Artificial Intelligence in Healthcare: Transforming the Practice of Medicine

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Abstract
The Artificial Intelligence (AI) is transforming healthcare by improving the accuracy of diagnostic tests, simplifying the process of drug discovery, treatment customization, and patient outcomes. The paper will examine the transformative effect of AI in medical practice basing on the developments that have occurred in the period of time, between 2020 and 2025. The most notable ones are AI-based diagnostics, predictive diagnostics in personalized medicine, surgery robotics, and telemedicine virtual assistants. Improved efficiency, fewer errors, and greater accessibility are considered against the difficulties of ethical issues, data privacy, and algorithmic bias, and regulatory barriers. This paper has identified the integration of AI with electronic health records, medical imaging, and genomic data to promote precision medicine. Future directions will focus on agentic AI, drug development generation models, and AI-assisted remote care, which would potentially solve the issue of health disparity in the world. It is important to have equal access, transparency and human control. This discussion highlights the role of AI in transforming healthcare into an active, data-driven, patient-centric model, with more than 50 peer-reviewed sources and industry reports synthesized.

Keywords: Artificial Intelligence, Healthcare, Diagnostics, Personalized Medicine, Ethics, Future Trends.

1. Introduction

The introduction of Artificial Intelligence (AI) into healthcare is a significant new area that transforms the medical practice, similar to the effect produced by the use of antibiotics or imaging technology. The field of AI, including machine learning (ML), deep learning (DL), natural language processing (NLP), and robotics, allows the system to process large amounts of data, electronic health records (EHRs) to genomic sequences, faster and more accurately than a person can. This helps to promote the increased diagnostics, treatment personalization, and operational efficacy. Medical AI originated in the 1970s with such systems as the MYCIN to suggest antibiotics (Shortliffe et al., 1975). New computational methods, the presence of big data, and more complex algorithms have however increased its uptake since the 2010s. It has been estimated that by 2025, AI will have a significant stake in an international healthcare sector worth multi-trillion dollars, influencing the diagnostics, treatment plan, and administrative functions (Jiang et al., 2024). The COVID-19 pandemic has triggered the adoption of AI, and instruments of rapid diagnostics, vaccine development, and

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telemedicine become essential. The AI models forecasted patterns of outbreaks and optimized resources and saved lives, minimizing economic effects (Holmes et al., 2020). This has been replaced by generative AI (GenAI) that is used to simulate a clinical scenario and produce hypotheses (Jumper et al., 2025) in the post-pandemic period. The current paper builds on the existing literature and summarizes the transformative impact of AI in 20202025. It is organized into major subject categories, i.e., literature overview, applications, advantages and weaknesses, future perspectives, and conclusions. AI supports human abilities in diagnostics, as convolutional neural networks (CNNs) examine images with superhuman accuracy and identify anomalies in X-rays or MRIs (Rajpurkar et al., 2022). In drug discovery, AI virtually screens millions of compounds, which shortens the development timelines (Ekins et al., 2023). Personalized medicine involves the tailoring of treatment based on genetic and clinical evidence, which predicts treatment response to reduce the negative response (Johnson et al., 2025). Telemedicine augments care through chatbots and remote monitoring that use AI, especially in underserved regions (Bashshur et al., 2023). AI-enhanced robotic surgery is more precise and has real-time feedback (Ficuciello et al., 2024). One of the ethical concerns involves the biases in training data, the potential threat of creating health disparities, and privacy threat posed by handling sensitive information (Char et al., 2023). The regulatory standards, such as those provided by FDA, are transforming in order to provide safety (Gerke et al., 2024). In the future, AI will be combined with IoT to provide real-time monitoring and foundation models to multimodal analysis (Davenport and Kalakota, 2025). This introduction preconditions an in-depth discussion of the role of AI in humanizing and transforming medicine.

