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ПРИМЕНЕНИЕ ТЕХНОЛОГИЙ ИСКУССТВЕННОГО ИНТЕЛЛЕКТА В МЕДИЦИНЕ: ВОЗМОЖНОСТИ, ПРОБЛЕМЫ И ПЕРСПЕКТИВЫ

Аннотация. *В статье анализируются роль искусственного интеллекта (ИИ) в современной медицине, основные направления его применения, практические преимущества и ограничения. Проведён нарративный аналитический обзор документов ВОЗ, рецензируемой литературы и регуляторной информации FDA; рассматриваются машинное обучение, глубокое обучение, обработка естественного языка и генеративный ИИ. Особое внимание уделено конфиденциальности данных, алгоритмической предвзятости, кибербезопасности, подотчётности, прозрачности и человеческому контролю. Имеющиеся данные показывают, что ИИ может улучшать отдельные аспекты клинического процесса, прежде всего в медицинской визуализации, однако результаты различаются в зависимости от задач и реальных условий. Главный вывод: ИИ следует внедрять как технологию поддержки врача, а не как автономную замену медицинским работникам, при условии клинической валидации, этического регулирования и ИИ-грамотности специалистов.*

Ключевые слова: *искусственный интеллект, медицина, машинное обучение, глубокое обучение, медицинские изображения, поддержка клинических решений, генеративный ИИ.*

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THE USE OF ARTIFICIAL INTELLIGENCE TECHNOLOGIES IN MEDICINE: OPPORTUNITIES, CHALLENGES AND FUTURE PROSPECTS

Abstract. *The article analyzes the role of artificial intelligence (AI) in modern medicine, its major application areas, practical benefits, and key limitations. A narrative analytical review of WHO guidance, peer-reviewed literature, and FDA regulatory information was conducted, covering machine learning, deep learning, natural language processing, and generative AI. Particular attention is paid to privacy, algorithmic bias, cybersecurity, accountability, transparency, and human oversight. Current evidence indicates that AI can improve aspects of clinical workflow, especially in medical imaging, but results vary across tasks and real-world settings. The main conclusion is that AI should be implemented as a clinician-support technology rather than as an autonomous replacement for healthcare professionals, supported by clinical validation, ethical governance, and AI literacy among healthcare workers.*

Keywords: *artificial intelligence, medicine, machine learning, deep learning, medical imaging, clinical decision support, generative AI.*

Introduction

Digital transformation is changing how medical information is collected, interpreted, and used. Electronic health records, laboratory systems, medical imaging, genomic data, wearable sensors, and telemedicine platforms produce large and heterogeneous datasets. Because clinicians cannot manually evaluate every relevant variable within routine time constraints, computational methods that identify patterns, classify cases, estimate risk, and support decisions are increasingly important.

The World Health Organization (WHO) recognizes considerable potential for AI in health, scientific research, public health, and pharmaceutical development, while emphasizing safety, transparency, equity, accountability, and respect for human rights [1, 2]. AI in medicine is not a single technology; it includes machine learning, deep neural networks, computer vision, natural language processing, recommender systems, and generative models [3]. Their roles range from narrow tools that detect findings in images to systems that summarize clinical documentation or assist medical education.

Materials and Methods

A narrative analytical review was conducted using WHO guidance and reports, peer-reviewed literature on healthcare AI, and official regulatory information from the U.S. Food and Drug Administration (FDA) [4, 5]. Comparative analysis, content analysis, synthesis, and thematic classification were used. Particular attention was given to real-world clinical implementation because high performance under experimental conditions does not necessarily guarantee clinical effectiveness after deployment [6].

Results and Discussion

AI in Medical Diagnosis

Diagnosis is one of the most developed applications of AI. Machine learning can process clinical variables, laboratory findings, physiological signals, and medical images to classify cases or estimate disease probability [7]. In clinical practice, AI may highlight suspicious findings, prioritize cases, or provide an additional quantitative assessment.

Medical imaging is especially important. CT, MRI, X-ray, ultrasound, and mammography can be analyzed using computer vision and deep learning [8]. A 2024 systematic review and meta-analysis identified 48 original studies of AI implementation in medical imaging; many reported reduced task time, although substantial heterogeneity prevented simple conclusions about overall effectiveness [9]. This indicates both the promise and the importance of real-world evaluation.

Clinical Decision Support

AI-based clinical decision support can combine age, symptoms, vital signs, laboratory findings, previous diagnoses, and medication history to estimate risk or rank possible explanations. Its main value is to help clinicians process many variables quickly. However, AI should augment rather than replace professional judgment [10]. Clinicians must integrate AI output with examination findings, medical history, patient preferences, and contextual information.

Personalized Medicine

Personalized medicine seeks to adapt prevention and treatment to individual patient characteristics. AI can integrate clinical, imaging, laboratory, and genomic data to identify patient subgroups, predict disease progression, and estimate treatment response. These applications are promising in oncology, cardiology, neurology, and rare diseases. Their reliability depends on

representative data, external validation, and subgroup performance assessment [11].

Telemedicine and Remote Monitoring

AI can support telemedicine by organizing patient information, analyzing symptoms, detecting risk patterns, and interpreting data from remote-monitoring devices. Applications may include heart rate, blood pressure, glucose, and sleep monitoring. Such tools may improve access where specialists are limited, but systems need clear escalation pathways, secure data transmission, and professional review of clinically important findings.

Generative AI in Medicine

Generative AI can produce text, images, or multimodal outputs and may assist clinical documentation, literature synthesis, patient education, medical training, and research. WHO's guidance on large multi-modal models notes their potential in healthcare while stressing governance and risk management [12]. Generative systems may produce plausible but incorrect content; therefore, high-stakes clinical use requires human verification and should not be treated as autonomous decision-making.

Conclusion

Artificial intelligence is becoming an important component of modern healthcare. Its strongest contributions are related to large-scale information processing, pattern recognition, diagnostic support, patient monitoring, research, and drug development. Evidence from medical imaging suggests potential efficiency gains, but real-world effects remain dependent on workflow, system design, and evaluation quality [9].

The future impact of AI will depend not only on algorithmic performance but also on data quality, clinical validation, cybersecurity, ethical governance, and professional competence. AI should therefore be implemented according to a human-centered model in which technology augments professional judgment

rather than replacing it. The most appropriate principle is: AI + healthcare professional + clinical oversight.

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