Artificial intelligence in medical education: Potential and pitfalls

Lyndon Walker

Background
Artificial intelligence (AI) is increasingly being integrated into various sectors, including healthcare and education, offering transformative potential to enhance learning, assessment and professional development. In medical education, AI presents opportunities to enhance educational content and delivery. AI is also having a significant impact more generally in the medical sector.

However, its adoption raises ethical, privacy and accessibility concerns that must be carefully addressed.

Objective
This article explores a range of potential uses of AI in medical education, as well as highlighting some potential risks and pitfalls associated with this emergent technology.

Discussion
AI enhances medical education through personalised learning, simulations and efficient assessments, improving both content delivery and student outcomes. However, ethical concerns, data privacy and over-reliance on technology pose challenges. By addressing these issues through robust governance, human oversight and balanced integration, AI can complement traditional methods, fostering a more innovative and inclusive learning environment for future healthcare professionals.

THE INTEGRATION OF artificial intelligence (AI) into medical education represents a transformative shift in how medical professionals are trained. AI is increasingly used to enhance learning experiences, streamline diagnostic skills and improve patient interactions.[1] The role of AI in medical education extends from data management and cognitive skill development to robotics and simulations, preparing future clinicians for a rapidly evolving healthcare landscape.[2]

There are a wide variety of types of AI and potential applications, to which both learners and educators have increasing access. These include:

- Machine learning algorithms that can analyse large datasets to identify patterns in learner performance, enabling personalised learning pathways tailored to individual needs.[3]
- Large language models, which process and generate human-like text, are increasingly used to create realistic clinical case simulations, generate customised study materials and assist with research by summarising extensive medical literature.[4] These tools also facilitate AI-driven tutors and chatbots that assist learners with medical queries, provide explanations of complex topics and support language translation for diverse learners.
- Computer vision will play a crucial role in medical imaging education, allowing learners to practise diagnosing conditions using AI-assisted image recognition.
- Robotics and automation can be integrated into medical training, particularly in clinical and surgical simulations, where AI-driven robotic systems offer hands-on experience in minimally invasive procedures.[5]

The integration of these AI technologies enhances the adaptability, efficiency and accessibility of medical education, ultimately improving both learning outcomes and clinical preparedness. However, while AI presents significant opportunities for personalised learning and skill development, careful consideration must be given to potential pitfalls, including accuracy concerns, privacy issues, and the risk of over-reliance on this technology.

Aim

This article examines a range of potential applications of AI in medical education while also highlighting some of the risks and challenges associated with AI. Given the space constraints and the vast range of possibilities that AI presents, it is intended as a starting point for an interested reader rather than a comprehensive review. With AI technology changing so rapidly, focus is given to types of applications and types of technology rather than specific brands or apps.

Personalised learning and research-based content knowledge

AI-driven educational content offers significant advantages over traditional learning methods. Customised learning modules leverage AI algorithms to adapt to the unique needs of learners, ensuring a more personalised approach.[3]

Interactive case studies powered by AI provide immersive learning experiences, allowing trainees to engage with virtual patient simulations that enhance diagnostic reasoning and clinical decision-making.

AI can analyse vast volumes of medical literature and provide real-time updates on emerging treatments, ensuring that medical trainees and professionals remain current.[6] AI-driven real-time feedback systems further enhance learning by offering immediate corrections and suggestions, enabling medical learners to refine their skills effectively.[7] Continuous learning platforms powered by AI support continuing professional development (CPD), ensuring that general practitioners (GPs) remain equipped with the latest knowledge and best practices.[8]

Bias recognition and mitigation tools help trainees become aware of unconscious biases that may affect patient care.[9] Adaptive learning algorithms ensure that content is tailored to individual learning styles, maximising efficiency and comprehension.[10] Furthermore, AI supports evidence-based medicine training by analysing and summarising vast datasets, allowing medical professionals to make informed decisions, in real-time in the clinic, based on the latest research.[11]

Diagnostic support

AI-powered tools are reshaping how medical trainees develop their diagnostic skills. AI-based symptom analysis tools assist in recognising disease patterns, providing valuable insights for differential diagnoses.[12] Predictive analytics and image recognition technologies further support clinical decision-making by identifying disease markers that might be overlooked by human practitioners.[13]

Risk assessment models and treatment outcome predictions enhance the ability of medical trainees to assess patient prognosis and make informed decisions. These AI-driven diagnostic support tools bridge the gap between theoretical knowledge and practical application, allowing GP trainees to gain confidence in diagnosing and managing complex cases.

