Transforming Healthcare Education through Artificial Intelligence

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Abstract

The integration of artificial intelligence (AI) in public health education presents both transformative opportunities and complex challenges. AI enhances learning through personalised instruction, virtual simulations, supports decision-making, and improves large-scale data-based analytics. These innovations can enhance knowledge acquisition, clinical reasoning, and skill acquisition. The revolution of AI in public health supports public health surveillance and epidemiological research. However, the use of AI also faces significant barriers. Complex challenges include limited integration into curricula, inadequate faculty training, limited digital infrastructure, ethical issues related to data privacy, and unclear policies. These barriers have the potential to hinder the safe and effective use of AI in healthcare education, although most current research remains exploratory in nature. There is widespread agreement that AI should complement, not replace, educators or clinical assessors. Therefore, balanced and evidence-based integration of AI is crucial. This approach will ensure the development of healthcare professionals who are not only technically competent but also adaptive, reflective, and prepared to navigate the dynamics of future healthcare delivery. Artificial intelligence (AI) is reshaping healthcare and public health education, underscoring the importance of AI literacy, an innovative mindset, and digital competency. Studies show that there are limited AI education programs, inadequate preparedness among public health experts, and policy or ethical barriers, underscoring the importance of a balanced, evidence-based integration for adequate delivery by public health institutions.

Keywords: Artificial Intelligence, Digital Technology, Healthcare Education, Personalised Learning, AI Literacy

Introduction

Artificial intelligence (AI) is transforming public health education by reshaping how teaching, learning, and professional training are delivered (1-20). In recent years, AI has evolved from a theoretical innovation into a practical tool that directly enhances instruction, student engagement, and analytical thinking within the field of public health. The central argument of this paper is that integrating AI into public health education can significantly improve both teaching quality and learning outcomes. AI

powered adaptive learning platforms, for instance, provide interactive and personalised instruction that helps students connect theoretical knowledge with real-world public health challenges (2, 3, 4). By tailoring content and pacing to individual needs, these systems facilitate a deeper understanding of key topics, such as epidemiology, biostatistics, and population health management (5, 6).

Beyond instructional benefits, AI also supports educators by automating time-consuming administrative tasks, such as grading, attendance tracking, and progress monitoring (8, 5, 16). This allows instructors to focus on mentorship and meaningful interactions with students. Through advanced data analytics, AI can identify learning patterns and areas where learners may be struggling, enabling early and targeted intervention (6, 17). These data-driven insights enhance academic performance and encourage collaborative learning environments through intelligent discussion platforms and group project recommendations (14, 18, 19). As a result, the learning experience becomes more dynamic, inclusive, and responsive to student needs (8). Moreover, by streamlining academic workflows, AI contributes to a more efficient educational structure that promotes both student engagement and institutional effectiveness.

However, despite these clear advantages, integrating AI into public health education presents challenges. Concerns about data privacy, cybersecurity, and the ethical handling of sensitive health information are prominent (11, 12, 20). Many institutions also face barriers, including limited infrastructure, high implementation costs, and unequal access to digital tools, which can exacerbate existing educational inequalities (12, 13, 21). Additionally, faculty members often lack adequate training in AI literacy and digital pedagogy, which can hinder the effective adoption of AI (2, 4, 15). These limitations highlight the need for strategic investment, policy development, and faculty upskilling to ensure that AI technologies are used safely and equitably within educational contexts.

In addition to administrative and ethical considerations, AI-powered simulations and predictive models have introduced new ways for students to engage with real-world public health scenarios. For example, AI-based virtual environments allow learners to simulate disease outbreaks, test policy interventions, and analyse population-level data without exposing individuals to harm (6, 7, 9, 20). Through immersive learning experiences such as virtual and augmented reality, students gain practical skills in health surveillance, emergency response, and epidemiological decision-making. These technologies strengthen analytical reasoning and enhance preparedness for addressing complex health crises (9). As AI continues to evolve, its role in public health education extends beyond classroom learning—it helps shape professionals who are adaptable, reflective, and ready to manage the multifaceted challenges of global health (16, 20).

