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A Qualitative Analysis of the Current State of Artificial Intelligence in Medical Education

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Abstract

Artificial intelligence (AI) is transforming healthcare and medical education, offering opportunities to enhance learning, diagnostic reasoning, and personalized instruction. However, its integration into undergraduate medical education (UME) remains a challenge, necessitating a balance between technological advancements and ethical considerations. This study investigates best practices for incorporating AI into UME curriculum through a qualitative thematic analysis of recent literature. Key themes identified include AI's potential to improve medical student performance, ethical concerns related to privacy and bias, and the need for expanded AI education to allow for curricular integration. While AI offers significant benefits in medical training, challenges such as academic integrity, patient confidentiality, and the risk of over-reliance on AI highlight the necessity for structured, ethical, and evidence-based AI education. The findings underscore the importance of developing comprehensive curricula that equip future physicians with the knowledge and critical thinking skills required to navigate AI-assisted healthcare responsibly.

Keywords

Artificial Intelligence, Medical Education, Ethical Considerations

1. Introduction

Artificial intelligence (AI) is revolutionizing various sectors of society, including healthcare and education. AI has been readily integrated into the professional world of medicine, identifying different lung sounds and analyzing patient imaging with an accuracy equal to or greater than physicians [1] [2]. In medical education, AI

has the potential to enhance learning, improve diagnostic reasoning, and personalize instruction. However, its integration into undergraduate medical education (UME) remains an evolving challenge. As AI becomes increasingly prevalent in clinical practice, medical schools must determine how to strategically incorporate AI education into their curricula while still aligning this with their institutional goals. The thoughtful integration of AI in UME can help future physicians develop the necessary competencies to navigate AI-assisted healthcare environments while maintaining humanistic and ethical patient care.

The purpose of this study is to investigate how AI can be systematically and ethically incorporated into the curriculum of academic medical institutions. Specifically, this study aims to explore best practices for integrating AI into UME in a manner that supports both medical education and responsible AI use in clinical settings. The ethical dimensions of AI education are particularly important, as the implementation of AI in medicine raises concerns related to patient privacy, loss of interpersonal skills, and the potential for bias. Medical students must be equipped not only with technical knowledge but also with critical thinking skills to assess AI applications in practice.

To achieve these objectives, a qualitative thematic analysis of relevant literature was conducted. Scholarly articles and research studies were systematically reviewed to identify significant findings regarding AI integration in medical education. Through this process, key themes emerged, highlighting the opportunities, challenges, and institutional considerations involved in implementing AI-based learning in UME. These themes provide insights into current best practices, including curricular frameworks and ethical guidelines for AI education in medical training. By synthesizing these findings, this study aims to contribute to the ongoing discussion on how medical schools can effectively integrate AI into their curricula in a way that enhances education while upholding ethical and professional standards.

Relevant academic literature on the integration of artificial intelligence (AI) in undergraduate medical education (UME) was identified using a systematic approach. Given the exponential expansion of AI-related research, the initial search yielded a substantial volume of literature. However, to ensure the relevance and applicability of the findings to contemporary medical education, inclusion criteria were restricted to peer-reviewed articles published within the last five years that specifically addressed the role and integration of AI in UME. Following a rigorous selection process, eighteen articles were identified as most pertinent to the study's objectives. These articles were subsequently reviewed and analyzed through a qualitative thematic approach to discern key trends.

The findings from this review underscore the increasing global adoption of AI within undergraduate medical curriculum, reflecting a growing recognition of its potential to enhance educational outcomes. The identification of thematic consistencies across the selected studies was facilitated through qualitative thematic analysis, which is further detailed in the methodology and summary sections. This the-

matic synthesis provides a foundational understanding of the prevailing strategies and challenges associated with AI integration in medical education, offering valuable insights for academic institutions seeking to develop informed, ethical, and effective approaches to AI incorporation.

2. Methodology

2.1. Data Collection

A qualitative thematic analysis was conducted to explore best practices for integrating artificial intelligence (AI) into undergraduate medical education (UME). Academic databases, including **PubMed, Google Scholar, JSTOR**, and institutional electronic resources at **West Virginia University** and **Louisiana State University Shreveport**, were searched between January and June 2025. The following key terms were used: "*Artificial Intelligence in Medical Education*", "*AI in Undergraduate Medical Training*", "*Ethical Integration of AI in Medicine*", and "*AI Curriculum Design in Medical Schools*". Inclusion criteria required studies to be **peer-reviewed**, published between **2019 and 2025**, be indexed in PubMed, Google Scholar, or JSTOR, and to specifically address **AI integration, ethical implications, or performance outcomes in UME**. Of the 13,961 studies meeting the inclusion criteria, **eighteen studies** met inclusion criteria after title, abstract, and full-text screening. These included cross-sectional studies, systematic reviews, and mixed-methods research evaluating medical students' perceptions and institutional practices.

