Available online www.worldscientificnews.com

World Scientific News

An International Scientific Journal

WSN 207 (2025) 89-95 EISSN 2392-2192

Artificial Intelligence in Medical Education: A Cautionary Advice for Medical Students

Hasheem AL-Qahtanee[1,2]

[1]SMA Health Group, Ringvägen 121A, 116 61 Stockholm, Sweden

[2]King Abdalla Medical City, AL-Werda, Bahrain

*Corresponding author:

Dr. Hashem Al- Qahtanee

Västgötagatan 7, Zip code: 11152 Stockholm, Sweden

Email: hasheemalqahtanee@gmail.com

ABSTRACT

The integration of Artificial Intelligence (AI) into medical education offers substantial benefits but also presents critical challenges. As AI technologies become more embedded in healthcare, medical students face pitfalls such as over-reliance on AI tools, limited understanding of their limitations, and insufficient training in ethics and data quality. Many students feel unprepared to critically evaluate AI-generated recommendations, raising concerns about the erosion of clinical reasoning and decision-making skills. This dependence may result in future physicians who struggle to apply core medical principles independently. Furthermore, the lack of formal AI education leaves students unable to fully grasp ethical issues, including algorithmic bias and the opacity of "black box" decision-making. Although students recognize AI's potential to enhance clinical outcomes, they also express concern about inadequate preparation for navigating its ethical complexities. This disconnect highlights the need for structured training that addresses both technical competencies and ethical considerations. Experts stress the importance of integrating AI education into medical curricula, emphasizing not only how AI systems function but also how to critically appraise their outputs and ensure patient-centered care. A balanced curriculum should foster critical thinking, ethical awareness, and real-world application. By equipping students with these skills, educational institutions can prepare future healthcare professionals to use AI as a supportive tool without compromising their clinical judgment or ethical responsibilities. In doing so, the medical field can embrace AI innovation while safeguarding the integrity of patient care and upholding professional standards.

Keywords: Education, Data integrity, Skin carcinoma, Artificial Intelligence, DNA damage, Data integrity

(Received 10 July 2025; Accepted 17 August 2025; Date of Publication 13 September 2025)

KEY POINTS:

- Over-reliance on AI may weaken clinical reasoning and independent decision-making.
- Lack of AI ethics training leaves students unprepared for real-world complexities.
- Structured AI education is essential to balance tech use with patient-centered care.

1. INTRODUCTION

The integration of Artificial Intelligence (AI) into medical education is a rapidly evolving phenomenon that presents both significant opportunities and notable challenges for medical students. As AI technologies increasingly permeate healthcare, students must navigate a landscape fraught with potential pitfalls, including over-reliance on AI tools, inadequate formal education about these technologies, ethical dilemmas, and concerns regarding data quality and bias. The urgency for comprehensive AI education within medical curricula has become evident, as many students report feeling unprepared to critically engage with AI's capabilities and limitations, which are crucial for effective patient care [1,2,3]. One of the most pressing concerns is the tendency of medical students to depend heavily on AI-generated recommendations, which can compromise their critical thinking and clinical decision-making skills. This over-reliance risks leading to a generation of healthcare professionals who may struggle to apply fundamental medical principles in practice [4,5]. Additionally, a lack of structured AI education leaves students ill-equipped to understand and address the ethical implications of AI, such as the biases inherent in algorithms and the opaque nature of "black box" decision-making processes [6,7]. The ethical landscape surrounding AI in medicine adds another layer of complexity. While many students express optimism about AI's potential to enhance clinical practice, they simultaneously acknowledge a concerning gap in training related to ethical considerations and accountability. This disconnect raises questions about the responsibilities of future medical professionals when faced with AI-generated recommendations that may not align with patient welfare or ethical standards [8,9]. To address these challenges, experts advocate for a comprehensive approach to AI education that combines technical training with a strong emphasis on ethics, critical appraisal skills, and real-world applications. By preparing medical students to navigate the complexities of AI responsibly, educational institutions can ensure that future healthcare providers leverage AI as a powerful tool while maintaining a commitment to quality patient care and ethical practice [10,11].

