The BRICS HEALTH JOURNAL 2024; 1 (1): 20-34

journal homepage: https://www.bricshealthjournal.com
https://doi.org/10.47093/3034-4700.2024.1.1.20-34

REVIEW

Digital transformation of healthcare in the Russian Federation

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Contributors: Vadim V. Vankov contributed to conceptualization and design, discussion of results and conclusion. Oliya R. Artemova contributed to conceptualization and design of the study, collection and analysis of the study material, discussion of results and conclusion. Alexandr V. Gusev has contributed to collection and analysis of the study material based on data from the subjects of the Russian Federation. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Informed consent statement: Not required

Funding: None

Competing interests: The authors declare no conflict of interest

Ethical approval: Not required

Data sharing: Not applicable

Acknowledgments: None

Manuscript source: Unsolicited manuscript

Country/Territory of origin: Russia

Received: 14.08.2024
Accepted: 12.09.2024
Date of publication: 08.10.2024

ABSTRACT

The history of creating and using various information and communication technologies for medicine and healthcare in Russia dates back to the 1950s–1960s, when the first scientific research was launched in the USSR and the first practical developments and proprietary technologies were created. The creation and application of the first software products was aimed at the collecting and automating statistical reports and partial automation of auxiliary departments, such as accounting, personnel departments, etc. In the early 2000s, Russia began to form a commercial market of specialized software for medicine and healthcare. In 2011, by order of the President and with the active participation of the professional community, the Russian Ministry of Health and Social Development launched a federal project to create a "Unified State Information System in Healthcare", which became the starting point for the mass introduction of various information systems in the healthcare sector of the Russian Federation. In 2019, the federal project "Creation of a unified digital health care circuit based on Unified State Information System in Healthcare" was launched in Russia as part of the "Healthcare" national project. The implementation of the projects in 2011–2024 allowed to achieve high rates of application of medical information systems, as well as to move to projects on digital transformation of the industry, including the introduction of artificial intelligence technologies and various digital services and assistants for patients, doctors, and managers. The article presents a brief history of the development of digital projects, the current key directions in developing information technologies for healthcare and the results achieved so far.

Key Words: health digitalization; digital health; artificial intelligence; decision support systems; electronic health records; telemedicine

Citation: Vankov VV, Artemova OR, Gusev AV. Digital transformation of healthcare in the Russian Federation. *The BRICS Health Journal.* 2024;1(1):20–34. https://doi.org/10.47093/3034-4700.2024.1.1.20-34

Overview of the healthcare system of the Russian Federation

The healthcare system of the Russian Federation is one of the largest and most complex in the world. According to official data, the population of the Russian Federation in 2020 was 147.2 million people, of whom 75% live in urban areas and 25% in rural areas[1,2]. The working age population was 82.7 million (56.4%), the population under working age was 27.4 million (18.7%), and the population over working age was 36.6 million (24.9%).

Healthcare in the Russian Federation is represented by three systems: state, municipal, and private[3]. The dynamics of several indicators characterizing the healthcare system of the Russian Federation, including population by years, is presented in Table 1.

The total number of healthcare organizations in the Russian Federation in 2019 was 26.3 thousand organizations. As can be seen from Table 2, the number of hospitals is decreasing as well as the number of hospital beds. The total number of hospitals in 2018 was 5,257, and only 259 were of a private form of ownership. The number of outpatient healthcare organizations has been increasing since 2010 at the expense of private healthcare organizations[3].

Table 1. Some data characterizing the dynamics of health indicators of the Russian Federation

Indicator	2000	2010	2017	2018	2019
Population, million people	146.3	142.9	146.9	146.8	146.7
Number of hospitals, thousand	6.3	5.4	5.3	5.3	5.1
Number of outpatient healthcare organizations, thousand	21.3	18.6	20.2	20.2	21.2
Number of physicians, thousand people	680.2	680.9	697.1	703.7	714.6
Number of nursing staff, thousand people	1,563.6	1,537.9	1,525.2	1,491.4	1,491.3

Table 2. Data on the dynamics of the number of healthcare organizations in the Russian Federation[3]

Healthcare organizations of the Russian Federation	2010	2016	2017	2018
State and municipal hospitals	6,084	5,091	4,999	4,938
Private hospitals	115	205	241	259
State and municipal outpatient healthcare organizations	12,173	14,117	14,465	14,424
Private healthcare organizations	2,753	4,168	4,837	4,866

[1] Российский статистический ежегодник. 2020: Статистический сборник/Росстат. / Russian Statistical Yearbook. 2020: Statistical book/Rosstat. Moscow, 2020. 700 p. ISBN 978-5-89476-497-9. (In Russian). Accessed September 12, 2024. https://rosstat.gov.ru/storage/mediabank/Ejegodnik_2020.pdf

[2] Всероссийская перепись населения 2020 года / Russian Population Census (In Russian). Accessed September 12, 2024. https://rosstat.gov.ru/vpn/2020

[3] Здравоохранение в России. 2019: Статистический сборник/Росстат. / Healthcare in Russia. 2019: Statistical book/Rosstat. Moscow, 2019. 170 p. ISBN 978-5-89476-470-2. (In Russian). Accessed September 11, 2024 https://rosstat.gov.ru/storage/mediabank/Zdravoohran-2019.pdf

The total number of physicians in the Russian Federation in 2019 was 714.6 thousand (48.7 physicians per 10,000 people), and the number of nursing personnel was 1,491.3 (101.6 per 10,000 people). The dynamics of changes in the number of healthcare personnel in the Russian Federation are presented in Table 1.

