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Artificial Intelligence and Healthcare

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Abstract: Artificial intelligence (AI) has become an integral aspect of contemporary healthcare that has revamped hospital and administrative processes. AI-infused healthcare solutions have been addressing skyrocketing medical costs, inefficiencies in medical treatment and drug development, prolonged waiting times, and limited access to healthcare services and providers. By facilitating personalised treatment, data-driven decision-making, early disease detection, and administrative automation, AI has strengthened healthcare delivery across four key dimensions: quality of care, operational efficiency, accessibility, and timelines. The proliferation of AI innovation in healthcare has outpaced the development of corresponding ethical, legal, and institutional safeguards. The pivotal aspect of healthcare remains the treatment, safety, and wellness of the patient; hence, technological development must extend beyond algorithm accuracy to encompass clinical responsibility, human dignity, and broader public interest. The integration of AI into healthcare systems should support, rather than pervasively replace, the professional judgment and accountability of qualified healthcare practitioners. Against this backdrop, this paper critically examines the opportunities, risks, and governance challenges associated with AI in contemporary healthcare, focusing on its applications in mental healthcare, veterinary medicine, and medical education. It explores how AI can facilitate healthcare delivery while accentuating the significance of professional judgement, human oversight, and accountability in its responsible integration across these domains.

Keywords: Healthcare, Artificial Intelligence, Mental Health, Veterinary Medicine, Medical Education, Healthtech Ethics and Governance

Introduction

The prevalence of debilitating medical conditions and the intricacy of healthcare systems have made the effective use of medical information more pivotal than ever. Medical informatics, which pivots on finding and applying the right insights to the right patient at the right time from ever-expanding data, has become an essential aspect of contemporary medicine. The integration of data analytics and Artificial Intelligence (AI) has provided novel possibilities for improving how physicians learn, diagnose diseases, and make medical decisions. However, despite numerous advancements in medical science, the development of new medicines, and the introduction of novel technologies, medical education and the process of becoming a physician have remained largely unchanged. Medical schools continue to follow conventional approaches that were majorly designed for a pre-digital era, one in which access to online resources, digital textbooks, and AI-assisted tools was limited or non-existent. Medical professionals have conventionally been expected to retain vast amounts of knowledge in their minds to apply it effectively in clinical practice. This created a disconnect between the demands of contemporary medicine and the way physicians are trained. Whilst the innovations continue to advance swiftly, medical education has grappled to keep pace. Medical knowledge is expanding at a rate that no individual can fully absorb, and AI is further redefining what it means to be a physician. Medical AI systems can process enormous amounts of information, maintain consistency, and assist with multiple tasks simultaneously. Their potential to transform medical science and healthcare is considerable.[1]

The application of AI in medicine is already transforming healthcare by improving efficiency and changing how illnesses are researched, diagnosed, treated, and even prevented. AI can assist healthcare professionals with routine administrative tasks, including recording patient notes during consultations, allowing them to devote more time to patient care. In medical research, AI is accelerating drug discovery and improving the efficiency of clinical trials, potentially reducing the time and financial resources required to develop new treatments. Rather than testing numerous potential treatments through lengthy processes, AI can analyse vast amounts of data to help researchers identify the compounds and therapies most likely to be effective. This allows research efforts to be directed towards promising treatments at an earlier stage. AI can also improve the selection of suitable participants for clinical trials and monitor their responses during the study, helping researchers

[1] Eric J. Topol, "High-Performance Medicine: The Convergence of Human and Artificial Intelligence." *Nature Medicine* 25 (2019): 44-56. https://doi.org/10.1038/s41591-018-0300-7

identify potential issues more quickly. These applications can contribute to the development of treatments that are safer, more effective, and available to patients swiftly.[2]

AI is also being used to analyse medical images, identify patterns, and detect early signs of diseases that might otherwise go unnoticed. Furthermore, AI can analyse a patient's medical history to identify patterns and anticipate potential health risks. In the field of personalised medicine, it can process individual patient data to support treatment plans tailored to specific medical needs, moving away from a one-size-fits-all approach. These developments demonstrate how AI can make healthcare faster, more precise, and more personalised, while supporting medical professionals in making better-informed clinical decisions.[3]

However, there persist ethical and legal challenges associated with the use of AI in healthcare. One of the foremost concerns is patient privacy. As AI systems are trained and developed using medical data, important questions arise regarding who owns this data, how it is stored and shared, and what measures are in place to safeguard it. In healthcare, patient confidentiality is not merely a matter of policy; it is a fundamental basis of trust between patients and medical professionals. Another significant concern is accountability. When an AI-assisted diagnosis is incorrect or a treatment recommendation causes harm, determining responsibility becomes complicated. Should accountability rest with the doctor who relied on the AI system, the developer who designed the algorithm, or the hospital that implemented it? As AI becomes more involved in decisions that can have life-or-death consequences, these questions become pressing ethical and legal concerns.[4]

