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AI implementation in the UK landscape: Knowledge of AI governance, perceived challenges and opportunities, and ways forward for radiographers

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ABSTRACT

Introduction: Despite the rapid increase of AI-enabled applications deployed in clinical practice, many challenges exist around AI implementation, including the clarity of governance frameworks, usability of validation of AI models, and customisation of training for radiographers. This study aimed to explore the perceptions of diagnostic and therapeutic radiographers, with existing theoretical and/or practical knowledge of AI, on issues of relevance to the field, such as AI implementation, including knowledge of AI governance and procurement, perceptions about enablers and challenges and future priorities for AI adoption.

Methods: An online survey was designed and distributed to UK-based qualified radiographers who work in medical imaging and/or radiotherapy and have some previous theoretical and/or practical knowledge of working with AI. Participants were recruited through the researchers' professional networks on social media with support from the AI advisory group of the Society and College of Radiographers. Survey questions related to AI training/education, knowledge of AI governance frameworks, data privacy procedures, AI implementation considerations, and priorities for AI adoption. Descriptive statistics were employed to analyse the data, and chi-square tests were used to explore significant relationships between variables.

Results: In total, 88 valid responses were received. Most radiographers (56.6 %) had not received any AI-related training. Also, although approximately 63 % of them used an evaluation framework to assess AI models' performance before implementation, many (36.9 %) were still unsure about suitable evaluation methods. Radiographers requested clearer guidance on AI governance, ample time to implement AI in their practice safely, adequate funding, effective leadership, and targeted support from AI champions. AI training, robust governance frameworks, and patient and public involvement were seen as priorities for the successful implementation of AI by radiographers.

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Conclusion: AI implementation is progressing within radiography, but without customised training, clearer governance, key stakeholder engagement and suitable new roles created, it will be hard to harness its benefits and minimise related risks.

Implications for practice: The results of this study highlight some of the priorities and challenges for radiographers in relation to AI adoption, namely the need for developing robust AI governance frameworks and providing optimal AI training.

Introduction

Artificial Intelligence (AI) is an ‘umbrella’ term that uses computational methods and statistical procedures to mimic the decision-making skills of humans and their learning behaviours.[1] AI is being rapidly developed and deployed in most healthcare disciplines.[2–4] In healthcare, AI has the potential to transform clinical practice,[5] enable precision medicine, improve diagnostics, and empower healthcare professionals.[6] Medical imaging has been one of the first disciplines to attract the interest of AI researchers,[7] with AI-based applications able to improve workflows and image quality, minimise radiation dose, and standardise patient safety.[8] In addition, AI can potentially reduce turnaround times in medical imaging by reducing the time needed for diagnosis,[9] for image acquisition,[10] or even for organ-at-risk contouring and dosimetry in radiotherapy.[11] Employing AI-based automatic algorithmic filtering to improve or assess image quality is only an example of current AI-based applications.[12,13]

Radiographers will be key stakeholders in AI adoption, alongside radiologists, medical physicists, IT specialists, and biomedical engineers, to name just a few; hence, the profession must ensure that they are adequately equipped with all essential knowledge, guidance, and resources when introducing AI into clinical practice.[3] In this context, the Society and College of Radiographers have already issued specific guidance to promote AI's safe and ethical use and guide radiographers into the digital transformation of services, including establishing key partnerships with all key stakeholders of the AI ecosystem.[14] Clear, robust AI governance frameworks should be in place to safely guide radiographers and other medical imaging professionals into AI implementation.[15] These will also help evaluate AI tools, facilitate AI procurement, and monitor its performance over time. In addition, AI-related training should be central to AI adoption,[3,16] and radiographers should develop digital competencies and invest in AI-specific knowledge.[17–19] However, previous studies have noted low levels of AI-related knowledge among radiographers,[20–22] despite overall eagerness to use these technologies in clinical practice.

Many challenges exist around AI implementation in healthcare,[23,24] and healthcare leaders have already affirmed that the digital transformation of healthcare professions will enable a successful AI adoption.[25,26] In this context, digital transformation should include proportionate education and the creation of new roles regarding data science, ethics, data security, and implementation strategies.[25] The National Health Service X service (NHSx) has already proposed the creation of six main archetypes for healthcare professionals who will work in AI.[18,19] Healthcare professionals should adopt responsible and ethical AI practices.[18,19,27] Data quality and security challenges are also present since AI-enabled applications need vast data to be trained appropriately and validated.[28] Data-sharing policies should be in place, and rigorous governance frameworks would help to guide healthcare professionals and cultivate trust among staff and patients.[29] In the UK, using NHS data must be in line with secure data environments.[30] The UK General Data Protection Regulation (GDPR)[31] should be strictly followed to ensure data security, and all healthcare professionals should ensure that their practices respect the rights and freedoms of patients in confidentiality, anonymity, and informed consent, protect any personal identifiable information, similarly to the original GDPR applied in the European Union. The provisions of the EU GDPR have been incorporated directly into the UK Data Protection Act 2018, and all professionals who operate in the UK need to comply with this. Standardised validation protocols should also be implemented, and these should be further categorised into internal validation techniques used by software engineers to test the AI models and clinical (or external) validation procedures used onsite to assess the models' clinical effectiveness using real-world data. AI models should be interoperable, interpretable, transparent, and fair. Post-market surveillance is also needed to ensure that the benefits of AI are equally distributed and that all patients have access to beneficial innovations, patients are not harmed, and all ethical principles have been followed.[23]

