

## ARTIFICIAL INTELLIGENCE'S USE IN MEDICAL EDUCATION: PRESENT SITUATION AND PROSPECTS

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### Abstract

**Background:** From undergraduate to graduate school, specialist training, and beyond, medical education is a lifelong learning process. This principle also applies to other medical professionals, including physicians, nurses, and allied health care providers. Therefore, in our current era of rapidly advancing technology, it is crucial to acknowledge the significant role of artificial intelligence in medical education. This innovative technology enhances the learning experience and helps personalize educational pathways for individual learners. By leveraging AI, educators can analyze performance data to customize training programs, ensuring that medical professionals are well-prepared to address the challenges of modern healthcare. Medical education requires lifelong learning from undergraduate to postgraduate to specialty. Over the last decade, AI has played a major role in medical education, notably with COVID-19, which has increased online courses and conferences globally. **Materials and Methods:** Included were high-quality data that satisfied the study's goals. A lot of research papers from trustworthy databases like PubMed, Research Gate, PubMed Central, Web of Science, and Google Scholar were also carefully read for the literature review. **Result:** Over the past ten years, artificial intelligence has resolved several problems in education, such as cognitive modelling, reasoning, language processing, and planning. These advancements have enhanced the learning experience for students and improved the efficiency of educational institutions. As technology continues to evolve, it is expected that AI will play an even larger role in personalizing education and addressing the diverse needs of learners. **Conclusion:** Medical education can utilize it in several ways, such as medical distance learning and management, a virtual inquiry system, and medical school video teaching. Additionally, it can enhance the value of the non-analytical humanistic elements of medicine. The aim of this review study was to present the current and future implications of AI in medical education. This exploration highlights AI's transformative potential in improving both the efficiency and effectiveness of medical training. As we move forward, it is essential to embrace these advancements while also addressing ethical considerations and ensuring that human interaction remains at the core of medical education.

## INTRODUCTION

The study of artificial intelligence (AI) is a relatively recent field that emerged in the middle of the twentieth century. It involves technology that mimics human thought processes primarily through computer systems. Although AI encompasses languages, psychology, philosophy, mathematics, and various other disciplines, it is predominantly associated with computer science. Since AI was first developed in 1955, its applications have expanded

significantly within a rapidly evolving digital landscape, where social media, business leaders, and healthcare professionals shape public expectations. Over the past decade, artificial intelligence has addressed numerous challenges in education, including language processing, reasoning, planning, and cognitive modelling.<sup>[1]</sup> There is an increasing interest in AI within medical education, as indicated by the initial Web of Science search on the topic. The application of AI in medical education research and development has surged recently, as evidenced by a rise in both the total number of publications and the

frequency with which these papers have been cited over the last 20 years.<sup>[2]</sup> Examples of its use in medical education include virtual inquiry systems, remote learning and management, and the production of instructional videos for medical schools.<sup>[1]</sup>

From undergraduate to graduate, specialty training, and beyond, medical education constitutes a lifelong learning process. This principle also applies to other medical professionals, including physicians, nurses, and allied health care providers. In light of how quickly technology changes these days, it is important to understand that to move the field of AI in medical education forward, new works must build on existing ones.

AI can enhance the value of the non-analytical and humanistic aspects of medicine. As medical knowledge expands rapidly, healthcare professionals must be adept at abstracting information from a wide range of options and making sense of the data when rendering medical decisions. Artificial intelligence will improve doctors' diagnostic and problem-solving skills while reducing their efforts to comprehend digital data.<sup>[3]</sup>

Compared to previous generations, learners in the digital age are distinct. They value social connections and are growing up immersed in technology. Students from this demographic prefer collaborative work and utilize various software applications to share the details of their assignments with peers. They require personalized academic support and appreciate recognition for their accomplishments. To engage and sustain students' interest, educators must identify and implement effective teaching strategies. "Training Tomorrow's Doctors" offered recommendations for public policy, healthcare institutions, accrediting bodies, and similar organizations, along with examples of challenges facing the educational mission.<sup>[4]</sup> Medical education must adapt to the evolving healthcare landscape in a highly interconnected world, which includes digitization and a new generation of healthcare students.<sup>[3]</sup>

