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Citation: Malamateniou, C., O'Regan, T., McFadden, S. L. & Jackson, M. (2024). Artificial intelligence (AI) in radiography practice, research and education: A review of contemporary developments and predictions for the future. *Radiography*, 30(2), pp. 56-59. doi: 10.1016/j.radi.2024.09.062

This is the accepted version of the paper.

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Permanent repository link: <https://openaccess.city.ac.uk/id/eprint/34338/>

Link to published version: <https://doi.org/10.1016/j.radi.2024.09.062>

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Artificial intelligence (AI) in radiography practice, research and education:

A review of contemporary developments and predictions for the future.

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Artificial intelligence (AI) in radiography practice, research and education: A review of contemporary developments and predictions for the future.

Introduction

Artificial intelligence (AI) has been described as the new frontier of healthcare, particularly its use in medical imaging and radiotherapy treatments. Its development in respect of technological advances and subsequent application has been rapid and widespread both in the UK and internationally. Previously published work showed that for the real benefits of AI to materialise radiographers, and other healthcare practitioners, should be competent and confident in its application in their respective scope of practice and varied clinical or educational settings¹⁻³. Timely, customised and evidence-informed education in AI and its application needs to be further developed and enacted for all radiography practitioners and across the multidisciplinary space that healthcare and healthcare education operates⁴. Such an endeavour requires judicious consideration of the technology alongside ethical considerations and a unifying governance structure⁵. It also necessitates comprehensive assessment in terms of the educational design and content to fully validate its implementation⁶⁻⁸.

In the UK there have been multiple drivers to support this interest in the efficacious implementation of AI. The Topol Review explored and proffered recommendations on how best to prepare the healthcare workforce through education and training interventions⁹. In 2023 the HCPC added a Standard of Proficiency that required radiographers in training to 'demonstrate awareness of the principles of AI and deep learning technology, and its application to practice' (standard 12.25)¹⁰. Also, in 2023 the NHS was awarded a £21 million AI Diagnostic Fund to support the deployment of AI as a decision support tool via imaging networks¹¹. The Society and College of Radiographers (SCoR) continue to support the radiography workforce through a comprehensive AI implementation guidance document¹² and a range of e-resources such as an AI webinar series organised by the AI advisory group¹³.

The aim of this guest editorial is to offer an up-to-date rapid review on AI implementation developments in radiography, an area that changes so quickly and one that will have a profound impact on education, clinical practice and research trajectories in the very immediate future.

AI governance for radiographers and other healthcare professionals

The guidance for clinical imaging and therapeutic radiography workforce professionals in the UK published by SCoR in 2021¹² is currently being updated using the best available research evidence from published literature, patient information sheets and healthcare professional policy and practice. These guidelines follow the same format as the 2021 version and are currently in draft format. They discuss the emerging and ongoing work in different areas of radiographic practice using AI within both clinical imaging and therapeutic services with the same priority areas as the 2021 publication: clinical Practice, education, research, stakeholder partnerships. Other more generic publications, which could be used up by radiographers and other medical imaging and radiotherapy professionals have also been published recently, focussing on responsible AI^{6,14,15}. Other regulations and governance frameworks also exist¹⁶,

the uptake, though, seems to be quite low given the lack of formalised education to explain their uses, interpretation and relate them to the sector applications and needs.

There is heavy emphasis in AI governance in 2024 with two important governance documents being released, the EU AI act¹⁷ and the UK AI Bill¹⁸. There are high hopes that this regulation will enable better adoption and bolster trust, but also fears that it could stifle innovation, particularly in the European geographical area.