Previous research[21,22,32] aimed to elicit information about perceptions and knowledge of radiographers in general. These studies noted an overall positive attitude of radiographers towards AI, although a general lack of understanding of AI concepts was highlighted. However, these studies may also include perceptions of non-experts. Our study focuses specifically on those with knowledge and expertise in AI, which can better inform AI implementation initiatives.

This study aims to a) assess the AI implementation landscape in medical imaging and radiotherapy in the UK, b) to explore any AI governance frameworks and policies currently used in clinical practice by radiographers, c) to evaluate their level of AI governance knowledge, d) to identify challenges and opportunities around AI adoption, as perceived by radiographers, and e) to indicate any priority areas requiring further support for successful AI implementation in medical imaging and radiotherapy practice.

Methods

All findings of this study are reported in line with the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional studies[33] and the Checklist for Reporting Results of Internet E-Surveys (CHERRIES).[34]

Study design

This study used an online survey built on Qualtrics (Qualtrics, Provo, UT), which automatically captured all responses. Purposive sampling was employed to better align the sample to the study's aims and objectives and ensure the results were trustworthy.[35]

Data collection tool

This online survey consisted of 28 closed questions and five open-ended questions, which prompted participants to give their responses in specific free-text boxes. This instrument was developed based on previous AI-related online surveys,[36–40] a recent scoping review of the topic,[41] and a multidisciplinary focus group discussion with field experts (n = 10). Participants were radiographers and radiologists with expertise in AI, AI developers, and an IT specialist. This focus group was conducted to gather information on AI governance principles, important aspects of AI adoption, challenges for AI adoption, and decisions on procurement of AI tools, to help us design a clinically relevant survey. The findings of this focus group will not be published anywhere, since this was conducted only to inform this study.

Piloting was performed by a multidisciplinary team (n = 9) consisting of radiographers, radiologists, academics, medical physicists, and a linguist to ensure face and content validity of the instrument. This resulted in amendments regarding question order, numbering, phrasing, and terminology. Adaptive questioning, a well-established strategy that reveals specific questions where certain conditions have been previously met, was used to reduce the number and complexity of questions. To minimise the possibility of multiple entries from the same individual, responses from the same IP address were not allowed. Participants could return to previous pages to review or change their responses.

The survey was electronically distributed through the AI advisory group of the Society and College of Radiographers and the researchers' social media accounts on LinkedIn, X (formerly called Twitter), and Facebook. Further advertisement was via email through the researchers' professional networks. Data collection lasted from November 7, 2022, to December 12, 2022.

The first section of the data collection tool was devoted to demographics of participants, therefore, information on participants' age, gender, geographical location, type of work setting, professional background, predominant role in work setting, and years of experience was collected. The next survey section was related to AI education/training, and this explored provision of education, types of AI education/training (e.g., online), and providers of this training (e.g., conference, professional body, university). The next section explored their knowledge on specific AI governance frameworks (e.g., NHSx, NICE), their use by organisations, and their awareness of certain standards and guidance for AI in healthcare. The next section was related to data security protocols when using AI, protocols for informed consent, and knowledge of the GDPR. Later, participants were asked to report on specific aspects of AI implementation, such as use of clinical AI validation frameworks, evidence of validation before AI procurement, ongoing monitoring of AI solutions, usability and interoperability of AI tools, and expected costs/scalability of costs. Finally, the open-ended questions of this tool asked the participants to describe their priorities for a successful AI adoption in medical imaging, their perceived challenges around AI implementation, and the opportunities that AI will bring to clinical practice.

Participants

Eligibility criteria included a) being a UK-based and qualified radiographer, working either in medical imaging or radiotherapy (this included both diagnostic/therapeutic radiographers and sonographers), and b) having self-declared theoretical and/or practical knowledge of AI tools.