The issue of bias presents a further challenge. When AI models are trained on incomplete or biased datasets that fail to adequately represent different demographic groups, they may produce inaccurate diagnoses or recommend inappropriate treatments for certain patients. It is therefore essential to ensure that the data used to develop these systems reflects the diversity of the populations they are intended to serve. A biased algorithm in healthcare is not simply an issue of technical inaccuracy; it can reinforce persisting inequalities, compromise patient safety, and potentially threaten lives. The

[2] Thomas Davenport, and Ravi Kalakota, "The Potential for Artificial Intelligence in Healthcare." *Future Healthcare Journal* 6, no. 2 (2019): 94-98. https://doi.org/10.7861/futurehosp.6-2-94

[3] Pablo Cruz-Gonzalez et al., "Artificial Intelligence in Mental Health Care: A Systematic Review of Diagnosis, Monitoring, and Intervention Applications." *Psychological Medicine* (2025). https://doi.org/10.1017/S0033291724003295

[4] Jianxing He et al., "The Practical Implementation of Artificial Intelligence Technologies in Medicine." *Nature Medicine* 25 (2019): 30-36. https://doi.org/10.1038/s41591-018-0307-0

responsible use of AI consequently requires continuous scrutiny of the data, methods, and outcomes associated with these systems to ensure fairness and prevent discrimination.[5]

Beyond these challenges, there are deeper concerns regarding the extent to which AI can fulfil the human responsibilities associated with medical care. AI can analyse information and generate recommendations, but it does not experience suffering, fear, or hope, nor does it possess human empathy. Difficult medical decisions often require more than the interpretation of data; they demand an understanding of a patient's circumstances, values, and emotions. Doctors bring compassion, contextual understanding, and moral reasoning to their interactions with patients, qualities that remain central to the practice of medicine. No matter how advanced AI becomes, these human dimensions of care cannot simply be reduced to computational processes. The application of AI must therefore be accompanied by an appreciation of the limitations of machine intelligence and the continuing importance of human judgment.

Ethical healthcare should not be inferred as a choice between human judgment and machine intelligence. Rather, it requires a meticulous synergy of the strengths of both. AI has the potential to support medical professionals by improving diagnostic capabilities, reducing administrative burdens, and facilitating more informed decisions, but it should not replace the expertise, empathy, and accountability of healthcare providers. Its purpose should be to empower medical professionals, not diminish their role, and to transform healthcare without losing sight of the human needs at its core.[6] The challenge, therefore, lies in ensuring that the integration of AI into healthcare is guided not only by technological progress but also by ethical responsibility, fairness, and public accountability. AI should serve as a tool to revolutionise healthcare while preserving the principles of patient welfare, dignity, and human-centred medical practice.

Impact of AI on Contemporary Healthcare Systems

Artificial intelligence is impacting contemporary healthcare systems by improving disease detection, supporting medical research, enabling personalised treatment, and facilitating clinical decision-making.[7] One of its most

[5] Rahim Hirani et al., "Artificial Intelligence and Healthcare: A Journey through History, Present Innovations, and Future Possibilities." *Life* 14, no. 5 (2024): 557. https://doi.org/10.3390/life14050557

[6] Fei Jiang et al., "Artificial Intelligence in Healthcare: Past, Present and Future." *Stroke and Vascular Neurology* 2, no. 4 (2017): 230-43. https://doi.org/10.1136/svn-2017-000101

[7] Charlotte J. Haug and Jeffrey M. Drazen, "Artificial Intelligence and Machine Learning

significant contributions is its ability to identify diseases and potential health risks at an early stage, sometimes before they are recognised by a doctor. By analysing large amounts of medical data, AI can detect subtle signals that may indicate the development of a health condition, allowing medical professionals to intervene earlier. There has been a shift from the conventional approach of treating diseases after diagnosis to prevention, early screening, and promoting longer, healthier lives. AI is also reducing the costs associated with scientific and medical research and has the potential to improve transparency in the diagnostic process, helping patients better understand their conditions and the decisions made regarding their care.[8]

AI is significantly contributing to healthcare by enabling more precise and personalised treatment. Through the analysis of extensive datasets, it can help medical professionals understand individual disease risks and identify suitable treatment options based on patients' specific characteristics. Although personalised risk assessment requires substantial amounts of data, AI assist in determining the minimum information necessary to assess the risk of disease for each individual. This may support more efficient clinical decision-making while reducing the cognitive and administrative workload of clinicians. AI also help healthcare professionals organise patient information in ways that facilitate clinical decisions and provide relevant insights into treatment responses. By examining factors such as diet, the microbiome, sleep patterns, and existing comorbidities, AI may help researchers better understand differences in how individuals respond to therapies. The availability of extensive immunological data can further support the identification of treatment approaches suited to individual patients. In addition, AI can assist in discovering new disease mechanisms and empowering biologists and scientists to advance medical research. Its application to clinical trials may also help address challenges associated with trial failures and the recruitment of participants who do not adequately represent the populations for whom treatments are intended.[9]

