

EDITORIAL

Artificial Intelligence in Medical Education: Preparing Future Physicians for an AI-Driven Healthcare System

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Artificial intelligence (AI) is a transition from an old speculative idea to a new comprehensive idea that is a vital element for healthcare and medical education. AI is either generative or assistive, strengthening the field of study. The most popular generative AI platform, ChatGPT, along with other language models, has been widely used by medical students to access information, solve problems, develop clinical reasoning, and prepare for examinations. On the other hand, educators are searching for AI-assisted technologies for assessment and evaluation design, feedback generation, curriculum development, teaching methods and strategies, and various research. This notable evolution presents huge opportunities while also raising concerns about ethical practice, data privacy, learners' professionalism and dependency, writing individuality, academic integrity, and professional accountability.

In the evolution and development of science and technology, medical education has evolved historically. There is extensive incorporation of machine-based learning, simulation-based learning, digital anatomy platforms, virtual patients and simulation, electronic medical records, and electronic mannequins that demonstrate and facilitate the learning process and underscore the importance of innovation in learning. AI enhances the future phase of this evolution. Generative AI not only disseminates information but also supports original writing, summarisation, formulation of clinical cases, and problem-solving and decision-making.

However, medical schools face challenges in whether to incorporate AI into the education system and how to ensure that incorporation maintains the integrity and core values of the medical profession.

Opportunities for Transforming Medical Education

AI brings remarkable opportunities to intensify learning in both undergraduate and postgraduate medical education. The most significant is individual learning. In traditional medical teaching, the same materials are delivered to every student, while AI offers the opportunity to tailor content to individual needs, allowing students to learn at their own pace and create content according to their requirements. This system also helps students understand their own weaknesses and strengths. Therefore, this adaptive learning approach directs the self-directed learning that is the part and parcel of lifelong learning in medicine.

Generative AI is used as a learning helper for students. By using AI, students can improve their ability to understand complex physiological mechanisms, prepare revision notes, summarise lecture notes or book reviews, prepare clinical case problems and scenarios, and practise exam questions related to the topic. These tools promote active learning and understanding according to students' level. Traditional classroom teaching only provides notes and understanding within a defined time; an AI-powered virtual tutor supports them indefinitely and guides them to explain and give feedback when used properly and effectively.

Moreover, medical educators benefit from AI-assisted technologies. Educators can use AI to prepare daily lessons, learning objectives or outcomes for classes, prepare quizzes for in-class activities, construct multiple-choice questions, modified essay questions, and short-answer questions, create objective structured clinical examinations (OSCE) and objective structured practical examinations (OSPE), and draft lecture

materials. Administrative work can be less time-consuming by using AI, such as mentoring students, assisting clinical reasoning, and nurturing professionalism.

AI application is promising in another aspect of medical education, that is, simulation-based education. AI enhances virtual patient encounters with realistic clinical conversations, stimulating students to practice history-taking, physical examination, diagnosis, and clinical decision-making in a realistic, in-house clinical environment. Though this innovation is expensive to support students, it provides real patient scenarios where limited patient availability allows students to practice as long as they can.

Challenges That Cannot Be Ignored

When there are pros, there are also cons. AI advantages are significant, but it has educational risks as well. Firstly, most language models contain unscientific, fabricated, and inaccurate information that can give students wrong guidelines. Medicine deals with human beings, not machines. Therefore, any wrong information that students learn directly has an impact on patient care, which can have serious consequences. Educators and students should be careful to verify information before applying it to patients. On the other hand, AI should collect and deliver information through evidence and recognised sources.

Secondly, academic integrity is another major concern. Assignments, essay writing, reflective writing and question answers can be produced directly by generative AI. Previous traditional methods could detect students' understanding, writing ability and patterns of answers. But due to AI assistance, it is difficult to evaluate this performance. Though it is difficult to stop using AI and it has beneficial effects also, therefore, medical schools should redesign the assessment techniques, in-class activities, physical examinations, oral examinations, work-based assessments, clinical performance and practical-oriented evaluations rather than written assessments outside the supervisor's settings.