Healthcare expenses in the Russian Federation are financed by public and private funds. Public funding is formed by the Compulsory Health Insurance Fund, payments by constituent entities of the Russian Federation for the non-working population, as well as federal and regional budgets. Private expenses are formed by payments by citizens, as well as payment for healthcare provided within the framework of voluntary health insurance. In total, in 2020, total healthcare expenses in the Russian Federation amounted to 6 trillion rubles, of which public expenses were 65% (3.34 trillion rubles), and private 35% (2.66 trillion rubles) [1, 2].

Pioneering research and development in healthcare information technology

The first studies in the field of information and communication technologies and their application in medicine and healthcare began in the 1950s and 1960s, mainly based on large Soviet research institutes and scientific centers. At that time, several research teams were created that studied methods of collecting and processing data using computer systems and automation tools. The Soviet scientific school of medical cybernetics was formed and began to develop [3]. The first developments in the field of telemedicine technologies have appeared in several areas at once – from analyzing electrocardiogram results to using them in the space industry [4, 5].

By the end of the 1970s, the Union of Soviet Socialist Republics (USSR) had accumulated the first experience in creating and using automated control systems and information processing tools. A department of computer technology and automated control tools was created based on the USSR Ministry of Health, and the main computing center began its work, ensuring the functioning of the country's automated healthcare management system. The first healthcare institution management systems were launched, for example, the "Automated control systems of a medical university" and the "Medical information system of a multidisciplinary hospital" [6, 7].

Research teams have accumulated a large reserve in terms of designing and developing various software solutions, including those intended for diagnostics, monitoring, and assessing the health status of patients. In particular, the first clinical decision support systems based on expert knowledge bases were developed [8].

In the 1980s, the first geographically distributed systems began to appear, in which several medical organizations operated at once. These developments began to demonstrate signs of complex solutions, including data collection and automation of both treatment and diagnostic processes, and elements of management decision support at various levels: from the heads of structural divisions to industry planning and management. The use of fairly powerful computing complexes at the time, such as the Unified System of Electronic Computing Machines and System of Mini Computers as well as the first personal computers, began. At this time, specialized scientific and practical conferences began to be held regularly to discuss projects and research results [6].

In the early 1990s, amid the active development and relative cheapening of personal computers, the use of computers and the creation of local area networks became available to a wider range of healthcare organiza-

tions. At the same time, the first operating systems with a graphical control interface appeared, as well as accessible means of creating software, which led to a significant simplification of both the software development processes and its development by users: physicians, nurses, managers of any level [9, 10].

The creation of the first software products was mainly aimed at collecting and automating statistical reports, and partial automation of auxiliary departments, such as accounting, human resources departments, etc. As the compulsory health insurance system was being established, many developments appeared in the field of forming registers and information exchange with insurance companies. Gradually, computer systems found their application in treatment and diagnostic processes. It started with the automation of registries and accounting of incoming patients and then moved on to maintaining records in electronic health records.

In the early 2000s, a commercial market for specialized software for medicine and healthcare began to form in Russia. Creative teams and small commercial companies, often numbering up to 10 people, began to develop the first versions of medical information systems with the capabilities of complex automation, maintaining electronic health records (EHR), and accounting and generating statistical and financial reports.

The number of companies and the solutions they offered began to grow rapidly. By 2007, there were already over 50 such developers. However, despite the wide variety of solutions offered, the actual level of their use and deployment in practical healthcare was quite low. Projects for the implementation of various information systems were launched by proactive managers and financed from their own, rather limited funds.

In 2009, the level of practical application of information and communication technologies was low. Less than 20% of healthcare organizations used various medical information systems, most often implementing them fragmentally in individual departments or for a limited range of processes. Less than 7% of healthcare organizations kept any records in the EHR, most often of a statistical and accounting nature. The most acute problem of that time was an acute shortage of hardware, only 10% of medical workers could have access to a computer, and only 7% of the available computers had an Internet connection [6].

In 2008, the Department of Information Technology and Communications was created in the Ministry of Health and Social Development of the Russian Federation, which began developing state policy in the field of digital healthcare. Since 2009, federal initiatives in the field of digitalization have been launched, and a regulatory and methodological framework has been prepared for the implementation of a federal project to introduce information systems in the healthcare sector.