Patient interaction

AI plays a crucial role in developing essential patient interaction skills among medical trainees. AI-powered communication skills enhancement tools analyse speech patterns and provide feedback on tone, clarity and empathy.[14] AI-driven empathy training modules expose trainees to virtual patients, helping them develop a compassionate bedside manner.

Language translation services powered by AI facilitate communication with patients from diverse linguistic backgrounds, ensuring better patient care. Additionally, AI systems analyse non-verbal communication cues, such as facial expressions and body language, to help medical trainees refine their interpersonal skills.

Best practice training for AI tools

As AI tools like scribes, imaging and diagnostic become a standard part of clinical practice, training programs will need to incorporate training on the best practice use of these tools.[15] By incorporating AI training, institutions can ensure that clinicians not only develop technical proficiency in using these tools but also understand their broader implications for patient care. This includes fostering critical thinking skills to interpret AI-generated data appropriately and recognise the limitations of these systems. In addition to best practices for technical use, training should emphasise the safe and sensible application of AI, addressing issues such as ethical decision-making, data privacy and the importance of maintaining human oversight in clinical judgements. A well-rounded AI curriculum will empower healthcare professionals to integrate these advancements confidently while ensuring patient safety and high-quality care.

Robotics and simulations

AI-driven robotics and simulations provide hands-on learning opportunities for medical trainees.[5] Robotic surgery training allows trainees to practice complex procedures in a controlled environment, improving precision and reducing errors. Haptic feedback mechanisms enhance tactile learning, enabling trainees to develop a sense of touch, which is essential for physical examinations.[16]

AI simulations can be used to create a wide range of scenarios for trainees. Emergency response drills powered by AI simulate real-life crisis scenarios, preparing trainees for high-pressure situations. Anatomical three-dimensional models and procedure practice simulators offer interactive learning experiences that reinforce clinical skills. Virtual reality scenarios further immerse trainees in realistic patient interactions, bridging the gap between theoretical knowledge and practical application.[17]

Data management

AI can facilitate Electronic Health Records training, ensuring that medical trainees develop proficiency in handling patient data securely and efficiently. Big data analysis techniques allow trainees to interpret complex datasets, identifying trends that inform clinical decision-making.[18] AI-driven health informatics tools streamline workflow processes, enabling GPs to access relevant patient information quickly. AI-powered data retrieval systems enhance research capabilities, allowing medical trainees to explore extensive medical databases easily. Additionally, AI-driven population health management tools support public health initiatives by identifying patterns and predicting disease outbreaks.

Potential pitfalls and solutions

AI hallucinations and information accuracy

One of the key concerns with AI in medical education is the phenomenon of AI hallucinations, where AI generates incorrect or misleading information.[19] It is important to recognise that errors are not unique to AI; textbooks and human educators can also have inaccuracies,[20] whereas AI models can be updated more frequently to reflect new medical knowledge. However, this does not diminish the significance of hallucinations, which can pose a serious risk, particularly because they can be recurring, may differ with each new generation of output and frequently appear plausible at first glance. This variability makes them difficult to detect, especially for learners who may lack the clinical experience to question or verify such content. Unlike static errors in textbooks, hallucinations can present as confidently phrased, contextually relevant, yet factually incorrect, undermining trust and potentially reinforcing misinformation if not identified and corrected promptly. While hallucination rates are generally improving as AI models become more sophisticated,[21]

the accuracy of AI-generated content is still a primary concern.

