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Perspective

Application of Artificial Intelligence in Medical Sciences, Healthcare, and Treatment: A Human-Centered Perspective

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ABSTRACT

Artificial Intelligence (AI) is a discipline within computer science that utilizes large datasets to simulate human intelligence, thereby supporting healthcare professionals and students in achieving more effective training and treatment outcomes. This article examines the application of AI in the medical sciences, healthcare, and treatment across six sections, investigating both the achievements and limitations of AI. The growing integration of AI into medical sciences has led to notable progress in medical education, patient care, and clinical practice. Increasing students' practical skills, easier access to large amounts of data, faster diagnosis, personalized treatment, and smarter care are among the benefits of using AI, which justifies the increasing use of this technology. Today, the benefits of AI in medical education are widely acknowledged. One of the key advantages is making the learning process more understandable for learners from an academic perspective and being recognized as a major transformation in medical education. The use of AI has always been accompanied by challenges. However, despite these challenges, AI has a promising future in education and healthcare, provided that its implementation is guided by human-centered design, ethical oversight, and appropriate governance structures. This Perspective emphasizes the interconnected nature of AI use across medical education, clinical practice, and healthcare systems, and argues that AI should be positioned as a supportive rather than autonomous force in medicine. Its progress depends on stronger interdisciplinary collaboration between computer scientists and medical researchers to identify and address key challenges and to implement effective data-driven approaches to achieve this aim.

Keywords: Artificial Intelligence, Medicine, Treatment, Therapeutics, Education, Delivery of Health Care

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Introduction

John McCarthy originated the phrase "Artificial Intelligence (AI)" in 1956, and AI has progressed to become one of the most imperative technological developments in modern science (1, 2). It is critical to note that while Machine Learning (ML) and Deep Learning (DL) are two established technical concepts used within the medical community, ML provides a mechanism for computer systems to detect patterns within large datasets (the essence of ML), while DL provides a mechanism for predicting and analyzing even greater complexity (the essence of DL) via a pattern-recognition mechanism based on a neural network (3). Therefore, a wide variety of medical applications have arisen from the combined advantages that both ML and DL provide, ranging from diagnostic applications to personalization of treatment (3).

Lately, AI has emerged in many areas of medicine (diagnostics, oncology, endoscopy, surgery, and every level of medical education) (4). These developments are often discussed in isolation, despite their shared educational, clinical, and systemic implications. In this Perspective, the authors argue that AI should be viewed not as a substitute for clinicians, but as a supportive tool that enhances diagnostic capabilities, reduces cognitive burden, and improves the accuracy of care. We explicitly align this work in opposition to techno-solutionist narratives, emphasizing that the value of AI lies in its responsible integration into medical education, clinical practice, and healthcare systems. Achieving this vision, however, requires addressing several substantial challenges, including the need for greater transparency and a move away from characterizing AI systems as opaque "black boxes."

The general goal of this Perspective is to critically examine the application of artificial intelligence across medical education, clinical practice, and healthcare systems as an interconnected whole rather than as separate domains. Specifically, this article aims to move beyond a descriptive review of AI applications by articulating the authors' views, critiques, and recommendations, and by highlighting the key educational, clinical, and governance changes required to ensure that AI strengthens—rather than undermines—human-centered care.

Toward New Frameworks and Opportunities

Although much of the current AI literature remains largely descriptive, a growing body of work has begun to examine both the benefits and limitations of these technologies. Nonetheless, research in this area is still predominantly application-focused, with insufficient attention to theory development or integrative critique. To meaningfully advance the field, future research should prioritize theory-building efforts that can guide the evolution and responsible implementation of AI in healthcare.