Creation and development of the Unified State Information System in the field of healthcare in 2011-2018

In 2011, on the instructions of the President and with the active participation of the professional community, a project was initiated to create the “Unified State Information System in Healthcare” (in Russian: Edinaya Gosudarstvennaya Informatsionnaya Sistema Zdravookhraneniya, EGISZ), the basic principles of which were defined by the order of the Ministry of Health and Social Development of Russia No. 364 of 28.04.2011[4].

[4] Приказ Минздравсоцразвития России №364 от 28.04.2011 г. "Об утверждении Концепции создания единой государственной информационной системы в сфере здравоохранения" / The Order of the Ministry of Health and Social Development of Russia No. 364 of April 28, 2011 "On approval of the Concept for creating a unified state information system in healthcare". (In Russian). Accessed September 12, 2024 https://minzdrav.gov.ru/documents/%207200-prikaz-minzdravsotsrazvitiya-rossii-364-ot-28-aprelya-2011-g

In 2011-2012, due to state funding, basic conditions for the creation of infrastructure and implementation of information systems in the healthcare sector were created in the constituent entities of the Russian Federation. The project activities included the mandatory purchase of computer equipment, creation and protection of local area networks, acquisition, and implementation of medical information systems of healthcare organizations, as well as state information systems in the healthcare sector of the constituent entities of the Russian Federation. The work was coordinated with the help of regularly updated methodological recommendations, during the development of which the regulator interacted with industry experts and companies developing the solutions being implemented.

By 2014, all constituent entities of the Russian Federation had completed the 1st stage of the project implementation. As a result, the transition to personalized registration of rendered medical services became possible, the minimum necessary conditions for the deployment of EHRs were provided, and the introduction of the first digital services for citizens, such as, for example, making appointments online, began.

A significant driver for the development of digitalization of healthcare in the Russian Federation was the release of Federal Law No. 242-FZ of July 29, 2017, which defined the key legal framework for the implementation of information systems in the healthcare sector, including the status of the EGISZ, "Other Information Systems" and other components. This law also created the opportunity for the development and further regulation of the use of telemedicine technologies, the transition to electronic document management, and information exchange in the healthcare sector[5].

Another important document was the Resolution of the Government of the Russian Federation Resolution N 555 of May 5, 2018, which established the legal basis for the functioning of the EGISZ, its architecture, and key requirements, presented the composition of the components, requirements for providing access and collecting the necessary information[6]. It was thanks to this document and subsequent targeted funding that the basic components of the EGISZ were created. They currently comprise the main source for coding and storing data on the operation of the Russian healthcare system – the Federal Register of Regulatory and Reference Information, the Federal Register of Healthcare Professionals (in Russian: Federal'nyi Registr Meditsinskikh Rabotnikov, FRMR), the Federal Register of Healthcare Organizations (in Russian: Federal'nyi Registr Meditsinskikh Organizatsii, FRMO), the Federal Electronic Registry, the Federal Integrated Electronic Health Record, etc.

In 2013-2018, the 2nd stage of the EGISZ development was implemented. This stage was aimed at developing the infrastructure created in 2011-2012. The healthcare authorities of the constituent entities of the Russian Federation, development companies, and system integrators were given an ambitious task to ensure increased efficiency of healthcare management by automating all major treatment, diagnostic, and auxiliary processes and collecting data on the work of healthcare organizations in

[5] Федеральный закон от 29.07.2017 № 242-ФЗ "О внесении изменений в отдельные законодательные акты Российской Федерации по вопросам применения информационных технологий в сфере охраны здоровья" / Federal Law of July 29, 2017 No. 242-FZ "On Amendments to Certain Legislative Acts of the Russian Federation on the Application of Information Technologies in the Sphere of Healthcare". (In Russian). Accessed August 27, 2024. http://publication.pravo.gov.ru/Document/View/0001201707300032

[6] Постановление Правительства Российской Федерации от 5 мая 2018 г. N 555 "О единой государственной информационной системе в сфере здравоохранения" / The Resolution of the Government of the Russian Federation of May 5, 2018 N 555 "On the Unified State Information System in Healthcare". (in Russian). Accessed September 12, 2024. http://static.government.ru/media/files/SgyOw5b7VRXOWBZeBlHnwl6co7vid2am.pdf

digital form. Another important task of this stage was the creation of convenient services for citizens. In just a few years, almost all state healthcare organizations and healthcare authorities in the constituent entities of the Russian Federation launched their websites with detailed information on the provision of medical care in the region, online and through the Unified State Public Services to make an appointment with a physician appeared everywhere, electronic queuing systems were implemented in many clinics, and information terminals for making an appointment and obtaining certificates were installed in clinics.

One of the key areas of basic healthcare digitalization in 2013-2018 was the transition from paper-based document management to maintaining electronic health records. The key objective of implementing EHR was to reduce the labor costs of health workers, including maintaining medical records, patient health records, certificates, appointments, prescriptions, conclusions and other documents.

