової трансформації економічної діяльності особливе місце в останні роки посідає сервісна індустрія, яка, як свідчить міжнародний досвід, у постіндустріальній парадигмі світогосподарського розвитку значною мірою детермінує структурну динаміку національних економік більшості країн світу. Йдеться насамперед про суттєве випередження сервісною індустрією промислового й аграрного секторів за внеском у виробництво глобального валового внутрішнього продукту, концентрацією сукупної робочої сили та генеруванням усезростаючих масштабів доданої вартості. З огляду на це, є всі підстави стверджувати, що фрагментарно впроваджені в умовах діджиталізації якісно нові бізнес-моделі цифрової системи охорони здоров'я вже у найближче десятиліття акумулюють потужний інституційно-технологічний ресурс для «підриву» традиційних бізнес-моделей медичного обслуговування з їх відходом від звуженого формату первинної ланки медичних послуг до глибокого проникнення в усі ланки сформованого в охороні здоров'я вартісного ланцюга, а отже – формуванням стійких грошових потоків для продуцентів медичних послуг.

**Ключові слова:** цифрова медицина, світовий медичний сектор, цифровізація, бізнес-моделі медичного обслуговування, діджиталізація медицини, телемедичні мережі, цифрове здоров'я.

**Statement of the problem.** The key issue is that the steady growth of labor productivity in industry and the agricultural sector due to the introduction of digital technologies, the increasing automation of production and sales processes, as well as the widespread use by economic entities in their operational activities of the Internet, cloud computing, robotics and artificial intelligence is a powerful driver of the transformation of the service sector into a "shelter" for the labor force released from traditional industries and sectors of the economy. This thesis is confirmed, in particular, by the evaluations of the global expert group Digital McKinsey, according to which modern technological shifts in the world economy and the consequences caused by them are commensurate with the industrial revolution of the XVIII–XIX centuries in terms of their scale and degree of coverage of subsystems and structural components of national economies. and by 2036 they will automate up to 50% of all work operations.

**Analysis of recent research and publications.** Studies of the economy of the health care system and the market of medical services were and are the object of close attention of both domestic and foreign scientists: E. Aristov, O. Baeva, M. Bas, Yu. Baluk, E. Gaponova, N. Iordanska, T. Kaminska, V. Kevorkov and O. Romanov, D. Kicha and A. Fomina, F. Kotler, N. Malakhova, A. Mishchuk, V. Pashchenko, A. Serzhuk, E. Taisberg, I. Togunov. Numerous scientific works of Ukrainian authors and foreign scientists testify to the importance of scientific research in the field of state management of health care as the newest digitalized system. Recognizing the indisputable achievements of the above-mentioned scientists, the issue of digital transformational changes in the health care system in the rapid conditions of global technological development and in the context of reforming the domestic medical industry requires further scientific research. However, the reform of the medical industry and the COVID-19 pandemic are changing the traditional paradigms of market development, transformational mechanisms and digitalized competition tools, which makes this article relevant.

**Highlighting previously unresolved parts of the overall problem.** It is necessary to focus attention on the order of systemic digitalization of health care as a material basis for the implementation of qualitatively new social policies by states in global coordinates, oriented towards the development of effective health management systems (as opposed to the model of disease treatment operating in the "pre-digital" period). This will make it possible to improve the methodology and speed up the process of penetration of digital technologies into all spheres and structural links of the global medical sector, turning their information technologies into the main driver of its deep structural changes and "rebooting" on a qualitatively new – digital – paradigm.

**Objectives of the article.** Disclosure of conceptual approaches to the systematic implementation in global coordinates of the key priority of digital health – the formation of values for patients in an ethical, safe, reliable, fair and sustainable way, while fully complying with such principles of providing medical services as: its transparency, safety and accessibility to a wide range segments of the population, scalability of medical care and its regularity, digital compatibility of structural components of the

digital ecosystem, and strict confidentiality of medical information.

**Summary of the main results of the study.** Currently, in the global systemic processes of digital transformation of economic activity, a special place has been occupied by the service industry in recent years, which, as international experience shows, in the post-industrial paradigm of world economic development largely determines the structural dynamics of the national economies of most countries of the world.

In practical terms, this means not only a colossal release from the economy of labor resources with a low and medium level of professional qualifications, but also a rapid deepening of differentiations in the levels of remuneration of employees of various degrees of qualification and digital skills, which is capable of bringing domestic and interstate asymmetries of socio-economic development to critically dangerous, from the point of view of property stratification of the population, limit. Let's turn to the numbers: according to the analytical report *The Future of Jobs for 2020* by experts of the World Economic Forum [1], the systemic digitalization of economic activity together with the Covid-19 pandemic will in the coming years create a scenario of the so-called "double disruption" for workers in the global industrial sector. when "pandemic blockages" of the economic activity of business entities will be actively superimposed on the cyclical factors of structural dynamics and technological modernization traditional for each national economy.