Another concerning issue is independent clinical reasoning. Medical education is not just about providing knowledge to students but also about training them to communicate with empathy to patients, interpret uncertainty, and balance patient preferences with professional judgement. Unfortunately, higher-order thinking and interpersonal competencies cannot be possible with AI tools. Therefore, students might lack training in analysing complex situations and dealing with patient empathy.

Integrating AI into medical education is complicated by ethical considerations. It is very challenging to address copyright, patient confidentiality, informed consent, transparency, and so on. Students might not know how to use AI ethically or when it should not be used. Proper and ethical use of AI that adheres to professional ethics and clinical decisions, not for algorithms, which are the backbone of healthcare professionals.

AI Literacy as a Core Competency

Although AI has many beneficial effects and provides guidance to students, medical schools should emphasise AI literacy as a core competency. They must train students in the ethical considerations of AI, its appropriate applications in clinical and educational settings, and its limitations.

Medical graduates with AI training must have sufficient knowledge about AI-generated information. They should be able to understand potential biases and inaccuracies, patient confidentiality, evidence-based information and decision-making skills. They should know AI is for assistance, not to replace their knowledge and skills, clinical reasoning, professionalism and ultimate patient care.

Moreover, Faculty need to play vital roles in the effective use of AI. Most faculty members do not have an idea about the use of AI in teaching, assessment and evaluation. Therefore, faculty must arrange workshops or training for faculty members to effectively use AI in teaching, learning, assessment and evaluation. This will help them train students and apply AI effectively (Figure 1).

Implications for Medical Schools in Malaysia and Southeast Asia

The incorporation of AI in medical education in Malaysia and other Southeast Asian countries is appropriate. In this region, medical schools have digital learning platforms, simulation-based education and blended-learning methodologies. However, AI implementation cannot be fully effective because of faculty expertise, lack of technological infrastructure and institutional policies. Therefore, complete coordination is essential to incorporate AI in medical education and provide students with

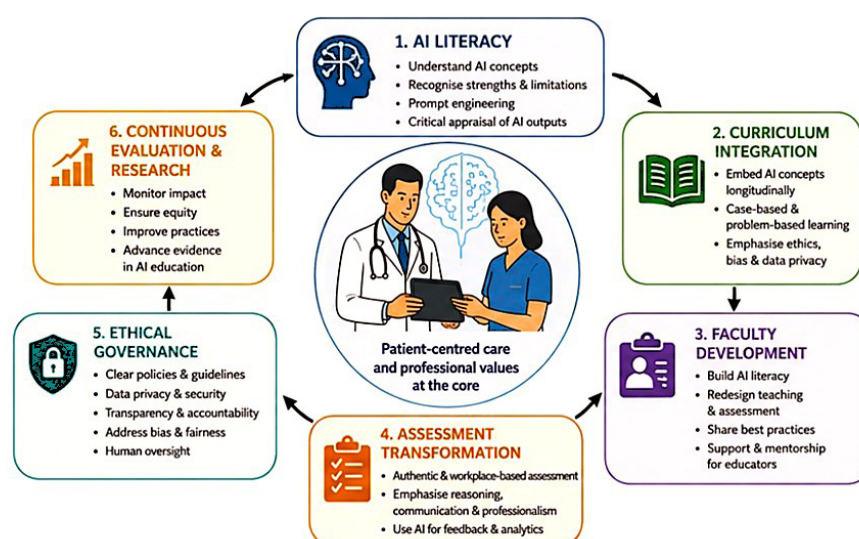


Figure 1: Framework of responsible AI integration in medical education.

AI-enhanced educational opportunities.

AI incorporation in medical education is therefore not limited to a single lecture but needs to be considered in the curriculum as longitudinal incorporation for both undergraduate and postgraduate students. To train healthcare students about AI, the fundamentals of AI, ethical considerations, data governance, algorithms, critical appraisal, and clinical decision support should be integrated into the core competency curriculum.