As federal and regional projects were implemented, the work to improve regulatory and technical regulation continued. On December 24, 2018, The Ministry of Health issued Order No. 911n, which defined the basic requirements for medical information systems of healthcare organizations and state information systems in the healthcare sector of the constituent entities of the Russian Federation, including a list of processes to be automated using the relevant software products, as well as requirements for information exchange and information security[7].

Thus, the created regulatory framework and the results of the implementation of various information systems achieved in the constituent entities of the Russian Federation provided the opportunity for the total collection of a huge amount of data on the healthcare system, personnel and financial support, and the results of medical care. The process of transition to EHR was launched throughout the country, various software products were created to support management decision support and, most importantly, digital services for citizens were created.

Creation of a Unified Digital Circuit in Healthcare in 2019-2024

In 2019, within the framework of the "Healthcare" national project, the federal project "Creation of a Unified Digital Circuit in Healthcare Based on the Unified State Health Information System" was launched in Russia. It marked a fundamental change in the attitude towards information systems and the role assigned to them by the regulators and the expert community. In 2011-2018 the implemented solutions were intended to create an infrastructure for the implementation of healthcare information systems and state information systems in the healthcare sector of the regions of the Russian Federation. The project to create the Unified Digital Circuit in Healthcare was formulated as preparation for the digital transformation of healthcare. The key difference and the main objective of this stage was a significant increase in the efficiency of the Russian healthcare system through in-depth development and implementation of unified platform solutions and new technologies, such as telemedicine, artificial intelligence, remote monitoring, and de-

[7] Приказ Министерства здравоохранения Российской Федерации от 24.12.2018 № 911н "Об утверждении Требований к государственным информационным системам в сфере здравоохранения субъектов Российской Федерации, медицинским информационным системам медицинских организаций и информационным системам фармацевтических организаций" / The Order of the Ministry of Health of the Russian Federation of December 24, 2018 No. 911n "On approval of the Requirements for state information systems in healthcare of the constituent entities of the Russian Federation, medical information systems of medical organizations and information systems of pharmaceutical organizations". (in Russian). Accessed September 12, 2024. http://publication.pravo.gov.ru/Document/View/0001201906190017

cision support systems based on raw data. The state project included federal-level activities: the creation of a regulatory framework, issuance of methodological documents and regulations, development of the EGISZ and regional-level activities: developing the digital contour of each subject of the Russian Federation, taking into account the specifics of the region, population, climatic conditions, and structure of the healthcare system.

Each subject of the Russian Federation, in coordination with the Russian Ministry of Health, developed individual programs for the creation of the Unified Digital Circuit in Healthcare in the subjects of the Russian Federation. The implementation and control of the projects were carried out according to strict roadmaps, including various areas and final indicators developed taking into account regional characteristics.

The projects were implemented in priority areas:

1. Development of functional capabilities and integration of healthcare information systems and state information systems in the field of healthcare of the constituent entities of the Russian Federation, including a gradual transition to centralized solutions that are fully integrated and automatically exchange data with each other without re-entry.
2. Development of services for patients. In this area, the main focus was on improving the convenience and functionality of the patient's personal "My Health" account on the Unified Portal of State and Municipal Services, ensuring interaction between citizens and the healthcare system, the development of telemedicine technologies and remote medicine, and monitoring the health status of patients with chronic non-communicable diseases.
3. Development of intelligent systems, including the active implementation of business intelligence technologies, medical devices with artificial intelligence technologies, systems for supporting clinical decision-making, and tools for forecasting and monitoring the work of the healthcare system in a variety of areas and data sections.

The key achievements in the creation of a single digital circuit in the Russian healthcare sector were:

- Implementation of digital services for patients: the maximum availability of various products and services to increase conve-nience and satisfaction from interaction with the healthcare system, including remote appointments with a doctor, remote registration of a compulsory health insurance policy and registration with a clinic, receiving electronic medical records in a personal account, remote monitoring of health status, telemedicine consultations, etc.
- Implementation of digital services for healthcare professionals: elimination of paper-based document flow, reduction of time spent on processing medical records, including various reports, use of artificial intelligence technologies, voice assistants and other digital services in the provision of medical care.
- Transition to data-driven management – automated processing and analysis of primary data collected from the healthcare information systems of healthcare organizations and EGISZ services, including with the use of artificial intelligence (AI) technologies, increased transparency and improved monitoring and evaluation of the performance of healthcare organizations, introduction of promising management tools and approaches, such as predictive analytics and management decision support based on digital twins.

Level of development of digital healthcare in the Russian Federation

Development of federal services

The federal services of EGISZ are the basis for strategic planning and development of the Russian healthcare system and are also used regularly by employees of the Ministry of Health and authorized organizations to support operational management decision-making. In total, the EGISZ includes 22 services and components that provide a unified information exchange and management decision support.