It is the latter for the period until 2025 that will fundamentally change both the specifics of production tasks of economic entities and the distribution of jobs and professional skills of the workforce. In particular, 43% of managers of enterprises and firms surveyed in 2020 emphasized their intention to significantly reduce the number of personnel due to the integration of technologies; 41% – to expand the practice of transferring part of specialized production functions to external contractors, and 34% – to increase the number of employees based on technological integration [7, c. 12]. And although by 2025 the total time spent by workers, machines and technical equipment for the performance of current production operations will remain practically unchanged, a significant part of the surveyed companies and firms expect significant changes in their locations, mechanisms of organization and regulation of value chains, as well as the number of workforce due to the influence of non-technological factors [2].

Under such conditions, it is the service sector that will be able to absorb the labor force released from traditional sectors of the economy and become a reliable source of stable employment for the socially vulnerable sections of the world population. Therefore, today there is no doubt in anyone's mind that the dynamics and vector direction of the development of the service sector, as a universal and all-encompassing process to a greater degree, in the last decade are largely determined by the global processes of digital transformation. A special place in such transformations is occupied by the health care system, which, given its priority role in the processes of expanded reproduction of the national human capital of all countries without exception, urgently needs the introduction of qualitatively new instrumental and technological approaches. The latter should be able to provide both a significant reduction in

the level of financial costs of this sector, and a significant increase in the effectiveness of medical therapy and preventive measures. In addition, the key vector megatrend of the structural transformation of the global health care system for the coming years is also related to the implementation by states of complex measures in the field of ensuring the maximum convergence of public interests in maintaining high indicators of public and individual health of people, on the one hand, and economic interests of business entities regarding profit maximization, from the second.

In this context, the tools and mechanisms of systemic digitization of health care deserve the greatest attention as the material basis for the implementation by states in global coordinates of qualitatively new social policies, oriented towards the development of effective health management systems (in contrast to the model of disease treatment operating in the "pre-digital" period). Digital medicine materializes the most innovative approaches in the medical service of citizens, based, on the one hand, on advanced medical knowledge, information and equipment, and on the other hand, on the systematic implementation of information and communication technologies in the treatment process, capable of remotely providing operational diagnosis and medical therapy for patients. Let's turn to the numbers: the size of the global market for digital medical services only in the period from 2019 to 2021 increased from 175 to 268 billion dollars. USA with a prospective trend of increasing capitalization to 829 billion in 2026 and average annual growth rates of 25% during 2019–2026 [6]. If in 2010 only 234 investors were represented on the global market of digital health care, then in 2015 – almost 1.1 thousand; the total number of deals increased from 160 to 889 over the specified period, and the total volume of capital investments increased from 952 million to 5.7 billion dollars. USA respectively [8, p. 12–13].

We know from history that the digitization of the national health care systems of the leading countries of the world during the last half century has always gone hand

in hand with the fundamental processes of informatization of their national economies. Thus, with the transition of Western corporations from the end of the 1950s to the automation of standard routine operations in the field of accounting and personnel accounting, a number of subjects of their medical services markets (primarily insurance companies) begin to actively use information technologies to process huge arrays of static data related to medical care. With the transition of the Western corporate sector to the integration of key and auxiliary business processes and information support for the uninterrupted functioning of technological chains at the level of networks of partner companies, laws are being passed in the USA, Germany and Great Britain and the implementation of special complex programs for the development of institutional and technical infrastructure for the informatization of national systems is being launched health care [11]. And, finally, since the 2000s, there has been not only a deep penetration of digital technologies into all spheres and structural links of the global medical sector, but also the transformation of information technologies into the main driver of its deep structural changes and "reboot" on a qualitatively new – digital – paradigm. This is confirmed, in particular, by data on the dynamics of capitalization of the world market of telemedicine technologies and services (English – Telemedicine Technologies and Services), which increased from 8.2 only in the period 2009–2014 [8, p. 14] to 49.8 billion dollars. USA with a prospective growth trend to 266.8 billion in 2026 [14] and to 459.8 billion in 2030 [15] at an average annual growth rate of 19% during 2019–2025 [12]. At the same time, about 18 billion dollars. In the United States in 2019, telephone consultations accounted for 13 billion dollars for telemonitoring of patients' health. In turn, the specific share of telehospitals in the total market capitalization of telemedicine technologies and services currently exceeds 65%, which fully corresponds to the corresponding indicators of the past years [7, p. 24].