Data analysis

All quantitative data were analysed on the Statistical Package for the Social Sciences (SPSS) (IBM: Armonk, NY), using descriptive statistics for reporting frequencies and Pearson's chi-square test (x^2) for associations between variables. Cramer's V was used to measure the strength of associations, with V > 0.25 indicating a very strong effect size, V > 0.10 a moderate effect, and V > 0.05 a weak effect.[42] Graphs and tables were also used to better visualise some of the results. Qualitative data deriving from the survey's open-ended questions were analysed by a researcher using a content analysis approach and by classifying the data into themes and categories with common content.[43] This process was manually performed, using the colour-coding technique to label important categories in the data. Categories with common content were then grouped and formed broader themes. A senior researcher, the principal investigator of this study and responsible for the conceptualisation, methodology, and design of the whole project, acted as a second reviewer, to ensure consistency of the results. Although there was overall good agreement between the two observers, final consensus was reached after discussions within the broader research team.

Ethics

This study, part of a wider research project on exploring AI governance and implementation in medical imaging and radiotherapy, has received approval from City, University of London School of Health and Psychological Sciences Research Ethics Committee (ref: ETH2122-1015), which covers all project phases, from piloting to data analysis and dissemination. The anonymity of the participants was ensured, and all data were safely stored according to institutional protocols. Informed consent was obtained from all the participants in the form of e-consenting[44] on the first page of the survey. Participants were also informed about the purpose of this study, the principal investigator, and the data storage procedures. The participation was voluntary, and no incentives were offered to the participants.

Results

In total, 88 valid responses were received. Among the respondents, 63/88 (71.6 %) were diagnostic radiographers, 12/88 (13.6 %) were therapeutic radiographers, and 13/88 (14.8 %) were sonographers. It should be noted that the above radiography specialities have been combined in the analysis and interpretation of the results, and no specific sub-analyses have been performed between these groups given small numbers. In addition, all percentages and frequencies reported below refer to the actual number of responses received for each question, and not to the total number of respondents, since attrition was noted in this study as respondents moved further into the survey, a common phenomenon when conducting online surveys.[45]

The following table (Table 1) summarises the participants' primary demographic data.

AI training/education

Over half of the radiographers (n = 47/83, 56.6 %) reported not receiving any AI-related training/education, compared to those who had (n = 36/83, 43.4 %). Female radiographers were more likely to have received such training (n = 21/48, 43.8 %) compared to males (n = 10/29, 34.5 %), and the chi-square test exhibited a statistically significant difference ($p < 0.001$), with a very strong effect size (V = 0.376). Table 2 demonstrates the types of training among radiographers.

Respondents sought and received AI training from different agencies, such as the Society of Radiographers,[46] the British Institute of Radiology,[47] the British Association of Magnetic Resonance Radiographers,[48] the International Society for Magnetic Resonance in Medicine,[49] and the NHS AI Lab.[50] Online training was the most prominent response among radiographers (n = 19/36, 52.7 %), followed by onsite/campus training (n = 14/36, 38.8 %), hybrid

Table 1
Participants' demographic data.

Gender (n = 88)	
Male	30 (34.1 %)
Female	52 (59.1 %)
Non-binary	3 (3.4 %)
Prefer not to say	3 (3.4 %)
Age (n=88)	
23–30 years old	8 (9.1 %)
31–40 years old	36 (40.9 %)
41–50 years old	26 (29.6 %)
51–60 years old	12 (13.6 %)
60+ years old	6 (6.8 %)
Geographical location (n=88)	
Greater London	25 (28.4 %)
South East England	14 (15.9 %)
South West England	10 (11.4 %)
East of England	7 (8.0 %)
West Midlands	7 (8.0 %)
Scotland	5 (5.7 %)
East Midlands	4 (4.5 %)
Wales	4 (4.5 %)
Yorkshire and the Humber	4 (4.5 %)
The Chanel Islands	3 (3.4 %)
Northern Ireland	2 (2.3 %)
North West	2 (2.3 %)
North East	1 (1.1 %)
Predominant role (n=88)	
Clinical practitioner	54 (61.4 %)
Academic/Researcher	16 (18.2 %)
Academic/Educator	14 (15.9 %)
Another role	13 (14.8 %)
Clinical applications specialist	8 (9.1 %)
Vendor representative	3 (3.4 %)
Consultant on medical informatics/digital health	1 (1.1 %)
Professional or regulatory body officer	1 (1.1 %)
Years of experience in the above role (n=84)	
0–5 years	11 (13.1 %)
6–10 years	25 (29.8 %)
11–15 years	20 (23.8 %)
16–20 years	10 (11.9 %)
20+ years	18 (21.4 %)

forms of training (n = 12/36, 33.3 %), textbooks (n = 6/36, 16.6 %), and online applications (n = 4/36, 11.1 %).