Ultimately, the integration of AI in public health education represents a pivotal step toward modernising the training of future public health leaders. While technological and ethical barriers remain, the potential benefits—ranging from improved knowledge retention to enhanced decision-making—are substantial. Effective and responsible adoption of AI can bridge the gap between theoretical instruction and real

world application, fostering a workforce capable of applying innovation to protect and improve community health. By embracing AI thoughtfully and ethically, public health institutions can ensure that education remains not only technologically advanced but also equitable, human-centred, and aligned

with the evolving needs of global health systems (11, 12, 21)

Meaterial and Methods

Material (instruments and analysis techniques)

This study using various academic references and secondary data focused on the application of Artificial Intelligence (AI) in public health education. This includes peer-reviewed scientific journals, reports, and conference papers published between 2020 and 2025. The primary focus is on the use of AI to improve digital literacy, public health learning, and policy development (5, 12, 13). Literature sources were retrieved from PubMed, Scopus, ScienceDirect, SpringerLink, and Google Scholar using keywords such as "artificial intelligence," "public health education," "digital transformation," and "AI literacy." The collected data were then analyzed using thematic synthesis methods to identify trends, challenges, and benefits of AI integration in the context of community health promotion, data-driven policymaking, and strengthening public health capacity (8, 6).

Method

Based on frameworks from previous studies (5, 8). The process included finding, sorting, and examining research papers about how AI is used in public health education. The selected articles met specific criteria, focusing on relevant, clear methods, and AI applications that help improve digital skills, promote health, and support learning driven by data (12, 13). The researchers analyzed the data using a thematic method, following (6) looking at three main points: how AI learning tools are adopted, their effects on learning results, and challenges like ethical issues and infrastructure problems (11, 3, 12). Combining these studies gave a broad understanding of how AI supports innovation in education and helps build skills for public health students and workers.

Results and Discussions

Results

This article uses data tables to facilitate readers' understanding by summarising and reviewing journal & article references. This data presents the final results regarding the impact of AI on entering the world of health education, particularly in public health education. It contains the article sources, methods, and refinement.

Table 1. Result of Reviewed References

Article Source	Methods	Analysis and Synthesis	Refinement
Wang, J., & Li, J. (2024)	Narrative review	Artificial intelligence is considered a key factor in driving innovation in public health education, but in order for it to be implemented effectively, comprehensive ethical guidelines and strong institutional readiness are required.	Adopt clear ethical standards, provide training for teaching staff on artificial intelligence, and promote equal access to artificial intelligence suported educational tools.

Feigerlova E, et al (2025)	Systematic review	Artificial intelligence has been shown to significantly enhance learning outcomes, particularly through the use of adaptive learning technologies and immersive virtual simulations.	Promote broader integration of AL-driven tools that are supported by empirical research, while consistently assessing their effectiveness in improving teaching and learning processes.
Konstantinidis, S. T., et al (2020)	Descriptive analyses	When digital innovation is included in the curriculum, connected the gap between theoretical knowledge and practical Health care skills.	Encourage teamwork between different fields and keep updating the curriculum to keep up with digital innovation.
Panteli, D., et al. (2025)	Policy and conceptual analysis	Successful integration of artificial intelligence demands robust policy structures, opennes, and systems for accountability.	Develop global standards for the management of artificial intelligence for public health, while emphasizing the importance of balancing ethical norms and legal reglations.
Virk, A., et al. (2025)	Comparativ e legal analysis	Implementing artificial intelligence without cybersecurity measures puts patient data and institutional trust at risk.	Use global cybersecurity standards and make digital ethics training for healthcare workers stronger.
Gunasekeran, D. V., et al. (2021)	Systematic scoping review	Artificial intelligence has made a significant contribution in dealing with the pandemic, but on the other hand, it has led to inequality in access to tecnology and raised ethical dilemmas.	Strengthen adaptive digital systems and integrate AI learning into public health education.
Wang, X., et al. (2023)	Descriptive and applied study	The use of artificial intelligence can provide adaptive learning methods for each student, although its success is determined by institutional support and educators digital literacy.	Develop a public health curriculum that includes AI technology and support professional development focused on improving technical skills.
Parmar, S., et al. (2025)	Mixed methods educational intervention	The application of artificial intelligence in education helps improve learning outcomes while preparing students to adapt to a healthcare world that focuses on data analysis	Optimize the use of AI in the educational framework and monitor its long term impact on the development of professional workforce skills.
Love, A. S., Niu, C., et al. (2025)	Ethical and conceptual analysis	The ethical application of artificial intelligence requires a balance between technological development, human involvement, and respect for cultural values.	Design a curriculum that emphasizes ethical values and integrate artificial intelligence literacy as an important part of public health education.
Malerbi, F.K., et al. (2023)	Narrative review	Online learning contributes greatly to the long-term implementation of AI, but its implementation still requires inter-organizational synergy and adequate resource support.	Build a culture of lifelong digital learning and create uniform AI competency standards to improve the professionalism of healthcare workes.