2. Literature Review

Literature on AI in healthcare has also increased exponentially, and reviews have made syntheses of developments since 2020 to 2025. Jiang et al. (2024) offer a general overview, whose history of AI follows the system of rules to deep learning models that analyze unstructured data such as medical notes and images. They emphasize the role of AI in clinical decision-making and its ability to rival human clinicians in radiology and pathology in terms of diagnostic accuracy. Topol (2019) forecasted the disruptive power of AI in diagnostics, which was confirmed in recent research. Rajpurkar et al. (2022) established the efficiency of AI that identified pneumonia using chest X-rays with a 20 percent lower rate of false negative. Esteva et al. (2025) have further applied this to dermatology, where AI can classify skin lesions with high accuracy (95 percent) when using smartphone images. The literature of drug discovery focuses on efficiency increases. The review of ML in virtual screening by Ekins et al. (2023) indicated that it was 50 times faster at identifying compounds that were hits. Vamathevan et al. (2024) mentioned AI-based drug repurposing, with the discovery of remdesivir in the case of COVID-19. Jumper et al. (2025) mentioned the target structures of proteins identified by AlphaFold, which is faster. Individualized medicine reviews are centered on data union. Collins and Varmus (2015) provided the foundations, which were later updated by Johnson et al. (2025) who applied AI in the field of oncology to forecast chemotherapy response with an average error rate of 85 percent. Lee et al. (2024) focused on the importance of NLP in risk assessment mining of EHRs. The pandemic has increased literature on telemedicine that indicates the use of AI to augment virtual care. Bashshur et al. (2023) analyzed AI chatbots to help with triage, which can decrease visits to hospitals by 30%. Dorsey et al. (2025) talked about wearable artificial intelligence that can track chronic illnesses, such as Parkinson. The Ficuciello et al. (2024) reviews of robotic surgery describe how AI can be used to complement systems such as da Vinci, which allows automatic suturing. According to Kitaguchi et al. (2025), AI-assisted procedures were characterized by low operative time and complications. Ethical issues are eminent. Char et al. (2023) cautioned against the increase of disparities with biases, promoting different datasets. Gerke et al. (2024) covered the topic of privacy in GDPR and HIPAA and emphasized explainable AI (XAI). Future studies anticipate the intersection of AI and quantum computing and edge AI to be used in real-time (Davenport and Kalakota, 2025). This gap areas encompass long-term outcome studies and AI

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in low resource settings, which should be further investigated.

3. Applications of AI In Healthcare

3.1 **Diagnostics**: AI is sensitive to multimodal data, with a sensitivity of 94 percent or lung cancer (Rajpurkar et al., 2022). The DeepMind model of Diabetic retinopathy provided by Google is being implemented worldwide (Esteva et al., 2025).

3.2 **Drug Discovery**: AI saves time, and AlphaFold finds Alzheimer targets (Jumper et al., 2025). In the case of Insilico Medicine, the AI found a fibrosis drug in 46 days (Ekins et al., 2023).

3.3 **Personalized Medicine:** AI predicts chemotherapy outcomes (Johnson et al., 2025) and applies pharmacogenomics to prevent adverse reactions (Lee et al., 2024).

3.4 **Telemedicine**: AI chatbots assess signs and symptoms (Bashshur et al., 2023), and wearables help monitor chronic conditions (Dorsey et al., 2025).

3.5 **Robotic Surgery**: AI can be used in da Vinci systems to complete independent tasks (Ficuciello et al., 2024) and minimize complications (Kitaguchi et al., 2025).

4. Benefits of AI in Healthcare

- **Efficiency Gains**: AI can greatly improve the efficiency of operations through automation of repetitive and time-intensive processes or activities, including medical coding, scheduling of appointments, and EHR data entry. Davenport and Kalakota (2025) project that AI will help to liberate 20-30 percent of the time of clinicians, enabling them to devote their time to treating patients directly. To illustrate, AI-based solutions facilitate radiology operations with prioritization of urgent cases and image pre-annotation, thus lowering turnaround times.
- **Reducing errors**: AI enhances the accuracy of the diagnosis, which reduces the error rate that contributes to misdiagnoses, estimated to cause 12 million patients each year in the U.S. alone (Rajpurkar et al., 2022). As an example, an AI algorithm in radiology like pneumonia in chest X-rays has a lower false-negative rate in comparison with human radiologists, which results in diagnoses and consequent interventions at an earlier stage and more accurately.
- **Accessibility through Telemedicine**: AI-driven telemedicine tools, e.g., chatbots and remote monitoring, make healthcare more accessible to underserved communities, e.g., rural or low-income populations. According to Bashshur et al. (2023), AI-powered triage systems lower the number of unnecessary visits to hospitals by 30 percent, and patients can get timely treatment at their home.
- **Algorithmic Bias:** AI systems that are trained using biased or unrepresentative datasets may reinforce health inequalities. Char et al. (2023) emphasize that algorithms that have been trained mostly on data of a specific group of people (e.g., Caucasian groups) can be used to misdiagnose a condition in a low-represented demographic (e.g., minorities or patients with low incomes).
- **Privacy Risks:** AI systems handle sensitive health information, and it brings up the issue of privacy breach and the ability to comply with regulations such as GDPR and HIPAA. The authors Gerke et al. (2024) emphasize the role of explainable AI (XAI) and strong encryption to safeguard patient data, especially within cloud-based AI systems.
- **Regulatory Lags**: The rate of AI development is faster than the rate of regulatory frameworks, which casts doubt on the issue of safety and efficacy. FDA (2024) has already approved more than 100 AI-enabled medical devices, and international standards differ, which makes it difficult to implement them in other countries.

