REVIEW ARTICLE

CONTENTS

Integrating artificial intelligence in healthcare practice: challenges and future prospects

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ABSTRACT

Aim: To highlight the features of artificial intelligence application in healthcare, with an emphasis on specific AI solutions and the assessment of risks associated with such integration in ethical and regulatory dimensions.

Materials and Methods: To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, methodological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – to compare and generalize the experience of using artificial intelligence in healthcare, empirical methods – conversations and interviews with participants in the educational process, modeling – to implement a scheme for providing medical care using AI.

Conclusions: Generative artificial intelligence is rapidly developing and is already being used in healthcare. The resources discussed that utilizing artificial intelligence can be used by practicing doctors, patients, as well as higher education students and academic staff in the educational process for examining various clinical cases, better understanding the material, and accessing visualization databases. Therefore, the need to integrate AI technologies into the training process of healthcare professionals at higher medical educational institutions is evident. An important part of the research is addressing the key challenges that arise when applying AI in medicine: ethical and regulatory issues, as well as the difficulties in integrating with existing medical information systems. Further research should be aimed at developing clear recommendations for medical institutions and educational establishments regarding the implementation and use of AI technologies.

KEY WORDS: artificial intelligence, healthcare, medicine, diagnostics, machine learning, digital health, medical education, regulation, ethics

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INTRODUCTION

Currently, artificial intelligence (AI) is quite widespread and adapted to all areas of human activity: medicine (diagnostics, drug development, personalized medicine), finance (credit risk assessment, automated trading operations, fraud prevention), transport (autopilot for cars, logistics optimization), marketing (consumer behavior analysis, advertising), education (adaptive learning, virtual assistants, text generation, information search), manufacturing (process automation, equipment maintenance forecasting), agriculture (crop condition monitoring, yield prediction), cybersecurity (threat detection, network protection, data analysis), law (legal document analysis, automated contract drafting, court case outcome prediction), energy (optimization of energy consumption, power grid management, energy demand forecasting).

The application of AI systems in any field, including healthcare, is associated with certain limitations and challenges [1]. These include data availability and quality, data bias, AI malfunctions, privacy issues, and the lack of clear transparency mechanisms: since the algorithms on which the system bases its decisions are usually inaccessible to end users, this may complicate trust in the technology, verification of its accuracy, and elimination of potential biases. It is important to note that these are only some of the possible issues and risks associated with artificial intelligence. The development and use of AI require a responsible approach and consideration of ethical aspects.

The integration of AI into biomedical research has been a key trend over the past decade. However, most existing AI models operate within a narrow range of tasks, such as analyzing a single data source (e.g., CT images or DNA analysis). Meanwhile, in clinical practice, doctors consider data from multiple sources simultaneously: medical imaging, electronic medical records, genetic data, wearable device data, and information on social determinants of health. The use of multi-format AI can improve the integration of these