Medical education can leverage AI in various areas, including learning, assessment, and curriculum development and analysis. AI is capable of addressing complex problems, enhancing classification accuracy, reducing the time required to analyze different curricula, and demonstrating how the parameters in the curriculum assessment relate to one another. To prepare future physicians, AI, for example, can evaluate the "effectiveness of the curriculum" and the "overall satisfaction" of medical students with the course. AI supports students in their learning process by providing tailored, flexible content that evolves based on student feedback. This capability allows students to identify their knowledge gaps and respond accordingly. Furthermore, AI can deliver comprehensive, personalized feedback and enhance the accuracy, speed, and cost-effectiveness of the evaluation process.<sup>[5]</sup>

According to Wartman et al., reforming the medical education system requires more than merely focusing

on patient safety, risk management, teamwork, and communication. They conclude that the following adjustments are necessary to effectively teach students "medical practice" in an AI-revolutionized society.<sup>[6]</sup> Future medical students must adapt to a new educational approach driven by rapidly advancing technologies such as AI and machine learning.

- In addition to the traditional method of fact-based memorization and clinical internships, authorities must place greater emphasis on innovation and research.
- Educational institutions must prioritize skills such as statistical reasoning and compassion.
- Medical students will need to transition to a value-based payment system, where purchasers of healthcare services can hold the healthcare system accountable for both quality and cost.

The purpose of this article was to emphasize the necessity for medical education to incorporate AI technology to meet the evolving needs of students and the expanding digital ecosystem. The article also discusses the good things that AI can do for medical education, such as improving diagnostic problem-solving skills, improving curriculum and analysis, making personalized learning easier, and accelerating the evaluation process. The article also talks about how important it is to teach future medical professionals how to adapt to changes in AI and machine learning, how to prioritize research, how to learn skills beyond memorization, and how to take a value-based approach to medical practice. The goal of this research was to promote AI integration in medical education as a strategy to tackle challenges, seize opportunities presented by the digital age, and ensure high-quality healthcare services.

## MATERIALS AND METHODS

In this analysis, we looked at how AI has changed medical education over the last 20 years and how it will change things going forward. All of the data that were considered for the study were of good quality. For this literature review, we combed through academic journals' articles in databases including Google Scholar, PubMed, ResearchGate, and PubMed Central. Topics covered in the literature review included artificial intelligence (AI), healthcare, medical education, AI in medical research, physicians, AI, new aspects of medical education, postgraduate medical courses, and medical doctors. Scholarly works written in English that addressed the aims of the study were part of it. We excluded studies that either did not use artificial intelligence in medical education or did not use English. Publications published prior to 2002 were also not included.

## RESULTS

In 2018, the American Medical Association (AMA) approved its inaugural policy on artificial intelligence (AI), which encourages research in medical education to make use of AI. At Duke Institute for Health Innovation, data scientists and future doctors work together to improve healthcare for patients. To address healthcare issues, students at Stanford University's Centre for Artificial Intelligence in Medicine and Imaging utilize machine learning.

AI technologies notify physicians of clinical issues, saving time and reducing the need to review previously taught content or scan unnecessary materials. Johns Hopkins University School of Medicine customizes education with informatics. ChatGPT helps scientists and medical researchers with writing abstracts, articles, literature reviews, summarizing data, title, reference, structure, language reviews, and paper drafts

Residents in the University of Florida's radiology department partnered with a technology company to create computer-aided detection systems for mammography. The Carle Illinois College of Medicine offers a course that explores emerging technologies, taught by a scientist, clinical scientist, and engineer. Furthermore, medical students can enrol in a course on the latest healthcare technologies offered by the Sharon Lund Medical Intelligence and Innovation Institute. The University of Virginia Centre for Engineering in Medicine positions medical students in engineering labs to devise innovative medical technologies.<sup>[7]</sup>

Physicians can conserve time by utilizing AI to deliver pertinent knowledge when clinical issues emerge, instead of reviewing previously acquired information or sifting through extraneous data. Johns Hopkins University School of Medicine tailors informatics to correspond with the curriculum and pedagogical approaches for students.<sup>[8]</sup> The "Human Diagnosis Project," also known as "Human Dx," represents a cutting-edge AI-powered healthcare system. "Human Dx" seeks to amalgamate machine learning with the cumulative knowledge of physicians to deliver enhanced, precise, cost-effective, and readily accessible healthcare for everybody. Researchers are now partnering with leading medical institutions globally, such as Harvard, Stanford, and Yale, alongside other stakeholders, to investigate its application in clinical decision-making.<sup>[9,10]</sup>

In the same way, new technologies like Med A ware, developed with Harvard University, use machine learning and big data to analyze large amounts of information from electronic medical records (EMRs) and understand how doctors actually treat patients. The algorithm flags a prescription as a possible mistake when it doesn't match standard treatment guidelines, prompting doctors to check for any errors. Researchers at MIT created the MedEye prototype to eradicate pharmaceutical errors.<sup>[11]</sup>

