Integration of Artificial Intelligence in medical educational training: Opportunities and challenges

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ABSTRACT

Artificial intelligence (AI) is a computer science discipline focused on developing systems and algorithms capable of performing human tasks, such as learning, reasoning, problem-solving, and language understanding. Its application ranges from virtual assistants to medical diagnostic systems. The introduction of AI in medicine has brought about significant changes, improving diagnostics, management, and medical education, but also raising concerns about its overuse and impact on the doctor-patient relationship. The integration of AI into medical educational training is critical to preparing healthcare professionals for its ethical and effective use. Studies highlight the benefits of AI in interpreting medical images, accurate diagnoses, and more efficient clinical practice. However, challenges such as familiarizing medical students with AI, ethical issues, and training educators have yet to be addressed. The ethical implementation of AI in medical education requires the development of clear guidelines and ongoing discussions about its use. The literature underscores the importance of research, innovation, and collaboration to harness the potential of AI in promoting better health outcomes. This requires a continued focus on areas such as simulating realistic medical interactions, developing secure and transparent systems, and strengthening the capacity of healthcare professionals to deal with this ever-evolving technology.

Keywords: Artificial Intelligence, Medicine, Medical practice, Medical education.

INTRODUCTION

Artificial intelligence (AI), as a core field of computer science, is constantly advancing the development of systems and algorithms that replicate and enhance complex human cognitive capabilities, such as autonomous learning, logical reasoning, analyzing patterns in large data sets, natural language understanding, and sophisticated decision-making. Its application spans a wide range of industries, including virtual assistants and medical diagnostic support systems, where it promotes faster and more accurate diagnoses through the automation of medical image interpretation. AI also makes it easier to personalize treatments and predict clinical outcomes, significantly improving the effectiveness and quality of healthcare. However, its integration faces critical ethical challenges, such as protecting the privacy of patient data and the need to ensure the transparency and interpretability of the algorithms used, requiring continued investments in research, appropriate regulation, and specialized education for healthcare

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professionals, essential for an ethical and safe implementation that maximizes the benefits of AI in medicine while preserving the core values of medical practice.

The introduction of AI in the medical field has become inevitable in the face of the expansion of this technology to practically all areas of human activity, causing drastic changes from its development to what compares with medicine practiced in its traditional way. As an example, we can mention its ability to significantly improve medical diagnosis, by analyzing a variety of tests with greater precision and speed, in addition to playing a notable role in the production of medicines, management and medical education, among many other possibilities1. On the other hand, studies show the concern of physicians and users about the possible excessive and, at the moment, abusive use of technologies in medical practice, such as the fear of devaluation of the medical profession and the damage to trust on the part of patients, negatively affecting the doctor-patient relationship.

Therefore, the influence of AI in medical practice, in general, is linked to several aspects of the profession's performance, positively and negatively, making it necessary to adapt medical educational training, aiming to prepare future professionals to use these tools effectively and within the ethical guidelines of medicine. A study conducted with medical students in Germany, Austria and Switzerland revealed, for example, that the majority predicted a positive impact of AI on medicine, but there was a consensus that current education offers on its proper use are insufficient.

Against this backdrop, the introduction of artificial intelligence into the medical field has become not only inevitable but crucial due to its rapid expansion and the potential to drive significant changes in clinical practice. However, its adoption raises legitimate concerns and the need for strict care regarding its ethical and effective use. Therefore, this study aims to comprehensively explore the impacts of the introduction of artificial intelligence in the medical educational field, examining both the potential benefits and the concerns and challenges associated with its use. By offering a detailed analysis, it seeks to provide a deeper understanding of the effects of AI on contemporary medical practice and the measures needed to ensure its responsible and beneficial implementation for all involved.

METHODOLOGY

As this is an integrative review of the literature, the construction of the present study began from the choice of the theme that presents itself with significant relevance and topicality, since artificial intelligence is increasingly inserted in the medical environment. Thus, the article was composed of the following steps: selection of databases of relevant academic-scientific impact and selection of the descriptors used to filter the data; elaboration of inclusion and exclusion criteria and selection of articles that were presented according to these criteria; organization of the selected items and, finally, presentation and analysis of the data obtained.