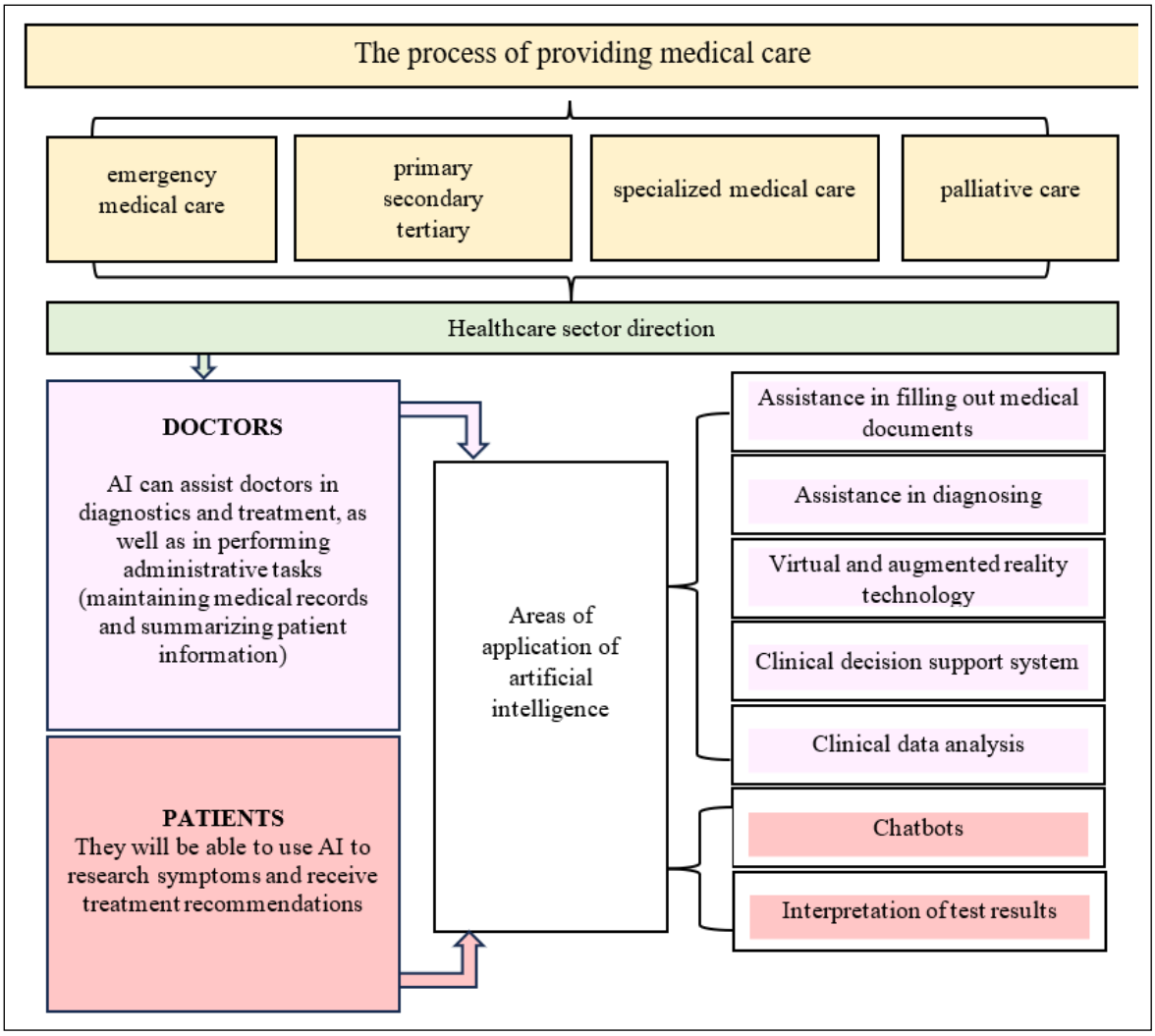

Fig. 1. AI usage diagram: doctor-patient

data, ensuring more accurate diagnostics, prognosis, and treatment.

Artificial intelligence in medicine refers to the use of machine learning models to analyze medical data and extract information that can help improve health conditions and patient experience. Thanks to recent advances in computer science and informatics, artificial intelligence is rapidly becoming an integral part of modern healthcare. AI algorithms and other AI-based applications are used to support medical professionals in clinical settings and ongoing research [2].

AIM

The aim of the article is to highlight the features of artificial intelligence application in healthcare, with an emphasis on specific AI solutions and the assessment of risks associated with such integration in ethical and regulatory dimensions.

MATERIALS AND METHODS

To achieve the research objective, general scientific theoretical and empirical methods were used, including: bibliosemantic method – analysis of scientific, methodological, psychological, pedagogical literature, and regulatory documents on the research problem, system analysis method – to compare and generalize the experience of using artificial intelligence in healthcare, empirical methods – conversations and interviews with participants in the educational process, modeling – to implement a scheme for providing medical care using AI.

REVIEW AND DISCUSSION

For the medical field, a significant number of AI-based integrated systems are currently available. They can be classified by type (text-based, assistants, clinical decision support systems, etc.) or based on the user and area of application (healthcare professionals and administrative staff, patients, etc.) (Fig. 1).