2. PITFALLS OF AI USAGE IN MEDICAL EDUCATION

The integration of Artificial Intelligence (AI) into medical education presents both opportunities and challenges. Despite the growing presence of AI technologies in healthcare, medical students often encounter several pitfalls in their use of these tools, which can impact their education and future practice. One significant concern is the tendency of students to over-rely on AI for various academic tasks. This reliance can undermine critical thinking and problem-solving skills, as students may default to AI-generated solutions without engaging in deeper analysis or understanding the underlying principles of medicine [1]. The perception of AI as a quick fix can lead to a lack of preparedness in clinical decision-making, potentially affecting the quality of patient care in the future [2]. Despite high levels of engagement with AI applications, a considerable number of medical students report insufficient formal education regarding these technologies. A study highlighted that 88% of medical students feel their education on AI is inadequate, revealing a substantial gap in medical curricula [3]. This lack of structured education raises concerns about students' abilities to critically evaluate AI tools and their outputs, which are crucial in ensuring effective and safe patient care [3,4].

The ethical implications of AI usage in medical contexts are another area of concern. Many students express optimism about AI's role in medicine, with 71.1% perceiving its potential benefits, yet, this optimism is not grounded in adequate training [3]. Students may overlook significant limitations, including the risks associated with "black box" decision-making, where AI algorithms make conclusions that are not transparent or understandable to users [5,6]. This opacity can lead to a dangerous overconfidence in AI recommendations, which could compromise clinical judgment. AI systems are highly dependent on the quality of the data used to train them. Poor or biased data can lead to inaccurate outcomes and may inadvertently reinforce existing health disparities [2,5]. Medical students must be educated about these issues to critically assess AI tools and their applications. Without a thorough understanding of data representation and potential biases, students risk perpetuating inequalities in healthcare delivery [2].

3. THE NEED FOR COMPREHENSIVE AI EDUCATION

In light of these challenges, there is a pressing need for comprehensive AI education integrated into medical curricula. Such education should not only cover the technical aspects of AI but also emphasize ethical considerations and critical appraisal skills [4]. Preparing future medical professionals to navigate the complexities of AI will be crucial for ensuring that these tools are used responsibly and effectively in clinical practice, ultimately benefiting patient outcomes and healthcare systems as a whole [2,4].

4. CAUTIONS FOR MEDICAL STUDENTS

As artificial intelligence (AI) becomes increasingly integrated into medical practice, it is crucial for medical students to approach this technology with caution. The rapid advancement of AI capabilities poses significant ethical and practical challenges that students must navigate as they prepare for their future roles in healthcare. While AI has the potential to enhance clinical decision-making, diagnosis, and patient care, it also raises concerns about responsibility, over-reliance, and the erosion of critical thinking skills among future physicians [7,8]. One of the primary dangers associated with AI in medicine is the risk of medical professionals becoming overly reliant on AI-generated recommendations. This dependency could undermine their clinical judgment and decision-making skills, leading to a decrease in critical thinking abilities [9,10]. Moreover, students have expressed apprehension about the ethical implications of AI, particularly regarding biases inherent in AI algorithms and their impact on patient care. As highlighted by recent studies, medical students report feeling inadequately prepared to address patients' concerns about AI, indicating a significant gap in their training related to this emerging technology [7,11]. The integration of AI in medical practice also raises important questions about responsibility and accountability. Medical students are concerned about the lack of clear regulations governing AI applications, which could leave them unprepared to address potential ethical dilemmas in their future practices [11,12]. It is essential for educational institutions to include discussions on AI ethics and accountability within their curricula to ensure that future healthcare providers are equipped to handle these challenges responsibly.

5. RECOMMENDATIONS FOR MEDICAL EDUCATION

To mitigate the risks associated with AI, medical schools should adopt a dual-focused educational approach that combines data science and AI training with traditional medical education. This could involve the inclusion of dedicated modules on AI, biostatistics, and the ethical implications of technology in healthcare [11,12].

Encouraging students to critically assess AI tools, including their limitations and biases, will be vital in fostering a generation of physicians who can utilize AI effectively while maintaining a strong foundation in clinical reasoning and ethical practice. By cultivating a balanced understanding of AI's capabilities and limitations, medical students can better prepare themselves to leverage this technology as a valuable tool rather than a crutch that could compromise patient care and their professional development [13,14].