Beyond diagnosis and treatment, AI has the potential to support patients and clinicians throughout the healthcare journey, from prevention and early diagnosis to treatment and follow-up. Healthcare systems often operate with limited resources and must determine which patients require attention,

in Clinical Medicine, 2023." *The New England Journal of Medicine* 388, no. 13 (2023): 1201-8, https://doi.org/10.1056/NEJMra2302038

[8] Julian N. Acosta et al., "Multimodal Biomedical AI," *Nature Medicine* 28 (2022): 1773-84, https://doi.org/10.1038/s41591-022-01981-2

[9] Xiaoran Lu et al., "Artificial Intelligence for Optimizing Recruitment and Retention in Clinical Trials: A Scoping Review," Journal of the American Medical Informatics Association 31, no. 11 (2024): 2749-59, https://doi.org/10.1093/jamia/ocae243

when they should be seen, which professionals should provide care, and how follow-up should be organised. AI may help address these challenges by supporting resource allocation and facilitating interactions between patients and healthcare providers. Rather than replacing pathologists, AI can assist in prioritising and triaging cases, potentially making pathology services more accessible in underserved areas.[10] Similarly, AI-assisted ambient scribing provides a relatively inexpensive and convenient means of recording information during medical appointments and other clinical encounters. However, generative AI systems may produce inaccurate information or hallucinations, making human review essential. Clinical documents and treatment plans must therefore continue to be reviewed by clinicians to ensure that the information generated is accurate and appropriate.[11]

Despite these opportunities, the integration of AI into contemporary healthcare systems presents considerable challenges. Existing healthcare structures may not be adequately prepared to accommodate technological changes, and centralised systems can be resistant to innovation, particularly when changes do not align with established financial interests. The successful implementation of AI consequently relies not only on technological development but also on the willingness and capacity of healthcare institutions to adapt their persisting practices.[12] Furthermore, although AI can reduce clinicians' workloads and provide more precise information, excessive reliance on technological systems may increase disconnect between physicians and patients. The relationship between a patient and a doctor remains an essential aspect of healthcare, and the introduction of AI should not undermine this connection. Healthcare workers and physicians must therefore be involved in the deployment and implementation of AI to ensure that its use remains accurate, accountable, and responsive to patients' needs.[13] The technology itself cannot guarantee better healthcare outcomes unless the people and processes involved in its implementation receive equal attention.

Another prime concern is the impact of bias and data quality on the performance of AI systems. AI algorithms are only as reliable as the data on which

[10] Mark D. Zarella et al., "Artificial Intelligence and Digital Pathology: Clinical Promise and Deployment Considerations," *Journal of Medical Imaging* 10, no. 5 (2023): https://doi.org/10.1117/1.JMI.10.5.051802

[11] Matthew J. Duggan et al., "Clinician Experiences With Ambient Scribe Technology to Assist With Documentation Burden and Efficiency," *JAMA Network Open* 8, no. 2 (2025): https://doi.org/10.1001/jamanetworkopen.2024.60637

[12] Molla Imaduddin Ahmed et al., "A Systematic Review of the Barriers to the Implementation of Artificial Intelligence in Healthcare," *Cureus* 15, no. 10 (2023): 10.7759/cureus.46454

[13] Linda T. Li et al., "Technical/Algorithm, Stakeholder, and Society (TASS) Barriers to the Application of Artificial Intelligence in Medicine: A Systematic Review," *Journal of Biomedical Informatics* 147 (2023): https://doi.org/10.1016/j.jbi.2023.104531

they are trained. If the datasets contain biases, the resulting algorithms may reproduce and reinforce those biases in their predictions and recommendations.[14] This is particularly concerning because some previous medical trials have not included adequately representative populations, while medical knowledge may also reflect biases in the ways information has historically been collected and assembled. AI does not automatically eliminate these shortcomings; instead, it may encode existing biases into automated decision-making systems. Ensuring that datasets are accurate, representative, and suitable for training AI models is therefore pivotal to attaining reliable results. These concerns also have implications for global healthcare access and inequality. The potential of AI to improve healthcare accessibility must be considered alongside the inequalities that may affect its availability and performance across different populations.

