EHR SYSTEMS IN UKRAINE: ENHANCING PATIENT CARE AND DATA MANAGEMENT

Abstract. Ukraine's current healthcare reform, namely the eHealth system, is aimed at improving and making care more accessible to patients. Improving the quality of medical care and creating a modern database involves creating effective mechanisms for social protection of citizens. The electronic healthcare system is the largest information technology system in Ukraine that reliably stores health data of about 35 million Ukrainians who use such services as electronic prescriptions and referrals, electronic sick leave, etc. Automation of control procedures using modern computer hardware and special software plays an important role in improving the quality of control. The above requirements are met by electronic and information systems, including a set of methodological techniques, technical means and management algorithms designed to collect, store, process and transmit information on quality control of medical care at various levels of management. The implementation of healthcare informatization has partially resolved the issue of providing medical institutions with computer equipment, software products, and staff training. It is important to create an electronic healthcare system with the formation of a single electronic space at all levels of management, which will improve the quality of medical care, as well as continuous modernization and improvement of modern technologies and innovations in the field of healthcare, staff training, and information support for people as users of eHealth services. The article presents a number of key criteria that need to be addressed in an EHR: integrating patient-centered data collection; collecting structured survey data using standard EHR features (interfaces and standard workflows); ongoing staff development and
the creation of reusable automated reports that will improve patient care and data management through an EHR.

**Keywords:** electronic information systems, healthcare, software, medical care.

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**ЕЛЕКТРОННА СИСТЕМА ОХОРОНИ ЗДОРОВ’Я В УКРАЇНІ: ПОКРАЩЕННЯ ДОГЛЯДУ ЗА ПАЦІЄНТАМИ ТА УПРАВЛІННЯ ДАНИМИ**

Анотація. В наш час реформування охорони здоров’я України, яке безпосередньо відноситься і до електронної системи медичної допомоги населеню спрямовано на покращення якості та доступність догляду за пацієнтами. Покращення якості медичної допомоги та створення сучасної бази даних передбачає використання ефективних механізмів соціального захисту громадян. Електронна система охорони здоров’я є найбільшою інформаційно-технологічною системою України, яка надійно зберігає дані про здоров’я близько 35 мільйонів українців, які користуються такими послугами як: електронні рецепти та направлення, електронні лікарняні та ін. Важливе місце серед підвищення якості контролю займає автоматизація процедур контролю з використанням сучасної комп’ютерної техніки та спеціального програмного забезпечення. Вищепереліченим вимогам відповідають електронні, інформаційні системи серед яких комплекс методологічних прийомів, технічних засобів і алгоритмів керування, призначених для збору, зберігання, обробки й передачі інформації з питань контролю якості медичної допомоги на різних рівнях управління. Виконання інформатизації галузі охорони здоров’я дозволило частково вирішити питання забезпечення медичних закладів комп’ютерною технікою, програмними продуктами та навчання персоналу. Актуальним є створення електронної системи охорони здоров’я з
формуванням єдиного електронного простору на всіх рівнях управління, що підвищить якість надання медичної допомоги, а також постійна модернізація та вдосконалення сучасних технологій та інновацій в галузі охорони здоров'я, навчання персоналу, інформаційна підтримка людей, як користувачів послуг електронної охорони здоров'я. У статті представлено ряд основних критеріїв, які потребують вдосконалення електронної системи: інтегрування збору даних, які орієнтовані на пацієнта; збір даних структурованого дослідження шляхом використання стандартних функцій електронної системи (інтерфейси та стандартні робочі процеси); постійне підвищення кваліфікації персоналу та створення багаторазових автоматизованих звітів, що покращить догляд за пацієнтами та управління даними за допомогою електронної системи охорони здоров'я.

Ключові слова: електронні інформаційні системи, охорона здоров'я, програмне забезпечення, медична допомога.

Problem statement. Over the past 10 years, Ukraine has been widely discussing the problems of providing affordable and high-quality medical care to patients. One of the state's priorities is to protect and promote the health of citizens. To address these issues, the entire healthcare system has been reformed [1]. Currently, the healthcare system of Ukraine is financed under the new Law “On State Financial Guarantees of Medical Care for the Population,” a guaranteed package of medical services for each patient, the “Medical Guarantees Programme,” has been introduced, and the National Health Service of Ukraine has been established with the introduction of an eHealth system [1; 2]. There is a unified electronic health information system for specific reporting from the regional level upwards, but at the municipal and community levels, reporting is done on paper using standardised forms. Other local information systems exist, but they are not always interoperable and are designed for the management of individual facilities rather than for national planning and coordination. It has also been argued that facilities do not provide the government with fully accurate and relevant information, including funding, surveillance, and programme data, in a form suitable for sufficiently effective monitoring of the health system. With the exception of a few projects, the Ukrainian healthcare system does not have a unified, person-centred health information management system. Evaluation of health IT is not yet inherent in the national system, and there is no institution responsible for systematically assessing the effectiveness, cost, and impact of health IT to inform health policy. Automation of processes, namely electronic health records (EHR systems), is a pressing issue in medicine and healthcare, which is necessary for making quick, correct, and timely medical decisions. The priority area is quality patient care, fast, accurate, and reliable diagnostics, prevention, and treatment by doctor or other medical personnel. This can be achieved through the development and implementation of an e-service system based on objective data. Thus, the
provision of data-driven e-services is necessary to create continuous remote monitoring of the patient's condition and the long-term effects of the drugs the patient takes [3; 4]. The main results of the reform in Ukraine should be: an effective and accessible healthcare system, improved living standards and quality of life, improved quality and safety of medical care, productive employment of healthcare personnel, improved social security, and optimisation of the social support system [1; 2].