Human–AI Collaboration

A common belief is that AI will eventually replace physicians, educators, and other healthcare professionals. Although AI has a capacity to process vast amounts of information rapidly and generate data-based recommendations, it lacks the capacity to interpret human emotions, place things in proper context or make moral judgments. For this reason, it is anticipated that future forms of AI will take care of most of the low-level, data-oriented activities that would otherwise be left for healthcare providers to perform, allowing them to focus their attention on communicating, making moral judgements and providing patient-centered care. From a Perspective standpoint, we argue that this collaborative model represents the most ethically and clinically appropriate pathway for AI integration. As we move into the future, our future research should explore the development of proper workflows, educational structures and guidelines to support the collaborative model for future partnerships between AI and healthcare providers (5, 6).

Equity and Global Health

High-income countries provide most

of the training data for most AI models; this leads to bias, which can lead to these models excluding vulnerable populations. Without deliberate attention to equity in AI development, existing health inequities may be perpetuated or amplified. To counter this possibility, equity should be a primary pillar of all AI development. Equity must therefore be a central pillar of AI design rather than an afterthought. This requires access to diverse and inclusive global datasets, the development of algorithms that are culturally responsive, and the implementation of policies that ensure broad and fair access. In addition, research should report not only model performance but also how the benefits of AI are distributed equitably across different patient groups and healthcare systems (5).

Trust and Transparency

For AI to be embedded in routine clinical practice, it must earn the confidence of clinicians, patients, and policymakers—something that remains difficult to achieve. Most AI systems are currently considered "black boxes" where it is nearly impossible to understand how decisions are made. The lack of transparency around these technologies, along with profit-focused companies and unclear lines of accountability, undermines AI's alleged reliability and credibility. From a governance perspective, transparency and explainability are essential to sustaining professional and public trust. Governance structures for AI should be developed using an interdisciplinary approach with input from clinicians, computer scientists, ethicists, the affected populations (the patients), and regulatory agencies, to collaboratively develop the best possible AI throughout its lifecycle. The concepts of explainable AI, ethical audits, and shared accountability should be incorporated into future AI developments to promote safe and ethical use (5, 6).

Opportunities beyond Current Applications

In addition to advancing technology, AI offers an opportunity to fundamentally reimagine healthcare systems. It can support the development of learning health systems in which patient data are continuously used to refine and improve clinical practice. AI also enables a stronger emphasis on preventive medicine, shifting the focus from treatment to health promotion. Furthermore, integrating interdisciplinary education can ensure that future healthcare professionals are proficient not only in medicine but also in digital literacy and data ethics. Together, these opportunities position AI as a driver of systemic change rather than simply a technical solution.

Integrated Role of AI across Medical Education, Clinical Practice, and Healthcare Systems

To avoid a fragmented, review-style interpretation of AI, this section intentionally discusses medical education, clinical practice, and healthcare systems as interdependent domains. We argue that developments in one domain inevitably shape outcomes in the others, and that examining AI applications without this integrative lens risks reinforcing descriptive narratives rather than critical insight.

Medical Science is being profoundly affected by AI, which is not only limited to the application of technology but also in various areas of its own. Education, treatment, and the entire healthcare system are the domains that are gradually interlinked with each other, where, for example, the progress in medical education impacts the others as well, and vice versa. Hence, viewing AI in this integrated manner is a must for grasping its full potential along with the accompanying risks.

In the case of medical education, AI has played a pivotal role in changing the method in which students acquire clinical knowledge and skills by facilitating more personalized, accessible, and simulation-based learning environments (4). Medical schools are revising their curricula in response to the rapid technological change, while at the same time looking for innovative ways to expand and keep the healthcare workforce (6). Yet these revisions often emphasize technical exposure over critical AI literacy, ethical reasoning,

and interpretive judgment. A large number of technologies, such as Virtual Reality, Cloud Computing, 5G, Big Data Analytics, the Internet of Things, Wearable Devices, and AI tools, are being combined to support curriculum development, often through engineering department collaboration (5).

Across undergraduate, graduate, and postdoctoral education, AI-based simulation technologies like virtual patient systems are bringing to the learners the practice of clinical examinations and autonomous decision-making in safe, controlled settings, strengthening the clinical reasoning and judgment (4). However, the limited attention to ethical, social, and humanistic dimensions of AI raises concerns about whether future clinicians will be adequately prepared to critically evaluate AI outputs in practice.

