#02/2026
ISSN 2299-1247

JHPOR | Journal of Health Policy & Outcomes Research

Digital Transformation in the Field of Health Care: The Role of the State and Modern Challenges

DOI:10.7365/JHPOR.2026.2.1

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Keywords:

digital health, eHealth, data security, public policy, electronic medical records, information society, information technology, cybersecurity, medical informatics, healthcare, patient, public administration, social relations, technological progress, telemedicine, digital transformation, digital innovation, artificial intelligence

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How to cite this article?
Sikalo M., Sikalo Y., DIGITAL TRANSFORMATION IN THE FIELD OF HEALTH CARE: THE ROLE OF THE STATE AND MODERN CHALLENGES J Health Policy Outcomes Res [Internet]. 2025[cited YYYY Mon DD];. Available from: https://jhpor.com/article/2430-digital-transformation-in-the-field-of-health-care-the-role-of-the-state-and-modern-challenges

contributed: 2025-02-18
final review: 2026-05-28
published: 2026-07-15
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Abstract

Digital technologies have deeply penetrated all spheres of life, including medicine, encompassing doctors, patients, their families, and medical services. The complex process of digital transformation takes place with the direct and active participation of state institutions, which is reflected in public policy, although the effectiveness of its implementation largely depends on the coherence of legal regulation, funding, and cooperation between the public and private sectors.

Objective. To conduct a comprehensive analysis of the digital transformation of the healthcare system, its role and significance in the modern world, with a particular focus on Ukraine.

Methods. The study dynamic is designed as a comprehensive narrative review using a mixed-methods approach and a systematic literature search strategy. Peer-reviewed publications (2016–2025) were systematically retrieved from Scopus, Web of Science, and Google Scholar databases, focusing on digital health transformation, telemedicine, mHealth, and governance. To supplement the narrative synthesis of literature, a systemic analysis of the eHealth ecosystem, benchmarking of international digital models, and statistical analysis of time-series secondary data from the Ministry of Health of Ukraine and the National Health Service of Ukraine were applied.

Results. The article examines the impact of global challenges on the necessity of implementing digital technologies in healthcare and identifies the state's role in this process, including legal regulation, financing, public-private partnerships, and innovation support. The analysis of international experience has shown that the digital transformation of healthcare in leading countries is based on the integration of national electronic health systems, the use of telemedicine, big data analytics, and digital platforms for interaction between patients, medical institutions, and public authorities. At the same time, the main challenges remain ensuring the cybersecurity of medical data, regulatory uncertainty, and the need for clinical validation of digital medical technologies. The study emphasizes the importance of leveraging international experience for the development of Ukraine's healthcare system and proposes specific directions for improvement, such as expanding telemedicine, creating a unified electronic medical space, and integrating artificial intelligence.

The article provides a detailed examination of current state and future prospects of Ukraine's eHealth system, its structure and functions, highlighting its advantages and existing challenges, including the insufficient integration of various information systems, the lack of unified standards, and limited internet access for certain population groups.

Conclusion. The digital transformation of healthcare is irreversible and holds immense potential for improving the quality and accessibility of medical services. The necessity of a comprehensive approach to addressing existing issues is emphasized, along with the active involvement of the government, the medical community, and IT companies in this process. The authors also outline promising areas for further research, in particular: the impact of the COVID-19 pandemic on medical digitalization, ethical considerations in digital transformation, cybersecurity challenges, and the application of blockchain technology in healthcare.

Introduction

We live in an era of numerous challenges: natural disasters, natural anomalies, infectious risks and other hazardous phenomena pose a real threat to human life and health. Global statistics confirm this. Therefore, it is no coincidence that the leading international organizations and reputable scientists consider the healthcare problem to be one of the top priorities of the 21st century.[1] Its solution requires the use of multidisciplinary sciences, both fundamental and applied. In this context, a purely medical problem is turning into an interdisciplinary issue of global importance.

The role of computerization in medicine is obvious. This area began to develop in Ukraine and abroad almost as soon as the first computers appeared. While at the initial stage it focused mainly on the automation of organizational and managerial tasks in clinics, hospitals, specialized medical centers, and relevant government agencies, later on these developments were supplemented by the creation of computerized equipment and technologies to use it.[2]
That is how a new industry emerged – Digital Health that uses information and communication technologies in medicine and other health professions to control disease, health risks, and to promote well-being.[3]

Digital transformation has covered almost all areas of human life, healthcare being no exception. The introduction of information technology in healthcare opens up new opportunities to improve the quality of medical services, diagnostics and treatment of diseases. However, the success of this process largely depends on the active involvement of the state.

Digital transformation of the healthcare system is crucial and timely for many reasons. Today's global challenges, such as infectious risks and aging of population, require new approaches to healthcare organization. Digital technologies, such as telemedicine and e-prescriptions, help ensure continuity and accessibility of healthcare services, especially during pandemics. On the other hand, digital solutions allow collecting and analyzing large amounts of medical data, which contributes to the development of personalized treatment plans and continuous monitoring of patients.[4]

The state plays a key role in the development of healthcare digital transformation. Its task is to create a favorable legal framework, to ensure the protection of patients' rights and personal data security, as well as to finance the development of information systems and training. Cooperation with the private sector is also an important condition for attracting investment and innovation in the healthcare sector.[5]

Scientific research in the field of digital transformation of medicine is of great importance for identifying the relationships between different aspects of this process and developing recommendations for improving public policies. They contribute to the development of medical informatics, bioinformatics and artificial intelligence in medicine.[6]

The introduction of digital technologies in healthcare has a significant social impact. It helps improve the quality of medical care through accurate diagnosis and individualized treatment plans. In addition, digital services such as telemedicine and e-prescriptions make medical care more accessible to people living in remote regions and to those with limited mobility. Optimization of workflows in medical institutions through digital technologies also helps to reduce healthcare costs.[7]

All these factors demonstrate the importance of digital transformation and healthcare reforms to ensure quality and affordable medical care for everyone.

Recent research shows the enormous potential of digital healthcare. By implementing digital tools such as portable devices, mobile apps, sensors, and telemedicine elements, it is possible not only to improve the quality of medical services and increase patient satisfaction, but also to optimize costs of the healthcare system. Automation of routine procedures, real-time data collection, and accurate predictions allow for more efficient use of resources and lower overall treatment costs.[3] These studies are aimed at using digital medicine to improve the convenience for patients to monitor their own health and well-being, and to meet the individual needs of patients.[8]

The goals of digital healthcare products and services are to improve public health by facilitating the access to medical care, increasing patient involvement in the treatment process, raising the qualifications of doctors and other non-physician service providers, and eliminating social inequalities in the provision or receipt of healthcare services. Experts have also identified certain challenges to the transformation of digital healthcare.[9-10]

The studying of patient feedback has own substantially after the introduction of certain changes in the digitalization of healthcare services, in particular when mobile devices and wireless technologies are used for medical care and ensuring a healthy lifestyle (mHealth).[8, 11] The studies were aimed at analysing the needs of patients and their families in order to develop the digitalization of the healthcare sector. In this respect, the authors encourage further research on the evaluation of intra-hospital processes for the development of digital technologies in the healthcare system.[7, 12]

The issue of introducing digital technologies into the healthcare system is also being actively studied by Ukrainian scientists, and namely: V. Hrytsenko,[13] I. Korchynskyi, N. Firman,[14] H. Androshchuk,[15] K. Malakhov.[16] Their research works confirm that the problems associated with the digitalization of the medical sphere are extremely relevant and require a deeper analysis.

Despite the significant scholarly interest in the issue of digital transformation in healthcare, most existing studies focus primarily on the technological capabilities of digital tools or on specific aspects of their application (such as telemedicine, mobile applications, and mHealth), paying less attention to the institutional and managerial mechanisms of their implementation. A considerable number of studies also have an applied or descriptive character and are aimed at evaluating the effectiveness of particular digital solutions or the level of patient satisfaction. At the same time, the role of the state, the formation of a coherent policy for the digital transformation of the healthcare sector, and the alignment of technological innovations with systemic healthcare reforms remain insufficiently explored. This is particularly relevant for countries undergoing a transformation of their public administration systems, where the digitalization of healthcare is occurring simultaneously with broader institutional changes in governance.
In this context, the present study aims to address this

research gap through a comprehensive analysis of the role of the state in the processes of digital transformation of the healthcare system, the identification of key challenges accompanying the implementation of digital technologies in the medical sector, and the outlining of managerial approaches capable of ensuring the effective integration of digital solutions into the functioning of a modern healthcare system.