It scans and recognizes various substances using cameras. MedEye employs image recognition and machine learning to verify the accuracy of medications by comparing them to the hospital information system.<sup>[12]</sup>

The Homer Stryker M.D. School of Medicine at Western Michigan University has built a modern simulation center. The medical school is testing a program developed by the UK-based start-up "Resource Medical," which employs artificial intelligence chatbots to simulate patient visits, aimed at assisting second-year students in honing their clinical skills. Furthermore, users can interact with the robot to replicate a patient visit by inquiring about the reasons for the robot's need for medical care and exploring the robot's problems and medical history.<sup>[13]</sup>

The Buckingham Virtual Tympanum and Touch Surgery programs exemplify surgical simulations that facilitate students' understanding of surgical anatomy. Nonetheless, they differ from training on actual patients.<sup>[14,15]</sup> Distance education, a mode of instruction that overcomes temporal and spatial barriers, facilitates real-time learning in both online and offline contexts. China has established a dual approval system for its continuing medical education programs and institutions.

AI-based simulation-based training is another popular teaching method. These medical simulators mirror real-life processes or settings for interactive digital learning. Simulations encourage active learning and decision-making by simulating real-life events. SBT improves healthcare professional learning. High-fidelity mannequins, standardized patients, and hybrid simulations are SBTs. SBT improves skill development, reduces errors, and allows repeated practice without risking patients. Hybrid simulations sometimes use mannequins to simulate medical emergencies. CPR mannequin Resusci Anne was created in the 1960s. In recent years, Laerdal (Stavanger, Norway) has produced high-fidelity mannequins that can simulate cardiac rhythms, breathing patterns, and complex medical crises like myocardial infarction, angina, acute asthmatic episodes, and poisoning. The powerful software of these simulators lets instructors construct dynamic and realistic training environments.



**Figure 1: SBT teaching methods at Christian Medical College & Hospital in Ludhiana, Punjab, India.**

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Christian Medical College & Hospital in Ludhiana, India, uses SimPad Plus, Laerdal, and the Resusci Anne Simulator to teach students how to handle various emergencies at its Central Skills Lab. Resusci Anne, an AI-based mannequin, is being used to imitate the clinical presentation of organophosphorus (OP) poisoning, a prevalent agricultural issue in Punjab. This is being utilized as a teaching tool for students. Students can engage with the AI-based mannequin using SimPad Plus, Laerdal. The correct organophosphorus poisoning medicine normalizes vitals. Thus, students understand OP poisoning and its treatment. The SBT models utilized at Christian Medical College & Hospital are depicted in [Figure 1].

## DISCUSSION

### **Future Prospects and Challenges of AI in Medical Education:**

A comprehensive review by Han et al. addresses future trends in medical education.<sup>[3]</sup> The review article encourages medical students to work with other medical professionals to develop a more empathetic perspective. Additionally, it emphasizes the importance of exposing students to patient-centered healthcare settings at an early age, leveraging cutting-edge technologies to improve learning, and studying outside of hospital walls. Medical students can benefit from tailored training, peer and instructor communication, and access to a wealth of knowledge through the use of contemporary technology. AR and virtual patient simulations can provide realistic clinical settings without endangering patients, and they can also help medical students learn and interact more effectively. Widely available, mobile, and online technologies can improve student learning and encourage interaction between students and teachers.<sup>[3]</sup>

Artificial intelligence possesses the capacity to enhance diagnostic precision, elevate medical education, and significantly influence the future of healthcare professions. Anticipating the future necessitates considering several perspectives and challenges.<sup>[17]</sup> The capacity of artificial intelligence to transform and customize the learning experience is a crucial leap in medical education. Contemporary digital learners possess specific requirements that AI can address due to their diverse preferences and learning modalities. Artificial intelligence (AI) can provide customized instructional content that addresses each student's knowledge deficiencies and learning pace by employing machine learning algorithms and analyzing extensive datasets. Medical education improves understanding and engagement through a tailored approach. While AI has great potential, effectively integrating it into medical education requires addressing specific challenges.