The wider application of AI in healthcare also raises questions pertaining to data safety, privacy, and ethical responsibility. Patients' data must be safeguarded against exploitation for commercial purposes, and the use of personal health data must be considered in relation to its potential consequences for individuals. These concerns include the possibility of data-driven analysis leading to enforced or prescriptive treatment decisions and the threat of individuals becoming uninsurable. Ensuring that individuals cannot be identified from datasets is another essential consideration. At the same time, the information used to train AI systems must remain sufficiently accurate and representative to support reliable predictions and clinical decisions.[15] Ergo, the responsible application of AI involves more than improving diagnostic efficiency or treatment precision; it also requires the protection of patients' interests and careful consideration of the consequences of automated decision-making.[16]

These challenges make accountability a fundamental consideration in the clinical use of AI. The possibility of inaccurate predictions, biased recommendations, and hallucinations in AI-generated clinical documentation raises questions about whether existing accountability mechanisms adequately address the risks associated with its implementation. There are several areas that require attention, including the accuracy of AI-generated outputs, the quality and representativeness of training data, the protection of patient

[14] Ziad Obermeyer et al., "Dissecting Racial Bias in an Algorithm Used to Manage the Health of Populations," *Science* 366, no. 6464 (2019): 447-53, https://doi.org/10.1126/science.aax2342

[15] World Health Organization, *Ethics and Governance of Artificial Intelligence for Health: WHO Guidance* (Geneva: World Health Organization, 2021).

[16] Jessica Morley et al., "From What to How: An Initial Review of Publicly Available AI Ethics Tools, Methods and Research to Translate Principles into Practices," *Science and Engineering Ethics* 26 (2020): 2141-68, https://doi.org/10.1007/s11948-019-00165-5

information, and the continued involvement of healthcare professionals in clinical decisions. Human oversight is particularly crucial when AI is used to generate clinical notes or treatment plans, as such outputs cannot be assumed to be reliable without appropriate review.[17] Correspondingly, the reproduction of bias through AI algorithms accentuates the need to consider how data are collected, assembled, and used in the development of these systems. Accountability must also take into consideration the potential consequences of data-driven decisions for patients, including privacy violations and the possibility of inappropriate or incorrect treatment. Nonetheless, the concerns regarding accuracy, bias, privacy, and professional oversight signify the relevance of ensuring that AI is implemented with appropriate human involvement and responsibility.[18]

AI has been revamping healthcare through prevention, early detection, personalised treatment, medical research, and clinical decision-making, thereby contributing to more effective and accessible healthcare services. However, inaccurate predictions, overreliance on AI, implementation costs, unequal access, biased datasets, and data privacy concerns may limit these benefits. The harmonious integration of AI requires healthcare institutions to address these limitations while ensuring that technological development does not come at the cost of patient safety or the relationship between patients and medical professionals. The future of healthcare is not necessarily one in which AI replaces clinicians, but one in which clinicians collaborate with AI and patients to determine the most appropriate advice and treatment. Maintaining this balance requires continued attention to accuracy, data quality, ethical responsibility, and accountability, ensuring that technological advancement remains focused on improving healthcare and patient outcomes.

Artificial Intelligence in Mental Healthcare Delivery

Artificial intelligence has the potential to address two major challenges in mental healthcare: improving access to treatment and ensuring that the treatments provided are as effective as possible.[19] The two main avenues of treatment are medication and psychotherapy. Medication-based treatments

[17] Chiara Longoni et al., "Resistance to Medical Artificial Intelligence," *Journal of Consumer Research* 46, no. 4 (2019): 629-50, https://doi.org/10.1093/jcr/ucz013

[18] Thomas Grote and Philipp Berens, "On the Ethics of Algorithmic Decision-Making in Healthcare," *Journal of Medical Ethics* 46, no. 3 (2020): 205-11, https://doi.org/10.1136/medethics-2019-105586

[19] Simon D'Alfonso, "AI in Mental Health." *Current Opinion in Psychology* 36 (2020): 112-17. https://doi.org/10.1016/j.copsyc.2020.04.005

can be effective for some individuals, while psychotherapy provides an alternative approach through therapeutic conversations and psychological interventions. Both forms of treatment play a fundamental role in mental healthcare, making it essential to evaluate their effectiveness and identify ways to improve patient outcomes.[20]

Albeit treatment outcomes are routinely measured in clinical practice, this is not the case in most psychotherapy settings. However, measuring these outcomes can significantly improve the understanding and delivery of treatment. Recording and measuring the effect of treatment allows therapists and patients to assess how treatment is progressing, while the systematic analysis of collected data can provide insights and support the discovery of novel approaches to mental healthcare.