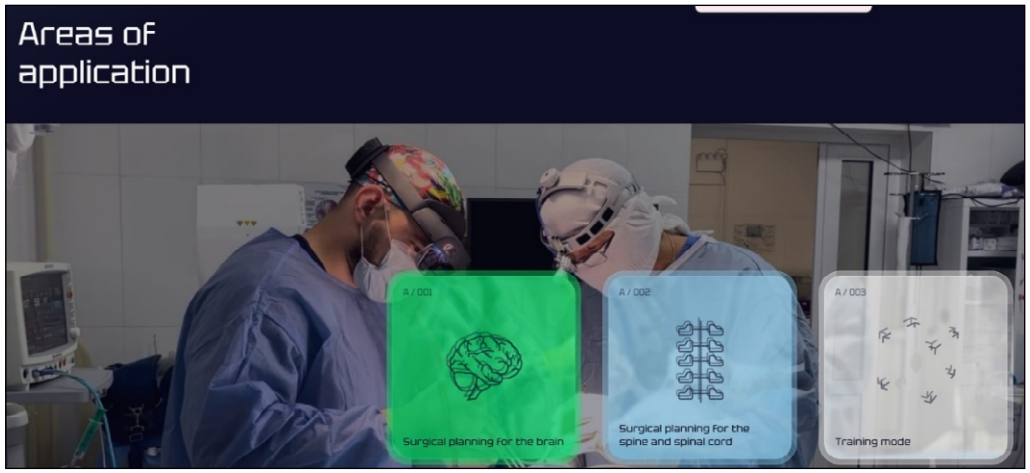

Fig. 2. The page of the Extra Vision platform

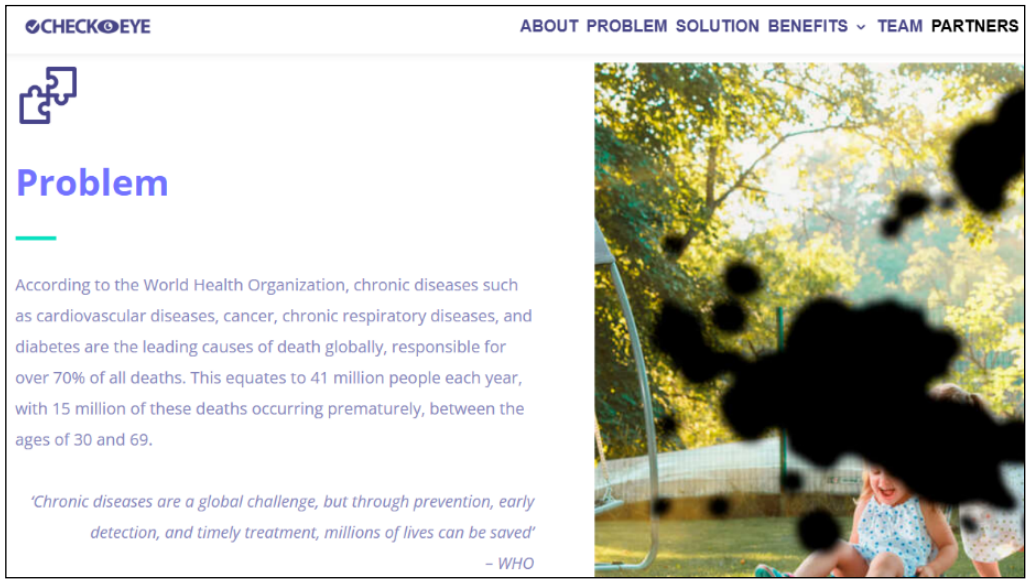

Fig. 3. CheckEye platform page

Let's consider the application of some AI-based tools for doctors in practical and scientific activities:

- **Insillico Medicine** [3] – An AI platform used to analyze large volumes of molecular data to identify potential candidates for new drugs.
- **Verily** [4] a company owned by Alphabet (the parent company of Google), uses AI to develop new vaccines and optimize their production. It relies on clinical, sensory, imaging, and omics data to scale research and implement new decision-making models for treatment.
- **Clinithink** [5] The cutting-edge AI technology from Clinithink provides fast analytics based on unstructured healthcare data, allowing pharmaceutical organizations and healthcare institutions to more effectively focus their time, money, and resources, leading to better and more accessible healthcare
- **Viz.ai** [6] A comprehensive AI-based solution aimed at improving neurovascular outcomes. It uses AI to accelerate medical care coordination, reducing system delays between patients and life-saving treatments. This innovative use of technology transforms clinical workflows and patient care. The platform includes real-time notification systems that alert healthcare professionals to possible stroke cases, providing critical information as early as possible. Viz.ai offers a secure collaboration platform where doctors and other medical professionals can remotely exchange diagnostic images, simplifying access to specialists' conclusions and helping reduce treatment delays. Additionally, the platform provides links to images, publications, and webinars from top doctors in the US and EU, access to a medical image database, and the possibility to request a demo version.
- **UpToDate** [7] – A clinical decision support resource developed by doctors, based on factual data, that helps healthcare professionals provide the best possible care for patients. The platform offers access to over 12,000 topics covering various medical specialties and contains over 35 million pages of content. It features interactive graphics and videos for better visualization of complex procedures or