AI data privacy

The majority (n = 62/70, 88.6 %) of radiographers reported that their organisations follow the UK GDPR and have no concerns about that. A few radiographers (n = 3/70, 4.3 %) expressed some concerns, and a further 4.3 % were unsure about that. Only 2.8 % (n = 2/70) said the GDPR is not routinely followed. Regarding concerns on GDPR, they noted this document should be clearer for AI development and data use. In addition, they expressed concerns about AI companies having access to a vast amount of data when performing troubleshooting and implementation tests in the hospitals and urged for clearly defined procedures.

Table 2
Types of AI training provided to radiographers (n = 36).

Self-guided training	20 (55.5 %)
Training provided by AI companies/medical imaging vendors	18 (50.0 %)
Training provided by universities	13 (36.1 %)
Training at conferences (*ISMRM, ECR, EUSOMII, UKIO, Intelligent Health UK*)	10 (27.7 %)
Training in clinical settings	8 (22.2 %)
Training by professional bodies/societies	5 (13.8 %)
Training provided by the Topol Digital Fellowships	1 (2.8 %)

Nearly half of the respondents (n = 31/68, 45.5 %) said that their organisations follow a specific protocol for obtaining informed consent from data owners when this data is to be used for AI adoption purposes, compared to those who do not (n = 6/68, 8.8 %). Also, 36.7 % (n = 25/68) of them felt unsure about that, while 4.5 % (n = 3/68) expressed concerns about these procedures. Other responses (n = 3/68, 4.5 %) included gaining consent only when recruiting participants for research studies, not routinely following such protocols, and using only archival patient data to run AI software. The main concerns were about having clear guidance on obtaining consent for AI development and the need to separate consent for the clinical part from consent for data use with AI. Finally, the respondents highlighted that these procedures have some time implications for clinical practitioners.

Over half of the radiographers (n = 34/64, 53.1 %) said that their organisations have locally devised protocols to ensure data security, 7.8 % (n = 5/64) of them use commercially available software solutions, and 31.2 % (n = 20/64) were unsure. Only 3.2 % (n = 2/64) said they do not use such protocols. Other responses (n = 3/64, 4.7 %) included pseudo-anonymisation of data before this leaves the hospital, so the AI company does not have access to patient identifiable information and also following local non-standard software, including risk assessment.

AI frameworks/standards

The following table (Table 3) demonstrates radiographers' knowledge of certain AI governance frameworks and standards and their use in clinical practice.

Radiographers who undertook AI training were more likely to be aware of the guidance issued by the Medicines and Healthcare products Regulatory Agency (MHRA) (n = 19/29, 65.5 %) compared to those who had not received such training (n = 11/35, 31.4 %). A statistically significant association ($p = 0.011$) was noted, with a very strong effect size ($V = 0.314$). In addition, awareness of the standards (82304-1) issued by the International Organisation for Standardisation (ISO) was again very strongly ($V = 0.381$) associated with AI-related training ($p < 0.001$), since trained radiographers were more likely to have such knowledge (n = 7/29, 24.1 %) compared to those not trained (n = 4/34, 11.7 %).

Most radiographers (n = 31/55, 56.3 %) were unsure if their organisations had specific operational policies for using AI; 20 % (n = 11/55) said that they had such policies, and 16.4 % (n = 9/55) did not. Other responses (n = 4/55, 7.3 %) included policies currently being in progress and the onus being on site of implementation.

AI implementation/considerations

Radiographers were asked if AI embedded in medical imaging/radiotherapy equipment makes them more likely to buy a product. Many (n = 23/54, 42.5 %) reported this was true. The main reasons for that were that AI should simplify the workflow and minimise the need to use additional software and equipment. On the contrary, 24 % (n = 13/54) of radiographers felt that they would not necessarily buy a product when AI has been already embedded in equipment. According to them, this would depend on costs/benefits versus quality, the clinical benefit from the application, and the purpose of the AI tool, whilst they also noted the need to choose whether AI is embedded in their equipment.

Also, to reinforce the above question, radiographers were asked to report if they would prefer AI software to be sold separately to medical imaging/radiotherapy equipment. Almost a third of them (n = 19/59, 32.2 %) were unsure. A further 30.5 % (n = 18/59) said that they would not like AI to be sold separately, highlighting the

Table 3
Use of AI governance frameworks (n = 88).