In addition, faculty development is also important. Educators must know the uses and limitations of generative AI and how to incorporate this tool into their teaching, assessment, and evaluation practices. Therefore, the train-the-trainers method can be used to train the educators. Continuous professional development can build their practical knowledge and skills related to AI use, assessment redesign, incorporating students in class, evaluating students using AI, and ethical digital professionalism.

Moreover, medical schools must have clear institutional policies for AI use. These guidelines should properly mention brainstorming, formative learning, revision summarisation, as well as inappropriate techniques and misuse of AI. Clear guidelines and transparent policies can provide educators and students with a clear understanding of AI use.

Keeping Humanity at the Centre of Medical Education

Despite rapidly evolving technology, the basics of medicine remain deeply human. Compassion, ethics, professionalism, cultural sensitivity, effective communication, and, most of all, empathy are the fundamentals of medicine that cannot be entrusted to AI. Diagnosis is not the only strategy for the patient; rather, it is a health practitioner-patient relationship that includes reassurance, trust and shared decision-making.

Therefore, AI is not a substitute for educators or clinicians; rather, it is an educational partner. Future physicians will

know how to integrate theoretical and practical knowledge to critically assess AI-generated information, communicate uncertainty, acknowledge algorithm limitations, and make context-sensitive clinical decisions. Medical education should include AI technologies, and graduates should have the confidence to use them through lifelong learning, reflective practice, and fostering curiosity.

Educators have opportunities to incorporate AI in assessment methods. Not only can AI be used to assess, but it can also be used to evaluate, such as assessing clinical reasoning, ethical judgment, teamwork, communication, patient-oriented problem-solving, and clinical decision-making. AI techniques can support humanisation techniques.

Recommendations for Medical Schools

To effectively prepare future physicians, medical schools should consider several strategic initiatives:

1. Integrate AI literacy as a core competency for both undergraduate and postgraduate students.
2. Institutional guidelines for the implementation of AI in teaching, learning, assessment and evaluation should be established.
3. Assessment strategies should be redesigned for clinical reasoning, professionalism and workplace-based competency.
4. Curriculum review in faculty to incorporate AI-assisted teaching, learning and assessment.
5. Train the students to critically assess AI-generated answers by using evidence-based clinical guidelines.
6. Interdisciplinary collaboration among clinicians, medical educators, policy makers, data scientists, and ethicists to ensure safe and sound integration of AI in healthcare education (Figure 2).

AI is the most innovative transformation in medical education. It significantly contributes

OPPORTUNITIES	CHALLENGES	KEY RECOMMENDATIONS
 Personalised and adaptive learning	 AI hallucinations and inaccuracies	 Teach AI literacy and critical appraisal skills
 Intelligent tutoring and instant feedback	 Academic misconduct and integrity issues	 Redesign assessment (authentic, workplace-based)
 Simulation and virtual patients	 Bias and inequity in AI outputs	 Ensure fairness, diversity in data and outputs
 Clinical decision support and learning tools	 Privacy and data security concerns	 Strengthen data governance and confidentiality
 Efficiency in curriculum and assessment design	 Overreliance and erosion of critical thinking	 Promote human oversight and balance technology with human judgement
 Research assistance and evidence synthesis	 Lack of transparency and explainability	 Use explainable AI and require transparency of AI use

Figure 2: Opportunities, challenges and key recommendations for AI in medical education.

to self-learning, increases educational efficiency, supports simulation-guided training, and promotes self-motivated learning, offering valuable opportunities for both students and educators. In addition to these benefits, there are challenges related to accuracy, bias, academic integrity, professionalism, and ethical considerations. To train the future physicians, there is now a demand to prepare them for an AI-driven healthcare landscape to adopt AI-related technologies. Every medical school should prepare future graduates who can critically, responsibly and ethically utilise these AI technologies while keeping the humanistic values that are the backbone of the medical profession. Therefore, the aim is not to produce healthcare professionals who simply accept or rely on AI, but rather to produce physicians who understand when, how, why, and where to apply AI for patient care and needs, while maintaining clinical judgment, professionalism, and compassion.

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