Among the specific reasons that determined the rapid pace of digital transformation of the health care

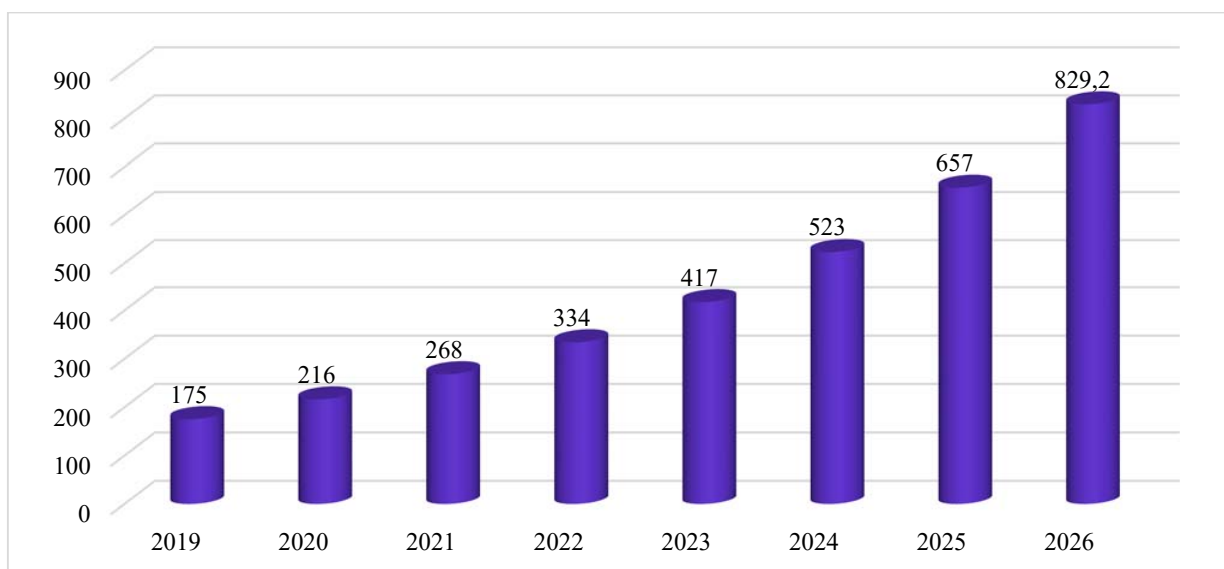


Figure 1. Forecast size of the global digital health system market during the period 2019–2026

Source: elaborated by the author based on reference [9]

system in recent years, the following played a key role: active support by national governments of complex IT solutions in the medical field; dynamic expansion of the application of big data technologies here; a relatively high level of profitability of investment capital investments in innovative developments in the field of medical IT solutions; the growth of market demand and the use of digital technologies due to the Covid-19 pandemic; as well as the objective need to optimize the ever-increasing costs of financing national health care systems based on the expansion of telemedicine segments for remote monitoring of patients' health.

As for global health care costs, only in the period 2000–2018 they increased from 8.7 [5] to 10.4% of global GDP [4]; and during 2018–2027, the annual growth of global health care costs will average 5.5% [17], which significantly exceeds the corresponding indicator for the period 2015–2019 (2.8%) [8, p. 26]. Suffice it to say that only during 1980–2020, the annual volume of aggregate consumer spending by Americans (for all groups) of consumers on health care increased from 728 [8, p. 13] to almost 5.2 thousand dollars. USA (including medical insurance costs – 3.7 thousand dollars, medical services – 864 dollars, medical goods – 170 dollars) [14]. In the regional dimension, the most dynamic increase in financing of national healthcare systems in the coming years is expected in Australia, Asian countries (5.3% annually) and countries with transition economies in Central and Eastern Europe (5.2%) [8, p. 17].

Taking into account the fact that the share of patient costs in the total financing of the medical sector currently exceeds 35%, annually up to 100 million people worldwide fall into situations of extreme impoverishment and poverty [1], as well as personal bankruptcy, due to the inability to pay medical bills. In turn, the Covid-19 pandemic caused an "explosive" growth in market demand for digital medical services, primarily in terms of remote diagnostic and treatment procedures, implementation of complex IT solutions for telemedicine, timely exchange of patients' medical records between doctors, safe receipt of relevant medical information in electronic format, as well as constant remote monitoring of patients' health by medical workers using digital non-invasive devices such as portable electronic devices, home tonometers, glucometers or heart rate monitors, etc. And this is not to mention the urgent needs of medical personnel and patients in conducting medical online consultations and video conferences, as well as social distancing, which raised the issue of the development of digital medicine and digital healthcare ecosystems (including cross-border ones) to a qualitatively higher level of theoretical understanding and practical implementation.

Thus, according to the results of the first four years of the implementation of the pilot program of remote monitoring of patients' health by St. Joseph's Mercy Hospital in Oakland, their mortality decreased by 35% [9]; and thanks to the pilot application in a number of US hospitals within the framework of a six-month randomized clinical trial of cardiac sensors-implants connected by wireless networks to the storage of clinical medical data, the frequency of hospitalizations of patients with heart failure decreased by 30% [2].