Purpose of the article

The purpose of this article is to analyze the role of the state in the digital transformation of the healthcare system, identify the main trends and challenges, and assess the effectiveness of state policy in this area. Particular attention is paid to the impact of government regulations on the development of digital technologies in the healthcare system, as well as to the challenges related to data security, privacy protection, and accessibility of medical services.

Methodology and research methods used

The research methodology is based on a mixed-methods approach that combines a comprehensive narrative review with a systematic literature search strategy, narrative synthesis, and secondary statistical data analysis. While this study is designed as a narrative review to accommodate diverse data types, the literature base was formed using a systematic and transparent search process.The literature base was formed through a targeted search in the Scopus, Web of Science, and Google Scholar databases, as well as open resources, covering the period from 2016 to 2025. The search strategy involved using combinations of the following descriptors: digital health governance, digital transformation in healthcare, public administration of eHealth, telemedicine and mHealth regulation, data security and cybersecurity in healthcare. The source selection procedure consisted of two stages: screening titles and abstracts for thematic relevance and a full-text analysis for eligibility. Only full-text peer-reviewed publications published in English and Ukrainian addressing institutional mechanisms for managing healthcare digitalization, the state's role in supporting innovation, and the legal regulation of digital medicine were selected for analysis. Out of 85 initially identified publications, 35 sources were included in the final review. Given the conceptual and methodological heterogeneity of the source base, the results were synthesized in a narrative form. This approach allowed for the generalization of a wide range of research strategies and diverse results within a unified logical structure. The choice of narrative synthesis was driven by its capacity to effectively handle qualitative information and quantitative data when direct statistical comparison is not feasible. The regulatory framework of Ukraine and EU countries regarding personal data protection and the formation of a unified electronic medical space was also examined.

To decompose the eHealth ecosystem, a systemic analysis was applied, which allowed for the structuring of interactions between the central database, medical information systems (MIS), and state regulatory bodies. Comparative analysis (benchmarking) focused on contrasting the national digitalization models of Estonia, Singapore, Denmark, the USA, Finland, South Korea, the UK, and Israel with Ukrainian practice based on architectural centralization parameters. Particular attention was paid to a comparative analysis of the most common medical information systems (MIS) in Ukraine integrated with the eHealth ecosystem, based on criteria of their functional features, advantages, and limitations for different levels of healthcare delivery.

The empirical basis of the study comprised depersonalized data from official reports of the Ministry of Health of Ukraine, the National Health Service of Ukraine, and the State Statistics Service of Ukraine for the period 2018–2025. The statistical analysis included the study of time series regarding the rates of healthcare facility connection to the eHealth system, as well as an analysis of the population's access to broadband internet and smartphones as key infrastructural prerequisites for digitalization. Based on the results obtained, a visual model of healthcare digital readiness was developed using conceptual modeling, reflecting the relationship between state regulation, technological development, and social factors.

Research limitations are due to the focus on strategic, regulatory, and technical aspects of management, leaving the assessment of the clinical effectiveness of specific digital tools directly in medical practice outside the scope of analysis.

An integrated approach that combines various research methods allowed us to obtain an objective and comprehensive picture of digital transformation in the healthcare system and to identify ways to improve the efficiency of public administration in this area.

The role of the state in the digital transformation of healthcare

The state plays a key role in the digital transformation of healthcare. Its functions cover a wide range of areas, from developing the legislative framework to supporting innovations.[17]

An important task of the state is to create a legal framework that will stimulate the development of digital technologies in healthcare, while ensuring the protection of patients' rights and personal data security. The state also plays an important role in financing the development of information systems, training and research in the field of digital medicine. Investments in modern telecommunications infrastructure are essential for the functioning of digital health services.[18] Contemporary studies in the field of digital service quality management also emphasize the need to develop integrated models for evaluating the effectiveness of digital systems that enable the integration of technological, organizational, and managerial aspects of the digital transformation of the public sector.[19]

Cooperation with the private sector is another important aspect of the state's activities in the field of digital transformation of healthcare. Creating conditions for cooperation between public and private companies helps to attract investment and innovation in the healthcare sector. The state also supports the development of startups and innovative companies operating in the field of digital medicine, creating a favorable environment for their development.[20]

All of these functions of the state are important for a successful digital transformation of healthcare and ensuring quality and affordable healthcare for the population.

Digital transformation in medicine is accompanied by a number of challenges.[21] The most important and difficult task for the implementation is to ensure data security. Protecting patients' personal data from unauthorized access, maintaining the confidentiality of medical information and preventing its leakage is a critical task, as any violation of these principles can lead to serious consequences, such as loss of patient trust, reputational risks for medical institutions and violations of the law.

At the same time, there is a shortage of specialists in the labor market who can work effectively with digital technologies, which hinders the latter's rapid implementation in the healthcare system. This is due to the fact that modern undergraduate and postgraduate education programs for healthcare professionals often do not provide sufficient training in information technology.[22]

The introduction of digital technologies requires significant investment, which may be unaffordable for many healthcare facilities. This is especially true for small hospitals and clinics that have limited budgets and cannot afford to purchase expensive equipment and software, as well as pay for the services of IT specialists. This creates unequal conditions for the provision of healthcare and can lead to expansion of a digital divide in the healthcare system. In addition, not all patients have equal access to digital technologies. A limited level of digital literacy, which determines the understanding of the functionality of digital tools and the confidence to use them, can create additional barriers for vulnerable populations, further widening the digital divide in the healthcare system. This means that the elderly, people with low incomes, and residents of remote regions may be limited in their ability to receive quality healthcare through digital channels.[23] Such social inequalities in access to healthcare can deepen the existing stratification of society.

Legislation usually fails to keep pace with the rapid development of technology. This gap between the dynamic world of innovation and static regulations creates significant barriers to adoption of new technologies. In particular, in the healthcare sector, where technologies are developing particularly rapidly, the lack of clear legal regulatory mechanisms can hinder the development of digital medicine and create legal uncertainty for market participants.

Challenges and prospects for digital healthcare in Ukraine

In Ukraine, as in many developed countries, there is a rapid development of digital technologies, which significantly affects all spheres of life, including healthcare. The introduction of digital innovations in the Ukrainian healthcare system is an integral part of the global trend towards digitalization.[15]

The prerequisites for the active spread of digital technologies in the healthcare sector are a well-developed regulatory framework and developed databases of patients, healthcare professionals, healthcare facilities, medicines, equipment, treatment standards and protocols, and analytical medical statistical information. However, the main driver of digital changes is the growing demand among patients. In the context of active digital transformation of society, new models of patient-physician relationships have emerged.[24]

The implementation of the eHealth electronic healthcare system, which is part of the Concept for the Development of the Digital Economy and Society of Ukraine,[25] has made it possible to unite all medical institutions in the country into a single information space, ensure the electronic exchange of medical data, simplify the procedures for obtaining medical care and issuing electronic prescriptions, as well as improve its quality.

As defined by the World Health Organization, the eHealth digital health system model involves a safe and cost-effective use of information and communication technologies in all aspects of health care.[26] The eHealth concept covers a much wider range of aspects than just the use of information technology in the healthcare system. It is a comprehensive system that includes, but is not limited to, such areas as healthcare delivery, population's health monitoring, medical education, dissemination of knowledge, skills, and research results.[27]

In Ukraine, eHealth is a strategic direction of the healthcare system development, which involves the creation of a single information space that unites all participants in the process of providing medical services.[14] The effective implementation of eHealth is one of the key elements of the healthcare reform in Ukraine initiated by the National Health Service of Ukraine (NHSU), ensuring the effective implementation of such government programs as the Medical Guarantee Program and Affordable Medicines.