Analysis of the latest research and publications. This article addresses the most pressing issue - the implementation of eHealth. The Government of Ukraine has a strong political will to launch an eHealth system for the benefit of its citizens and healthcare institutions. Since 2017, the Ministry of Health of Ukraine has declared the implementation of the eHealth project as its priority for the coming period. The article states that the state aims to create a medical data system that will maintain an all-Ukrainian register of patients, doctors, and medical institutions, as well as data on contractual relations between them. The aim of this reform is to achieve maximum information and minimum regulatory burden to transform the highly inefficient Ukrainian healthcare system.

Current issues of improving patient care and data management through electronic healthcare systems in Ukraine have been studied in the works of: D. H. Havrychenko [1], V. M. Pashkov [2], B. Kerin [3], I. Izonin [4], T. V. Pluzhnikova [5], S. V. Knysh [6].

The purpose of the article – is to define criteria for improving patient care and data management through the electronic healthcare system in Ukraine.

Summary of the main material. The main objective of healthcare organisations is to provide the best possible care to patients at the lowest possible cost. The Ukrainian government launched a healthcare reform in 2015 to improve the health of the Ukrainian population and provide financial protection against excessive out-of-pocket medical expenses. As part of this healthcare reform, the healthcare delivery system is being modernised and integrated, and payment mechanisms are being changed to increase efficiency and improve quality [1].

An analysis of scientific approaches to healthcare reform in foreign countries has shown that most of them are aimed at improving the information, organisational and financial mechanisms of public administration. But mechanisms that are effective in one country may not always be so in other countries. This is due to differences in mentality, priority areas of state policy for the development of the healthcare system, etc.

Improving data quality, harmonising access to shared data, services for efficient data storage, integration with other sources of health data, and the use of EHR systems and data requires constant effort, significant funds, and takes away from other healthcare system priorities [7; 8; 9].

EHR systems are one of the important factors in the implementation of healthcare reform; Ukraine has developed and implemented an e-Health system consisting of two interconnected components: a central database controlled by the state and a private medical information system through which institutions will have access to the central database (Fig. 1).
Fig. 1. Organisation of an electronic healthcare system on the example of the e-Health system

The electronic healthcare system and website are operated by the National Health Service of Ukraine, which has information on the e-Health electronic healthcare system [6], a modern service for doctors, patients, and healthcare authorities that helps to effectively provide and receive specific medical services and facilitate the work of healthcare professionals, as it allows them to quickly create medical reports, prescriptions, referrals, and access patient records.

Another project developed by the Ukrainian Institute for the Future, Ukraine 2030E - a country with a developed digital economy (Ukraine 2030E - a country with a developed digital economy, 2020), provides for different levels of system functioning (Table 1).

Table 1. Levels of functioning of the National Health Service of Ukraine

<table>
<thead>
<tr>
<th>Levels</th>
<th>Functions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strategic technologies</td>
<td>Widespread introduction of digital jobs; open government data as a tool for evaluating and monitoring the work of the government and the state, etc.; digital government platforms; blockchain</td>
</tr>
<tr>
<td>Cloud strategies</td>
<td>Implementation of cloud computing technologies. The main advantage is that users of cloud technologies (government agencies, local governments) do not need to invest heavily in building their own, often redundant infrastructure, but rather pay only for its actual use, according to demand</td>
</tr>
<tr>
<td>E-government</td>
<td>Development and maintenance of central registers, cadastres, identifiers, directories, and other critical information elements of the architecture (on the blockchain) used in the process of providing services directly by providers</td>
</tr>
<tr>
<td>E-identification</td>
<td>Use of technical means for mass identification of citizens through the introduction of accessible, secure, and convenient means of alternative identification, in particular, BankID (identification through a bank) and MobileID (identification through a mobile operator)</td>
</tr>
<tr>
<td>Digitalisation of the social sector</td>
<td>Building a communication ecosystem of social services, agencies, NGOs, and service providers for joint coordinated actions to meet the needs of citizens.</td>
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T. V. Pluzhnikova and her co-authors argue that the creation of a unified information system has many advantages [5]. One of the main issues is the provision of reliable, relevant, constant, timely information to all healthcare institutions in Ukraine, as well as to patients as part of public health management processes to ensure the quality of medical care. The sociological method of systems analysis, a scientific method of knowledge that helps to establish structural relationships between system elements, allows us to study the social structure and its impact on health. The EHR medical system is a set of methodological techniques and management algorithms designed to collect, store, process and transmit information in healthcare facilities. A unified information system ensures that reliable information is provided in the right amount, in the right place, and at the right time for healthcare professionals.