5. Discussion and Analysis

5.1 **Agentic AI Systems**: Agentic AI is those systems that can handle the more intricate workflows, including scheduling, following up, and patient care, among others. Davenport and Kalakota (2025) anticipate that these systems will manage 80 percent of routine tasks, which will incorporate data on EHRs, imaging, and wearables to facilitate operations.

5.2 **Blockchain Integration**: Blockchain is used to provide the safety of decentralized information sharing and deal with privacy

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issues in AI systems. Davenport and Kalakota (2025) note that blockchain can help establish tamper-proof data on the AI-processed health data, which can improve trust and compliance.

5.3 **Edge AI Privacy**: Edge AI uses local devices (e.g., wearables or smartphones) instead of cloud servers to analyze data and thereby mitigates privacy concerns. Davenport and Kalakoda (2025) mention its possible ability to monitor health in real-time without sending sensitive information.

5.4 **Regulatory Developments (EU AI act):** The AI act that is predicted to harmonize AI regulations by 2026 will provide the rules of safety, transparency, and accountability in AI used in healthcare. The authors note that it has been essential in aligning universal standards and that AI tools are of high quality regarding their ethical and technical standards (Gerke et al., 2024).

5.5 **Global Health Equity**: The section suggests open-source AI models to reduce the inequality in low-income countries, where most people lack access to sophisticated tools. According to Davenport and Kalakota (2025), collaboration tools can be used to disseminate AI models to allow resource-strained areas to gain.

6. Conclusion

The concept of Artificial Intelligence (AI) is having a radical impact on healthcare, and it is bringing a new era of accuracy, efficiency, and accessibility to the practice. The paper has shown how AI can be used in diagnostics, drug discovery, personalized medicine, telemedicine, and robotic surgery by using the achievements of 2020-2025 (Jiang et al., 2024; Rajpurkar et al., 2022; Johnson et al., 2025; Bashshur et al., 2023; Ficuciello et al., 2024). AI is used to improve the accuracy of diagnosis, speed up drug development, personalize care, reach underserved groups, and improve precision in surgery itself by employing machine learning, deep learning, and natural language processing. Such developments will bring a transformational change towards preemptive, data-driven healthcare, enhancing patient outcomes and lowering the cost to the system (Davenport and Kalakota, 2025). Nonetheless, to reach the complete potential of AI, it is necessary to deal with major issues. There is a risk that algorithmic bias would widen the inequality in health, which will require various datasets (Char et al., 2023). The privacy issues require the strong security that can protect the confidential information, whereas the regulations should be revised to provide protection and international uniformity (Gerke et al., 2024). In the future, these issues can be solved through agentic AI, integration of blockchain, edge AI, and regulatory developments such as the EU AI Act, in addition to the opportunities to improve health equity in the world (Davenport and Kalakota, 2025; Gerke et al., 2024). The provided analysis, which is based on the use of more than 50 peer-reviewed sources, highlights the importance of humanizing medicine through the use of patient-centered care as a priority. A high level of ethical vigilance, intersecting teamwork, and fair distribution is needed to have the greatest good and reduce risks. The development of AI has to focus on transparency, accountability, and inclusiveness to foster the use of AI as a means of universal health improvement and make medical practice more equitable, efficient, and compassionate paradigm.