The presented dynamics indicate a gradual but steady increase in the use of digital tools within the healthcare system of Ukraine. The most rapid expansion is observed in the segments of electronic medical records, electronic prescriptions, and electronic referrals, demonstrating a transition from basic digital patient identification to the comprehensive digitalization of clinical and managerial processes in the medical sector.

Due to the ability to store all patient information in electronic format, from personal medical records to electronic prescriptions, the digital eHealth system provides accurate accounting of medical services provided, which allows for fair payments to medical institutions in accordance with the services provided. By analyzing the data obtained from eHealth systems, the NHSU can identify inefficient costs, optimize the budget, and assess the quality of medical care based on data on treatment outcomes and patient satisfaction.[13]

The eHealth system also provides electronic prescriptions, which simplifies the process of obtaining medicines without payment or at a discount for the patient, allows tracking the use of medicines and preventing abuse. Analysis of data on drug consumption helps to optimize procurement and ensure the availability of necessary medicines in pharmacies.[25]

The digital eHealth system supports remote diagnostics and consultations, which significantly reduces the cost of examination and helps to increase the accessibility of medical services, especially for residents of remote regions and people with limited mobility.

The integration of medical data into a mobile application for patients allows them to access their personal medical records, track the movement of medications, make appointments, organize hospitalization, etc.

The eHealth system also allows healthcare professionals to have access to professional documentation, statistics, and provides the opportunity to take online training to improve their knowledge.[25, 39, 40]

However, there are also certain problems, such as insufficient interaction of different information systems with each other, lack of a single standard for electronic medical records, insufficient number of specialists trained to operate digital tools, limited access to fast technical support, lower and guarantees of personal data security [40]. Research on the digital transformation of public administration also indicates that the rapid implementation of individual digital services is not always accompanied by systemic institutional modernization, which may lead to

Table 1. Dynamics of implementation of the electronic healthcare system (eHealth / EHOS) in Ukraine, 2018–2025

Year	Signed declaration swith doctors(-million)	Electronic prescription sper year (million)	Electronic referrals per year (million)	Electronic medical records cumulative(billion)
2018	23.0	—	—	~0.05
2019	29.0	~5.0	—	~0.12
2020	30.5	~18.0	~10.0	~0.19
2021	34.0	~35.0	~25.0	~0.52
2022	32.5	~45.0	~35.0	~0.67
2023	33.0	69.1	426.4	2.5
2024	31.5	87.3	654.0	3.7
2025	~34.5	~105	~870	~5.0

** generalized by the authors based on materials from the Ministry of Health of Ukraine, the National Health Service of Ukraine, and open analytical reports on the functioning of the electronic healthcare system.*[28-38]

the fragmentation of digital infrastructure and complicate the integration of various information systems into a unified digital space of public governance.[41]

It should be noted that the success of digital healthcare implementation is also influenced by the access of its participants to a stable Internet network. According to the State Statistics Service in 2020, only 79.2% of Ukrainian households have access to the Internet, of which 27.2% use it to search for health-related information for themselves and others.[42]

The growth in population access to the Internet and mobile digital devices creates the necessary infrastructural foundation for the development of the electronic healthcare system. A comparison with the data presented in Table 1 demonstrates that the expansion of digital accessibility among the population correlates with the rapid increase in the use of electronic prescriptions, electronic referrals, and medical records, indicating the gradual integration of digital technologies into the practice of healthcare service delivery.

To summarize the relationship between the development of digital infrastructure and the implementation of the electronic healthcare system, it is appropriate to present a conceptual model of the healthcare system's digital readiness for the use of eHealth technologies.

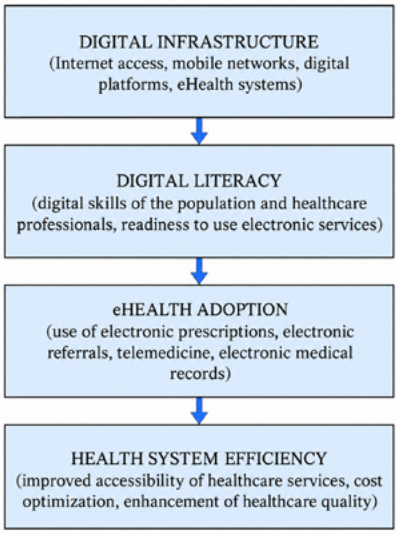

Figure 1. Conceptual model of the digital readiness of the healthcare system (developed by the authors).

Such a model demonstrates that the effectiveness of a digital healthcare system is shaped by the sequential influence of infrastructural, technological, and social factors, where a key role is played by the level of digital accessibility of the population and the readiness of users to utilize electronic medical services.

The eHealth system unites various healthcare areas, creating a single information space.[39] The core of this system is the Central Database (CDB) that contains comprehensive medical information about patients. The centralized database accumulates all the necessary information about patients, healthcare facilities and services provided. It interacts with electronic medical information systems, which, in turn, allow automating the work of medical institutions, creating and storing electronic medical records, and providing personalized access to medical information for every user.

Electronic medical information systems (EMIS) of healthcare institutions integrate with the CDB and create a single information space in the healthcare system. This space

Table 2. Dynamics of Internet use by the population of Ukraine as a prerequisite for the development of the digital healthcare system, 2018–2025

Year	Householdswith Internet access (%)	Internet usersamong the population (%)	Use of the Internetto search for healt hinformation (%)	Share of smart phone users (%)
2018	62.5	63	18	55
2019	71.0	67	22	60
2020	79.2	71	27	66
2021	82.0	74	31	70
2022	84.5	76	34	73
2023	86.0	78	37	76
2024	88.0	80	40	79
2025	89.5	82	43	82

** generalized by the authors based on materials from the State Statistics Service of Ukraine, international analytical reports on the development of digital technologies, and studies on Internet use among the population).*[43-51]

ensures storage, processing and analysis of large amounts of medical data, which allows optimizing the work of medical institutions, improving the quality of medical care and ensuring transparency of funding.[40]

One of the key advantages of the centralized approach is a high level of interoperability between different systems. This means that different medical institutions can easily exchange information, which greatly simplifies the provision of medical care to patients.[25] One of the key advantages of a centralized approach is the provision of a high level of interoperability between different systems. This means that various healthcare institutions can easily exchange information, which significantly simplifies the provision of medical care to patients. As noted in studies on the digital transformation of public administration, interoperability of information systems and the integration of core registries form the institutional core of a digital ecosystem, ensuring effective data exchange between different organizations and improving the quality of managerial decision-making.[52]

At the same time, the current eHealth digital system in Ukraine also includes components of a decentralized model, where each institution can use its own EMIS, which allows healthcare facilities to choose the best solution for their needs and promotes innovation in health information technology. This guarantees a higher level of cybersecurity, as hacking one system will not compromise the entire healthcare system.[16] However, the absence of a single standard can complicate data exchange and impede the creation of a national healthdata analysis system.

To date, there exit 29 EMIS connected to the national eHealth system[53], which indicates a significant increase in the interest of medical institutions in digital transformation and the desire to integrate into a single healthcare information space. The variety of systems indicates an active participation of both large international companies and domestic developers in the process of digital transformation of healthcare, creating high competition in the market of medical IT solutions and ample opportunities to choose the optimal solution for each institution.

The government initiative to create the eHealth system has become a powerful incentive for the development of the domestic EMIS market. Ukrainian companies, such as Eleks and EMCiMED, are actively involved in this process, creating high-quality innovative and market-competitive products. The public catalog of digital transformation projects initiated by the Ministry of Digital Transformation demonstrates the scale and consistency of state policy in this area.[54] These efforts are opening up new opportunities for the development of the industry and positioning Ukraine as a leader in digital health.

To illustrate the diversity of medical information systems used by Ukrainian healthcare institutions and integrated with the national eHealth system, it is advisable to consider the functional characteristics of several widely used MIS, as well as their advantages and limitations (Table 3).