2.2. Data Analysis

Each study was independently coded by the primary investigator to identify recurring concepts, attitudes, and reported challenges. Codes were grouped into thematic clusters reflecting major domains of AI in medical education: **performance enhancement, ethical considerations,** and **curricular integration**. The data were organized in Microsoft Excel, where axial coding was used to identify relationships between themes, supported by a frequency analysis of repeated subtopics such as *academic integrity*, *data privacy*, and *bias mitigation*.

Findings were synthesized into a narrative framework that emphasized both convergence and divergence across global contexts. A reflexive analysis process was used to ensure transparency and reproducibility. Discrepancies between sources were reconciled through iterative review and alignment with emerging evidence from recent educational frameworks on AI literacy.

3. Results

Themes

Performance and Competency Enhancement

Many studies indicate that students believe AI can play a critical role in reducing medical errors and improving diagnostic accuracy, ultimately contributing to better patient outcomes [3] [4]. Additionally, AI is perceived as a tool that could

expand access to healthcare, particularly for lower-income populations, by streamlining workflows and optimizing resource allocation [5]. This belief underscores AI's capacity to bridge gaps in healthcare accessibility and efficiency. Additionally, some studies have even suggested that medical students believe AI helps them grasp concepts better than traditional didactic learning [5].

However, quantitative studies examining the direct impact of AI-driven education on student performance reveal more nuanced findings. While AI-driven tools such as ChatGPT can provide rapid and personalized feedback, they do not necessarily translate into superior performance in clinical skills examinations when compared to traditional expert feedback [6]-[8]. Furthermore, studies highlight that AI was not initially designed as an educational tool but rather as an aid for clinical decision-making [9]. Nonetheless, some researchers argue that AI has diverse applications in health professional education, particularly in areas such as personalized learning, adaptive testing, and even grading of Objective Structured Clinical Examination (OSCE) notes [10].

Despite these potential benefits, larger qualitative studies emphasize the limitations of existing research, noting that much of the available literature lacks clearly defined learning objectives and structured curriculum goals at the outset of AI integration [9]. This lack of clarity has resulted in inconsistent findings regarding AI's effectiveness in improving student performance. Additionally, concerns have been raised about AI-led educational approaches, particularly in their impact on interprofessional education and diagnostic reasoning, where AI-led groups tend to score lower compared to human-led instruction [9]. These concerns are contrasted by a recent study that demonstrated the efficacy of a wearable smart watch that can provide real-time feedback to learners on clinical encounters, including feedback on empathy, tone, and clarity [11].

A consistent finding across multiple studies was the perceived potential of AI to enhance diagnostic reasoning and decision-making among medical students [12]. Students reported optimism that AI could reduce medical errors, improve diagnostic efficiency, and complement their learning by providing immediate feedback and adaptive case simulations. Other studies have demonstrated the utility of AI-powered simulators and language models in enhancing student engagement and formative assessment accuracy [7] [10].

However, quantitative outcomes remain mixed. As noted in a prominent global mixed-methods study, improvements in conceptual understanding do not always translate to improved clinical performance or empathy-related communication [13]. This finding underscores the need for hybrid pedagogical models that blend AI-driven analytics with human mentorship and classical addressing of Cognitive and Psychomotor learning domains through the use of experiential learning to preserve essential physician-patient skills.

Ethical and Professional Considerations

A cross-sectional study revealed that medical students harbor concerns that AI may devalue the role of physicians, raising questions about the long-term impli-

cations of AI in clinical decision-making and patient care [3]. The fear that AI could replace or diminish the physician's expertise and human connection with patients underscores the need for careful and intentional AI integration within medical curricula. Another major ethical concern is the potential for AI to facilitate academic misconduct. The increasing use of AI tools by both students and faculty has led to concerns about artificially inflated academic achievements, particularly in competitive arenas such as residency applications. If AI-generated work is not properly distinguished from independently completed student efforts, the credibility of academic and professional accomplishments may be compromised [14]. These concerns highlight the necessity for clear institutional policies governing AI use in academic settings.