The key service of the EGISZ is the FRMO, which contains detailed structured data on all healthcare organizations in the country, including their structural subdivisions, buildings, equipment, licenses for clinical activities, and much more. Currently, the FRMO contains data on 76,200 medical organizations, of which 23,300 are state-owned and 52,900 are private organizations.

The FRMR, which includes detailed information on the staffing of the industry, including detailed social data, information on education and advanced training, data on the workplace, and much more. Currently, the FRMR contains information on 2.577 million healthcare professionals, of which 768 thousand are specialists with higher medical education. In addition, the FRMR includes information on 163.7 thousand pharmaceutical workers.

Federal nosological registers are intended to automate the collection, processing, and analysis of data on patients suffering from relevant diseases to organize the provision of medical care, including the provision of medicines. Such registers include registers of persons with HIV, tuberculosis, rare (orphan) diseases, COVID-19 and other diseases.

As part of the development of digital transformation, work is underway to create the “Healthcare” domain. The core of the “Healthcare” domain, according to the planned areas of development of the architecture of the unified digital platform in healthcare, consists of:

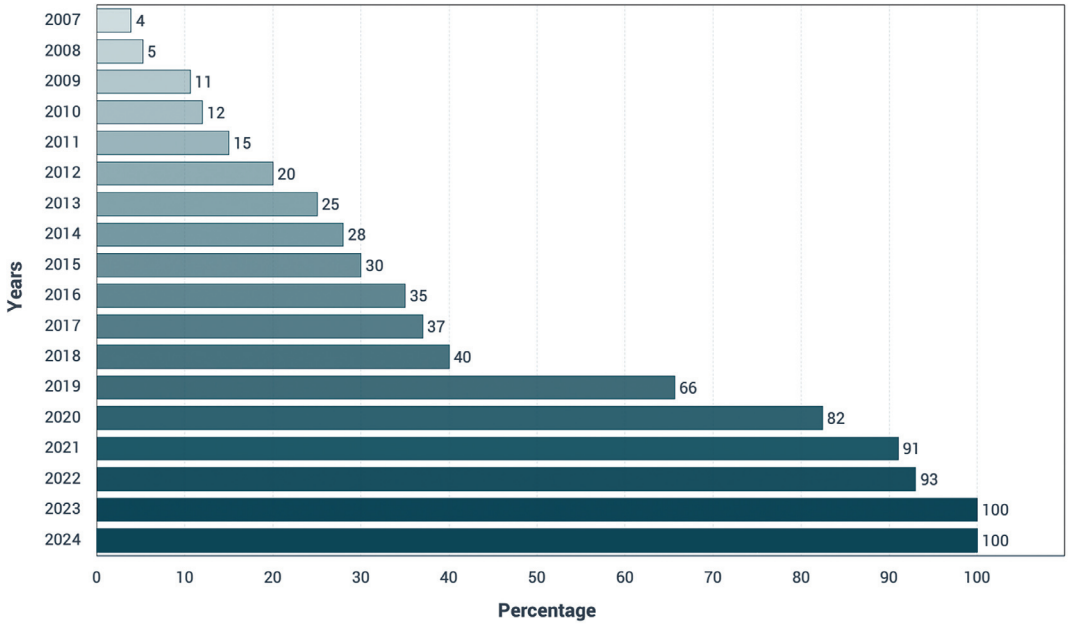
- The Unified Patient Register based on the Unified Register of Insured Population and information from related agencies, consolidating patient information into a master register; universal patient identifier for the entire healthcare system, used by all domain participants;
- Digital health profile of a patient, consolidating information on the state of health, medical services provided and enabling the creation of services aimed at organizing the provision and improving the quality of medical care;
- Digital twin of a medical professional, created based on the FRMR, consolidating all information on healthcare professionals;
- Digital twin of a healthcare organization created based on the FRMO, consolidating all information on healthcare organizations;
- Digital twin of processes created based on clinical guidelines and processes of medical care organization and accompanying processes.

The above services are accompanied by unified normative and reference information and are built on a unified data model.

Implementation of healthcare information systems in healthcare organizations

The implementation of several federal projects and initiatives in 2011-2024 attracted substantial public investment in infrastructure and implementation of healthcare information systems, which ensured that healthcare organizations were equipped with computer equipment, including

Fig. 1. Dynamics of the use of healthcare information systems in healthcare organizations of the Russian Federation, % of the total number



automated workstations for healthcare professionals, server capacity, information storage and protection facilities, system-wide software, etc.

All 100% of public healthcare organizations and their structural subdivisions have the necessary computer equipment and connection to unified secure data transmission networks. 1.028 million automated workstations are equipped with electronic signatures and connected to secure access to healthcare information systems. Moreover, other services have been created for medical professionals.