In addition to hallucinations, AI applications in medicine and medical education can introduce or exacerbate biases, depending on the datasets used for training and the design of the AI models themselves.[22] These biases may reflect historical inequities, underrepresentation of certain populations or systemic patterns within the training data. The risk becomes even greater when biased AI-generated content is used as input for further AI training, creating a feedback loop that reinforces and amplifies existing inaccuracies or prejudices over time.[23] This cyclical amplification can subtly distort educational materials, diagnostic tools or clinical decision support systems, potentially leading to unequal care or misinformation, particularly for marginalised or under-represented patient groups. To ensure the accuracy and reliability of AI-generated content in medical education, several solutions can be implemented. Human oversight is essential, with experienced medical educators reviewing AI outputs to verify their accuracy. Multi-source verification should also be employed, requiring AI systems to cross-check information against multiple reputable medical sources to minimise errors.

AI tools that provide transparent outputs should be prioritised. These are tools that indicate their confidence levels in predictions and offer references for verification, thereby fostering trust and accountability in their use.

Ethical and privacy concerns

AI's role in medical education raises ethical concerns, particularly regarding data privacy, data security and algorithm bias.[24] Ensuring that AI respects patient confidentiality is crucial, as AI systems often require access to vast amounts of medical data to function effectively. The collection, storage and usage of patient data must adhere to strict privacy standards to prevent unauthorised access and data breaches. Additionally, medical institutions must ensure that AI systems are not used in ways that compromise patient consent and confidentiality. Transparent policies on data usage, robust encryption measures and stringent compliance with ethical standards are essential to maintaining trust in AI-driven medical education.

To address data privacy and ethical concerns in the use of AI in medical education, a multifaceted approach is essential. First, institutions must establish strict data governance frameworks, implement robust data privacy policies and ensure compliance with regulatory standards. Second, anonymisation techniques should be employed to train AI systems on de-identified patient data, minimising the risk of privacy breaches. Third, integrating ethical AI training into medical curricula is crucial to equip trainees with the knowledge and skills needed for responsible AI implementation in clinical practice. These measures collectively safeguard patient privacy, promote ethical standards and ensure the responsible use of AI in medical education and healthcare.

Over-reliance on AI

There is a risk that medical trainees may become overly dependent on AI, potentially diminishing critical thinking and clinical decision-making skills. Where educators rely heavily on AI tools to produce content, it could also result in reduced exposure to 'real' cases given the ease with which AI can produce artificial scenarios.

To mitigate the risk of over-reliance on AI in medical education, a balanced and thoughtful approach is necessary. AI should be integrated into a balanced curriculum that complements, rather than replaces, traditional learning methods, ensuring that foundational skills and human interaction remain central to medical training. Case-based learning should be emphasised, encouraging trainees to critically evaluate and apply AI-generated insights rather than accepting them uncritically. Fostering a culture of human–AI collaboration is essential, positioning AI as a supportive tool that enhances, rather than supplants, human expertise and judgement. These strategies ensure that AI serves as an augmentative resource, preserving the critical thinking, empathy and ethical decision-making that are fundamental to medical practice.

Conclusion

AI presents transformative opportunities in GP medical education, enhancing diagnostic support, patient interaction, cognitive skills development, robotics and simulations, and data management. While challenges such as AI hallucinations, privacy concerns, and over-reliance exist, these pitfalls can be mitigated through human oversight, ethical AI training and robust verification mechanisms.

By harnessing AI's potential responsibly, medical education can become more adaptive, efficient and tailored to the evolving needs of GPs. As AI continues to evolve, its integration into medical training will play a crucial role in shaping the next generation of healthcare professionals, ensuring they are well equipped to navigate the complexities of modern medicine.