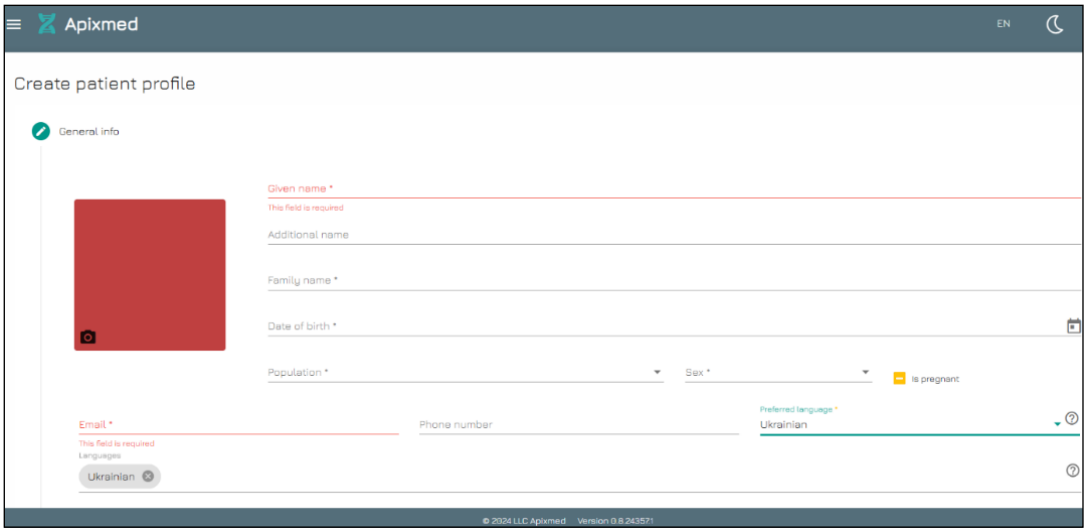

Fig. 4. User Registration Page on the Apixmed Platform

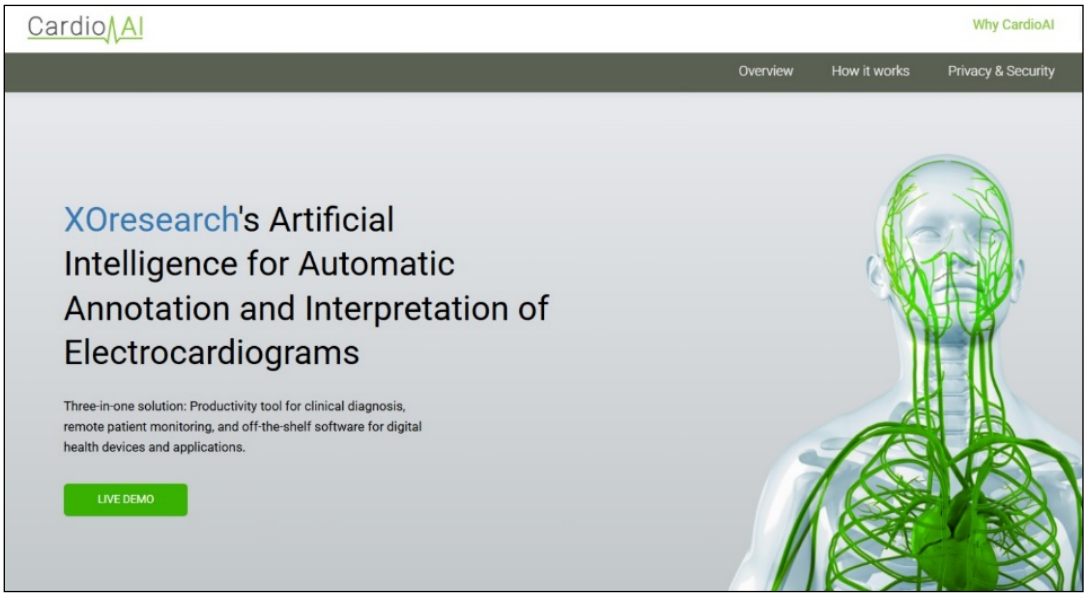

Fig. 5. The page of the CardioAI® service with a demo version option

diseases. This feature helps users quickly grasp concepts by breaking down complex information into understandable visual guides. The UpToDate mobile app allows users to access the database anytime, anywhere, on their smartphones or tablets, even without an internet connection. The Ministry of Health of Ukraine's Public Health Center website provides instructions for free access to the resource [8], offering the following benefits:

– remote access from any computer connected to the internet;
– earning Continuing Medical Education (CME/CE/CPD) credits after completing clinical tasks on the UpToDate site or remotely, including on mobile devices;
– quick access to useful information with the ability to save browsing history, most visited sections, and bookmarks;
– automatic synchronization of your browsing history, most visited sections, and bookmarks across all devices with access to UpToDate, from computer to mobile phone;
– notifications about new materials on topics previously searched, whenever information is updated according to new data published in medical literature;
– electronic "Current UpDate" news every two weeks with important clinical information updates.

The Ukrainian platform Extra Vision [9] is an innovative resource that uses holographic 3D visualization for objects. The process of creating a 3D model involves several stages: the first stage is the analysis of CT/MRI data; the second stage involves processing the images using cloud technologies and artificial intelligence; based on the processed data, a 3D model is formed, which is then integrated with virtual reality technology through VR glasses (Fig.2).

- **CheckEye** [10] – Ukrainian AI-based platform for mass screening of chronic diseases, making preven-

tive medicine accessible to everyone. The company CheckEye (Fig. 3) developed a cloud solution for detecting diabetic retinopathy using photographic images of the fundus through an ML/AI algorithm. CheckEye enhances early detection capabilities for chronic diseases in collaboration with the Ukrainian Academy of Family Medicine (АСМУ). The joint project began at four medical universities in Ukraine in Kyiv (O.O. Bogomolets National Medical University), as well as in Dnipro, Odesa, and Kharkiv. Additionally, screening technologies will be implemented as part of the professional community activities of АСМУ, and soon, in one of the communities in Mykolaiv region [11].

- Ukrainian startup Apixmed [12] is a service that analyzes medical and genetic information of a patient to develop an optimal treatment plan for complex diseases (Fig. 4). The result is a personalized report that not only helps select the best therapy but also contains important warnings and recommendations for the most effective and individualized treatment.
- **CardioAI** [13] simplifies and accelerates the interpretation of electrocardiograms (ECG) (Fig. 5). This solution comprehensively integrates various equipment, including ECG machines, Holters, event monitors from different manufacturers, electronic health records (EHR), and ECG analysis software. It allows monitoring the entire process, from receiving the ECG and printing the report to routine medical examinations and outpatient heart monitoring during rehabilitation. The technology enables doctors to remotely monitor high-risk patients, regardless of their location.

Let's consider the application of some AI-based tools for patients:

- **Helsi+** uses AI to expand the capabilities of the Helsi app, offering users new features and an enhanced experience:
  - **Analysis Decoding** (Helsi+ uses AI to analyze laboratory test results, such as blood and urine tests. The service helps patients understand their results, providing information about potential health risks and recommendations for further action.)
  - **Personalized Recommendations** (Based on the analysis of medical data and other factors such as age, gender, and medical history, Helsi+ can provide personalized recommendations for a healthy lifestyle, nutrition, physical activity, etc.)
- **911HELP** [14] is an app designed for quick access to emergency services for people with hearing, vision, and mobility impairments. Key functions include transmitting sound, location, and medical information.
- **Medico AI Assistant** [15] – an innovative tool designed to provide medical information, support medical education, and offer advice on a healthy lifestyle. It does not replace professional medical consultations but serves as an additional resource for users who want to better understand their health status. Key functions of Medico AI Assistant:
  - **Providing Medical Information**: The Medico AI Assistant offers comprehensive information on various diseases, their symptoms, and treatment methods. For example, it can explain the pathophysiology of diabetes, its symptoms, and treatment strategies.
  - **Health and Lifestyle Tips**: The Assistant provides practical advice on healthy eating, physical activity, and other aspects of a healthy lifestyle. For example, it can offer dietary recommendations for managing hypertension.
- **Twill by Dario/twill.health** [16] is a platform created to support mental health and assist pregnant women. This paid U.S.-based service is available in 10 languages and offers a demo version. The platform provides access to a vast library of real clinical cases covering various medical specialties such as cardiology, neurology, gastroenterology, etc. The Twill.health platform uses 139 machine learning algorithms to analyze your performance in testing and case studies, then offers personalized learning paths tailored to your level and needs. It also allows medical students from all over the world to collaborate on case studies and discuss complex topics with one another. The platform features various webinars from renowned doctors sharing their knowledge on the results of advanced research.