Advances in computational techniques, particularly AI, have made it possible to analyse the content of psychotherapy in greater detail, including the individual words used by therapists. Data-driven approaches are being applied in psychotherapy services, contributing to efforts to improve treatment outcomes and recovery rates. AI has extended mental healthcare services to individuals who may face geographical or financial barriers. In addition to facilitating remote access to treatment, AI can support the systematic collection and analysis of clinical data, potentially contributing to the development of more effective treatments.[21]

Beyond improving access to treatment, AI has the potential to encourage behavioral changes and identify early indicators of potential mental health difficulties. By analysing relevant patterns and changes over time, AI systems may help forecast emerging concerns and support earlier intervention. This shifts the focus of mental healthcare beyond diagnosing and treating individuals once they become unwell towards identifying potential risks at an earlier stage. Such an approach may create opportunities for timely support and preventive care.[22]

AI has been adopted in hospitals, medical practices, and therapy applications. Its applications range from supporting the diagnosis of rare diseases to assisting individuals experiencing anxiety and depression. However, these developments also raise crucial questions concerning the reliability of

[20] Falk Leichsenring et al., "The Efficacy of Psychotherapies and Pharmacotherapies for Mental Disorders in Adults: An Umbrella Review and Meta-Analytic Evaluation of Recent Meta-Analyses," *World Psychiatry* 21, no. 1 (2022): 133-45. https://doi.org/10.1002/wps.20941

[21] Danicsa Karina Espino Carrasco et al., "Sustainability of AI-Assisted Mental Health Intervention: A Review of the Literature from 2020-2025." *Int J Environ Res Public Health* (2025): https://doi.org/10.3390/ijerph22091382

[22] Moustafa Elmetwaly Kandeel et al., "AI Applications Integrating Legal and Regulatory Perspectives in Mental Health: Systematic Review." *JMIR AI* (2026). https://pmc.ncbi.nlm.nih.gov/articles/PMC13117227/

AI, accountability when errors occur, and its implications for the future of healthcare.[23]

Despite its benefits, AI-based mental healthcare has limitations. A human therapist or coach can help individuals recognise and challenge existing beliefs rather than reinforcing them, as AI systems may inadvertently do. Excessive reliance on digital tools may also reduce opportunities for meaningful human interaction. Human connection plays an important role in emotional regulation, the formation of therapeutic relationships, and the process of psychological change. Therefore, AI should not overlook the value of emotional attunement and the relationship between patients and trusted professionals.

Data collection and privacy are additional concerns associated with AI in mental healthcare. These systems may handle sensitive personal information, making responsible data management essential. If AI systems are developed with appropriate safeguards for privacy and avert the misuse of personal information, they can provide considerable potential to improve mental healthcare. Hence, the effective delivery of AI-assisted mental healthcare requires a balance between technological innovation, treatment effectiveness, patient privacy, and the essential role of human connection.[24]

Artificial Intelligence in Veterinary Medicine

The integration of artificial intelligence technologies into veterinary medicine is facilitating veterinary clinics improve animal care, diagnostic accuracy, personalised treatment planning, patient monitoring, and clinical efficiency. AI provides veterinary professionals with tools to support animal health management and facilitate faster diagnosis. AI technologies can analyse medical images, including X-rays, ultrasound images, and digitised pathology slides, to identify abnormalities and accentuate areas requiring further examination.[25] They can also assist in analysing laboratory results, summarising patient histories, and identifying findings that may help veterinarians assess potential diagnoses. Predictive analytics can analyse an animal's medical history to identify potential health risks and support pro-

[23] Charlotte Blease and Adam Rodman, "Generative Artificial Intelligence in Mental Healthcare: An Ethical Evaluation," *Current Treatment Options in Psychiatry* 12 (2025) https://doi.org/10.1007/s40501-024-00340-x

[24] Xi Wang, Yujia Zhou, and Guangyu Zhou, "The Application and Ethical Implication of Generative AI in Mental Health: Systematic Review." *JMIR Mental Health* 12 (2025): https://doi.org/10.2196/70610

[25] Sadi Elasan and Osman Yilmaz, "Comprehensive Global Analysis of Future Trends in Artificial Intelligence- Assisted Veterinary Medicine," *Veterinary Medicine and Science* 11, no. 3 (2025): https://doi.org/10.1002/vms3.70258

active care.[26] Similarly, AI-driven wearable devices can monitor activity and selected health indicators, helping pet owners and veterinarians identify concerning changes in an animal's condition. Virtual veterinary assistants and chatbots can provide general health information and guidance; however, they cannot replace physical examinations and professional veterinary judgment. There is also potential to decipher animals' communication and emotional states. AI can contribute to veterinary research and drug development through the analysis of large datasets and the identification of patterns. However, the reliability of these applications depends on the quality of the data, veterinary-specific training, and appropriate clinical validation. Ethical concerns include the privacy and confidentiality of animal health records, informed consent for data use, potential bias in training datasets, and the risk of inaccurate results. Veterinary professionals therefore require appropriate training to understand the capabilities and limitations of AI tools and use them responsibly. Although AI may improve efficiency and support clinical decision-making, it cannot replace physical examinations, professional judgment, and the practical expertise required for diagnosis and treatment. Its role in veterinary medicine is therefore to complement veterinarians by supporting informed clinical decisions while prioritising animal health and welfare.[27] The application of AI in veterinary medicine relies not only on technological development but also on responsible implementation. The implementation of AI in veterinary practice also requires consideration of its practical limitations.[28] Veterinary clinics vary in their access to digital infrastructure, financial resources, and technical expertise. The cost of acquiring and maintaining AI-based systems may impact their accessibility, particularly in smaller practices. In addition, veterinary professionals need to understand how a system is designed to function, the types of cases for which it has been evaluated, and the circumstances in which its results may be unreliable. Another important consideration is the quality and representation of data used to develop AI systems. Veterinary patients vary across species, breeds, ages, and health conditions. If the data used to train a model do not adequately represent this variation, its performance may differ when