6. SOLUTIONS AND BEST PRACTICES

To successfully integrate artificial intelligence (AI) into medical education, a multidisciplinary approach is essential. This includes innovative data annotation methods and the development of rigorous AI techniques and models. Collaboration between computer scientists and healthcare providers will foster an environment conducive to creating practical and usable technology for clinical practice [15]. Sharing data across multiple healthcare settings will also enhance data quality and verify analyzed outcomes, which are critical for the successful adoption of AI technologies [15]. Medical schools must prioritize the incorporation of AI into their curricula. This should involve developing AI-focused modules that are engaging and easy to learn, ensuring that students acquire the necessary skills to thrive in their future medical careers [12,16]. A longitudinal approach to teaching AI across various subjects will help students understand its breadth and applicability in healthcare [11]. Practical, hands-on experience with AI technologies should be emphasized, as students expressed the importance of real-world applications and the use of advanced visualization techniques like 3D models and animations [17]. Developing AI curricula requires collaboration among educators from various disciplines. This collaborative effort can facilitate the integration of AI into existing medical training and ensure that all learners have equal opportunities to benefit from these technologies. Institutions should invest in infrastructure that supports AI education and foster partnerships with AI experts to create interdisciplinary learning opportunities [11,18]. Furthermore, incorporating case-based learning and simulation scenarios with AI-driven recommendations can familiarize students with AI solutions in clinical settings [11]. To prepare educators for the evolving role of AI in medicine, investment in their training and development is crucial. Creating a safe environment for educators to explore AI applications will be vital for guiding students through this transformation [18]. Ongoing workshops and seminars on emerging AI technologies can support continuous professional development, ensuring that faculty remain knowledgeable and competent in teaching AI-related content [17].

7. ETHICAL CONSIDERATIONS

Medical education should also emphasize ethical considerations surrounding the use of AI. Students have indicated the necessity for transparency and explainability in AI systems to understand their decision-making processes better. This includes addressing ethical challenges that may arise from AI applications, as future physicians will encounter complex scenarios that require a solid understanding of ethical principles [8,19,20]. The incorporation of ethical training into AI education will equip students with the skills necessary to navigate these challenges effectively [8].

8. RESEARCH AND EVALUATION

Future research should focus on evaluating the long-term impact of AI education on clinical outcomes and the effectiveness of various teaching methodologies. Policymakers are encouraged to allocate funding for AI training programs and establish guidelines for ethical AI use in healthcare settings.

Developing a national framework for AI literacy in medical education will also ensure that students are adequately prepared for a technology-driven healthcare environment [17,21]. By implementing these solutions and best practices, the medical education community can effectively integrate AI into training programs, ultimately enhancing healthcare delivery and outcomes.

9. CASE STUDIES AND REAL-WORLD EXAMPLES

Recent advancements in artificial intelligence (AI) have introduced dynamic approaches to case-based learning in medical education. Utilizing scenarios where AI is currently implemented in clinical practice serves as effective examples for students, fostering a deeper understanding of both AI capabilities and limitations [22]. Such methods allow for the integration of AI-based recommendations into clinical scenarios, enhancing students' exposure and familiarity with AI applications in medical contexts [11]. Real-world case studies highlight various ethical challenges associated with AI in medicine. For instance, when generative AI collaborates with human medical professionals, it leads to non-frozen interactions, where both the AI and the clinician can modify their views on medical diagnoses through mutual interaction [14]. This collaborative environment necessitates a critical examination of ethical implications, particularly when AI encounters pitfalls in clinical settings [23]. Public attitudes toward AI in healthcare are mixed. A significant proportion of the population is skeptical about the potential improvements AI could bring to health outcomes; only 38% believe AI applications like disease diagnosis and treatment recommendations would enhance patient care [24]. Concerns regarding empathy, emotional well-being, and the ability of AI to navigate unforeseen situations underscore the limitations of AI in addressing complex human factors inherent in medical practice [12]. Moreover, issues such as accountability in case of errors, AI's potential to undermine physician autonomy, and the biases that may be perpetuated by AI systems have emerged as major points of contention [5,25]. To address these concerns and improve students' mastery of AI tools, medical education institutions are encouraged to implement practice-oriented teaching formats. Workshops based on real-life cases and online simulation courses can provide students with safe environments to engage with AI technology [26]. This experiential learning approach can build confidence in the technology while simultaneously addressing the ethical and practical considerations that arise from its use in clinical settings.

10. CONCLUSION

As artificial intelligence becomes increasingly embedded in medical education, it is vital that its integration is guided by careful consideration, ethical awareness, and structured training. While AI offers promising tools to support learning and clinical practice, uncritical reliance and lack of adequate education can undermine core competencies and patient care standards. By equipping medical students with technical knowledge, critical thinking skills, and a strong ethical foundation, educational institutions can ensure that future healthcare professionals use AI responsibly and effectively.

