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Research Article

Lessons on AI implementation from senior clinical practitioners: An exploratory qualitative study in medical imaging and radiotherapy in the UK

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ABSTRACT

Introduction: Artificial Intelligence (AI) has the potential to transform medical imaging and radiotherapy; both fields where radiographers' use of AI tools is increasing. This study aimed to explore the views of those professionals who are now using AI tools.

Methods: A small-scale exploratory research process was employed, where qualitative data was obtained from five UK-based participants; all professionals working in medical imaging and radiotherapy who use AI in clinical practice. Five semi-structured interviews were conducted online. Verbatim transcription was performed using an open-source automatic speech recognition model. Conceptual content analysis was performed to analyse the data and identify common themes.

Results: Participants spoke about the possibility of AI deskilling staff and changing their roles, they discussed issues around data protection and data sharing strategies, the important role of effective leadership of AI teams, and the seamless integration into workflows. Participants thought that the benefits of adopting AI were smoother clinical workflows, support for the workforce in decision-making, and enhanced patient safety/care. They also highlighted the need for tailored AI education/training, multidisciplinary teamwork and support.

Conclusion: Participants who are now using AI tools felt that clinical staff should be empowered to support AI implementation by adopting new and clearly defined roles and responsibilities. They suggest that attention to patient care and safety is a key to successful AI adoption. Despite the increasing adoption of AI, participants in the UK described a gap in knowledge with professionals still needing clear guidance, education and training regarding AI in preparation for more widespread adoption.

RÉSUMÉ

Introduction: L'intelligence artificielle (IA) a le potentiel de transformer l'imagerie médicale et la radiothérapie, deux domaines dans lesquels l'utilisation des outils d'IA par les radiographes est en augmentation. Cette étude visait à explorer les points de vue des professionnels qui utilisent actuellement des outils d'IA.

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Méthodologie: Un processus de recherche exploratoire à petite échelle a été employé, où des données qualitatives ont été obtenues auprès de cinq participants basés au Royaume-Uni; tous sont des professionnels travaillant en imagerie médicale et en radiothérapie qui utilisent l'IA dans la pratique clinique. Cinq entretiens semi-structurés ont été menés en ligne. La transcription verbatim a été réalisée à l'aide d'un modèle de reconnaissance automatique de la parole à source ouverte. Une analyse conceptuelle du contenu a été réalisée pour analyser les données et identifier les thèmes communs.

Résultats: Les participants ont évoqué la possibilité que l'IA déqualifie le personnel et modifie son rôle, et ont discuté des questions relatives à la protection des données et aux stratégies de partage des données, du rôle important d'une direction efficace des équipes d'IA et de l'intégration transparente dans les flux de travail. Les participants ont estimé que les avantages de l'adoption de l'IA étaient des flux de travail cliniques plus fluides, le soutien du personnel dans la prise de décision et l'amélioration de la sécurité/des soins des patients. Ils ont également souligné la nécessité d'une formation adaptée à l'IA, d'un travail d'équipe multidisciplinaire et d'un soutien.

Conclusion: Les participants qui utilisent actuellement des outils d'IA estiment que le personnel clinique devrait être habilité à soutenir la mise en œuvre de l'IA en adoptant des rôles et des responsabilités nouveaux et clairement définis. Ils suggèrent que l'attention portée aux soins et à la sécurité des patients est la clé d'une adoption réussie de l'IA. Malgré l'adoption croissante de l'IA, les participants britanniques ont décrit un manque de connaissances, les professionnels ayant encore besoin d'une orientation, d'une éducation et d'une formation claires en matière d'IA en vue d'une adoption plus généralisée.

Keywords: Artificial intelligence; AI; Governance; Medical imaging; Radiotherapy; Implementation

Introduction

Artificial Intelligence (AI) has been described as the use of technology and computers to simulate human intelligence and critical thinking [1]. AI algorithms are machine-based systems that infer, from the input they receive, how to generate outputs which influence physical or virtual environments [2]. AI may revolutionize many disciplines and there has been relatively rapid deployment in healthcare. AI-based clinical applications have the potential to transform clinical practice and care delivery [3], to optimise precision medicine [4], and to improve the experience of both patients and staff [5]. Particularly in medical imaging and radiotherapy, AI offers promising solutions with the potential to improve image quality, reduce radiation dose, optimise workflows [6]. and increase diagnostic accuracy in a range of clinical tasks [7-9]. However, challenges exist when implementing AI into clinical practice, and medical imaging and radiotherapy departments need to develop specific protocols to align with regulations and standards around AI adoption, AI governance frameworks, and validation processes [10,11]. This will enable responsible and ethical AI practices in clinical environments.