[26] K.E. Sobkowich, "Demystifying Artificial Intelligence for Veterinary Professionals: Practical Applications and Future Potential," *American Journal of Veterinary Research* (2025): https://doi.org/10.2460/ajvr.24.09.0275

[27] Navid Ghavi Hossein-Zadeh, "Artificial Intelligence in Veterinary and Animal Science: Applications, Challenges, and Future Prospects," *Computers and Electronics in Agriculture* 235 (2025): https://doi.org/10.1016/j.compag.2025.110395

[28] Samuel V. Neal, Daniel G. Rudmann and Kara N. Corps, "Artificial Intelligence in Veterinary Clinical Pathology-An Introduction and Review," *Veterinary Clinical Pathology* (2025): https://doi.org/10.1111/vcp.70012

applied to animals outside the population on which it was developed.[29] Consequently, AI systems require appropriate testing and validation before their findings can be relied upon in clinical settings. Continuous evaluation is also essential as new data and applications become available. The effective integration of AI into veterinary medicine requires cooperation between veterinarians, researchers, developers, and other professionals involved in animal healthcare.

Artificial Intelligence in Medical Education

Artificial intelligence is transitioning medical education by shifting from rote memorisation towards the application of knowledge in clinical decision-making. It supports this approach by facilitating information summarisation, differential diagnosis, clinical documentation, and clinical data analysis. These capabilities facilitate medical students in progressing more quickly from acquiring foundational knowledge to developing advanced clinical reasoning and analytical skills. However, fundamental medical knowledge remains core for understanding clinical problems and evaluating the information provided by AI systems. The integration of AI should therefore complement the learning process rather than replace the acquisition of basic medical knowledge and clinical competencies.[30]

AI can support learning throughout medical education, including pre-clinical courses, clinical skills training, clinical clerkships, and post-clerkship learning. AI tools can assist students in preparing clinical notes and refining differential diagnoses. Medical curricula may consequently need to place higher emphasis on applying knowledge to clinical situations rather than focusing predominantly on the recall of information. In clinical education, AI can assist students and trainees consider possible diagnoses, identify relevant clinical information, and explore uncommon conditions. Students must learn to interpret diagnostic possibilities in the context of each patient's medical history, symptoms, individual circumstances, and lived experiences. Clinical reasoning requires the integration of available evidence with patient-specific information, an essential skill that medical education must continue to develop alongside the application of AI.[31]

[29] Hesameddin Akbarein et al., "Applications and Considerations of Artificial Intelligence in Veterinary Sciences: A Narrative Review," *Veterinary Medicine and Science* 11, no. 3 (2025): https://doi.org/10.1002/vms3.70315

[30] Rasheed A. M. Thompson et al., "Artificial Intelligence Use in Medical Education: Best Practices and Future Directions," *Current Urology Reports* 26 (2025): https://doi.org/10.1007/s11934-025-01277-1

[31] Kody Shaw, Marcus A. Henning, and Craig S. Webster, "Artificial Intelligence in Medical

The integration of AI into medical education presents challenges. AI-generated responses may contain inaccurate information or fabricated details. Students must therefore develop the ability to critically evaluate generated information and verify its accuracy against reliable sources. Accepting AI-generated responses without independent assessment may undermine the development of analytical reasoning and clinical judgment. Medical education should consequently emphasise the responsible use of AI, ensuring that students understand its limitations and remain actively involved in the reasoning process.[32]

Another concern is the potential for AI systems to reproduce biases present in their training data. These biases may reflect patterns in existing human knowledge and healthcare practices, potentially impacting the information generated by such systems.[33] Medical students need to recognise that AI-generated outputs are not necessarily neutral or universally applicable. Critical evaluation is particularly crucial when interpreting clinical information and considering the needs of patients with different backgrounds and circumstances. Educational policies should also clarify the appropriate use of AI in assignments, self-directed learning, and clinical documentation while ensuring that students continue to develop independent thinking and essential clinical skills.

The effective integration of AI also requires faculty development. Medical educators need to become familiar with AI tools and understand their appropriate applications. Developing clear prompts, critically reviewing responses, and refining outputs are important aspects of their effective use. Faculty members must also guide students in distinguishing between using AI as a learning aid and relying on it as a substitute for independent understanding.