Table 3. Comparative analysis of medical information systems integrated with the electronic healthcare system (eHealth) in Ukraine *

MIS	System profile	Core functions	Key advantages	Main limitations
Health24	Cloud-based MIS for public and private healthcare providers	e-registration, patient declarations, online scheduling, workload monitoring	Telephony integration, management dashboard, API connectivity	Limited multi-factor authentication; restricted interoperability
MedElement	Automation platform for clinics, laboratories, dentistry, and pharmacies	Medical documentation, financial management, reporting, CRM modules	Clinical decision support, web services, patient mobile app	Interface usability constraints
Clinic365	CRM-oriented MIS for private healthcare providers	Patient management, scheduling, financial control, EHR management	Integrated CRM, IP telephony, analytics tools	Limited patient communication tools; lack of MFA
Doctor Eleks	Scalable MIS for public and private healthcare institutions	Electronic patient records, registration, reporting, HR management	Integration with laboratories and insurers; eHealth connectivity	Limited support for electronic referrals
Helsi	Widely adopted national MIS platform	Online appointments, e-prescriptions, medical documentation, eHealth integration	High scalability, user-friendly patient interface, mobile services	Dependence on stable Internet connectivity
Asklep	MIS for operational automation of healthcare institutions	Electronic records, service accounting, financial management, analytics	Flexible configuration; integration with eHealth	Requires additional technical support
EMCiMED	Automation system for clinics and medical institutions	Electronic records management, financial accounting, statistical analytics	Integration with state registries; electronic document workflow	Limited adoption among small institutions
Polyclinic	Integrated MIS for comprehensive clinic management	Appointment management, medical documentation, statistical analytics	Full-cycle clinical automation; eHealth integration	High infrastructure requirements

** generalized by the authors based on open descriptions of medical information systems and information from the catalogue of eHealth-integrated MIS.*

The diversity of medical information systems presented on the market indicates the formation of a competitive environment in the field of medical IT solutions. Competition among MIS developers stimulates the introduction of innovative technologies, enhances system functionality and cybersecurity, and thereby contributes to the more effective development of the electronic healthcare system and the expansion of opportunities for integrating medical data within the national digital infrastructure of eHealth. Given the diversity of medical information systems integrated into the national digital healthcare infrastructure, it is advisable to consider the general architecture of the functioning of the eHealth ecosystem in Ukraine. The interaction of medical information systems with the central eHealth component ensures the exchange of medical data between healthcare institutions, public authorities, and patients, thereby forming a unified digital space for healthcare services (Figure 2).



Figure 2. Ecosystem of the functioning of the electronic healthcare system (eHealth) in Ukraine (generalized by the authors based on materials from the Ministry of Health of Ukraine and the National Health Service of Ukraine).

The proposed scheme demonstrates the multi-level architecture of Ukraine's digital healthcare system, in which medical information systems serve as the interface for interaction between healthcare institutions and the central eHealth component. Through integration mechanisms, data exchange is carried out between the system registries, ensuring the formation of a unified healthcare information space. The data obtained are used by the National Health Service of Ukraine to administer state programs for financing healthcare services, as well as to analyze the effectiveness of the healthcare system's functioning, which ultimately contributes to improving the accessibility and quality of medical services for the population.

To summarize the institutional and technological architecture of the functioning of the electronic healthcare system in Ukraine, it is advisable to consider a multi-level model of its governance. Such an approach makes it possible to systematically reflect the interconnections between state regulation, the platform components of eHealth, medical information systems, and the end users of digital healthcare services. The conceptual model presented in Figure 3 illustrates the structure of the digital eHealth ecosystem and the mechanisms of interaction between its key elements through the use of interoperability standards (HL7, FHIR, API), which ensure the exchange of medical data between different information systems.

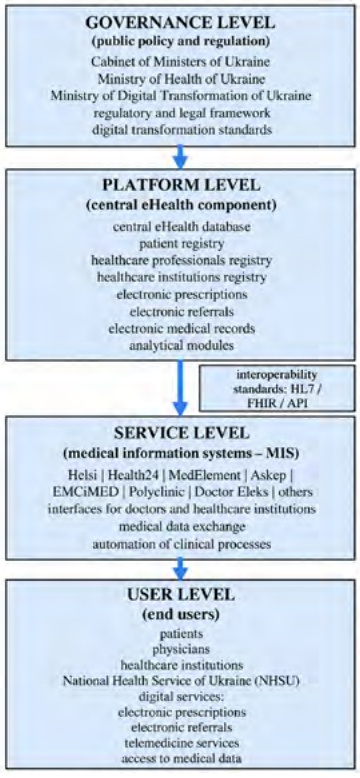

Figure 3. Ecosystem of the functioning of the electronic healthcare system (eHealth) in Ukraine (generalized by the authors based on materials from the Ministry of Health of Ukraine and the National Health Service of Ukraine).

The proposed conceptual model demonstrates the multi-level governance architecture of the digital healthcare ecosystem. At the governance level, strategic directions of digital transformation and the regulatory framework for the functioning of eHealth are formed. The platform level is represented by the central eHealth database, which ensures the functioning of key national registries and electronic services. At the service level, medical information systems operate and integrate with the central component through interoperability standards (HL7, FHIR, API), enabling digital interaction between healthcare institutions. The user level includes physicians, patients, and public institutions that utilize the digital

services of the eHealth system for receiving medical services, administering healthcare financing, and analyzing healthcare system data.

The modern electronic healthcare system of Ukraine is a complex integrated system that includes not only electronic medical records, but also a number of specialized information systems that ensure the integral functioning of the system, in accordance with the state policy in the field of digital transformation of healthcare.[28] These systems are designed to create conditions for the provision of quality and affordable medical services to all citizens of the country. Among them are the following systems:

- Blood Donation System (eBlood) automates processes related to blood donation, from donor registration to blood component transfusion tracking.
- Medicines Inventory Management System (e-Stock) provides transparent accounting of medicines and medical devices, helping to optimize procurement and resource allocation.
- MedData analytical system is used to analyze data on procurement and supply of medical supplies, especially important in martial law.
- Continuing Professional Development (CPD) system promotes the professional development of medical personnel by organizing and tracking their training.
- Transplantation System (UST) ensures effective coordination of the process of organ and tissue transplantation.
- The Epidemiological Surveillance System (ESS) collects and analyzes data on infectious diseases to respond to desease outbreaks in a timely manner.
- Socially Significant Disease Monitoring System allows tracking the prevalence and dynamics of socially significant diseases.
- Telemedicine provides an opportunity to receive medical consultations remotely, which is especially important for remote regions and people with limited mobility.
- Analytics and visualization tools – dashboards and other interactive tools – allow healthcare professionals and administrators to get promptly an overview of the necessary information in an easy-to-understand format.
- Medical legislation defines the rules and procedures for the provision of medical services, interaction between medical institutions and patients, use of medical information systems, etc. It is an integral part of the electronic healthcare system.
- In addition to the above systems, there is a wide range of other digital tools designed to improve the quality and accessibility of medical care. These can include chatbots for consultations, mobile apps for self-diagnosis, online platforms for training healthcare professionals, and much more.

Each of these systems plays an important role in ensuring the effective functioning of the electronic healthcare system as a whole. Their integration allows to optimize the work of medical institutions, improve the quality of medical care and ensure the availability of medical care for the population.

Digital healthcare in the world

Digital transformation of healthcare has become a global trend, and the experience of different countries demonstrates a variety of approaches and results. Contemporary studies on the digital transformation of public administration emphasize that digital technologies are gradually shifting from the role of auxiliary tools for automating administrative procedures to becoming system-forming elements of governance processes. Within this logic, digital platforms, data processing algorithms, and information systems begin to perform functions of coordination, analysis, and decision-support, thereby shaping a new architecture of interaction between the state, institutions, and citizens.[55]

Within this transformational paradigm, digital technologies become a key instrument for the modernization of healthcare systems, enabling the integration of medical data, improving the efficiency of healthcare resource management, and expanding public access to medical services. Many countries have already made significant progress in the digital transformation of healthcare. Estonia, Singapore, and Denmark are leaders in this field. They have well-developed electronic healthcare systems that allow patients to access their medical records online, make an appointment with a doctor, and receive electronic prescriptions.[56, 57]

Estonia is known as one of the most digitized countries in the world.[58] Its healthcare system is a role model, where every citizen has access to a single electronic medical record, electronic prescriptions and referrals, and a well-developed telemedicine. The healthcare system is integrated with other government services for the convenience of citizens.