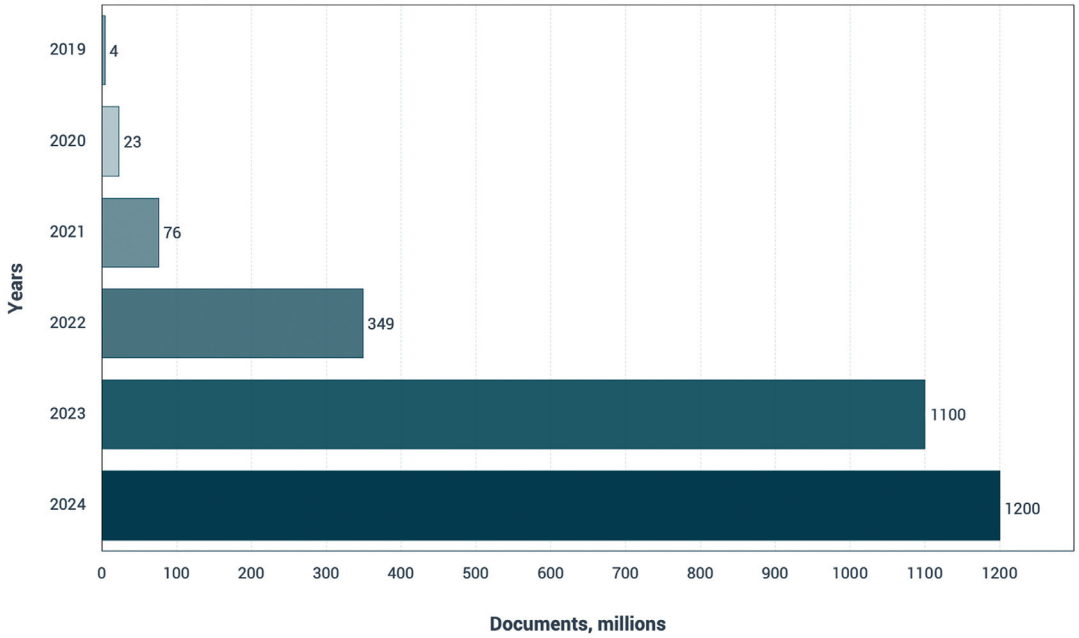
By the end of 2023, 100% of public healthcare organizations use various healthcare information systems for maintaining electronic health records, physicians' work schedules, automating diagnostic and treatment units, generating statistical, financial and management reporting (Fig. 1).

Information exchange in the healthcare system

The basis of automated information exchange between various information systems and components of the EGISZ is a structured electronic medical document (SEMD), created on the basis of the international HL7 standards stack. Since 2019, 113 types of SEMD have been developed in Russia, which provide at least 80% of the needs of healthcare organizations for paperless medical document flow in all types of clinical activities, and 24 of them were created in 2023. The creation of new SEMDs and corresponding federal reference books for coding metadata and clinical information is carried out on an ongoing daily basis.

Thus, the Russian Federation provides automated collection and transfer of data via secure communication channels from the Ministry of Health of the Russian Federation to state information systems in the field of healthcare of the regions of the Russian Federation, and from them to the federal services of the EGISZ. Aggregated data is actively and continuously used for operational and strategic planning and management of the

Fig. 2. Dynamics of transfer of electronic medical documents to the federal service "Register of Electronic Medical Documents" EGISZ



industry at all levels, from the heads of healthcare organizations to the federal minister of health, and the volume of transferred data is constantly increasing. Thus, in 2019, 4.2 million electronic medical documents were transferred, in 2023 – more than 1 billion documents. Over the first nine months of 2024, more than 1.2 billion documents have already been transferred between the regions of the Russian Federation and the federal services of the EGISZ, the average daily volume of transferred data exceeds 3.6 million documents (Fig. 2).

Seamless information exchange is provided and gradually develops both within the healthcare sector and with related organizations and executive authorities. For example, 100% of state healthcare organizations provide information interaction with medical and social expertise institutions, for which the Federal Register of Electronic Medical Documents service of the EGISZ is used. Since March 2022, interdepartmental interaction with the National Guard of Russia has been introduced, which is currently carried out exclusively electronically in terms of transferring information on passing a medical examination to obtain the right to bear arms. It has made it possible to strengthen the control and responsibility of healthcare organizations for the accuracy of the transmitted information. Over the first 8 months of 2024, 502,248 birth records were registered in the registry offices based on electronic birth certificates generated by healthcare organizations, through the service on the Unified Portal of State and Municipal Services or through a direct visit to the Multifunctional Public Services Center.

Development of digital services for citizens

Digital services for citizens are implemented to increase patient-centricity, ensuring the convenience of citizens' interaction with the healthcare system, and the possibility of their involvement in caring for their health.

Digital services allow for early diagnosis of diseases, timely prevention of deviations from clinical recommendations during treatment and the organization of continuous monitoring of each patient, interdepartmental interaction, the use of telemedicine technologies, the creation of electronic services and services for citizens in the personal "My Health" account on Unified Portal of State and Municipal Services, providing citizens with digital services for remote dispensary monitoring using medical devices with a data transfer function.