Crucially, the application of AI reinforces the need to preserve the human aspects of medical practice. Compassionate communication, cultural competence, physical examination, and meaningful patient-physician interaction remain core components of medical education. Students must learn to understand patients as individuals, communicate sensitively, and incorporate personal and clinical circumstances into their decisions. AI may assist with routine information-processing tasks and clinical documentation, poten-

Education: A Scoping Review of the Evidence for Efficacy and Future Directions," *Medical Science Educator* 35 (2025): https://doi.org/10.1007/s40670-025-02373-0

[32] Carl Preiksaitis and Christian Rose, "Opportunities, Challenges, and Future Directions of Generative Artificial Intelligence in Medical Education: Scoping Review," *JMIR Medical Education* 9 (2023): https://doi.org/10.2196/48785

[33] Morris Gordon et al., "A Scoping Review of Artificial Intelligence in Medical Education: BEME Guide No. 84," *Medical Teacher* 46, no. 4 (2024): https://doi.org/10.1080/0142159X.2024.2314198

tially allowing physicians to devote more time to direct patient interaction. AI should therefore be integrated into medical education in a manner that strengthens clinical reasoning while preserving the essential human dimensions of healthcare.[34]

AI Governance in Healthcare

The integration of artificial intelligence into healthcare requires governance that extends beyond legal compliance to address ethical responsibility, public trust, and patient rights. Although AI can revamp diagnosis, clinical efficiency, and expand access to healthcare, its application raises concerns regarding data confidentiality, informed consent, algorithmic discrimination, and liability for harm. These issues become particularly challenging when responsibility is distributed among developers, healthcare institutions, and practitioners. Responsible governance must ensure transparent decision-making, secure patient data, equitable access, continuous risk assessment, and meaningful human oversight.

A responsible governance mechanism should embed accountability into every stage of AI adoption in healthcare by clearly defining stakeholder responsibilities, ensuring appropriate human oversight, maintaining transparent decision-making, and providing effective remedies when harm occurs. Rather than focusing solely on regulatory compliance, governance must also address who regulates these technologies, whose interests they serve, and how responsibility is assigned when clinical decisions lead to adverse outcomes. AI should complement professional judgment, safeguard patient autonomy, and promote equitable healthcare while remaining accountable to the public interest.[35]

Responsible AI governance must extend beyond regulatory approval to encompass continuous evaluation, clinical accountability, and public interest. AI systems should undergo rigorous assessment before deployment, be monitored throughout their use, and be evaluated against clinically meaningful outcomes rather than accuracy scores alone. Depending on the intended application, evaluation may include sensitivity, specificity, positive and negative predictive values, and evidence of patient safety. A system that performs well statistically may nevertheless be clinically inappropriate if

[34] Mahdi Zarei et al., "Application of Artificial Intelligence in Medical Education: A Review of Benefits, Challenges, and Solutions," *Medicina Clínica Práctica* 7, no. 2 (2024): https://doi.org/10.1016/j.mcpsp.2023.100422

[35] Tuan Pham, "Ethical and Legal Considerations in Healthcare AI: Innovation and Policy for Safe and Fair Use," *Royal Society Open Science* 12, no. 5 (2025): https://doi.org/10.1098/rsos.241873

its recommendations do not improve patient outcomes or introduce unacceptable risks. Therefore, governance should require not only evidence of technical performance but also evidence that an AI system is suitable for its intended clinical purpose.

Particular attention must be given to rare but serious failures that may remain hidden behind favorable average performance measures. This is especially important for generative AI systems, whose outputs may vary between interactions and may occasionally produce misleading or clinically unsafe recommendations. Such failures should be systematically investigated, documented, and disclosed to relevant users. Clinicians and patients should also receive appropriate education and training to understand an AI system's capabilities and limitations, interpret its recommendations critically, and calibrate their level of reliance accordingly. A novel principle of governance is therefore to validate locally, monitor continuously, and disclose limitations transparently.[36]

Local validation is essential because AI models may not perform consistently across different healthcare institutions, patient populations, or clinical settings. A model developed using data from one hospital may perform poorly in another because of differences in demographics, disease prevalence, clinical practices, and available resources. Consequently, successful evaluation in one setting should not automatically justify deployment elsewhere. Governance mechanisms should require validation using locally relevant data, followed by ongoing monitoring for changes in performance over time. Data and model documentation should disclose the populations represented, the provenance and quality of training data, the intended uses, known limitations, and the risks associated with deployment. This documentation enables healthcare institutions and clinicians to make informed decisions about whether a particular system is appropriate for their patients.[37]

Governance must also distinguish between different levels of clinical risk rather than impose identical safeguards on every application. AI used for administrative assistance may require proportionate oversight, whereas systems impacting diagnosis, treatment, medication administration, or other life-critical interventions demand stronger validation, monitoring, and human supervision. The consequences of failure should determine the intensity of safeguards. The risk assessment should consider not only the probability