Not sure		35 (39.8 %)
National Institute for Health and Care Excellence (NICE)[51]		18 (20.5 %)
NHSx[52]		12 (13.6 %)
NHS England		9 (10.2 %)
No AI frameworks used		9 (10.2 %)
Locally developed frameworks		6 (6.8 %)
AIGA framework[53]		2 (2.3 %)
Knowledge of guidance and standards		
	Yes	No
Knowledge of MHRA guidance	32/72 (44.4 %)	40/72 (55.6 %)
Knowledge of ISO 82304-1 standards	14/71 (19.7 %)	57/71 (80.3 %)

need for AI to be fully integrated with medical imaging equipment since they felt that systems usually perform better when designed as single units, and also noting that funding is more difficult to be obtained when outside the equipment's procurement process. In contrast, 23.7 % (n = 14/59) of radiographers indicated their preference to have AI sold separately to medical imaging equipment since this is a way to have more vendors and options to select from, there is potentially better company support, it is easier to identify any errors, and it is easier to understand how it works and how it has been trained. Other responses (n = 8/59, 13.6 %) were mainly expressed as uncertainties on whether AI should be separately sold, and they generally concluded that it should depend on the clinical application and intended use of AI.

Validation/evaluation considerations of AI tools

Although approximately 63 % (n = 55/88) of radiographers used an evaluation framework to assess the AI models' effectiveness before implementation, many respondents (n = 21/57, 36.9 %) were still unsure about suitable evaluation methods. Also, 35 % (n = 20/57) said they do not use such frameworks, but they are keen to learn more about this. A further 21 % (n = 12/57) said they use locally developed frameworks. Other responses (n = 3/57, 5.3 %) indicated that already established frameworks should be used in the future. Regarding established frameworks (n = 1/57, 1.8 %), the framework developed by the National Consortium of Intelligent Medical Imaging (NCIMI) was mentioned.

Many (37.5 %, n = 21/56) of them mentioned that they require vendors to provide certification evidence (Fig. 1), and specifically that all solutions must be appropriately approved, and they need to comply with the Digital Technology Assessment Criteria (DTAC).[54] Similarly, they reported that for AI-enabled products clinical efficacy must be evidence-based.

Over half of the radiographers (n = 29/56, 51.7 %) said they were unsure if their organisations assessed the AI model's usability and interoperability before procurement. A further 39.2 % (n = 22/56) of the respondents said they assess the model's usability/interoperability, while 5.5 % (n = 3/56) said that they do not. Other responses (n = 2/56, 3.6 %) highlighted that although interoperability is assessed, this is not performed in a timely manner.

Similarly, over half of radiographers (n = 30/54, 55.5 %) were not sure if their organisations performed ongoing monitoring to assess the AI model's effectiveness and safety over time. Only 22.3 % (n = 12/54) said they perform such monitoring, and 9.2 % (n = 5/54) said they do not. Other responses (n = 7/54, 13 %) highlighted that their organisations are currently developing monitoring strategies.

Economics of AI

Regarding the economics of AI, almost half (n = 25/55, 45.5 %) of the respondents said that their organisations examine the expected costs and scalability of costs before procuring AI solutions, 41.9 % (n = 23/55) of them were unsure, and a further 9 % (n = 5/55) said that their organisations do not perform an economic evaluation.

Most respondents (n = 32/55, 58.2 %) were unsure if their organisations considered evidence of cost savings and budget impact before making reimbursement decisions, compared to those who answered positively (n = 19/55, 34.5 %). Other responses (n = 3/55, 5.5 %) included the need for updating these procedures, consideration in the early stages of development, and consideration (e.g., economic evaluations) made by vendors.

Radiographers were also asked to report where they thought that AI could generate the most cost savings in medical imaging and radiotherapy (Fig. 2). The most prominent responses in descending frequency were: turnaround times for reporting (n = 44/88, 50 %),

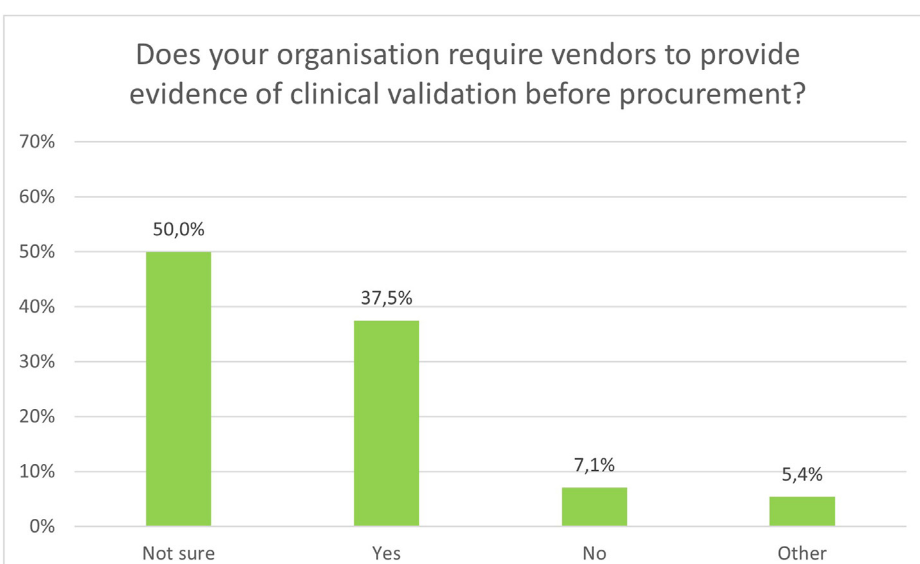

Figure 1. Evidence of clinical validation before procurement (n = 56).