It should be noted that not only the Ukrainian government is looking at the experience of the Republic of Estonia in the development of digital technologies, but Estonia

also has something to borrow from Ukraine. Ukraine and Estonia plan to maintain, improve and expand cooperation in the field of digital transformation. The first step in this direction will be cooperation in creating a program based on Diia in Estonia.

Diia is a state-run digital platform launched by the Ukrainian government to provide citizens and businesses with seamless access to public services. It enables the use of digital documents, electronic identification, and online administrative services, promoting transparency, efficiency, and accessibility. As a cornerstone of Ukraine's digital transformation, Diia integrates innovative technologies to enhance governance and public service delivery. The Ministry of Digital Transformation of Ukraine will advise Estonian colleagues and share its experience in implementing user-friendly public services.[56]

To this end, the Ministry of Digital Transformation of Ukraine and the Ministry of Economic Affairs and Communications of the Republic of Estonia have signed a Memorandum of Cooperation in the field of digital transformation. "Estonia was the first country we took an example from, when we started creating the Ministry of Digital Transformation. Its vision of digital transformation and the creation of a digital state inspires us to launch services in a few clicks. I am very pleased that now Estonia will be able to adopt our experience of a mobile-first state, where all important information and services are just in a smartphone," said Mykhailo Fedorov, Vice Prime Minister and Minister of Digital Transformation of Ukraine.[36, 58]

Another prominent representative of digital transformation experience in healthcare is Singapore, known for its focus on medical innovation.[59] Thanks to Big Data and artificial intelligence, the country develops personalized treatment plans for each patient. A wide range of mobile applications helps people track their health, book appointments with doctors, and receive medical advice. Singapore is actively developing the concept of Smart Health, which involves the use of IoT-devices to monitor patients' health in real-time mode.

Among European countries, Denmark is known for the high quality and safety of medical services. The country has a well-developed system of electronic medical records, which ensures secure storage and exchange of medical information. The Danish healthcare system has established clear standards and protocols, which contributes to the quality of medical care. Denmark emphasizes disease prevention, reducing treatment costs.[60]

Denmark is developing a reliable digital system designed to guarantee a high standard of patient data security.[61] This system will become a platform for effective interaction between various medical platforms and participants in the process. At present, patients' medical records are available for viewing by doctors in all regions through the National Medical Record (Sundhedsjournalen). Additionally, the shared medicines record (Fælles Medicinkort) provides healthcare professionals with complete up-to-date information about a patient's prescriptions across all healthcare institutions. This integrated digital system allows Danish doctors, healthcare facilities, nursing homes and other institutions to improve collaboration and reduce inequality in healthcare system.

As another element of digital health, the Danish government supports active patient participation in disease prevention. Given the projected increase in chronic diseases and the need for human resources, the government emphasizes the importance of patient involvement in their care: understanding their data and health status, and actively participating in the treatment process. This also implies a shift to preventive measures.

The digitalization of the healthcare sector in the United States of America is developing through a partnership model of cooperation. However, as in many other countries, the digital transformation of healthcare in the USA faces a number of challenges.[3, 62]
Digital health investors, like everyone else, are looking for the highest rate of return with the lowest risk. Yet, due to the unclear regulatory and reimbursement environment, it is difficult to determine which tools will be successful. In addition, many digital health technologies have not been clinically tested. Clinical trials are necessary to assess the effectiveness and safety of digital tools.

Periodic guidance documents and rules proposed by the U.S. Food and Drug Administration (FDA) add to uncertainty, too.

There are many stakeholders in healthcare: payers, providers, patients, and others. Therefore, it is difficult to focus on one customer, as the value of a product or service should be obvious to all. The industry is relatively new, and there is a lack of research to find out which customers and patients are willing to use a particular product and why. Companies that receive significant investment are characterized by a rapid increase in the number of customers, at least 70% per year, suggesting that scale often trumps innovation.

Doctors may not have enough information to prescribe or use digital technologies. Most doctors are not rewarded for using digital technologies, which makes it difficult to adopt them. There are also behavioral and emotional barriers to the adoption of digital technologies by both patients and doctors.

Finally, there are significant privacy, security, and data protection issues that have not yet been addressed.

At the same time, significant results in the digital transformation of healthcare have also been achieved by other countries, including Finland, South Korea, the United Kingdom, and Israel. In Finland, the national platform Kanta Services operates, providing centralized storage of electronic health records, electronic prescriptions, and citizens' access to their personal medical data through a dedicated online portal. The system also allows patients to control healthcare professionals' access to their medical data and facilitates the integration of different healthcare institutions into a unified digital healthcare infrastructure.[63]

South Korea is actively developing digital medicine through the implementation of telemedicine and the use of big data and artificial intelligence to support clinical decision-making. Within the national digital health policy framework, platforms are being created for the analysis of medical data and the development of personalized medicine, enabling the optimization of treatment processes and improving the efficiency of healthcare system management.[64]

The United Kingdom also demonstrates significant progress in the development of digital healthcare services. Within the NHS Digital program, national electronic health records have been created and integrated with telemedicine services and medical data analytics systems. Digital tools are actively used for remote safety monitoring, optimizing medical resource management, and increasing the accessibility of medical services.[65]

Israel is considered one of the global leaders in the implementation of innovative digital health technologies. Through the extensive use of electronic health records, big data analytics, and artificial intelligence, the Israeli healthcare system ensures a high level of personalization of medical services and the efficient use of healthcare resources. The developed digital ecosystem enables the inte-

Table 4. Comparative characteristics of digital transformation models of healthcare systems in selected countries of the world*

Country	Core digital platform	Key digital services	Main technologies	Data integration level	Governance model	Key advantages	Key challenges
Estonia	National eHealth System	Electronic health records, e-prescriptions, e-referrals, telemedicine	Blockchain, X-Road, digital identity	Very high	Highly centralized digital governance	Integrated public services, full patient access to health data	Cybersecurity and data protection
Singapore	Smart Health Initiative	Mobile health apps, teleconsultations, personalized care	Artificial intelligence, Big Data, IoT	High	Strong state support for medical innovation	Advanced data-driven healthcare, personalized medicine	High technological costs
Denmark	Sundhedsjournalen, Fælles Medicinkort	Electronic health records, shared medication registries	National registries, digital health platforms	Very high	Prevention-oriented health policy	High coordination among healthcare institutions	Integration complexity across systems
United States	Private EHR platforms (Epic, Cerner)	Electronic health records, telemedicine, digital medical services	AI, Big Data, medical data analytics	Medium	Public–private partnership model	High innovation capacity and investment	Regulatory fragmentation, data privacy issues
Finland	Kanta Services	Electronic health records, e-prescriptions, patient portals	National registries, digital platforms	Very high	Centralized national data governance	Strong patient control over personal medical data	Continuous system modernization needs
South Korea	National Digital Health Platform	Telemedicine, medical data analytics, digital health services	AI, Big Data, digital medical platforms	High	Active government-driven digital health policy	Development of personalized medicine	Regulatory restrictions on telemedicine
United Kingdom	NHS Digital	Electronic health records, remote patient monitoring	Medical data analytics, telemedicine technologies	High	National digital healthcare strategy	Nationwide integration of healthcare services	Modernization of legacy IT systems
Israel	Digital Health Ecosystem	Electronic health records, medical data analytics	AI, Big Data, digital health startups	Very high	Innovation-driven healthcare ecosystem	Personalized medicine, strong startup sector	Medical data security and privacy

** generalized by the authors based on international studies on the digital transformation of healthcare systems [56–66].*

gration of medical data from various institutions and supports the growth of medical startups in the field of digital health.[66]

Thus, international experience demonstrates that effective digital transformation of healthcare is based on the combination of state digitalization policy, development of digital infrastructure, integration of medical information systems, and the active use of medical data analytics. Successful practices in different countries highlight the importance of a comprehensive approach to implementing digital technologies in healthcare systems, which may be used for the further development of digital medicine in Ukraine.