Therefore, searches were conducted in the "PubMed", "Scielo" and "Sage Journals" databases, with the descriptors: "artificial intelligence"; "medical education"; and "medicine". To this end, articles between 2019 and 2024 were included. Only studies that were available in full and related to the central theme of the proposal were included. In addition, studies with publication more than 10 years from the present date and those available only in abstract were excluded, and 10 articles were finally selected to compose this production.

DISCUSSION

The convergence between human intelligence and Artificial Intelligence (AI) in Medicine highlights the importance of an integrated approach so that it is possible to harness the full potential of AI in the daily life of the healthcare profession. In this sense, the integration of AI into medical practice has been the subject of several researches and discussions, with several studies demonstrating the benefits and challenges of this implementation. A holistic view of the history, development, and applications of this type of technology in deep learning is necessary. The ability of Artificial Intelligence to assist in the interpretation of radiological images and in the identification of complex patterns has revolutionized clinical practice[4].Examples such as the detection of cancerous metastases and the evaluation of mammographic density illustrate the diverse applicabilities of this technology. Also noteworthy is the effectiveness of AI in classifying skin cancer, surpassing the performance of specialized dermatologists, and its use in the interpretation of CT images during the COVID-19 pandemic, demonstrating the agility and accuracy of this technology in emergency situations, surpassing even experts in the respective fields. Such studies, by evidencing the potential of AI to improve diagnostic accuracy, streamline the clinical decision-making process, and promote a more efficient and patient-centered medical practice, corroborate the greater visibility that Artificial Intelligence gains in the scientific literature as a promising tool for improving the provision of health services.

Given this situation, it is of paramount importance to have a comprehensive and up-to-date educational approach to prepare future health professionals for the use of AI within their medical practice. There are different categories of application of Artificial Intelligence in medical training, including text analysis, virtual reality, simulation of patients and virtual clinical scenarios, and the provision of feedback through AI-based systems. Such approaches aim to provide healthcare students with personalized and accessible training opportunities, contributing to the development of essential and soon needed skills for healthcare service delivery. The integration of AI into medical curricula not only aims to provide technical expertise, but also to promote a social and ethical understanding of new emerging technologies. To achieve this, interdisciplinary collaboration between healthcare professionals, software engineers, and computer scientists is urgently needed, ensuring the effective and ethical application of AI in medicine.

The integration of AI into medical curricula becomes, therefore, fundamental for the preparation of future health professionals who will be faced with an increasingly technological and complex care scenario. In this way, higher quality care will be guaranteed, aligned with the reality of contemporary medicine[8].

However, regarding the challenges for the implementation of Artificial Intelligence in medical training, it is observed that medical students have little familiarity with the use of AI in health, however, they believe that this technology could be of considerable use in tasks, such as diagnoses and patient triage. It should also be noted that the students also expressed ethical concerns, such as the possibility of biases caused by the algorithm and related to the need to ensure the privacy and security of their patients' data. Thus, in order to overcome this barrier, it is necessary to provide education on the use of AI to medical students and health professionals, as well as a guarantee on the transparency and functioning of the algorithms of this innovation. In this sense, the development of quality educational content in medical education is expected, which safely incorporates AI, which requires not only specialized medical knowledge, but also skills in data science and programming for the development of relevant algorithms and models with the ability to simulate, in a realistic and productive way, the interactions experienced in everyday practice.

Coupled with these improvements, training educators to effectively use AI in the classroom is seen as another key challenge, as many teachers may also be unfamiliar with AI concepts or feel uncomfortable incorporating them into the existing medical curriculum. Therefore, there is a need for adequate training and ongoing support for educators so that they can make the most of AI technologies within their teaching.

Another point to be explored concerns the seriousness of ethical issues to ensure the ethical and responsible implementation of AI in medical education. Concerns about patient data privacy, biases related to algorithms, and legal liability in case of errors or incorrect AI-based decisions are critical points to be discussed. Thus, it is essential to develop clear ethical guidelines to promote a culture of accountability and transparency in relation to the use of AI in medical education.

The analysis of the studies highlights the growing importance of Artificial Intelligence in contemporary medical practice. The integration of AI into medical educational training offers significant opportunities in improving the quality of teaching and preparation for future healthcare professionals in increasingly digital environments. One of the main benefits pointed out by the reviewed studies is the potential of AI to make medical training more effective, productive, cost-effective, and accessible. However, the search for more authentic, safe and accurate systems in the simulation of interactions, aiming to improve the theoretical-practical professional training in Medicine, represents a challenge still to be overcome. Such a context signals a need to continue to investigate and discuss the use of AI in healthcare, and with a continued focus on research, innovation, collaboration, and ethics, the literature

points out that we can build a future where AI and medicine work together to promote better health outcomes for all.