The data provided suggests that AI can support personalized learning, data driven instruction and health monitoring as well as provide pandemic response (such as machine learning, chatbots, and virtual simulations) (1-21). Despite these advantages, AI presents many challenges for realization. Such as the issues of data privacy and security, ethical and regulatory aspects (4, 5, 11, 12, 15, 20, 21). The successful implementation of AI depends on institutional readiness, faculty developmental competency and collaboration between academia, healthcare, and technology (6, 8, 13, 16, 17, 18, 19). To encourage responsible and efficacious AI usage, it is imperative that we weave literacy around AIs into the curriculum, set down guidelines for data governance/ethics, invest substantially in educator training and roll out decisive actions (3, 4, 7, 9, 10, 12, 14, 15, 16, 20, 21).

Conclusion

The analysis reveal that public health educators, student, academic institution are the most affected by the integration of Artificial Intelligence (AI) in public health education. Educators face challenges such as limited AI training and lack of digital pedagogy skills, while students experience unequal access to AI learning technologies. On top of that, they (Educators and Academic Institutions) also faces issues that are need to be address. Such as unclear policies, inadequate digital infrastructure, and ethical concerns bordering data privacy and security. These issues hinder the equitable adoption of AI and highlight the need for strategic faculty development, inclusive technological frameworks, and a clear policy guidance. Even though AI also offers significant potential to improve learning quality, analytical capacity, and data-driven decision-making. Evidence from recent studies (5, 12, 17) demonstrates that AI supports personalised and adaptive learning while enhancing students' understanding of epidemiology, health policy, and population health. However, several challenges persist, including limited infrastructure, ethical concerns, and uneven digital literacy among educators and students (11, 21).

To ensure public health institutions need to build stronger digital skills, create clear ethical and rule based guidelines, and encourage teamwork across different fields. AI should be used to support, not replace, human teachers by helping develop critical thinking and new ideas. Taking a balanced, well researched, and ethical approach will help train future public health workers to handle global health issues effectively, combining technology skills with a sense of social responsibility.

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References

1. Arora A. Conceptualising artificial intelligence as a digital healthcare innovation: an introductory review. Med Devices Evid Res. 2020 Aug 20:223–30.
2. Charow R, Jeyakumar T, Younus S, Dolatabadi E, Salhia M, Al-Mouaswas D, Anderson M, Balakumar S, Clare M, Dhalla A, Gillan C. Artificial intelligence education programs for health care professionals: scoping review. JMIR Med Educ. 2021 Dec 13;7(4):e31043.
3. Dave M, Patel N. Artificial intelligence in healthcare and education. Br Dent J. 2023 May 26;234(10):761–4.
4. El-Sayed BK, El-Sayed AA, Alsenany SA, Asal MG. The role of artificial intelligence literacy and innovation mindset in shaping nursing students' career and talent self efficacy. Nurse Educ Pract. 2025 Jan 1;82:104208.