AI education in radiography

Education and awareness in AI have greatly changed in the last 5 years and medical imaging professionals, whilst initially reticent, are now embracing the need for knowledge to aid AI acceptance and implementation. This is partly driven by the SCoR Education and Career Framework (ECF)¹⁹ which states the need for all practitioners and managers to have a critical awareness of the role of AI in radiography. In a bid to address this need, the SCoR ran a webinar series in September 2023 offering (i) a general Introduction to AI for radiographers, (ii) evaluated how AI can be used in radiography and (iii) evaluated the challenges and opportunities of AI implementation in practice¹³. These webinars had 1575 registrations, 785 live attendance and 446 additional views of the recordings (still available on the SCoR website). This was followed up by an e-learning for health (E-lfh) module entitled “An introduction to artificial intelligence for healthcare professionals” as part of the Clinical Imaging programme, sponsored by SCoR in October 2023²⁰. The E-lfh module is freely available online for all NHS staff and the programme currently has 10,000 active members. The range of participants in the E-lfh AI module ranged from AHPs (Radiographers, Physiotherapists, Podiatrists), General Practitioners, General medicine, Graphic design artists, Information technologists, Healthcare assistants, Nurses and Midwives to porters. This highlights the increasing need for a high level of digital fluency among all healthcare staff, as they must learn to evaluate, interact and oversee the actions of AI driven tools within their workflow. As radiographers are at the forefront technological changes influenced by AI, they are in an ideal position to facilitate this knowledge transfer to other health professionals. The provision of education should anticipate new technological advances not only in medical imaging but across the multidisciplinary landscape (both the pre- and post- registration). There is now a wider offering of online resources and webinars by different professional bodies, including the College of Radiographers, to introduce the basics of AI to clinical imaging and therapeutic radiography professionals in Europe⁶ and this pool of resources keeps growing exponentially to meet demand. A recently announced research study called AIMIROE (AI education for Medical Imaging and Radiotherapy prOfessionals in Europe), funded by the cross-disciplinary European Society of Medical imaging informatics (EuSoMII) and endorsed by EuSoMII and EFRS, is attempting to make these offerings easier to find and access, so the interested professionals can make an informed decision based on language and mode of delivery, duration, educational content and associated costs²¹. More results on this study and a dedicated website will be launched in the end of 2024, beginning of 2025 and will be hosted on the EuSOMII website²². A recent study evaluating a customised AI introductory training course for radiographers⁷ has shown the real benefits and culture shift of a hands-on, in person, intense training CPD programme delivered on campus at City St George’s University of London since 2020. The mix of theory and practice, interaction during hands-on sessions, networking with the native AI ecosystem and vendors, and professional interactions with all key stakeholders have established it as a useful CPD programme to advance radiographer learning in relation to AI and digital technologies²³. A recent scoping review²⁴ identified there

is still a great need to formally evaluate educational programmes on AI that have been designed and implemented or medical imaging staff, to ensure they are evidence based and clinically relevant.

Radiographers as innovators

As AI technology continues to find new applications in medical imaging and radiotherapy, it is imperative that radiographers, as frontline workers in service delivery and technology use, are at the forefront of research informing technology that ultimately impacts their daily practice. The National Health Service in the UK has prioritised AI and Digital health as part of its Long-Term Plan to help ease the pressure on an already stretched service²⁴, hence radiography as a profession needs to highlight and develop radiographer-led research on the implications of AI implementation into clinical practice. Examples of current innovative research include exploring the perceptions of trust, confidence in and decision switching due to AI²⁵ using radiographer feedback to codesign a preferred end user interface²⁶. With so many AI applications coming on the market, radiographers are in an ideal position, between technology and the patients, to lead prospective high quality clinical trials and to create and validate AI interventions for clinical service benefit.

Recent research has identified that patients themselves have their own concerns about AI making decisions on their healthcare/treatment. They too, need to understand more and expressed a desire for explainable AI on a global scale ²⁷ It is crucial that radiographers and AI manufacturers hear the patients voice and invite patients/service users to inform all developments of AI and treat them as partners in research²⁸.

Reflecting on the past and looking to the future

Approaches to the development and implementation of AI in diagnostic and therapeutic radiography are evolving. Initial discussions centred on theoretical and potential applications, affects and effects. Supported by the availability of digital images, datasets, increased computing power, and AI leaders and pioneers, speculative possibility has led to practical considerations of how AI can be used ²⁹⁻³¹. Moving from what some have referred to as routine and repetitive tasks toward support and decision tools that provide healthcare staff with more time; advancing onwards, perhaps even beyond the capabilities of humans. The heady conversation and ideal of AI providing more time for front-line staff to provide person-centred and tailored care has, however, been tempered by the practicalities of the vast volumes of work and number of patient pathways, waiting to swallow up that extra time³¹.