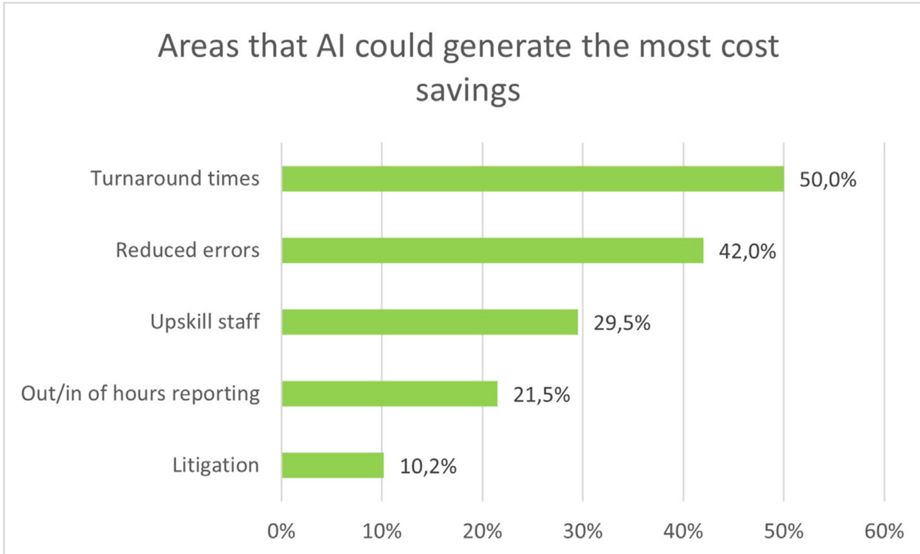

Figure 2. Areas where AI could generate the most significant cost savings, according to radiographers (n = 88).

reduction of errors (n = 41/88, 46.6 %), more efficient use of resources (n = 37/88, 42 %), upskill staff (n = 26/88, 29.5 %), out/in of hours reporting (n = 19/88, 21.5 %), and litigation (n = 9/88, 10.2 %). Other responses (n = 15/88, 17 %) included better patient experience, clinical decision support, dosimetry planning in radiotherapy, faster treatments, improved image quality, contouring in radiotherapy, training in anatomy and pathology, and workflow optimisation.

Looking into the future of AI in radiography

Radiographers were also asked to report the top priorities, in their opinion, for AI adoption in medical imaging, and these are depicted in the following table (Table 4). In addition, any challenges and opportunities around AI adoption in medical imaging are demonstrated below (Fig. 3).

Radiographers were also asked what support they needed for a successful AI adoption, and this is summarised in the following figure (Fig. 4). This was derived from the content analysis process. The following areas of support were reported by radiographers, in descending order: a) clear guidance on AI governance and regulation, b) specific AI-related training tailored to their needs and preferences, c) enough time allocated to explore these technologies and familiarise themselves with any new roles, d) effective leadership, e) availability of funding, and f) help from AI champions to be able to adopt AI-enabled solutions in clinical practice successfully.

Table 4
Top priorities for a successful AI adoption in medical imaging (n = 88).

A robust, unified AI governance framework	27 (30.7 %)
Guidance/standards on AI validation/evaluation	26 (29.5 %)
Training on AI basic principles	24 (27.3 %)
Radiographers to manage the workload that AI creates	22 (25.0 %)
Patient, public, and practitioner involvement	19 (21.6 %)
Research to create evidence for AI governance	19 (21.6 %)
Transparency around AI procurement	19 (21.6 %)
Teamwork among different professionals in medical imaging	18 (20.5 %)
Leadership to manage AI adoption	16 (18.2 %)
AI champions to scale up and support adoption	16 (18.2 %)
Transparency when it comes to regulation for clinical use of AI	12 (13.6 %)
Autonomy related to implementation for healthcare practitioners	8 (9.1 %)
Alignment between IT and Radiology	1 (1.1 %)
Unified interoperability and IT process	1 (1.1 %)

Discussion

AI education and training is key to adoption but needs to be formalised

The results of this study highlight the need to adequately educate the radiography workforce proportionately to the new requirements of an AI-enabled era. However, training still remains mainly online and self-guided; more formalised training, underpinned by the paedagogical principles of a higher education institution (HEI) and/or the signature and clinical relevance ensured by respective professional bodies needs to be established for better implementation.