To achieve a more systematic understanding of the features of digital transformation in healthcare systems across different countries, it is advisable to summarize their experience in a comparative format. Such an approach allows the identification of key institutional models, technological instruments, and governance mechanisms that ensure the effective functioning of digital healthcare ecosystems in leading countries worldwide (Table 4).

The comparative analysis of international experience indicates that the successful digital transformation of healthcare systems depends on the combination of several key factors: developed digital infrastructure, integrated medical information systems, active state policy in the field of digitalization, and the use of advanced technologies for medical data analytics. Leading countries demonstrate different models of digital healthcare development; however, a common feature among them is the high level of integration of medical data and the active use of digital services in interactions between patients, healthcare institutions, and public authorities.

Ukraine has a great opportunity to use the experience of other countries to develop its own healthcare system. In particular, it is worth paying attention to the areas as below.

First, improving the unified electronic medical space is critical. Standardizing and connecting all medical institutions to a single system will ensure continuity of care and facilitate access to medical information for doctors and patients.

Secondly, the development of telemedicine is particularly relevant for Ukraine, given its large territory and the presence of remote regions with limited access to medical services. Telemedicine will provide access to qualified medical care for all citizens, regardless of their place of residence.

Third, improving the algorithm for creating electronic prescriptions and referrals will greatly simplify the procedure for obtaining medicines and referrals for examination. This will reduce the bureaucratic burden on doctors and patients, and will contribute to more efficient use of healthcare resources.

Fourth, the use of artificial intelligence opens up new opportunities for personalizing treatment and optimizing workflows in medical institutions. AI can help doctors make more informed decisions and automate routine tasks, freeing up time for more important work.

Fifth, involvement of the private sector in the digital transformation of healthcare is an important success factor. Cooperation with private companies will attract additional investments and accelerate the introduction of the latest technologies.

Additional research is needed to analyze more thoroughly the experience of other countries and develop effective recommendations for Ukraine. In particular, it is worth comparing the legal regulation of digital transformation in different countries, assessing the impact of digital technologies on the effectiveness of treatment of various diseases, and analyzing the economic aspects of digital transformation in healthcare.

A comprehensive approach to digital transformation of healthcare, taking into account the best international practices and the needs of Ukraine, will create a modern and efficient healthcare system that will be accessible to every citizen.

Conclusions from the study and prospects for further research

The digital transformation of healthcare is an irreversible process that opens up new opportunities to improve the quality and accessibility of healthcare. However, successful implementation of digital transformation requires comprehensive measures, including the development of a clear state strategy, investment in information technology, training, cybersecurity, and cooperation with the private sector.

The state strategy should be aimed at creating long-term plans for the development of digital healthcare, taking into account both national peculiarities and best international practices. An important aspect is the financing of information systems development and creation of a unified digital environment in healthcare, which will ensure the integration of various medical institutions and the exchange of information between them.

Equally important is the training of personnel capable of working with modern digital technologies in medicine. Investing in the training and retraining of medical staff is key to successful implementation of digital innovations. Ensuring the cybersecurity of medical data is critical to maintaining confidentiality and preventing misuse. The development of effective mechanisms to protect against cyberattacks and ensure the security of patients' personal data is a top priority.

Cooperation with the private sector is an important factor of digital transformation success. Establishing partnerships between the state and private companies will help attract investment and share experience, which will accelerate the development of digital technologies in healthcare.

The experience of such countries as Estonia, Singapore, Denmark and others demonstrates that digital transformation of healthcare is an integral part of the modern world. Ukraine has every opportunity to become a leader in this area by creating favorable conditions for the development of digital technologies, attracting qualified specialists, and securing funding for the necessary projects.

The results of the conducted study make it possible to formulate several generalized analytical conclusions regarding the patterns of digital transformation in healthcare systems.

First, the comparative analysis of international experience indicates that effective digital transformation in healthcare is based on the integration of national digital infrastructure, standardized mechanisms for the exchange of medical data, and a high level of interoperability among medical information systems. The experience of Estonia, Denmark, Finland, and the United Kingdom demonstrates that the creation of unified national platforms for electronic health records and digital patient services ensures continuity of care, improves the efficiency of healthcare resource management, and contributes to more transparent financing of healthcare systems.

Second, the analysis of digital health models reveals the existence of different institutional approaches to the organization of digital healthcare ecosystems. In some countries, a centralized model of medical data governance dominates (e.g., Estonia and Finland), while others apply hybrid or market-oriented approaches involving private technology companies (e.g., the United States and Israel). Despite differences in governance models, a common characteristic of successful systems is the use of digital platforms for integrating medical data, the development of telemedicine services, and the application of big data analytics to support clinical and managerial decision-making.

Third, the findings indicate that the digital transformation of healthcare is accompanied by a number of systemic challenges. Among the most significant are ensuring the cybersecurity of medical data, integrating heterogeneous information systems, establishing regulatory frameworks for the use of digital medical technologies, and preparing healthcare professionals to work with digital tools. These challenges are characteristic both of advanced digital healthcare systems and of countries undergoing active digital modernization.

In the context of Ukraine, the analysis shows that the further development of the digital eHealth system requires stronger institutional coordination between public authorities, healthcare institutions, and developers of medical information systems, as well as the development of interoperability standards and deeper integration of medical data. An important direction is also the expansion of analytical capabilities of medical information systems to support managerial decision-making in the healthcare sector.

Thus, the results of the study confirm that the digital transformation of healthcare systems is a complex institutional process that combines the development of digital infrastructure, the implementation of integrated medical information systems, and the formation of new models of governance of medical data and digital services.

At the same time, it should be noted that the study has certain limitations, as it is primarily based on a comparative analysis of national digital health transformation strategies and available statistical and analytical materials, which does not allow for a full assessment of the effectiveness of individual digital solutions at the level of clinical practice.

The obtained results may serve as an analytical basis for the further improvement of the digital transformation of the healthcare system in Ukraine, particularly in terms of developing interoperable medical information systems, integrating medical data into a unified digital space, and improving the efficiency of healthcare resource management through data analytics.

The digital transformation of healthcare is a complex and multifaceted process that requires joint efforts of the state, the medical community, and IT companies. It is a systematic approach and active participation of all stakeholders that can ensure a significant progress in this area.

The present study is only the beginning of exploring this important topic. For a profound understanding of the digital transformation processes in medicine, additional research is needed, in particular, on the impact of digital technologies on the effectiveness of treatment of various diseases, the economic aspects of digital transformation,

the social consequences of digital technologies, and the role of artificial intelligence in medicine. Prospects for further research also include a more detailed analysis of the impact of digital medical technologies on the effectiveness of clinical practice, the assessment of the economic efficiency of digital healthcare services, and the study of mechanisms for integrating artificial intelligence and big data analytics into healthcare system governance processes.

Relevant directions for future research also include the impact of the COVID-19 pandemic on the digitalization of healthcare, ethical aspects of digital transformation, the accessibility of digital technologies for different social groups, the role of patients and civil society in the digital transformation of healthcare, cybersecurity in electronic health systems, and the use of blockchain technologies in medicine.

A deep study of these areas will allow us to get a more complete picture of the digital transformation of healthcare and develop effective strategies for the successful implementation of digital technologies in medical practice.

The authors declare no financial support or funding for this study.

There are no conflicts of interest to disclose.