Medical imaging and radiotherapy professionals, including diagnostic and therapeutic radiographers, radiologists, oncologists, and medical physicists, face similar challenges when implementing AI into clinical workflows; therefore, their aligned and complementary needs should be addressed by multidisciplinary teams to harness the benefits of AI in medical imaging and radiotherapy [12]. For a safe and successful AI implementation in medical imaging and radiotherapy, it is vital for radiographers to obtain tailored AI education/training, and all educational institutes should opt for updated academic curricula, adequate funding, and support from educators to address the learning needs of next radiography generations [13]. The AI ecosystem in medical imaging and radiotherapy will require the creation of multidisciplinary teams, involving all relative professions, to build trust in AI, minimise the potential risks, and optimise the path to successful implementation [14].

A growing body of work explores the perceived challenges associated with AI adoption in medical imaging, however, most of these studies remain theoretical in nature, without always integrating clinical practitioners' views from real-life implementation use cases [15-17]. Previous research on radiographers' perceptions of the potential challenges and benefits of using AI in medical imaging has shown a mixed picture around perceptions of AI including the potential for workflow optimisation and efficiency, trust in AI, and person-centred care practices [18-20]. This has mirrored the perceptions of radiologists [21,22] and other professionals, including radiation oncologists, medical physicists, and trainees [23]. For instance, a wide survey among radiologists and radiology residents confirmed the great role of AI education, since lower levels of AI knowledge were associated with fears of losing jobs, while a mixed attitude was noted towards AI [24]. These findings show that there are constant attitudes and perceptions on AI across all professions in medical imaging and radiotherapy.

So, there is a paucity of real-life evidence to date around the perceptions of practitioners who are actually using these AI tools clinically. Therefore, this project explores the perceptions of early adopters and of those who implemented AI into their clinical practice.

Methods

Study design

This study was part of a wider mixed-methods research project around AI implementation in medical imaging and radiotherapy; it aimed to explore a) perceived needs of medical imaging and radiotherapy professionals currently using AI tools in their clinical practice, b) the challenges they faced when adopting and using these AI solutions, and c) the benefits of the use of AI in clinical practice.

Table 1
Demographic characteristics of participants.

	Gender	Role	Years of experience
Participant 1	Female	Head of Screening* at a private diagnostic provider in the UK	25
Participant 2	Female	Lead Magnetic Resonance Imaging (MRI) Radiographer, NHS, UK	31
Participant 3	Male	Head of Radiotherapy Physics, NHS, UK	34
Participant 4	Male	Reporting Radiographer, NHS, UK	25
Participant 5	Female	Consultant Radiotherapy Physicist, NHS, UK	22

* Screening refers to all routine services provided to women in the UK in relation to annual breast imaging.

The study reported in this paper employed a qualitative research method to explore individuals' experiences [25]. Because the deployment and clinical use of AI is a research topic that has not been defined in depth, a small-scale exploratory research project was appropriate [26]. Reporting of this study is aligned with the Consolidated Criteria for Reporting Qualitative Research (COREQ) checklist [27].

Ethical approval was obtained by City, University of London School of Health & Psychological Sciences Research Ethics Committee [ref: ETH2122-1015].

Participant selection and setting

Purposive sampling was employed to recruit participants [28]. Participants were healthcare experts who volunteered to be interviewed during a wider mixed methods research project survey, which included a survey aimed to all medical imaging and radiotherapy professionals working in the UK [29], focus group discussions, dedicated research on UK radiographers [30], and a scoping review of the literature [10]. Volunteers were then approached via email by the principal investigator of this project. In total, 10 people with diverse qualities in relation to gender, profession, geographical location, and roles were approached, and these were identified from the information provided in the preceding survey. Although no volunteers declined the invitation to participate, it was necessary that the participants were recruited, and interviews took place, in accordance with the short-time scale of the project. Therefore, the final sample consisted of five participants who were able to join interviews within the timeline allocated for this section of the project. The rationale for the small sample of participants was based on the need to explore the subject among clinical practitioners actually using AI in practice, balanced with the project timeline, as opposed to academics with only theoretical knowledge of this topic.