Beyond academic integrity, AI integration raises significant privacy and security risks. Many AI-driven tools, including chat-based models and AI-powered clinical assistants, are not compliant with the Health Insurance Portability and Accountability Act (HIPAA). The risk of exposing sensitive Personal Health Information (PHI) poses a serious challenge to the ethical use of AI in medical education [3]. Without proper safeguards, students utilizing AI in clinical simulations or patient interactions may inadvertently compromise patient confidentiality.

Furthermore, AI's reliance on vast amounts of internet-based data introduces risks of bias and misinformation. AI systems are trained on existing datasets, which often reflect systemic biases present in society and healthcare. If left unchecked, AI may perpetuate discriminatory practices, potentially disadvantaging certain patient populations. This issue is particularly relevant in medical education, where AI-generated content could shape students' clinical reasoning and reinforce implicit biases. Some studies advocate for a hybrid approach, where AI-driven avatars or simulations are supplemented with human-led instruction to ensure that learning objectives are met and ethical considerations are adequately addressed [9].

Ethical tensions surrounding AI use were prevalent throughout the literature. Concerns centered on data security, academic dishonesty, and bias propagation, consistent with the findings of other studies [9] [14]. A notable observation made in the present literature is students' apprehension that excessive reliance on AI might erode their clinical autonomy and humanistic values [15]. Studies utilizing semi-structured interviews with both learners and faculty members highlighted the fact that while AI is projected to have a robust impact on medical education, concerns about the risks of over-reliance and deskilling are shared by faculty members [15]. Multiple studies demonstrated the ability of AI to mimic or even outperform its human counterparts in the evaluative letter writing process, underscoring the need for guidelines for the responsible use of generative AI in the letter of recommendation writing process [14] [16] [17].

The introduction of generative AI (gAI) tools such as ChatGPT has intensified these concerns. While gAI offers opportunities for self-directed learning and reflective practice, it simultaneously raises issues regarding academic integrity, mis-

information, and intellectual authorship [18]. Students expressed uncertainty about appropriate usage boundaries, signaling an urgent need for institutional policies to define ethical standards for AI-assisted learning.

Curricular and Institutional Readiness

The current research base remains insufficient to inform best practices for AI integration in medical curricula, further complicating efforts to develop comprehensive AI-focused educational interventions [9]. Despite these challenges, medical students express a strong interest in learning more about AI and its ethical implications in clinical practice [3]. This study indicates that students recognize AI's potential to enhance patient care and medical decision-making, but they also acknowledge the importance of understanding its limitations. Without proper training, there is a risk that future physicians will either over-rely on AI or dismiss its utility due to a lack of familiarity.

The literature suggests that AI education should not be limited to technical training but should also encompass ethical frameworks, critical appraisal of AI-generated information, and strategies for integrating AI into evidence-based clinical practice—all while being cognizant to prevent "overbloating" of UME curricula [2]. To achieve this, institutions must develop structured curricula that provide medical students with the necessary knowledge and competencies to engage with AI in a responsible and informed manner.

Across all included studies, a strong consensus emerged regarding the need for formal AI education within UME. While medical students globally recognize AI's transformative role in healthcare, they report inadequate preparation to evaluate, interpret, or ethically apply AI outputs in clinical decision-making [15]. The literature repeatedly emphasized the necessity of structured curricula that integrate foundational AI literacy, ethics, and clinical applications without overburdening existing coursework.

Despite enthusiasm, many institutions remain uncertain about where and how to embed AI training within already dense curricula. The adoption of a spiral learning model, where AI-related competencies are introduced progressively across the medical education continuum, has been proposed [15]. However, because some medical students prefer AI over traditional didactic lectures, this may be a welcome change to UME [5]. Such a model could ensure that students develop the necessary technical understanding while maintaining clinical empathy and judgment.

4. Discussion

This study identified three key themes relevant to the integration of AI into undergraduate medical education (UME). The reviewed literature highlights that medical students recognize AI's potential to enhance clinical decision-making, reduce medical errors, and improve overall efficiency in patient care. However, while students express optimism regarding AI's role in their future practice, the current research on AI integration into UME is insufficient and lacks structured learning

objectives. This gap in the literature suggests that while AI holds promise as an educational tool, its effectiveness in improving medical education remains largely unexplored.