If healthcare systems used standard specifications to represent data collected in EHRs, then applications for querying, reporting, and analysing clinical data could be reused within and between healthcare facilities. Currently, only a few types of data are coded using nationally recognised standards (e.g., diagnoses using International Classification of Diseases (ICD) codes, procedures using codes from current procedural terminology). The widespread and ongoing use of these code systems for clinical, epidemiological, and health research, despite their known limitations, demonstrates the value of standardised data. Standardisation of other types of data, such as symptoms, patient characteristics, goals, services, and outcomes, can facilitate research within and across health systems. Data standards can enable any clinician to implement a good idea (e.g., bilirubin chart, heart risk calculator, display of custom growth charts) to create an app and integrate it into any EHR system. Such standards-based innovations will offer providers and patients a choice in how they view and act on health data [8; 9]. Implementation of standardised data in EHRs will help reduce the cost and burden of research data collection, increase the ability to answer important clinical questions, and provide better patient care [10].

Despite the potential of EHRs to provide embedded research, their complexity, and variability can hinder the rapid configuration and implementation of research needed to address clinical and healthcare delivery issues as they arise. Differences in data and functionality from one EHR system to another mean that organisations cannot easily replicate a clinical or quality improvement study without costly and time-consuming code modification for setup (e.g., using alerts, preconfigured orders, or custom mappings) and query data for reporting and analysis [8].

There was no specific state strategy for the development of information technology systems in the healthcare sector, although local networks, telecommunications, and telemedicine projects in the healthcare sector were being developed. In 2012, the Concept of Informatisation of the Healthcare Sector of Ukraine for 2013-18 agreed on a number of priority areas for the development of
healthcare informatisation, including the introduction of computerisation standards, electronic medical records, healthcare management information systems, electronic prescription systems, telemedicine systems, and a national data analysis centre. Since 2015, a new investment has been planned under the World Bank's regional healthcare reform project to monitor the effective functioning of healthcare facilities at all levels, the health status and epidemiological health indicators of the population, and epidemiological surveillance indicators, as well as the coordination of healthcare management.

In March 2019, the government launched an electronic health record management system as part of a pilot project involving a small number of primary healthcare providers.

As of 1 January 2020, the use of the electronic healthcare system for medical data collection became mandatory for all primary healthcare providers, leading to a significant increase in the number of electronic health records.

In 2018, the government updated its drug reimbursement programme, known as “Affordable Medicines”, to include e-prescriptions. As of September 2020, more than 2.3 million Ukrainians regularly used the programme, and 17.8 million e-prescriptions were reimbursed. Digital technologies have also played a crucial role in providing healthcare to hard-to-reach communities in Ukraine.

Today, every hospital in the country, both in urban and rural areas, has access to and works with EHR systems. This is why this system is currently one of the most powerful and highly loaded in the country. EHR requires continuous improvement and development to provide better medical services to patients.

Right now, the patient chooses a doctor, draws up a declaration, and the doctor receives money. This is how the principle “money follows the patient” is implemented. More than 30 million Ukrainians have chosen their doctor in 1642 primary healthcare facilities, of which 33% are private facilities and private practitioners.

In addition, as of 1 April 2020, referrals to specialised care facilities are also electronic. The patient chooses the specialised healthcare facility where he or she wants to receive services under the Medical Guarantee Programme, regardless of his or her place of residence or registration or the district or city where the doctor who issued the referral works.

The patient can go to a municipal institution or a private clinic or a doctor who has his/her own practice if they have concluded contracts with the NHSU to provide the relevant services. And the NHSU will transfer funds to the institution where the patient has sought help.

The system also stores each patient's medical history, which makes it personalised, allowing the patient to avoid visiting the registry and the doctor to avoid wasting time searching for the necessary information in thick medical records. In addition, everyone has experienced a situation where a paper medical record was lost, and with it all the necessary information about vaccinations, chronic diseases, hospitalisations, etc.
In order for doctors to be able to provide proper treatment and prevent potential problems, medical history must be preserved - completely and throughout life. This is exactly what electronic medical records and electronic health records provide.