World experience proves that the digital transformation of the health care system in the last decade takes place

through two main channels: the first is the introduction of promising groups of pioneering digital technologies universal for all sectors of the world economy; the second is the forced implementation of information technology solutions that are unique and demanded by the medical industry in particular (which can be quite heterogeneous in nature). An eloquent example of the implementation of the second channel of the digital transformation of the medical sector is the numerous programs to overcome the Covid-19 pandemic implemented by national governments in 2020. Among them, in particular, the program to support telemedicine services in the United States of America with a total cost of 200 million dollars. USA [5]; financing of innovative projects in health care in the European Union in the amount of 55.2 million euros [11]; financing by the German Ministry of Health for the introduction of high-tech remote services for patients, medical robotics and systems for improving information security for a total of 3 billion euros [6].

The synergistic action of the specified areas of structural modernization of the medical sector takes its concentrated expression in the unification of individual types of medical services into single, integrated at the national and global levels, digital healthcare ecosystems. It is primarily about the smooth and secure exchange of specialized medical information between patients, medical professionals, managers of health care systems, medical data services, as well as between them for the formation and processing of information by the providers of medical services and the medical community.

As for the economic effect of the introduction of telemedicine technologies in the USA, recent assessments by authoritative international experts testify to the wide possibilities of significant savings (by 75%) in the costs of medical care for the population when they are used. And this is not taking into account the possibility of transferring more than half of the visits by patients to doctors in the format of video conferences, which is another 500 million dollars. US annual savings. And although a significant share of medical visits should continue to be implemented in the traditional format, the estimated amount of annual savings on a national scale still exceeds 100 billion dollars. USA [7, p. 18]. This fact is increasingly orienting the world community to the systematic implementation in global coordinates of the key priority of digital health – the formation of values for patients in an ethical, safe, reliable, fair and sustainable way, while fully complying with such principles of providing medical services as: its transparency, safety and accessibility to broad segments of the population, scalability of medical care and its regularity, digital compatibility of structural components of the digital ecosystem, and strict confidentiality of medical information [7, p. 19].

It is appropriate to note that the systemic digitization of the global health care system in recent years has led to the isolation of a specific "niche" in the structure of scientific research and technical and technological developments – research and development in the field of digital health care. Suffice it to say that only in 2020, the total investments in research and development of this profile amounted to more than 21 billion dollars. USA (while in 2010 they did not exceed 1 billion) [3]. Of this amount, 4.3 billion dollars. was invested in the development of telemedicine (4.2 billion – for the first half of 2021); 1.8 billion –

for data analytics (1.5 billion), 1.4 billion – for the "mobile health" program (1.6 billion); 1.2 billion – to support clinical decisions; 837 million – for practical management solutions; 815 million – for wearable health sensors; 792 million – for the development of digital health services of a health nature (1.7 billion, respectively); 765 million – for the medical care reservation program; 500 million for the development of social health networks [9]. In this connection, we would like to note that even before the Covid-19 pandemic, for several years in a row, there was a steady increase in investments in the development and implementation of digital health care tools, and therefore, a constant expansion of the volume of consumption of digital medical services by patients. In particular, as early as 2019, 42% of Americans reported regular use of digital health monitoring tools [13].

Let us also emphasize that it is the electronic means of constant monitoring of one's own health in recent years that have caused the formation and further rapid development of a qualitatively new structural element of the global market of health care goods and services – the segment of home digital technologies of the medical profile. It covers the purchase and sale of electronic devices, services and software applications for consumers who use them for health purposes outside of health care facilities.

**Conclusions.** So, we can say that the qualitatively new digital components of national health care systems emerging right before our eyes are nothing more than a "mirror reflection" of the fundamental processes of digital

transformation of the global medical industry, which go far beyond the actual technological and informational basis of it. functioning. From the point of view of the economy of health care, here we are talking about the implementation by health care institutions of innovative strategies and business models capable, on the one hand, of forming qualitatively new channels of value creation for consumers of medical services, and on the other hand, of developing a network (by its elements) the institutional "architecture" of the global health care system. That is, its ability to ensure deep convergent interaction of all key subjects of the system of medical care for citizens – from doctors, patients, health care institutions and states to health insurance companies, intergovernmental and non-governmental international organizations, business communities as employers of consumers – becomes a priority. medical services, etc. Relaying this conclusion to the social practice of the most economically developed states, we can single out the most common innovative business models of the digital health care system today. As a conceptual reflection of entrepreneurial activity, which includes tools for creating value and its delivery to target groups of consumers, mechanisms for generating profit and ways of connecting them based on available resources and processes, innovative business models of the digital medical industry have radically transformed its global competitive landscape in the last decade, demonstrating the highest efficiency in creating value propositions for consumers of medical services.

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