[36] Rui Xu and Zhong Wang, "Generative artificial intelligence in healthcare from the perspective of digital media: Applications, opportunities and challenges," *Heliyon* (2024): https://www.sciencedirect.com/science/article/pii/S2405844024083956

[37] Tijs Vandemeulebroucke, "The Ethics of Artificial Intelligence Systems in Healthcare and Medicine: From a Local to a Global Perspective, and Back," *Pflügers Archiv- European Journal of Physiology* 477 (2025):https://doi.org/10.1007/s00424-024-02984-3

of failure but also its potential severity and the availability of effective human intervention.

Transparency should extend beyond explaining algorithmic outputs to clarifying the sources and reliability of the information presented. Healthcare AI systems may combine verified information from electronic health records, references to established clinical guidelines, and AI-generated inferences. Where possible, these sources should be clearly distinguished so that users can assess the evidential basis of a recommendation. Although explainability can support clinical decision-making, explanations must not create a misleading impression of certainty or provide post hoc justifications that do not accurately represent how a system reached its output. Governance should therefore prioritise verifiable evidence, appropriate uncertainty disclosure, and traceable decision-making rather than treating explainability alone as proof of reliability.

Patient autonomy and informed consent are equally essential components of trustworthy governance.[38] Patients should be informed when AI meaningfully impacts their diagnosis, treatment, communication, or other consequential healthcare decisions, with the extent of disclosure and consent proportionate to the level of risk and the nature of the application. The use of AI for clinical documentation, for example, may raise different consent considerations from its use in determining treatment or influencing access to healthcare services. Governance must also recognise that human oversight is not automatically meaningful simply because a clinician is formally involved. Healthcare professionals need sufficient information, competence, and authority to question or override AI recommendations. At the same time, responsibility should not be assigned exclusively to individual clinicians when system design, institutional policies, or inadequate oversight contribute to harm.

Equity must remain central to the development and deployment of healthcare AI. Models trained on incomplete or unrepresentative data may reproduce existing inequalities associated with race, socioeconomic circumstances, geographical location, language, and access to healthcare. Excluding sensitive variables does not necessarily eliminate discrimination; it may instead conceal disparities that require investigation. Governance should therefore require the assessment and disclosure of differences in performance and outcomes across relevant patient groups, together with measures to mitigate identified harms. Patients, community representatives, clinicians, ethicists, and other affected stakeholders should participate in decisions about AI

[38] Ciro Mennella et al., "Ethical and Regulatory Challenges of AI Technologies in Healthcare: A Narrative Review," *Heliyon* 10, no. 4 (2024): https://doi.org/10.1016/j.heliyon.2024.e26297

design and implementation.[39] Equitable governance should also encourage applications that improve access to underserved populations rather than allowing financial incentives and operational efficiency to become the primary determinants of deployment.

The legitimacy of healthcare AI depends on whether its use serves patients and produces meaningful public benefit. Hence, responsible AI governance must combine rigorous evaluation, continuous monitoring, transparent disclosure, proportionate safeguards, patient participation, and clearly assigned accountability. Such an approach can ensure that technological innovation strengthens healthcare delivery without undermining professional judgement, human dignity, patient autonomy, or public accountability.

Conclusion

Artificial intelligence is rejigging healthcare by revamping diagnostic support, expanding access to services, and creating novel opportunities for clinical practice and education. However, its integration also raises concerns about privacy, algorithmic bias, cyberchondria, professional accountability, and excessive reliance on automated decisions. The implications differ across healthcare domains. In mental healthcare, AI must not undermine therapeutic relationships or patient safety. In veterinary medicine, decisions must prioritise animal welfare and professional judgement. In medical education, technological assistance should strengthen clinical reasoning rather than weaken independent thinking and practical competence. Responsible adoption of AI requires clear accountability, transparent decision-making, secure patient data, equitable access, and meaningful human oversight. Legal and ethical safeguards must ensure that professionals retain appropriate responsibility and that individuals can question decisions affecting their care. Governance should remain flexible enough to address the distinct needs of patients, animals, practitioners, and learners. AI's central concern is who controls its use, who benefits from it, and who is held responsible when harm occurs. Its success should therefore be measured not only by efficiency and innovation, but also by safety, fairness, trust, and respect for human dignity. Technology must complement professional expertise, ensuring that progress in healthcare remains accountable, inclusive, and centred on care rather than automation.

[39] Emanuele Ratti, Michael Morrison, and Ivett Jakab, "Ethical and Social Considerations of Applying Artificial Intelligence in Healthcare- a Two-Pronged Scoping Review," *BMC Medical Ethics* 26 (2025): https://doi.org/10.1186/s12910-025-01198-1

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