While formal AI-related education for radiographers is still lacking,[3] many AI training initiatives exist globally to assist radiographers with AI-related challenges. HEIs should rapidly respond to the new era and develop tailored education packages to ensure radiographers' competencies and knowledge of AI technologies.[15] Some formal AI modules dedicated to radiographers have already been developed.[55] Still, in general, most initiatives have been designed for a broader multiprofessional audience (e.g., radiologists, radiographers, medical physicists, engineers, informaticians, etc.).

Radiographers are now expected to have specific digital competencies to practice in the UK,[17] and many countries could follow similar policies to develop these essential skills in the international workforce. Also, some professional bodies have already developed specific policies to promote the ethical and safe use of AI technologies[14] and guide radiographers into AI-enabled clinical practice. A joint statement issued by the European Federation of Radiographic Societies (EFRS) and the International Society of Radiographers and Radiological Technologists (ISRRT) has called on all radiographers to adapt their practices to ensure safe, ethical, and appropriately regulated use of AI in clinical practice.[56] Professional bodies and learned societies should provide more opportunities for high quality, paedagogically-sound, practice-informed educational provisions in AI for the radiography workforce, since this is now a

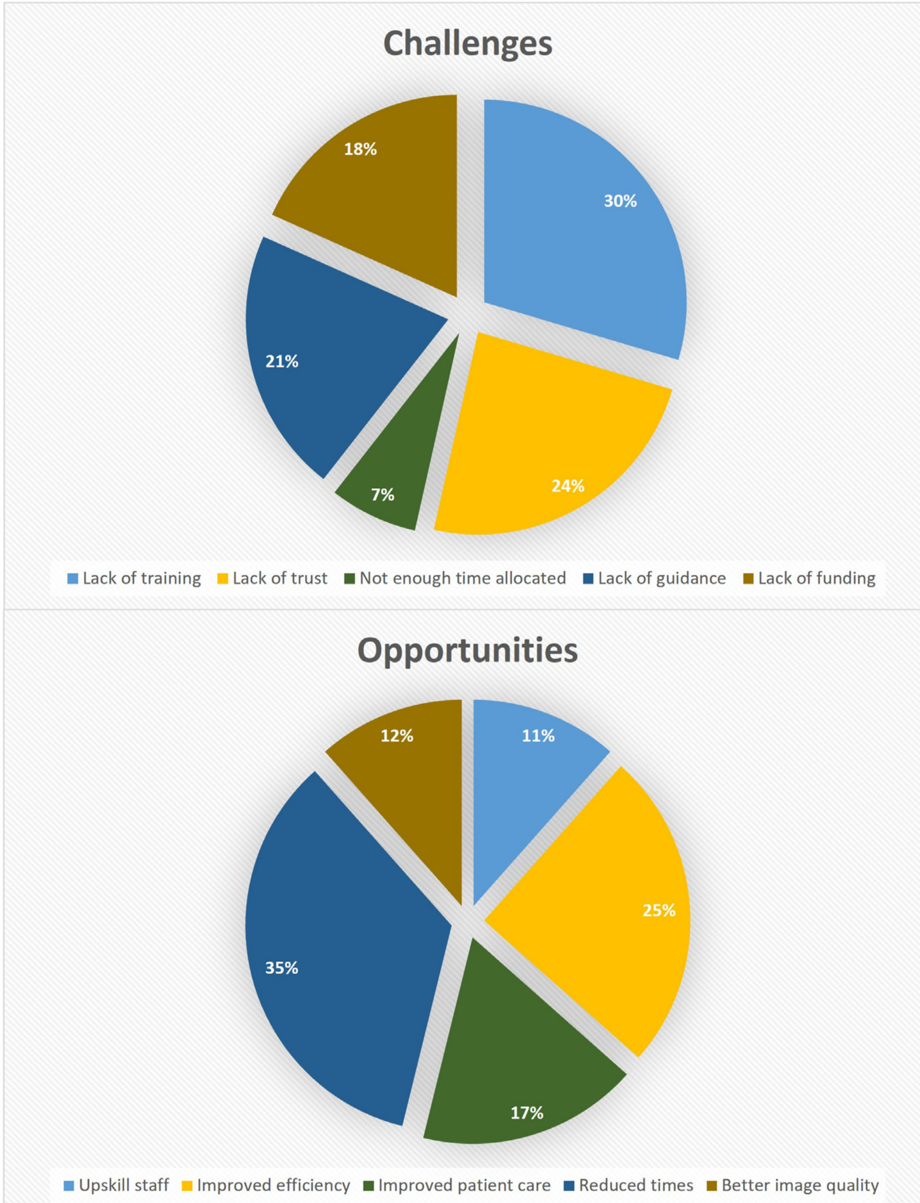

Figure 3. Challenges and opportunities around AI adoption in medical imaging, as reported by survey respondents (n = 47).

regulatory requirement for acquiring and maintaining professional registration.