Key points

- AI will affect medical education and clinical delivery.
- AI can customise educational content and delivery to enhance the learning experience.
- AI can provide a realistic, risk-free environment to practise clinical skills and decision-making.
- Human oversight is essential in the education process as AI becomes a larger part of medical education delivery.
- Education on the safe and sensible use of AI for educators and learners should be a priority.

Further reading and resources

Articles

- Gordon M, Daniel M, Ajiboye A, et al. A scoping review of artificial intelligence in medical education: BEME Guide No. 84. Medical Teacher. 2024;46(4):446–70. Available at www.tandfonline.com/doi/full/10.1080/0142159X.2024.2314198
- Zarei M, Mamaghani HE, Abbasi A, Hosseini MS. Application of artificial intelligence in medical education: A review of benefits, challenges, and solutions. Medicina Clínica Práctica. 2024;7(2):100422. Available at www.sciencedirect.com/science/article/pii/S2603924923000605

Free courses

- edX/IBM: AI for everyone: Master the basics, www.edx.org/learn/artificial-intelligence/ibm-ai-for-everyone-master-the-basics

- Google: Introduction to generative AI and responsible AI, www.cloudskillsboost.google/paths/118
- Coursera/Stanford: AI in healthcare specialization, www.coursera.org/specializations/ai-healthcare

Substack and blogs

- Ethan Mollick (Wharton Assoc Professor and AI Researcher) – One useful thing, www.oneusefulthing.org
- Luke Yun (Harvard Medical School AI Researcher) – Health intelligence, https://lukeyun03.substack.com

Author

Lyndon Walker BCom, BSc (Hons), MSc (Hons), PhD, GDipHE, Senior Education Researcher, The Royal Australian College of General Practitioners, Melbourne, Vic

Competing interests: None.

Funding: None.

Provenance and peer review: Commissioned, externally peer reviewed.

AI declaration: The authors advise that there was use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and accept full responsibility for all content. Details on how AI was used have been declared to the Editors.