In addition, electronic patient data enhances the patient's privacy. Unlike paper medical records, which can be accessed by any healthcare professional or even unauthorised persons, electronic patient data can only be accessed by clearly defined doctors.

The family doctor will see all the information about the patient, and the attending physician will see the information necessary to prescribe treatment.

EHR systems provide each patient with access to all data related to them. You might wonder why a patient would want this - openness, transparency of payments, contracted facilities, and so on. But now the patient can see which doctor they can sign a declaration with (out of those who have not yet reached the limit of the number of patients), and in which facility they can receive a service based on their electronic referral. The patient does not need to be tied to the place of registration or pay “charitable contributions” to the institution. The only condition is a valid contract with the NHSU. Therefore, manipulations about the alleged lack of funding can now be avoided and quality services can be demanded under the Medical Guarantee Programme.

The patient also sees how much money has been transferred to any institution that has a contract with the NHSU, to any pharmacy that dispenses medicines under the reimbursement programme.

From 1 April 2019, the prescription for “Affordable Medicines” became exclusively electronic. Thanks to electronic prescription, it is much easier for patients to receive medicines - they do not need to collect three or four stamps for a paper prescription, worry whether the local authorities have enough money for medicines in their district, village, or city. Now, when a patient runs out of medication, they can contact a doctor by phone. The doctor will write an electronic prescription under the reimbursement programme even without a personal appointment. Moreover, the patient does not have to go to the pharmacy himself. The e-prescription number can be easily forwarded or communicated to an authorised person, and they will receive the medicine instead. This is very convenient during the pandemic when Ukrainians belonging to risk groups need to take special care of their own protection against the virus.

According to Richesson RL, a pragmatic clinical trial has resulted in the following recommendations for an electronic healthcare system [10]:

- integrate patient-centred data collection into EHR systems;
- facilitate the collection of structured research data by using standard EHR functions;
- use interfaces and standard workflows;
- support the creation of high-quality research data through adherence to standards;
- provide appropriate IT staff to support embedded research;
- create aggregated resources such as multiple data for multi-site trials;
- create reusable automated queries.

To improve patient care and eHealth data management in Ukraine, many components need to be improved: infrastructure so that hospitals and community and social service providers can work together and patients do not have to repeat their medical history or care needs; systems need to interact with each other securely and reliably, using open data and interoperability standards, and be open to patients about how their information is used to improve An eHealth programme enables people to access, manage and share information about their health and the health of others as authorised by them electronically, securely, privately and confidentially.

Despite the obvious benefits to patients, the innovation has raised concerns among healthcare professionals, including the potential for clinical data disclosure and patient safety breaches as they increasingly access medical information online.

In addition, there are the challenges faced by users: primarily in terms of collaboration and communication, which require data storage and accessibility, as well as limitations on the types of information that EHR systems can provide. It needs to be familiar and user-friendly. The second issue relates to privacy, security, and reliability, including the confidentiality and integrity of the data repository and data owners, access to management protocols, and data transport protocols. The third issue relates to the infrastructure of EHR systems, such as the portability of devices and associated equipment. EHR solutions require efficient computer systems and a scalable infrastructure to support them. Fourth, there are integration concerns, such as health information collection templates and terminology used to collect and store personal health information, and interoperability is also critical. To overcome these challenges and barriers, it is necessary to link technology to human behavioural issues to better understand the end-user acceptance of personal health records, which will ultimately help to increase adoption rates.

Technology should be used to ensure that healthcare workers are effectively supported in their work.

Digital services need to be patient-centred: understanding who the users of the system, website, or service are, what they need to do, what problems or frustrations they experience, and what they need from the system, website, or service to achieve their goals. Healthcare facilities need to be equipped with state-of-the-art technology and healthcare innovation so that advanced technologies can be more easily developed and used in the health and social care system. The right skills and capabilities need to be developed to support staff and enable leaders to achieve the best results, as the right skills are not only digital competence but also the leadership and change management skills needed to iterate and improve processes. Supporting
people is also important: providing eHealth services that ensure electronic access for all, including electronic information services, access to electronic records, online support and care services, appointment booking, and remote services.

**Conclusions.** Ukraine has developed and implemented electronic healthcare systems, which initially covered primary healthcare - family doctors, general practitioners, and paediatricians. The systems enable citizens to quickly obtain personal medical information and doctors to make correct and timely diagnoses based on a holistic picture of a patient's health. The electronic healthcare system is a system of information relations of medical personnel based on the cost-effective and secure use of information and communication technologies aimed at supporting the healthcare system, including medical services, preventive healthcare, medical literature, and education. Therefore, to ensure the smooth operation of the electronic system, all of the above components constantly need to be improved in line with modern requirements and technologies.

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