A current focus on the implementation of AI algorithms into practice and how they are integrated into the workflow of our departments have shifted the discourse to practical implementation, safety, ethics and governance³²; a narrative that has developed alongside the maturing of AI technologies, beyond infancy but not yet to adulthood. That has enabled a more nuanced approach which allows front-line practitioners to begin to realise and envisage more potential uses case across the variety of modalities, patient pathways, specialities⁹, and different populations ^{4,33} that they care for each day.

The steady growth of AI in clinical practice, in research and education, has facilitated multidisciplinary development with current discussions and evidence of practical understanding, including knowledge of what doesn't work well, and progress of AI systems

and education. This is a self-perpetuating cycle which is helping to embed AI in our healthcare professions' practice and discourse.

Part of that process is now directing us to build and iteratively re-visit the growing evidence-base³¹, to develop AI clinical-decision support tools, to explore and address ethical concerns, to renew educational provision, and to look to safe and effective implementation of AI systems for staff and patients³⁴.

As we share this knowledge with and across organisations, future directions are towards true innovation of services, toward patient pathways that are fit and equitable for future populations' healthcare needs, and to the development of our roles in screening, prediction, and prevention of diseases to enable contribution to increased national health and wellness.

AI impact of the profession and careers

This technological change impacts not just patient outcomes, staff experiences and clinical workflows; it also impacts traditional career pathways and shapes professional identities. Professional cards will be reshuffled by this disruptive innovation AI brings upon medical imaging and radiotherapy and across healthcare. The NHS England digital transformation service has proposed some archetypes (namely the Shapers, Drivers, Creators, Embedders and Users), which "will have different knowledge and skills requirements to confidently develop, implement or use AI technologies, and hence specific educational needs"³⁵. It is expected that these archetypes won't necessarily align with traditional professional groups, specialisms or seniority, but will "depend solely on an individual's role in the development, implementation and use of AI technologies".³⁵

A recent European study has collected more than 2200 responses from radiographers on the impact of AI implementation on their professional identity³⁶; despite an overall optimistic view, in groups where education, knowledge or experience with AI are low, there is less trust and more scepticism towards this new technology. This further exemplifies the central role of education in building trust and enabling acceptability by practitioners³⁶.

The power of partnerships for AI implementation

For AI tools to be effective there must be collaboration between all relevant stakeholders in clinical imaging / radiology / or radiotherapy services¹². Multiple papers list essential stakeholders who are necessary to effect AI which is technically possible, clinically relevant/useful, safe, effective, well-governed, trust-worthy and ethical^{4,6, 12,37}. This should be in a manner that fits with the economics, politics, culture, legal and environmental situations of our services. Co-production is an essential concept in which to base those stakeholders' relationships and partnership approaches^{28,38}. Overall, the whole point of this is to enable everyone with an interest or desire to contribute, to do so, to facilitate AI research, development, implementation, and innovation.

Interplay between technology and patient care: technology at the service of patient benefit

AI technology is being implemented in services with early evidence of patient benefits in terms of patient access, needs, experience, and outcomes³⁹. Quality improvement in terms of

1 service efficiency and accuracy, conversely, also afford staff greater ability to tailor care to the
2 person.

3 For example, earlier diagnosis and intervention for lung cancer can be achieved with the
4 support of AI tools ^{40,41}. Staff using those tools consider that the effect and intersectionality of
5 technology with care highlights, and even heightens, the patient's need for human touch and
6 compassion from radiography staff during each potentially anxiety provoking care episode.
7

8
9 The contribution of AI therefore both intersects with and influences our environments. It can
10 improve services on a patient pathway level but also at individual level, pressing the need for
11 practitioner reflection and potential adjustments to practice, to facilitate individual person-
12 centred care.
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Acknowledgements

We are indebted to the College of Radiographers and College Board of Trustees for funding of AI special CORIPS calls, which made a huge difference in building the evidence base of AI in radiography and making important scholarly contributions in this field. We would also like to acknowledge that the seamless collaboration between the CoR, the EFRS and EuSOMII, and their endorsement of our research projects have massively increased recruitment of studies, the scope of our work, dissemination of findings and their interpretation in individual contexts. It is through the support and guidance of our professional bodies that we managed to make the contributions described in this editorial. Last but not least, we would like to thank all our colleagues in clinical practice, education, academia and policy that stood by us and embraced our work. We owe them everything.