Declarations

Ethical Approval: not applicable

Authors' contributions

HAQ: Conception, study design, literature review, writing, and final approval.

Conflict of Interest

The authors declare that they have no conflict of interest.

References

[1] Armstrong BK, Kricker A. The epidemiology of UV-induced skin cancer. *Photochem Photobiol Sci*. 2001;84447.

[2] Cadet J, Douki T. Formation of UV-induced DNA lesions: cyclobutane pyrimidine dimers and 6–4 photoproducts. *Photochem Photobiol Sci*. 2018; 12:1816–35.

[3] Mouret S, Baudouin C, Charveron M, Favier A, Cadet J, Douki T. Cyclobutane pyrimidine dimers predominate in human skin exposed to UVA. *Proc Natl Acad Sci U S A.* 2006; 37:13765.

[4] Fan F. Mechanism of ultraviolet radiation-induced basal cell carcinoma. *Ann Transl Med.* 2023; 11:55995.

[5] Mouret S. Cooperation between base and nucleotide excision repair on UV lesions. *Genet Mol Biol (São Paulo)*. 2006;29.

[6] Paulo MS, Symanzik C, Ádam B. Risk of cutaneous squamous cell carcinoma due to occupational solar ultraviolet exposure: protocol. *PLoS One.* 2023;18:e0282664.

[7] Gobba F, Modenese A, John SM. Skin cancer in outdoor workers exposed to solar radiation in Italy. *J Eur Acad Dermatol Venereol.* 2019; 33:2068.

[8] Ling G, Persson A. Persistent p53 mutations in single cells from normal skin. *Am J Pathol.* 2001;159:1247.

[9] Glass AG, Hoover RN. The rising epidemic of melanoma and non-melanoma skin cancers. *Photochem Photobiol.* 1989;38:569–75.

[10] Bajdik CD, Gallagher RP, Astrakianakis G. Non-solar UV radiation and risk of basal and squamous cell cancer. *Br J Cancer.* 1996; 73:1612–4.

[11] de Winter S. Solar-simulated UV exposure and epidermal DNA damage. *J Invest Dermatol.* 2001;117:867–74.

[12] Cadet J, Anselmino C, Douki T, Voituriez L. Photochemistry of nucleic acids in cells: UV-induced DNA damage. *Photochem Photobiol Sci.* 1992.

[13] Beani JC. Ultraviolet A-induced DNA damage: role in skin cancer. *Bull Acad Natl Med.* 2014; 198:273 95.

[14] Anderson MW, Hewitt JP, Spruce SR. Broad spectrum physical sunscreens: TiO_2 and ZnO. *Photodermatol Photoimmunol Photomed.* 1997.

[15] Protić-Sabljić M, Tuteja N, Munson PJ, Dixon K. UV light-induced pyrimidine dimers mutagenic in mammalian cells. *Proc Natl Acad Sci U S A.* 1986.

[16] Ley RD. Photoreactivation of UV-induced pyrimidine dimers in opossum skin. *Photodermatol.* 1985.

[17] Narayanan DL, Saladi RN, Fox JL. UV radiation and skin cancer. *Int J Dermatol.* 2010;49:978–86.

[18] C Seebode, Lehmann J, Emmert S. Photocarcinogenesis and skin cancer prevention. *Anticancer Res.* 2016;36.

[19] Wehner MR, Shive ML, Chren MM, Han J, Qureshi AA. Indoor tanning and non-melanoma skin cancer: systematic review. *BMJ.* 2012;345:e5909.

[20] Mohan SV, Chang AL. Advanced basal cell carcinoma epidemiology and innovations. *Curr Dermatol Rep.* 2014;3.

[21] Karia PS, Han J, Schmults CD. Cutaneous squamous cell carcinoma incidence and mortality. *J Am Acad Dermatol.* 2012;67.

[22] April 2001 study: UVA and melanoma, *J Am Acad Dermatol.* 2001;45(5).

[23] Wright C. Sun exposure and childhood melanoma risk. *Arch Dis Child.* 2006;91.

[24] Morton, CA. Occupation and melanoma risk. *Cancer.* 1995;75.

[25] Dennis LK. Airline pilots melanoma risk meta-analysis. *JAMA Dermatol.* 2015;151.