Correspondence to:
Lyndon.walker@racgp.org.au

References

1. Mir MM, Mir GM, Raina NT, et al. Application of artificial intelligence in medical education: Current scenario and future perspectives. J Adv Med Educ Prof 2023;11(3):133–40.
2. Alowais SA, Alghamdi SS, Alsuhebany N, et al. Revolutionizing healthcare: The role of artificial intelligence in clinical practice. BMC Med Educ 2023;23(1):689. doi: 10.1186/s12909-023-04698-z.
3. Gligorea I, Cioca M, Oancea R, Gorski AT, Gorski H, Tudorache P. Adaptive learning using artificial intelligence in e-learning: A literature review. Educ Sci (Basel) 2023;13(12):1216. doi: 10.3390/educsci13121216.
4. Xu X, Chen Y, Miao J. Opportunities, challenges, and future directions of large language models, including ChatGPT in medical education: A systematic scoping review. J Educ Eval Health Prof 2024;21:6. doi: 10.3352/jeehp.2024.21.6.
5. Hamilton A. Artificial intelligence and healthcare simulation: The shifting landscape of medical education. Cureus 2024;16(5):e59747. doi: 10.7759/cureus.59747.
6. Basnawi A, Koshak A. Application of artificial intelligence in advanced training and education of emergency medicine doctors: A narrative review. Emerg Care Med 2024;1(3):247–59. doi: 10.3390/ecm1030026.
7. Narayanan S, Ramakrishnan R, Durairaj E, Das A. Artificial intelligence revolutionizing the field of medical education. Cureus 2023;15(11):e49604. doi: 10.7759/cureus.49604.
8. Cohen B, DuBois S, Lynch PA, Swami N, Noftle K, Arensberg MB. Use of an artificial intelligence-driven digital platform for reflective learning to support continuing medical and professional education and opportunities for interprofessional education and equitable access. Educ Sci (Basel) 2023;13(8):760. doi: 10.3390/educsci13080760.
9. Salavati C, Song S, Diaz WS, et al. Reducing biases towards minoritized populations in medical curricular content via artificial intelligence for fairer health outcomes. In: Proceedings of the AAAI/ACM Conference on AI, Ethics, and Society 2024 Oct 16 (Vol. 7, pp. 1269–80). doi: 10.1609/aies.v7i1.31722.
10. Strielkowski W, Grebennikova V, Lisovskiy A, Rakhimova G, Vasileva T. AI driven adaptive learning for sustainable educational transformation. Sustain Dev (Bradford) 2025;33(2):1921–47. doi: 10.1002/sd.3221.
11. Nilsen P, Sundemo D, Heintz F, et al. Towards evidence-based practice 2.0: Leveraging artificial intelligence in healthcare. Front Health Serv 2024;4:1368030. doi: 10.3389/frhs.2024.1368030.
12. Kangra K, Singh J. Artificial intelligence in healthcare: A paradigm shift. In: Artificial Intelligence Technology in Healthcare 2024 Sep 5 (pp. 1–21). CRC Press.
13. Tariq M, Hayat Y, Hussain A, Tariq A, Rasool S. Principles and perspectives in medical diagnostic systems employing artificial intelligence (AI) algorithms. International Research Journal of Economics and Management Studies (IRJEMS) 2024;3(1).
14. Akdilek S, Akdilek I, Punyanunt-Carter NM. The influence of generative AI on interpersonal communication dynamics. In: Elmoudden S, Wrench J, editors. The role of generative AI in the communication classroom. IGI Global Scientific Publishing, 2024; p. 167–90. doi: 10.4018/979-8-3693-0831-8.ch009.
15. Balloch J, Sridharan S, Oldham G, et al. Use of an ambient artificial intelligence tool to improve quality of clinical documentation. Future Healthc J 2024;11(3):100157. doi: 10.1016/j.fhj.2024.100157.
16. Minopoulos GM, Memos VA, Stergiou KD, Stergiou CL, Psannis KE. A medical image visualization technique assisted with AI-based haptic feedback for robotic surgery and healthcare. Appl Sci (Basel) 2023;13(6):3592. doi: 10.3390/app13063592.
17. Chheang V, Sharmin S, Márquez-Hernández R, et al. Towards anatomy education with generative AI-based virtual assistants in immersive virtual reality environments. In: 2024 IEEE International Conference on Artificial Intelligence and eXtended and Virtual Reality (AIxVR), 2024; p. 21–30. doi: 10.1109/AIxVR59861.2024.00011.
18. Nova K. Generative AI in healthcare: Advancements in electronic health records, facilitating medical languages, and personalized patient care. Journal of Advanced Analytics in Healthcare Management 2023;7(1):115–31.
19. Zhou J, Zhang J, Wan R, et al. Integrating AI into clinical education: Evaluating general practice trainees' proficiency in distinguishing AI-generated hallucinations and impacting factors. BMC Med Educ 2025;25(1):406. doi: 10.1186/s12909-025-06916-2.
20. Cohen R, Renaud MC, Huguet F, André T, Duguet A, Steichen O. Discrepancies in medical textbooks and their impact on medical school students. Bull Cancer 2021;108(1):18–22. doi: 10.1016/j.bulcan.2020.11.005.
21. Vectara. Hallucination Leaderboard 2024. Available at https://github.com/vectara/hallucination-leaderboard [Accessed 14 February 2025].
22. Ferryman K, Mackintosh M, Ghassemi M. Considering biased data as informative artifacts in AI-assisted health care. N Engl J Med 2023;389(9):833–38. doi: 10.1056/NEJMra2214964.
23. Taori R, Hashimoto T. Data feedback loops: Model-driven amplification of dataset biases. In: International Conference on Machine Learning PMLR, 2023; p. 33883–920.
24. Farooqi MT, Amanat I, Awan SM. Ethical considerations and challenges in the integration of artificial intelligence in education: A systematic review. Journal of Excellence in Management Sciences 2024;3(4):35–50. doi: 10.69565/jems.v3i4.314.

correspondence **ajgp@racgp.org.au**