Despite the limitations of existing research, medical students overwhelmingly express a desire for more AI-focused education. Many believe that AI will play a significant role in their clinical practice and that understanding its applications will be essential for their professional development. However, a major challenge lies in the fact that many physicians themselves lack the necessary training to incorporate AI into medical education, further complicating the development of AI-based curricula. Without a well-defined strategy for AI education, medical institutions risk either failing to prepare students for the realities of AI-assisted healthcare or fostering overreliance on AI without adequate critical appraisal skills. Hybrid learning models combining AI tools with direct human mentorship pose a possible solution. Faculty oversight of the education AI is providing could mitigate the risk of eroding medical students' humanistic values and clinical autonomy by forcing students to blend the learning provided through AI into a clinical framework overseen by a faculty member. Further, simulation strategies where AI is initially used to augment patient care and then suddenly lost due to a simulated electronic failure may provide a way to maintain clinical acumen without overreliance on AI tools, while still taking away AI access in a way to maintain a suspension of disbelief in a simulated environment may be another tool.

Ethical considerations remain a crucial factor in AI integration. The literature underscores concerns related to patient privacy and data security, particularly the risk of exposing sensitive Personal Health Information (PHI) through non-HIPAA-compliant AI tools. Additionally, the use of AI in medical education raises concerns regarding the potential loss of interpersonal and diagnostic reasoning skills, as AI-driven simulations may lack the human complexity necessary for comprehensive medical training. Furthermore, the biases inherent in AI models pose a risk of perpetuating healthcare disparities, reinforcing the need for careful oversight in AI's application to medical education. From a faculty standpoint, the ability of AI to create letters of recommendation comparable or superior to those generated by traditional methods threatens to erode the formative evaluation process of medical students and studies are currently in process to develop guidelines for responsible use. Student learning modules discussing ethical considerations in AI use, including data privacy with these tools, critical appraisal of AI-generated clinical recommendations, and algorithmic bias, may serve as a viable undergraduate medical education (UME) curriculum for ethical AI use. This, paired with the previously mentioned paired AI and faculty teaching and simulation tools, may provide a viable framework for AI integration into current UME curricula.

While this study has strength in the fact that it draws from quantitative and qualitative data from several UME settings around the world, it has several limitations that must be acknowledged. First, the sample size of articles meeting inclusion criteria was relatively small (n = 18), which may limit the generalizability

of the findings. Additionally, a significant gap in the literature exists regarding the evaluation of specific educational outcomes related to AI integration in UME. Most studies focus on theoretical benefits and student perceptions rather than measurable improvements in clinical competency or learning effectiveness. Furthermore, AI technology is still in its early stages of adoption within medical education, meaning that long-term studies assessing its impact on training and patient care are scarce. As AI continues to evolve, ongoing quantitative research will be necessary to determine the most effective and ethical ways to incorporate this technology into medical curricula. Future studies should include the efficacy of integrating AI into UME and particularly which learning objectives may be most effective for this integration. Other studies could explore the impact of feedback provided by ambient listening devices in the simulated learning environment.

5. Conclusions

The integration of artificial intelligence into medical education represents a pivotal advancement in shaping the physicians of tomorrow. The findings from this thematic analysis reveal a shared optimism among students and educators regarding AI's capacity to **enhance diagnostic precision, foster adaptive learning, and streamline assessment.** However, these advantages are tempered by ethical challenges and gaps in curricular infrastructure.

The literature highlights a critical paradox: while students recognize AI's inevitability in medicine, few feel adequately trained to engage with it responsibly [14] [15]. Generative AI tools, though promising, necessitate **robust ethical guidelines** and **transparent educational frameworks** to prevent misuse and overreliance [15]. Further, the studies cited in this paper suggest that faculty members struggle with the implementation of generative AI even in clerical duties such as writing letters of recommendation [14] [16] [17].

Medical institutions must therefore adopt a **multifaceted strategy** that embeds AI literacy, ethical reasoning, and critical appraisal into all stages of undergraduate medical education. Faculty development, interdisciplinary collaboration, and global standardization of AI competencies will be essential to sustain this evolution. AI is advancing at an incredibly rapid rate, as many of the research articles that were referenced in this study were written based on prior generations of generative AI models. As a result, constant faculty development, updated research, and true implementation of lifelong learning will be necessary to keep pace with the advancement of this technology. As AI continues to redefine the clinical landscape, educators bear the responsibility to ensure that tomorrow's physicians are **technologically proficient yet deeply humanistic**, capable of harnessing AI as a tool for equitable, ethical, and patient-centered care.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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