Validation and evaluation as a window to clinical efficacy and performance

Validation frameworks are now available to radiographers and other medical imaging and radiotherapy professionals regarding the use of AI in healthcare, based on rigorous standards,[57] and these professionals should engage with them to assess the AI models' safety, quality, and ongoing performance of these technologies.[58] However, a great level of uncertainty and ensuing confusion was noted among radiographers regarding governance frameworks, strengthening the need for AI-specific training and clearer guidance on AI governance and validation, particularly in relation to the context these should be used and customised to. This training can support radiographers to play a pivotal role in the clinical validation of AI models alongside other professionals.[27] At the same time, they are also important components of the "human-in-the-loop" approach that aims to minimise automation bias. Radiographers could certainly play a vital role in AI governance and validation procedures, but there is still lot to be done; although most of them used a type of evaluation method, there are still important steps required to minimise uncertainty related to the most suitable governance frameworks for different contexts and practices related to a safe and effective clinical service.

Data protection in AI is paramount

Since data protection is vital when managing patient data, it was reassuring to confirm the great level of engagement and understanding that radiographers exhibited with GDPR during AI-based tasks.[59–61] Clinical use of AI poses significant challenges regarding data privacy, and this is why the European Commission

Figure 4. Areas requiring support for a successful AI adoption as indicated by radiographers.

has issued the Artificial Intelligence Act and the Guidelines for Trustworthy AI, as complementary to GDPR.[62] In the UK, the Data Protection Act 2018,[63] which is UK's implementation of EU's GDPR, must serve as an essential guide for radiographers using AI-based tools in clinical practice. Clear guidance on data sharing policies when interacting with AI should be available to assist radiographers in clinical practice.

Regarding procedures on obtaining informed consent from data owners, our findings show that there is still a significant level of uncertainty among radiographers on whether their organisations truly follow rigorous informed consent protocols. When using patient data for any AI-related purpose, it is vital that informed consent is sought from data owners, whether this is for AI algorithm training, validation, or development.[27] Varied levels of controversy exist around this process, since it has been argued that rigorous consent processes would significantly increase cost for AI developers, while this process also requires unique communication transactions.[64] It is imperative to work towards eliminating the "black-box" effect of AI, since this lack of explainability may prevent data owners from consenting for their data to be used in AI-based applications.

AI governance latest guidance

With the UK and EU now agreeing on safeguarding AI safety,[65,66] a new era of more formalised AI governance and specific regulation will ensure AI is safely implemented, with clearer pipelines. The fear as whether this will stifle innovation in the field should be compensated with the certainty that every new AI instrument brought into practice will be safe to use and properly validated for the benefit of the patients.

Limitations

This study was conducted using an online survey distributed through social media and the researchers' networks. Therefore, radiographers with limited or no access to social media or related IT literacy may have inadvertently been excluded from this study's sample. Also, over a quarter of the responses originated from Greater London; however, this is similar to other AI implementation studies, where the innovation and its applications are gathered around large cities as centres of innovation.[67] This may have led to limited generalisation of the results, as some underrepresented UK locations might face different challenges compared to the ones discussed in this paper, because of the differences in the availability of human resource, the density of AI-related businesses and research-led Universities, and local knowhow. In addition, because of the inevitably small sample size (as defined by the eligibility criteria), this study could not support robust statistical analyses between different subgroups (e.g. diagnostic radiographers, therapeutic radiographers, and sonographers). Therefore, individual characteristics pertained to different radiography specialities may have been missed. Knowledge of AI was self-declared by study participants; as the study was anonymous, this was not something we could either prospectively or retrospectively test. Attrition biases may also exist in this study, since participant dropout might have introduced significant differences in the characteristics of those who responded to certain questions and those who did not.

Conclusions

This study gives insights into some key elements required for a successful AI implementation in radiography, including staff training, regulation and governance, cost saving, challenges, enablers and future priorities. Lack of specific guidance, training, and funding represent the most significant barriers to AI implementation in radiography. Training, where available, is not yet customised to support clinical roles and should include expertise around AI governance frameworks, validation, and clinical evaluation strategies. Radiographers recognise the importance of AI governance frameworks and require further clarity on their optimal use within a specific clinical context. They perceive that effective leadership, establishing AI champions, ample time allocated on AI validation, and proportionate funding would further enable a safe and successful AI implementation for medical imaging and radiotherapy and accelerate the diffusion of innovation. Further research is needed to assess radiographers' knowledge, perceptions, and needs across Europe and enable coordination of AI educational and governance initiatives in this space.

Conflict of interest statement

Nothing to declare.

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