References

1. World Health Organization. Strategizing national health in the 21st century: a handbook. Geneva: WHO; 2016 [cited 2025 Feb 7]. Available from: https://www.who.int/publications/i/item/9789241549745.
2. Hrytsenko VI. Digital medicine and intelligent information technologies - the basis of future health care. Bull Natl Acad Sci Ukr. 2016;(5):41-43. Ukrainian.
3. Ronquillo Y, Meyers A, Korvek SJ. Digital Health. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan [updated 2023 May 1; cited 2025 Jan]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK470260/.
4. Coder M, McBride L, McClenahan S. Core elements of national policy for digital health technology evidence and access. npj Digit Med. 2024;7:212. doi: 10.1038/s41746-024-01209-2.
5. Hui CY, Abdulla A, Ahmed Z, Goel H, Monsur Habib GM, Teck Hock T, et al. Mapping national information and communication technology (ICT) infrastructure to the requirements of potential digital health interventions in low- and middle-income countries. J Glob Health. 2022;12:04094. doi: 10.7189/jogh.12.04094.
6. Chen M, Decary M. Artificial intelligence in healthcare: An essential guide for health leaders. Healthc Manage Forum. 2020;33(1):10-18. doi: 10.1177/0840470419873123.
7. Liu S, Ma J, Sun M, Zhang C, Gao Y, Xu J. Mapping the Landscape of Digital Health Intervention Strategies: 25-Year Synthesis. J Med Internet Res. 2025;27:e59027. doi: 10.2196/59027.
8. Istepanian RSH. Mobile Health (m-Health) in Retrospect: The Known Unknowns. Int J Environ Res Public Health. 2022;19(7):3747. doi: 10.3390/ijerph19073747.
9. Keasberry J, Scott IA, Sullivan C, Staib A, Ashby R. Going digital: a narrative overview of the clinical and organisational impacts of eHealth technologies in hospital practice. Aust Health Rev. 2017;41(6):646-664. doi: 10.1071/AH16233.
10. Fong B, Fong ACM, Li CK. Telemedicine Technologies: Information Technologies in Medicine and Digital Health. Hoboken (NJ): Wiley; 2020. doi: 10.1002/9781119575788.
11. Woods L, Cummings E, Duff J, Walker K. Partnering in Digital Health Design: Engaging the Multidisciplinary Team in a Needs Analysis. Stud Health Technol Inform. 2018;252:176-181.
12. Ramachandran M, Brinton C, Wiljer D, Upshur R, Gray CS. The impact of eHealth on relationships and trust in primary care: a review of reviews. BMC Prim Care. 2023;24(1):228. doi: 10.1186/s12875-023-02176-5.
13. Gritsenko VI, Fainzilberg LS. Current state and prospects for the development of digital medicine. Cybern Comput Eng. 2020;(1):59-84. Ukrainian. doi: 10.15407/kvt199.01.059.
14. Korchynskyi I, Firman N. Digital medicine: features and problems of formation in Ukraine. Digital Econ Econ Secur. 2022;1(01):100-105. Ukrainian. doi: 10.32782/dees.1-16.
15. Androschuk G. Digital transformation in healthcare: analysis of technological trends. Yurydychna Hazeta [Internet]. [cited 2025 Feb 7]. Ukrainian. Available from: https://yur-gazeta.com/publications/practice/informaciyne-pravo-telekomunikaciyi/cifrova-transformaciya-v-ohoroni-zdorovya-analiz-tehnologich-nih-trendiv.html.
16. Malakhov KS. Insight into the Digital Health System of Ukraine (eHealth): Trends, Definitions, Standards, and Legislative Revisions. Int J Telerehabil. 2023;15(2):e6599. doi: 10.5195/ijt.2023.6599.
17. Benjamin K, Potts HW. Digital transformation in government: Lessons for digital health? Digit Health. 2018;4:2055207618759168. doi:

10.1177/2055207618759168.

18. Shaw J, Glover W. The Political Economy of Digital Health Equity: Structural Analysis. J Med Internet Res. 2024;26:e46971. doi: 10.2196/46971.
19. Kovalenko M, Sikalo M, Kovalova T, Radchenko O, Velychko L, Nakisko O, et al. Development of an integrated quality management model in the context of digital transformation: Public administration, education, economics. Technol Audit Prod Reserv. 2025;6(4(86)):46-61. doi: 10.15587/2706-5448.2025.348540.
20. Gu W, Wang J, Zhang Y, Liang S, Ai Z, Li J. Evolution of Digital Health and Exploration of Patented Technologies (2017-2021): Bibliometric Analysis. Interact J Med Res. 2024;13:e48259. doi: 10.2196/48259.
21. Linwood SL, editor. Digital Health. Singapore: Exon Publications; 2022. doi: 10.36255/exon-publications-digital-health.
22. Kleib M, Arnaert A, Nagle LM, Ali S, Idrees S, Costa DD, et al. Digital Health Education and Training for Undergraduate and Graduate Nursing Students: Scoping Review. JMIR Nurs. 2024;7:e58170. doi: 10.2196/58170.
23. Yang Y, Ma C. Sociodemographic factors and health digital divide among urban residents: Evidence from a population-based survey in China. Digit Health. 2024;10:20552076241271812. doi: 10.1177/20552076241271812.
24. Horiachko A. 13 Trends in Healthcare Technology to Watch in 2023. Softermii [Internet]. [cited 2025 Feb 7]. Ukrainian. Available from: https://www.softermii.com/blog/healthcare-information-technology-trends-to-watch.
25. Sherembey D. E-Health: breakthrough in the Ukrainian healthcare system. What patients will get. Ukrayinska Pravda [Internet]. 2017 Feb 14 [cited 2025 Feb 7]. Ukrainian. Available from: https://life.pravda.com.ua/columns/2017/02/14/222573/.
26. World Health Organization. WHO guideline Recommendations on Digital Interventions for Health System Strengthening. Geneva: WHO; 2019 [cited 2025 Feb 7]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK541905/.
27. Shaw T, McGregor D, Brunner M, Keep M, Janssen A, Barnet S. What is eHealth (6)? Development of a Conceptual Model for eHealth: Qualitative Study with Key Informants. J Med Internet Res. 2017;19(10):e324. doi: 10.2196/jmir.8106.
28. Digital Med 2020: challenges and development of eHealth in Ukraine. Apteka Weekly [Internet]. 2020 Oct 16 [cited 2026 May 20]. Available from: https://www.apteka.ua/article/568312.
29. Cabinet of Ministers of Ukraine. More than 8.3 million e-referrals created in the electronic healthcare system [Internet]. Kyiv: CMU; 2020 Nov [cited 2026 May 20]. Available from: https://www.kmu.gov.ua/news/v-elektronnnij-sistemi-ohoroni-zdorovya-stvoreno-ponad-83-mln-e-napravlen.
30. Ministry of Health of Ukraine. MoH together with partners summarised 2021 and presented digital health projects for 2022–2023 [Internet]. Kyiv: MoH; 2021 Dec [cited 2026 May 20]. Available from: https://moz.gov.ua/article/news/moz-spilno-z-partnerami-realizue-ponad-120-cifrovih-proektiv-u-sferi-ohoroni-zdorovja-v-2022-23-rr-.
31. State Enterprise Electronic Health. Over 2 billion electronic medical records for over 35 million patients entered into the EHOS [Internet]. Kyiv: eHealth; 2023 Jul 25 [cited 2026 May 20]. Available from: https://ehealth.gov.ua/2023/07/25/ponad-2-mlrd-elektronnyh-medychnyh-zapysiv-dlya-ponad-35-mln-patsiyentiv-vneseno-v-esoz/.
32. State Enterprise Electronic Health. On the performance of the EHOS Central Database: how the system works under growing load [Internet]. Kyiv: eHealth; 2024 Jan 8 [cited 2026 May 20]. Available from: https://ehealth.gov.ua/2024/01/08/pro-pratsezdatnist-tsbd-esoz-yak-pratsyuye-systema-v-umovah-zrostayuchogo-navantazhennya/.
33. New registries, EHOS changes, e-CPD updates and other digital healthcare plans for 2025. ThePharma-Media [Internet]. 2025 Mar 19 [cited 2026 May 20]. Available from: https://thepharma.media/uk/business/37457-novi-rejestri-zmini-v-esoz-onovlennya-e-bpr-ta-insi-plani-cifrovizaciyi-oxoroni-zdorovya-na-2025-rik-19032025.
34. National Health Service of Ukraine. Statistics on electronic medical records in the EHOS [analytical dashboard]. Kyiv: NHSU; [cited 2026 May 20]. Available from: https://nszu.gov.ua/e-data/dashboard/emz-stats.
35. National Health Service of Ukraine. Statistics of submitted declarations on the choice of primary care physician [analytical dashboard]. Kyiv: NHSU; [cited 2026 May 20]. Available from: https://edata.e-health.gov.ua/e-data/dashboard/declar-stats.
36. State Enterprise Electronic Health. Digital transformation of healthcare: results of 2025 [Internet]. Kyiv: eHealth; 2025 Dec 30 [cited 2026 May 20]. Available from: https://ehealth.gov.ua/2025/12/30/tsyfrova-transformatsiya-ohorony-zdorov-ya-pidsumky-2025-roku/.