5. Feigerlova E, Hani H, Hothersall-Davies E. A systematic review of the impact of artificial intelligence on educational outcomes in health professions education. BMC Med Educ. 2025 Jan 27;25(1):129.
6. Georgieva-Tsaneva G, Serbezova I, Beloeva S. Application of virtual reality, artificial intelligence, and other innovative technologies in healthcare education (nursing and midwifery specialties): Challenges and strategies. Educ Sci. 2024 Dec 25;15(1):11.
7. Ntakakis G, Plomariti C, Frantzidis C, Antoniou PE, Bamidis PD, Tsoulfas G. Exploring the use of virtual reality in surgical education. World J Transplant. 2023 Feb 18;13(2):36. 8. Malerbi FK, Nakayama LF, Gayle Dychiao R, Zago Ribeiro L, Villanueva C, Celi LA, Regatieri CV. Digital education for the deployment of artificial intelligence in health care. J Med Internet Res. 2023 Jun 22;25:e43333.
9. Mir MM, Mir GM, Raina NT, Mir SM, Mir SM, Miskeen E, Alharthi MH, Alamri MM. Application of artificial intelligence in medical education: current scenario and future perspectives. J Adv Med Educ Prof. 2023 Jul;11(3):133.
10. Montejo L, Fenton A, Davis G. Artificial intelligence (AI) applications in healthcare and considerations for nursing education. Nurse Educ Pract. 2024 Oct 1;80:104158. 11. Virk A, Alasmari S, Patel D, Allison K. Digital health policy and cybersecurity regulations regarding artificial intelligence (AI) implementation in healthcare. Cureus. 2025 Mar 16;17(3).
12. Panteli D, Adib K, Buttigieg S, Goiana-da-Silva F, Ladewig K, Azzopardi-Muscat N, Figueras J, Novillo-Ortiz D, McKee M. Artificial intelligence in public health: promises, challenges, and an agenda for policy makers and public health institutions. Lancet Public Health. 2025 May 1;10(5):e428–32.
13. Qian L, Cao W, Chen L. Influence of artificial intelligence on higher education reform and talent cultivation in the digital intelligence era. Sci Rep. 2025 Feb 19;15(1):6047.
14. Sairete A, Balfagih Z, Brahimi T, Mousa ME, Lytras M, Visvizi A. Artificial intelligence: Towards digital transformation of life, work, and education. Procedia Comput Sci. 2021 Jan 1;194:1–8.
15. Sapci AH, Sapci HA. Artificial intelligence education and tools for medical and health informatics students: systematic review. JMIR Med Educ. 2020 Jun 30;6(1):e19285. 16. Konstantinidis ST, Bamidis PD, Zary N, editors. Digital innovations in healthcare education and training. Academic Press; 2020 Sep 8.
17. Wang J, Li J. Artificial intelligence empowering public health education: prospects and challenges. Front Public Health. 2024;12:1389026.
18. Gunasekeran DV, Tseng RM, Tham YC, Wong TY. Applications of digital health for public health responses to COVID-19: a systematic scoping review of artificial intelligence, telehealth and related technologies. NPJ Digit Med. 2021 Feb 26;4(1):40.
19. Wang X, He X, Wei J, Liu J, Li Y, Liu X. Application of artificial intelligence to the public health education. Front Public Health. 2023 Jan 10;10:1087174.
20. Parmar S, Suthar P, Das L, Ganguly P. Preparing future-ready public health professionals: a blended, AI-integrated pedagogical innovation. BMC Med Educ. 2025 Sep 30;25(1):1268.
21. Love AS, Niu C, Labay-Marquez J. Artificial intelligence in public health education: navigating ethical challenges and empowering the next generation of professionals. Health Promot Pract. 2025;15248399251320989.