Redefining the Role of Medical Physicists in the Age of Artificial Intelligence

Mitchelle Makwasha & Nyasha Njanji

Department of Medical Physics, University of Zimbabwe; Talk Cancer Zim

Abstract

Medical physicists have traditionally played a crucial role in ensuring the safe and effective use of radiation in medicine. This field is however somehow being transformed by the use of artificial intelligence (AI). Practitioners and students are therefore raising questions about the future of the profession. This paper examined how AI is reshaping professional responsibilities and the skills required of the next generation. The objective of this paper was to explore whether AI is a threat to the profession and its relevance or rather a breakthrough in redefining the role of the profession in society. Medical physics students at the University of Zimbabwe and mentees of the Talk Cancer Zim initiative attended a series of the International Organisation for Medical Physics (IOMP) webinars focusing on the roles of medical physicists in the age of artificial intelligence. The sessions highlighted the growing application of AI in tasks such as automated quality assurance and calibration. Findings revealed that AI functions as an assistive tool rather than as a replacement of medical physicists. Furthermore, AI lacks clinical context, ethical reasoning and human-centred communication essential for patient care and multidisciplinary collaboration. Instead of diminishing the profession, AI is redefining it, placing future emphasis on validating AI models, managing safety and ethical considerations. These insights reinforce the importance of embracing technological innovation while preserving the irreplaceable human elements of medical physics.

Keywords: medical physics, artificial intelligence, radiotherapy, education, future workforce

Introduction

Medical physicists are an essential facet of modern healthcare. They apply physics principles to medicine by ensuring the safe and effective use of radiation in diagnosis and treatment. However, the profession is undergoing significant transformation due to the rapid emergence of artificial intelligence (AI) in healthcare. This is raising concerns about the future of the profession; hence, students and professionals are increasingly asking a critical question: *Will AI eventually replace medical physicists, or will it redefine their professional roles?* To respond to this question, this paper was written to examine how AI is reshaping the roles, responsibilities and competencies of medical physicists and assess their continued relevance

and professional growth. The information was drawn from reflections from a series of International Organization for Medical Physics (IOMP) webinars and insights from related scholarly findings.

Background to the study

The work of medical physicists includes diagnostic imaging, radiotherapy, nuclear medicine and radiation protection. In each of these domains, they uphold rigorous quality assurance processes, calibrate and commission equipment, verify treatment plans, educate clinical teams and conduct research to advance patient outcomes. Artificial intelligence is one of the key technologies spearheading the Fourth Industrial Revolution and, as its presence in medical research expands, so does the scope of science to solve the most pressing medical challenges of our time (Fornell, 2018). Artificial intelligence is defined as computing technologies that can perform tasks which normally require human intelligence such as visual perception, speech recognition, decision making, and translation between languages (Lofts, 2019). In recent years, artificial intelligence (AI) has emerged as a transformative force across multiple industries including healthcare. Its adoption in medical physics is increasingly visible in applications such as automated quality assurance, equipment calibration, and data analysis. While AI promises efficiency and expanded analytical capabilities, it also introduces new challenges particularly regarding clinical interpretation, ethical oversight, and the preservation of human-centred patient care. To explore these opportunities and challenges, the International Organisation for Medical Physics has hosted a series of webinars addressing AI's role in medical physics practice and education.

Methods

Medical physics students at the University of Zimbabwe and mentees of the Talk Cancer Zim initiative participated in two such webinars. One webinar focused on AI's role in radiotherapy and the other on its integration into medical physics education. This paper adopted a qualitative reflective approach, integrating personal reflections and thematic insights drawn from professional webinars and supporting scholarly literature.

Results

The first webinar centred around a pressing question: Will AI eventually replace medical physicists in radiotherapy? The discussion acknowledged the increasing use of AI in treatment planning, quality assurance and even decision support. Technologies such as Varian's automated QA systems and XIM calibration tools are already transforming workflow

efficiency. Some participants expressed concern that AI's expanding role may render the medical physicist obsolete. However, the counterargument was strong: AI lacks contextual understanding, clinical judgment and the ability to adapt to edge cases in real-life patient care.

AI can analyse large datasets, automate routine tasks and assist in model generation, but it cannot make ethical decisions or ensure safe implementation without human oversight. It cannot communicate with patients and clinicians effectively and does not innovate new paradigms. Artificial intelligence is not accountable for clinical outcomes as well. Rather than replacing the profession, the webinar highlighted that AI is reshaping it. Medical physicists will increasingly be called upon to validate AI models, manage biases and integrate AI into existing clinical workflows, hence the profession is evolving not disappearing

The second webinar tackled the integration of AI in education. Other examples discussed were the use of AI-driven tools to generate practice problems and deliver instant feedback, assist in literature reviews, grant writing as well as article preparation and support personalised learning paths for students. This raises valid concerns such as: Will AI reduce the need for human educators and mentors in medical physics? The discussion concluded that, while AI can enhance the learning experience it cannot replace the mentorship, clinical insight and professional judgement offered by human instructors. A study by Abdul Sami (2025) established that AI is an effective and credible tool in medical education, offering personalised learning experiences and improved educational outcomes. However, there is a need to develop dedicated AI tools for medical education along with appropriate regulatory oversight to ensure AI can enhance human abilities rather than acting as a replacement for humans. In this study, the researchers sought to develop AI literacy alongside their core competencies. Understanding how to interact with AI tools and apply their outputs responsibly would be critical in training and future careers of current researchers and other students.

Discussion

The key takeaways and reflections from these webinars were that AI is a powerful enabler, but not a threat to the medical physics profession. There is therefore a need for it to be incorporated in the educational structure of medical physics. This would in turn expand and evolve the scope of practice for medical physicists. However, there is currently a shortage if not a total lack of courses or workshops on AI-related methods that approach an education programme focused purely on the medical physicists needs (Oliver Diaz, 2021). Future professionals in medical physics must be prepared to audit, validate and ethically manage AI technologies.

Communication, critical thinking and clinical judgment remain uniquely human and irreplaceable. Instead of fearing displacement, medical physicists ought to be inspired to embrace AI as a partner in progress. Researchers and students in the field ought to be more motivated now and be adaptive, innovative and open-minded.

Conclusion

The webinars that medical physicists attended offered more than just technical knowledge; they gave hope and direction. The profession of medical physics is not under threat from AI, but it is being refined. AI will not eliminate medical physicists but rather redefine their roles to become even more impactful. Fellow students and young professionals are therefore encouraged not to view AI as a replacement, but as a collaborative tool. By embracing this transformation with readiness and responsibility, the future of medical physics remains bright, meaningful and human-centred (Amoroso, 2025).

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