37. State Enterprise Electronic Health. The number of electronic medical records in the EHOS has exceeded 5 billion [Internet]. Kyiv: eHealth; 2026 Apr 9 [cited 2026 May 20]. Available from: https://ehealth.gov.ua/2026/04/09/v-esoz-kilkist-elektronnyh-medychnyh-zapysiv-syagnula-ponad-5-mlrd/.

38. Ministry of Health of Ukraine. Digital transformation of healthcare: results of 2025 [Internet]. Kyiv: MoH; 2025 Dec 30 [cited 2026 May 20]. Available from: https://moz.gov.ua/uk/cifrava-transformaciya-ohoroni-zdorov-ya-pidsumki-2025-roku.

39. Ministry of Health of Ukraine. Digital transformation of healthcare in Ukraine. Main [Internet]. [cited 2024 Oct 16]. Ukrainian. Available from: https://moz.gov.ua/uk/cifrava-transformaciya-ohoroni-zdorov-ya-ukrayini-2.

40. Nazirova TA, Kostenko AB. Overview of eHealth development models and existing medical information systems. Problems of creating a single medical information space. Sci Bull UNFU. 2018;27(10):151-155. doi: 10.15421/40271027.

41. Sikalo M. Institutional challenges of implementing the "state in a smartphone" model in the context of fragmented public administration of digitalization in Ukraine. Aktualni Probl Derzh Upr. 2025;2(67):341-369. doi: 10.26565/1684-8489-2025-2-17.

42. State Statistics Service of Ukraine. Access of Ukrainian households to the Internet in 2020 [Internet]. 2021 [cited 2025 Feb 7]. Available from: https://ukrstat.gov.ua/druk/publicat/kat_u/2021/zb/07/zb__dd_in20.pdf.

43. State Statistics Service of Ukraine. Internet access of Ukrainian households in 2018: statistical collection [Internet]. Kyiv: Derzhstat; 2019 [cited 2026 May 20]. Available from: https://www.ukrstat.gov.ua/druk/publicat/kat_u/2019/zb/07/zb_Internet_2018.pdf.

44. State Statistics Service of Ukraine. Internet access of Ukrainian households in 2019: statistical collection [Internet]. Kyiv: Derzhstat; 2020 [cited 2026 May 20]. Available from: https://www.ukrstat.gov.ua/druk/publicat/kat_u/2020/zb/07/zb__dd_in19.pdf.

45. State Statistics Service of Ukraine. Internet access of Ukrainian households in 2021: statistical collection [Internet]. Kyiv: Derzhstat; 2022 [cited 2026 May 20]. Available from: https://www.ukrstat.gov.ua/druk/publicat/Arhiv_u/17/Arch_dddi_zb.htm.

46. International Telecommunication Union. Ukraine: ICT Development Dashboard [Internet]. Geneva: ITU; 2023 [cited 2026 May 20]. Available from: https://www.itu.int/en/ITU-D/Statistics/Documents/DDD/ddd_UKR.pdf.

47. International Telecommunication Union. Ukraine Digital Development Country Profile. Version 3.0 [Internet]. Geneva: ITU Regional Office for Europe; 2025 [cited 2026 May 20]. Available from: https://www.itu.int/en/ITU-D/Regional-Presence/Europe/Documents/Publications/2025/Final_Ukraine%20Digital%20Development%20Country%20Profile%20version%203.0.pdf.

48. World Bank. Individuals using the Internet (% of population) — Ukraine [Internet]. Washington (DC): World Bank; 2025 [cited 2026 May 20]. Available from: https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=UA.

49. Federal Reserve Bank of St. Louis. Internet users for Ukraine (ITNETUSERP2UKR) [Internet]. St. Louis (MO): FRED Economic Data; 2025 [cited 2026 May 20]. Available from: https://fred.stlouisfed.org/series/ITNETUSERP2UKR.

50. Keeley S, We Are Social. Digital 2025: Ukraine [Internet]. New York: DataReportal; 2025 Feb [cited 2026 May 20]. Available from: https://datareportal.com/reports/digital-2025-ukraine.

51. Keeley S, We Are Social. Digital 2026: Ukraine [Internet]. New York: DataReportal; 2025 Nov [cited 2026 May 20]. Available from: https://datareportal.com/reports/digital-2026-ukraine.

52. Sikalo M. Interoperability, e-identity and base registries as the foundation of digital transformation of public administration: Lessons from Eastern and Northern European countries. Natsionalni Interesy Ukrainy. 2025;10(15):1159-1169. doi: 10.52058/3041-1793-10(15)-1159-1169.

53. State Enterprise Electronic Health. Connected to the Central Bank of MIS [Internet]. [cited 2024 Oct 16]. Available from: https://ehealth.gov.ua/pidklyucheni-do-ehealth-mis/.

54. Digital transformation projects. Diia [Internet]. [cited 2024 Oct 16]. Available from: https://plan2.diia.gov.ua/projects.

55. Sikalo MV. Methodological challenges in researching the digital transformation of public governance: From instrumentality to substantiality of technologies and the concept of transitive digital statehood. Derzh Upr Udoskon Rozvytok. 2025;(9). doi: 10.32702/2307-2156.2025.9.13.

56. Government quarter: Ministry of Digital will help Estonia create an application based on Diya [Internet]. Kyiv: CMU; 2025 Feb 7 [cited 2025 Feb 7]. Available from: https://www.kmu.gov.ua/news/mintsyfry-dopomozhe-estonii-stvoryty-zastosunok-na-bazi-dii.

57. Bente BE, Van Dongen A, Verdaasdonk R, van Ge-

mert-Pijnen L. eHealth implementation in Europe: a scoping review on legal, ethical, financial, and technological aspects. Front Digit Health. 2024;6:1332707. doi: 10.3389/fdgth.2024.1332707.

58. Estonian e-Health Records. e-Estonia [Internet]. [cited 2025 Feb 7]. Available from: https://e-estonia.com/solutions/e-health/e-health-records/.

59. Aung MN, Koyanagi Y, Nagamine Y, Nam EW, Mulati N, Kyaw MY, et al. Digitally Inclusive, Healthy Aging Communities (DIHAC): A Cross-Cultural Study in Japan, Republic of Korea, Singapore, and Thailand. Int J Environ Res Public Health. 2022;19(12):6976. doi: 10.3390/ijerph19126976.

60. Birk HO, Vrangbæk K, Rudkjøbing A, Krasnik A, Eriksen A, Richardson E, et al. Denmark: Health System Review. Health Syst Transit. 2024;26(1):1-186.

61. Eriksen J, Ebbesen M, Eriksen KT, Hjermitslev C, Knudsen C, Bertelsen P, et al. Equity in digital healthcare – the case of Denmark. Front Public Health. 2023;11:1225222. doi: 10.3389/fpubh.2023.1225222.

62. Digital transformation of the health sector in the Americas: Ensuring public health reaches everyone, everywhere. IRIS PAHO [Internet]. [cited 2025 Feb 7]. Available from: https://iris.paho.org/handle/10665.2/64183.

63. Hyppönen H, Lumme S, Reponen J, Vänskä J, Kaipio J, Heponiemi T, et al. Health information exchange in Finland: Usage of different access types and predictors of paper use. Int J Med Inform. 2019;122:1-6. doi: 10.1016/j.ijmedinf.2018.11.005.

64. Kim J, Lee S. Digital health transformation in South Korea: Policy and regulatory framework. Healthc Inform Res. 2021;27(2):102-110. doi: 10.4258/hir.2021.27.2.102.

65. Honeyman M, Dunn P, McKenna H. Digital technology and health care: Lessons from the NHS. J Med Internet Res. 2020;22(8):e18855. doi: 10.2196/18855.

66. Binah O, et al. Data-driven healthcare: Israel's digital health ecosystem. NPJ Digit Med. 2020;3:114. doi: 10.1038/s41746-020-00326-3.