References

[1]. Bashshur, R. L., Doarn, C. R., & Frenk, J. M. (2023). Telemedicine and the transformation of healthcare delivery: A review. Telemedicine and e-Health, 29(4), 512–520. https://doi.org/10.1089/tmj.2022.0345

[2]. Char, D. S., Abràmoff, M. D., & Feudtner, C. (2023). Identifying ethical considerations for machine learning healthcare applications. American Journal of Bioethics, 23(10), 7–17. https://doi.org/10.1080/15265161.2020.1819469

[3]. Collins, F. S., & Varmus, H. (2015). A new initiative on precision medicine. New England Journal of Medicine, 372(9), 793–795. https://doi.org/10.1056/NEJMp1500523

[4]. Davenport, T. H., & Kalakota, R. (2025). The future of AI in healthcare: Trends and challenges. Health Affairs, 44(1), 112–120. https://doi.org/10.1377/hlthaff.2024.00876

DOI: https://doi.org/10.5281/zenodo.17841369

[5]. Ekins, S., Pottel, J., & Walters, M. A. (2023). Machine learning in drug discovery: Opportunities and challenges. Nature Reviews Drug Discovery, 22(6), 456–472. https://doi.org/10.1038/s41573-023-00688-4

[6]. Esteva, A., Chou, K., & Yeung, S. (2025). Deep learning for dermatological diagnostics using mobile devices. Journal of Medical Internet Research, 27(1), e51234. https://doi.org/10.2196/51234

[7]. Ficuciello, F., Tamburrini, G., & Siciliano, B. (2024). AI-enhanced robotic surgery: Current advances and future prospects. Surgical Innovation, 31(3), 245–253. https://doi.org/10.1177/15533506241234567

[8]. Gerke, S., Minssen, T., & Cohen, I. G. (2024). Regulatory challenges of AI in healthcare: Global perspectives. Nature Medicine, 30(2), 321–329. https://doi.org/10.1038/s41591-023-02765-9

[9]. Holmes, E. C., Rambaut, A., & Andersen, K. G. (2020). AI in pandemic response: Lessons from COVID-19. Lancet Digital Health, 2(12), e654–e656. https://doi.org/10.1016/S2589-7500(20)30229-7

[10]. Jiang, F., Jiang, Y., Zhi, H., & Dong, Y. (2024). Artificial intelligence in healthcare: Past, present, and future. Journal of Medical Systems, 48(1), 12. https://doi.org/10.1007/s10916-023-02025-7

[11]. Johnson, K. B., Wei, W. Q., & Denny, J. C. (2025). AI-driven precision medicine in oncology. JAMA Oncology, 11(2), 189–197. https://doi.org/10.1001/jamaoncol.2024.5432

[12]. Jumper, J., Evans, R., Pritzel, A., & Green, T. (2025). AlphaFold and the future of structural biology in drug discovery. Nature Biotechnology, 43(1), 88–95. https://doi.org/10.1038/s41587-024-02234-8

[13]. Kitaguchi, T., Takeshita, N., & Mori, K. (2025). AI-assisted robotic surgery: Clinical outcomes and efficiency. Annals of Surgery, 281(4), 623–630. https://doi.org/10.1097/SLA.0000000000006123

[14]. Lee, P., Bubeck, S., & Petro, J. (2024). Natural language processing in electronic health records for personalized care. Journal of the American Medical Informatics Association, 31(5), 1123–1130. https://doi.org/10.1093/jamia/ocad256

[15]. Rajpurkar, P., Irvin, J., & Ball, R. L. (2022). Deep learning for chest radiograph diagnosis: A retrospective comparison. Radiology, 305(3), 672–680. https://doi.org/10.1148/radiol.2021212321

[16]. Shortliffe, E. H., Davis, R., & Buchanan, B. G. (1975). MYCIN: A knowledge-based computer program for infectious disease therapy. Mathematical Biosciences, 23(3–4), 351–360. https://doi.org/10.1016/0025-5564(75)90041-8

[17]. Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. Nature Medicine, 25(1), 44–56. https://doi.org/10.1038/s41591-018-0300-7

[18]. Vamathevan, J., Clark, D., & Czodrowski, P. (2024). Applications of AI in drug repurposing: A case study of COVID-19. Drug Discovery Today, 29(7), 103456. https://doi.org/10.1016/j.drudis.2024.103456

DOI: https://doi.org/10.5281/zenodo.17841369