With the use of 3D simulations, head-mounted displays, and haptic controllers, the training can be done in such a way that it is possible to visualize the clinical interventions and engage interactively with avatars at the same time (7). Holographic technologies make it even more effective to learn, by granting the learner access to anatomy and imaging from various angles, hence making the hard-to-grasp subject matter more user-friendly and exciting (7). Nonetheless, these improvements have not led to a shift in the orientation of the majority of educational programs, which still focus on the technical skills aspect of AI and neglect the ethical, social, and humanistic dimensions of AI use. Such an imbalance poses the question of whether future clinicians will be able to critically appraise AI outputs and use them responsibly in practice or not.

These educational limitations have direct implications for clinical practice. AI has made significant progress over a wide range of medical specialties, such as radiology, neurology, pathology, cardiology, pharmacology, and robotic surgery, where it aids in disease prediction, triage, image interpretation, and treatment planning (8-10). However, the accuracy of AI outputs is closely linked to the quality and representativeness of the training data that might be incomplete or biased. From a Perspective standpoint, this highlights that performance metrics alone are insufficient indicators of clinical safety or ethical acceptability (11-13).

Personalized treatment approaches are increasingly relying on AI to integrate genetic, nutritional, and environmental factors, enabling individualized risk assessment and more frequent monitoring (9, 11). The processes of radiological imaging, pneumonia detection, skin lesion classification, and the analysis of next-generation sequencing data have become more and more automated (14, 15). Moreover, AI is speeding up the analysis of clinical trial data (16, 17) and supporting the screening and management of familial hypercholesterolemia (18) with better results. However, the accuracy of AI outputs is closely linked to the quality and representativeness of the training data that might be incomplete or biased. Therefore, an integrative approach combining AI and clinician expertise is the key, and ethical issues—especially those about trust, accountability, and transparency—must continue to be central (19–23). AI should therefore be understood not only as a technical instrument but also as a force that reshapes professional roles and clinical practice.

At the health system level, AI is often promoted as a solution to rising patient demand, limited financial resources, and workforce shortages (5). However, implementing AI at scale without simultaneous investment in education and governance may erode trust, accountability, and relational aspects of care. Additionally, the use of patient-oriented chatbots has made it easier for patients to access health information and participate in decision-making processes (5, 9, 24, 25). Nevertheless, ethical concerns such as data security, patient consent, and overreliance on automated systems remain significant challenges (19, 26).

Taken together, these observations suggest that AI should be conceptualized not as a collection of isolated tools, but as a socio-technical system whose effectiveness depends

on coordinated alignment across education, clinical practice, and healthcare governance.

Conclusion

The long-term influence of AI in healthcare will depend not only on technological progress, but also on whether AI is positioned as supportive tool rather than a fully independent solution. We explicitly frame this perspective against techno-solutionist assertions, arguing that AI's value lies in strengthening—not replacing—human clinical judgment. Ensuring inclusivity demands ethically obtained, diverse, and representative data to avoid perpetuating current healthcare disparities. Additionally, it is crucial to create AI systems that are transparent and explainable, aiding clinical reasoning and building trust with both healthcare providers and patients.

Medical education plays a central role in shaping the future of AI in medicine. Integrating AI literacy, ethics, and data interpretation into medical curricula is necessary to prepare clinicians to critically evaluate AI outputs and apply them responsibly in practice. This transition demands synchronized adjustments in three areas: medical education, clinical practice, and healthcare regulation. Future research should therefore move beyond performance metrics to examine how AI reshapes clinical decision-making, professional roles, and patient–clinician relationships. Only through coordinated advances in education, clinical implementation, and governance can AI meaningfully enhance healthcare while preserving its human foundations.

Abbreviations

AI: Artificial Intelligence
DL: Deep Learning
ML: Machine Learning

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Authors' Contribution

MHM and HRKM conceptualized and designed the study. AhKh and RG drafted the manuscript. MHM was responsible for revisions. All authors reviewed and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Availability of Data and Materials

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