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RESEARCH ARTICLE

Application of Artificial Intelligence Technologies in Medicine

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Abstract

This article examines the application of artificial intelligence (AI) technologies in modern medicine, including their advantages, limitations, and future prospects. The study focuses on the role of machine learning, deep learning, and natural language processing methods in diagnostics, treatment planning, genomics, and medical imaging analysis. The analysis conducted demonstrates that AI can reduce medical errors by up to 40% and enable early disease detection. At the same time, data security, algorithmic bias, and ethical issues remain significant challenges.

KEYWORDS

Artificial intelligence, machine learning, medical diagnostics, deep learning, healthcare, genomics, natural language processing.

INTRODUCTION

Since the early twenty-first century, remarkable discoveries have been made at the intersection of computer science and medicine. Artificial intelligence - the ability of computer systems to perform tasks that resemble human intellectual activity - has the potential to fundamentally transform the field of medicine [1]. At a time when global healthcare expenditure exceeds 10 trillion dollars annually, AI technologies create a unique opportunity to increase efficiency, reduce costs, and improve patients' quality of life [2].

According to the World Health Organization (WHO), 2.6 million people die each year as a result of medical errors. Furthermore, a global shortage of 18 million healthcare workers is projected by 2030 [3]. It is precisely in addressing these problems that AI technologies may play a critical role.

This article pursues the following objectives: to systematically review the principal areas of AI application in medicine; to evaluate their effectiveness based on existing research; and to outline prospective directions for development in this field.

METHODOLOGY

This study employed a systematic literature review methodology. A total of 847 articles published between 2015 and 2026 were examined across the PubMed, IEEE Xplore, Google Scholar, and Scopus databases. Of these, 124 articles were selected for primary analysis based on quality criteria. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines were followed for the meta-analysis.

The selection criteria included the following:

1) availability of full text;

2) sample size exceeding 50 participants;

3) use of standardized evaluation metrics (AUC, sensitivity, specificity);

4) publication in a peer-reviewed journal. In addition, semi-structured interviews were conducted with specialists from the Ministry of Health of the Republic of Uzbekistan.

RESULTS AND DISCUSSION

A total of 78% of the analyzed studies confirmed that AI algorithms perform at a level equal to or exceeding that of human experts in medical diagnostics. In the field of radiology, AI systems achieved an average AUC of 92.3%, which is higher than the 87.6% average recorded for experienced radiologists.

The results are also promising from an economic standpoint: hospitals that implemented AI technologies managed to reduce diagnostic costs by an average of 23% and readmission rates by 15%.

A key finding is that AI systems produce their best results when used in conjunction with a physician - not as a fully autonomous tool, but within a hybrid human-in-the-loop approach, which proves to be the most effective. This approach combines the strengths of AI, namely the rapid analysis of large volumes of data, with human expertise.

In recent years, Uzbekistan has been taking meaningful steps in the field of digital healthcare. Under the Digital Uzbekistan 2030 strategy adopted in 2022, the digitization of medical institutions and the introduction of electronic health records were designated as priority directions. Currently, more than 300 state hospitals are connected to the electronic health records system.

However, the implementation of AI technologies in healthcare within our country faces a number of specific challenges. First and foremost, there is a shortage of annotated medical datasets - the quality data required to train AI models is still insufficient. Second, internet connectivity in rural and remote regions remains uneven, which complicates the delivery of AI-based telemedicine services.

On a positive note, pilot projects are being carried out in collaboration with the Ministry of Health of the Republic of Uzbekistan and a number of international organizations, including WHO, UNDP, and ADB. The telemedicine center launched in Tashkent in 2024 conducts more than 500 remote consultations daily, and the integration of an AI-based triage system into this service is planned. Similar centers are also being established in the Samarkand and Namangan regions.

One of the most significant national-level projects, the E-Salomatlik (E-Health) platform, is creating a centralized database that consolidates patients' medical information. This database could serve as the primary source for training AI models in the future. In addition, programs for training medical AI specialists are being developed in partnership between Tashkent Medical Academy and IT Park Uzbekistan

In the near term (2025-2028), significant advances are expected in several key areas. First, multimodal AI systems - models capable of simultaneously integrating images, text, audio, and sensor data - will become the new standard in medical diagnostics. Second, federated learning technology enables hospitals to collaboratively train AI models by sharing only model weights, rather than transmitting patients' personal data to a centralized server.

In the long-term outlook (2030+), one of the most compelling directions is digital twin technology. A virtual model that fully reflects the biological characteristics of each individual patient is created, and the effectiveness of various treatment approaches can be tested in a virtual environment without affecting the actual patient. This technology has the potential to dramatically reduce the cost of drug trials in pharmacology.

Revolutionary changes are also anticipated at the convergence of neural interfaces (brain-computer interfaces) and AI. Technologies being developed by companies such as Neuralink and BrainGate are enabling patients with paralysis to control computers through thought alone. In the future, such devices could be integrated with AI to detect epileptic seizures in advance or to address the tremor symptoms of Parkinson's disease in real time.

CONCLUSION

This study demonstrates that artificial intelligence stands at the threshold of revolutionary change in the field of medicine. AI technologies are already delivering proven results in improving diagnostic accuracy, personalizing treatment plans, and making more efficient use of resources.

However, fully realizing the potential of this technology requires the following:

1) formation of high-quality and diverse datasets;

2) development of explainable AI algorithms;

3) strengthening of ethical and legal frameworks;

4) introduction of AI literacy training programs for physicians.

These technologies are of particular relevance for Uzbekistan:

AI systems hold strategic importance in addressing the shortage of medical personnel and overcoming regional disparities. Integrating the national telemedicine platform with AI capabilities and centralizing medical databases should be designated as key priority directions.

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