The Ministry of Digital Transformation of Ukraine is actively working on regulating the use of artificial intelligence (AI). As part of this work, the "Roadmap" [17] and "White Paper" [18] are being developed and implemented to enhance the competitiveness of businesses and integration into global markets, according to EU standards. The main priority is ensuring the safety of citizens in the digital environment. According to current initiatives, businesses are expected to receive the necessary tools to adapt to new technologies, and subsequently, legislation will be developed to ensure effective AI regulation, considering safety requirements and ethical standards. The "White Paper" [18] states that, according to a survey conducted in April 2023 by Kantar Panel Ukraine (online survey, men and women aged 18-55, cities with a population over 50,000 excluding temporarily occupied territories and combat zones, n = 1000), 35% of respondents noticed the use of AI in healthcare.

The article "Conversational Medical AI: Ready for Practice" [19] explores the implementation of the AI assistant

(Mo) in medical consultations via chat. In a study involving 926 patients, AI improved the clarity of responses and overall user satisfaction while maintaining trust and empathy at the level of healthcare providers. Under medical supervision, 95% of the consultations were rated as safe. The research confirms the possibility of successfully integrating AI into medical practice.

In the paper "Transforming Healthcare: Navigating Digital Health with a Value-Driven Approach" [20], it is noted that digital technologies, especially artificial intelligence (AI), are actively transforming the modern healthcare system. Predictive AI, cloud computing, and the Internet of Things (IoT) are already being used in various medical systems, and telemedicine has become a routine practice. Generative AI holds the potential for further changes in the delivery of medical services. Large technology companies such as Microsoft are actively exploring the application of AI, such as integrating ChatGPT into healthcare applications. Thanks to AI and other digital innovations, healthcare is becoming more accessible, efficient, and personalized, contributing to the shift towards a hybrid model of medical service delivery.

In papers [21, 22], the authors analyze the current state of AI use in the educational process at the O.O. Bohomolets National Medical University and propose AI-based learning platforms that can be used to train future doctors. In paper [23], the existing types of artificial intelligence as a digital technology are examined for their further use in the educational process to form the digital competence of future healthcare professionals.

Despite the great prospects, the use of AI in medicine and pharmacy is associated with a number of challenges: ethical issues such as the use of patients' personal data, the potential for discrimination, and other ethical concerns need to be carefully considered; regulatory requirements: the development and implementation of new technologies must comply with current legislation; integration into existing systems: integrating AI systems into existing medical information systems can be complex and costly. Despite these challenges, the future of AI in medicine and pharmacy looks promising. Over time, AI will become an integral part of medical practice, helping to save more lives and improve the quality of life for millions of people.

CONCLUSIONS

Generative artificial intelligence is rapidly developing and is already being used in healthcare. The World Health Organization has developed recommendations for governments, technology companies, and healthcare professionals to ensure the safe and effective use of large multimodal AI models to improve public health.

The resources discussed that utilizing artificial intelligence can be used by practicing doctors, patients, as well as higher education students and academic staff in the educational process for examining various clinical cases, better understanding the material, and accessing visualization databases. Therefore, the need to integrate AI technologies into the training process of healthcare professionals at higher medical educational institutions is evident.

The results obtained allow for predicting the further integration of AI technologies into medical practice as a means to improve the quality of education and establish new standards in healthcare services.

An important part of the research is addressing the key challenges that arise when applying AI in medicine: ethical and regulatory issues, as well as the difficulties in integrating with existing medical information systems.

Further research should be aimed at developing clear recommendations for medical institutions and educational establishments regarding the implementation and use of AI technologies.

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CONFLICT OF INTEREST
The Authors declare no conflict of interest

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