Services are being created to involve citizens in caring for their health, to increase the transparency and efficiency of the healthcare system, to increase the satisfaction of patients, as well as the availability and convenience of receiving healthcare services by providing them in electronic form in compliance with the one-stop principle, ensuring the security of personal data and an equal level of quality of healthcare services regardless of the place of residence of citizens in the territory of the Russian Federation.

The central place in this area is occupied by the patient's personal "My Health" account on the Unified Portal of State and Municipal Services. By August 2024, 44.39 million citizens used the services and services of this information resource. Over 96% of healthcare organizations ensure continuous transfer of information from electronic health records to patients' accounts. As a result, 75.97% of the Unified Portal of State and Municipal Services users have access to their electronic medical documents, and when new medical records or examination and treatment results are received, patients receive corresponding push notifications, so the patient always knows that new data has appeared in his electronic health record.

The service of making appointments with physicians via the Internet is extremely popular, and it can be used not only on the Unified Portal of State and Municipal Services, but also on regional portals, at special information kiosks installed in clinics, and using mobile applications. As a result, 80.95% of appointments were made by citizens remotely.

Since December 2022, the State Information System of Compulsory Health Insurance has been maintaining a Unified Register of the Insured Population, containing more than 50 million digital compulsory health insurance policies based on a barcode, which frees citizens from the need to carry policies on physical media. Services related to the registration of a compulsory health insurance policy have also been digitized.

Implementation of telemedicine technologies

In the Russian Federation, a regulatory framework has been created for the implementation of telemedicine technologies, which has provided the opportunity for remote interaction between physicians, as well as the opportunity for consultations between patients and their legal representatives with physicians.

The goals of telemedicine consultation "doctor-patient" are prevention, collection, and analysis of the patient's medical history and complaints, assessment of the effectiveness of treatment and diagnostic measures, monitoring the patient's health, and deciding on the need for an in-person appointment. Diagnosis and treatment are not permitted during telemedicine consultation.

Remote monitoring of a patient’s health status can only be carried out using medical devices registered by the Federal Service for Surveillance in Healthcare (Roszdravnadzor).

A significant driving force for the wider use of telemedicine was the COVID-19 pandemic, during which these technologies became one of the

most valuable aids in reducing the burden on healthcare organizations, reducing unnecessary patient visits and thereby reducing the risk of spreading infection. Since 2019, the number of telemedicine consultations conducted in the regions of the Russian Federation has increased more than 11 times, and the number of telemedicine consultations conducted by specialists from federal centers of the Ministry of Health of the Russian Federation on complex cases has increased 5 times.

The most popular nosologies for telemedicine consultations are oncology, pediatrics and cardiovascular diseases, as well as obstetrics and gynecology. According to the results of 2023, more than 8.1 million consultations were conducted in the state healthcare system of the Russian Federation, including consultations, conclusions on the results of diagnostic studies, as well as remote monitoring of patients' health. Specialists from federal centers of the Ministry of Health of the Russian Federation conducted more than 205 thousand physician consultations using telemedicine technologies.

Implementation of personal medical assistants

One of the most important areas of industry development was the federal project "Personal Medical Assistants", the purpose of which was to digitally transform the dispensary monitoring of patients with chronic non-communicable diseases. The project includes the creation of services and medical devices for remote dynamic monitoring of the health of citizens. Its implementation is carried out in several areas at once:

- creation of a unified national system for the circulation of medical data in the field of remote monitoring of a patient's health
- creation of conditions for the implementation of remote monitoring of patients with chronic diseases living in remote areas, including the Far Eastern Federal District, the project is currently being implemented in the Magadan Region
- creating conditions for maximum preferences for domestic developers of IT solutions and manufacturers of medical devices, stimulating the development of the microelectronics industry and personal medical devices for citizens.

The initial stage of the implementation of the "Personal Medical Assistants" initiative is carried out in the form of a pilot project for remote monitoring of the health of patients with arterial hypertension and diabetes mellitus using the "Personal Medical Assistants" platform under an experimental regulation.

The participants of the project are the Ministry of Health of Russia, the State Corporation Rostec, national medical research centers of the Ministry of Health of Russia, medical organizations of 8 subjects of the Russian Federation (Irkutsk, Magadan, Novosibirsk, Ryazan, Samara and Tyumen regions, the Republic of Tatarstan, Khanty-Mansiysk Autonomous Okrug – Yugra) and the Federal Medical and Biological Agency of Russia, and Roszdravnadzor.

As of September 2024, a regulatory and methodological framework has been formed, a prototype of the Personal Medical Assistants platform has been created and is functioning, and information interaction of the Personal Medical Assistants platform with medical devices and healthcare information systems of healthcare organizations has been implemented. Requirements for medical devices have been defined and some Russian developments are being tested, for example, the INME-01 tonometer (manufacturer: Altonika), the HemoDin-GSM tonometer (manufacturer: AKSMA LLC), and the Satellite® Online glucometer (manufacturer: ELTA LLC).