**AI and Ethics:** One of these concerns is how to use AI ethically; as it becomes more common, worries about bias in algorithms, security, and data privacy arise. Establishing strong ethical frameworks is essential to ensure that AI algorithms make decisions that are transparent, fair, and impartial. A further problem is the necessity for education and healthcare workers to enhance their competencies and acquire requisite training. If medical education is to successfully incorporate AI, teachers must be trained in its application in both instruction and evaluation. Healthcare workers must also be aware of the limitations and possibilities of AI systems to implement them in clinical practice.<sup>[19]</sup>

To use AI in medical education, various infrastructures and technological resources are required. Modern computing equipment, data storage, and secure networks are necessary for educational institutions and healthcare organizations to successfully benefit from AI. To successfully use AI in medical education, academics, businesses, and regulatory agencies must collaborate to establish uniform standards, frameworks, and conventions. AI has enormous potential for the future of medical education since it can provide more tailored learning opportunities, enhance diagnostic skills, and make curriculum development and implementation easier. Infrastructure, training, and ethics are needed to integrate AI into medical education. AI technology in medical education prepares future healthcare professionals to provide excellent patient care in the rapidly changing healthcare sector.<sup>[20]</sup>

### **AI in education and its limits.**

Virtual inquiry systems like "DxR Clinician" can help teachers understand student behavior so that the adopted methods of teachings can be tailored. Students can learn to solve clinical issues quickly. Interacting with examples helps identify serious disorders. The system allows for the identification of students' errors, provides an in-depth review of their learning abilities, and offers support throughout the case study. Intelligent Tutor Systems, like DxR Clinician, monitor learners' cognitive processes to identify misconceptions. It assesses pupil comprehension. It also helps students develop self-regulation, self-reflection, and self-articulation by providing prompt guidance, instruction, and clarification.<sup>[1]</sup> Digital learning has many technological benefits, however computer-based education and artificial intelligence algorithms may discriminate or prioritize certain goals. Infrastructure, training, and ethics are needed to implement AI in medical education. Medical education that integrates AI technology aligns with the fast changing healthcare sector, enabling future healthcare workers with the knowledge and abilities to provide high-quality patient care.<sup>[20]</sup>

We must therefore thoroughly examine moral and ethical issues. The bio-psychosocial complexity of patients is a challenge for robots, so future medical practitioners should emphasize a humanistic approach. It is crucial, especially in distance learning,

to schedule participation times that are convenient for both parties. Even when students and professors are in various places, online peer tutoring works best when students experience a sense of belonging and connection, such as through emotional support and attachment. The course structure affects students' motivation and engagement, so it should be designed to encourage them to work on projects and participate in discussions.<sup>[3]</sup> Application of robots in medical sciences and their limitations

**The application of AI and its limitations in educational technology:** As an efficient analytic tool, virtual inquiry systems like "DxR Clinician" can help teachers gain a better understanding of their students' behavior and adapt their lessons based on assessment results. The necessary abilities to handle clinical circumstances can be mastered quickly by students. Students can gain valuable experience in recognizing critical illnesses by engaging with the provided examples. In the course of the case study, the system might use deep learning and analysis to help students overcome their mistakes. "Intelligent Tutor Systems" can track the student's "psychological processes" as they solve problems, much as DxR Clinician, and spot when they're misunderstanding. It evaluates the students' understanding as well. As an added bonus, it can help students practice self-regulation, self-observation, and self-explanation by providing them with timely feedback, guidance, and explanations.<sup>[1]</sup>

Digital learning has many benefits in terms of technology, however algorithms based on artificial intelligence and computer-based learning might be biased against some groups or utilized to forward agendas. We must therefore thoroughly examine moral and ethical issues. The bio-psychosocial complexity of patients is a challenge for robots, so future medical practitioners should emphasize a humanistic approach. It is crucial, especially in distance learning, to schedule participation times that are convenient for both parties. Even when students and professors are in various places, online peer tutoring works best when students experience a sense of belonging and connection, such as through emotional support and attachment. Designing the course structure to encourage students to work on projects and participate in discussions is crucial as it affects their motivation and engagement.<sup>3</sup>

## CONCLUSIONS

AI has improved diagnosis, treatment planning, and tailored care in healthcare and medical education. Despite its potential, it confronts challenges. Ethical considerations, accountability, data protection, high costs, and technological incompetence hinder full integration in healthcare. Medical instruction and research criticize ChatGPT for its lack of innovation, clinical reasoning, and empathy. Students and professors at my institute appreciate SBT because it

provides them with more hands-on emergency management training. AI will change healthcare and medical education. AI developers, governments, and healthcare providers must collaborate to ethically utilize AI to enhance patient care, medical education, and healthcare outcomes. AI will empower healthcare practitioners and improve patient lives worldwide with further innovation and deliberate development.

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