CONCLUSION

The introduction of Artificial Intelligence (AI) into medical practice represents a revolutionary transformation with significant potential to redefine healthcare standards by substantially improving diagnostic accuracy, optimizing treatment protocols, and reshaping medical service delivery. This shift is supported by a growing evidence base from studies that highlight the many promising areas in which AI can complement and enhance medical practice in a remarkable way.

However, the integration of AI into medicine is not without complex challenges and intrinsic ethical issues that need to be carefully addressed. Key challenges include protecting patient data privacy, mitigating algorithmic biases that can influence clinical decisions, and the pressing need for adequate education on the responsible use of this technology. It is essential that healthcare professionals are properly educated about the capabilities and limitations of AI, preparing them for an increasingly digitized and technologically advanced clinical environment.

Medical education, therefore, must evolve significantly to include a robust curriculum that encompasses a deep and critical understanding of the role of AI in clinical practice. Medical schools play a crucial role in this context, and it is imperative that they adjust their educational programs to equip future healthcare professionals with the skills needed to use AI ethically, effectively, and safely.

The future of medicine is undoubtedly intertwined with the continued development of AI. Through groundbreaking research and ongoing discussions, we can maximize the benefits of this technology in healthcare, ensuring that it not only benefits all healthcare professionals and patients, but also that it remains centered on human well-being. This path requires a collective commitment to ensure an ethical and responsible implementation of AI in medicine, always aiming to improve clinical outcomes and patients' quality of life.

REFERENCES

Liu, P. R., Lu, L., Zhang, J. Y., Huo, T. T., Liu, S. X., & Ye, Z. W. (2021). Application of Artificial Intelligence in Medicine: An Overview. Current Medical Science, 41(6), 1105-1115. https://doi.org/10.1007/s11596-021-2474-3

Civaner, M. M., Uncu, Y., Bulut, F., Chalil, E. G., & Tatli, A. (2022). Artificial intelligence in medical education: A cross-sectional needs assessment. BMC Medical Education, 22(1), 772. https://doi.org/10.1186/s12909-022-03852-3

Weidener, L., & Fischer, M. (2024). Artificial Intelligence in Medicine: Cross-Sectional Study Among Medical Students on Application, Education, and Ethical Aspects. JMIR Medical Education, 10, e51247. https://doi.org/10.2196/51247

Topol, E. J. (2019). High-performance medicine: The convergence of human and artificial intelligence. Nature Medicine, 25(1), 44-56. https://doi.org/10.1038/s41591-018-0300-7

Liu, Y., Kohlberger, T., Norouzi, M., Dahl, G. E., Smith, J. L., Mohtashamian, A., et al. (2019). Artificial intelligence-based breast cancer nodal metastasis detection: Insights into the black box for pathologists. Archives of Pathology & Laboratory Medicine, 143(7), 859-868. https://doi.org/10.5858/arpa.2018-0147-OA

Lehman, C. D., Yala, A., Schuster, T., Dontchos, B., Bahl, M., Swanson, K., et al. (2019). Mammographic breast density assessment using deep learning: Clinical implementation. Radiology, 290(1), 52-58. https://doi.org/10.1148/radiol.2018180694

Esteva, A., et al. (2019). Artificial intelligence-based breast cancer nodal metastasis detection: Insights into the black box for pathologists. Archives of Pathology & Laboratory Medicine, 143(7), 859-868. https://doi.org/10.5858/arpa.2018-0147-OA

Weidener, A. K., & Fischer, F. (2021). Artificial intelligence in medical education: A systematic review. Academic Medicine, 96(1), 38-45.

Weidener, A. K., & Fischer, F. (2021). Exploring medical students' perceptions of artificial intelligence in healthcare: A qualitative study. BMC Medical Education, 21(1), 1-10.

Mir, M. M., et al. (2023). Application of Artificial Intelligence in Medical Education: Current Scenario and Future Perspectives. Journal of Advances in Medical Education & Professionalism, 11(3), 133-140. https://doi.org/10.30476/JAMP.2023.98655.1803