By September 2024, more than 23,000 patients have been taken under remote monitoring, including 21,262 people under monitoring for arterial hypertension and 1,930 people for diabetes. By the end of 2024, it is planned to conduct a clinical and economic assessment of the effectiveness of remote monitoring in order to decide on replicating the results of the pilot project from 2025. At the same time, an interim analysis of the results, carried out by experts from the National Medical Research Center of Cardiology and the National Medical Research Center of Endocrinology, has already shown a positive effect.

Implementation of artificial intelligence technologies

According to the national strategy for the development of AI in the Russian Federation for the period up to 2030, the implementation of AI in the healthcare system is a priority task[8]. The goal of active use of AI is to improve the efficiency and quality of medical care, automate data processing, and support clinical and management decision-making.

By September 2024, Roszdravnadzor has registered 37 medical devices using AI technologies. Of these, 30 medical devices were created by Russian development companies and have been given priority for implementation in national healthcare.

By the end of 2023, 84 regions of the Russian Federation had launched projects to implement AI-based medical devices. The basis for the implementation of AI is data on the state of human health, including data from studies on fluorography, radiography, mammography, computed tomography, contained in the regional subsystems "Electronic Health Record" and "Digital Archive of Medical Images".

In the city of Moscow, as part of the implementation of an experiment on the use of innovative technologies in the field of computer vision for the analysis of medical images, 59 AI solutions are operating, 14 of which have marketing authorization as medical devices issued by Roszdravnadzor [11].

Voice services with artificial intelligence have been implemented in healthcare organizations to optimize the work of call centers; these services allow you to conduct a dialogue with a patient using a virtual assistant, make an appointment with a physician, and call patients with reminders.

Scientific medical research centers are creating data sets in the following areas: cardiology, oncology, pathomorphology, radiology, and critical obstetric conditions. A solution with AI for detecting colorectal cancer has been created, which allows reducing the risk of colon cancer by 90% due to early detection.

Conclusion

In December 2024, the implementation of the federal project "Creation of a single digital healthcare circuit based on the EGISZ" will be completed, within the framework of which the digitalization of healthcare in the Russian Federation has moved to a fundamentally new level. A common information technology infrastructure has been created and is actively used. The EGISZ has been created and is functioning at the federal level, state information systems in the field of healthcare are functioning in all regions, and 100% of state and municipal healthcare organi-

[8] Указ Президента Российской Федерации от 10.10.2019 № 490 «О развитии искусственного интеллекта в Российской Федерации» / Decree of the President of the Russian Federation of 10.10.2019 No. 490 "About the development of artificial intelligence in the Russian Federation". (In Russian). Accessed September 12, 2024. http://publication.pravo.gov.ru/Document/View/0001201910110003

zations have switched to operation in healthcare information systems and maintaining electronic health records.

The full implementation of digital technologies in healthcare has allowed the Russian Federation to achieve significant practical results in terms of the efficiency of processes for organizing and providing medical care.

Daily work of physicians in healthcare information systems allows doctors and nurses to switch to paperless electronic healthcare records, use time during appointments more efficiently, get instant access to digital archives, use systems to support clinical decision-making and artificial intelligence, voice input services, which significantly reduces medical errors and improves the quality of medical care.

The emphasis on developing patient services allows citizens to quickly and conveniently find the information they need, make an appointment, receive a telemedicine consultation, or use a remote health monitoring service.

The introduction of data-driven management technologies allows managers to see detailed information about the resource and personnel provision of the industry, to make operational and strategic decisions based on data and forecasts, including in the visual form of analytical dashboards. All this makes the work of managers more efficient, which is extremely important in the conditions of personnel and financial shortages.

In 2025-2030, the Russian Federation will implement the next stage focused on the comprehensive digital transformation of all key processes, from the treatment and interaction of patients with the healthcare system to the work of doctors, nurses and healthcare organizers. The Order of the Government of the Russian Federation of April 17, 2024 No. 959-r approved the strategic direction in the field of digital transformation of healthcare, which includes the following projects: platformization and creation of "digital twins", the "Healthcare" domain, artificial intelligence, personal medical assistants, and information security[9].

The goal of the strategic direction until 2030 is to achieve a high level of "digital maturity" of the participants in the implementation of the strategic direction through the accelerated transition of the healthcare sector of the Russian Federation to electronic document management, decision-making based on raw data and the use of "digital twins" of processes, the widespread use of artificial intelligence, increasing the quantity and quality of digital services provided to citizens in the field of healthcare and remote health monitoring.

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[9] Распоряжение Правительства Российской Федерации от 17 апреля 2024 г. № 959-р «Об утверждении стратегического направления в области цифровой трансформации здравоохранения» / The Order of the Government of the Russian Federation of April 17, 2024 No. 959-r "On approval of the strategic direction in digital transformation of healthcare". (In Russian). Accessed September 12, 2024. http://publication.pravo.gov.ru/document/0001202404190016

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