Informed written consent was confirmed by all participants in the form of electronically signed consent documents, which were sent by email prior to data collection. Consent was also confirmed verbally during interviews and related demographics were collected. Anonymity and confidentiality, as outlined in the participant information sheet and consent forms, were maintained throughout.

Diagnostic and therapeutic radiographers, reporting radiographers, and medical physicists working clinically were eligible to participate. Professionals who did not use AI tools in their practice were not eligible for this study. The participants' main demographic data is summarised below (Table 1).

The interviews and data analysis were conducted by two researchers who formed part of a wider mixed-methods research team of eleven researchers. Both have a diagnostic radiography background and training in research methods. One was a female senior academic/ researcher (associate professor) with a PhD degree and over 20 years of research experience; the other was a male clinical practitioner/researcher (lead diagnostic radiographer) with an MSc degree, currently working towards their doctorate. No personal relationships existed between the researchers and the participants.

Data collection

Semi-structured interviews are a method of obtaining rich and in-depth information from participants, and they are widely used in healthcare research [31]. The researchers used an interview guide consisting of questions about the participants' demographics, the context in which they were clinically using AI tools, their perceived challenges and benefits when using AI in clinical practice, and their main needs for AI implementation (Appendix A).

Each interview was conducted just once and lasted no longer than 45 min. Field notes were made during the interviews by one of the researchers as a means of collecting initial ideas and insights for the coding of data. Interviews were conducted online using a Microsoft Teams platform (version 1.6.00.29954) between March 21st to March 28th, 2023 (audio and visual recording). Interviews ended when all questions had been explored and participants did not have any other comments to add.

Data analysis

All interviews were transcribed using WhisperAI (OpenAI, Inc.), an open-source automatic speech recognition (ASR) model that provides accurate verbatim transcriptions from audio-recorded data. The model has previously been used effectively in research on mental health [32]. One researcher also checked audio file transcriptions for precision.

Data analysis was performed by the researchers who had conducted the interviews. They employed content analysis to describe phenomena in a conceptual form [33]. This method of analysis is widely employed in qualitative research and especially when conducting interviews. It enabled the researchers

to systematically transform text into an organized summary of results and key findings [34].

Themes were derived from the data following an inductive approach which involved the iterative coding of data; the codes used to label data were developed during the interview and analysis process [35]. The two researchers worked through the transcripts separately, coding to analyse the data, and a coding tree was generated to show the process of how the researchers converted raw data into themes [36]. The approach allowed the researchers to explore the study data with the flexibility for new categories to emerge spontaneously [37].

Participant member checking [38] was used after coding as a means of increasing the credibility of the results and validating the data collection methods [39]. The themes and categories were sent to study participants, seeking to ensure that their opinions and views on the topic had not been misinterpreted. Their feedback was then integrated into the final results. Participants' quotes are also used in this paper to illustrate the themes and categories for the purpose of authenticity. All data was safely stored in a password-protected drive and will be maintained according to local research protocols.

Results

Results are organized around two themes with associated categories: a) benefits (four categories) and b) challenges (eight categories). In addition, the overall needs of the respondents were also discussed, and these will be presented later in the results. Categories are presented in a descending order, corresponding to the number of times that these appeared in the data. Quotes are presented here to illustrate the categories. It should be noted that some of the categories have appeared in both themes.

Theme: benefits of AI

Category 1: workforce changes

There was a general view among the participants that AI is helping imaging and radiotherapy professionals to **advance their knowledge, to acquire new skills**, and that AI innovations result in positive changes in their professional roles including some **upskilling and advancing levels of practice**:

> *"…they will free them up to be true experts and to be able to have time to breathe and research and develop and move the profession forward"* (participant 2, Lead MRI radiographer).

> *"AI will help those who wish to go further into advanced practitioner roles"* (participant 5, Consultant Radiotherapy Physicist).

> *"…we also have quite a lot of advanced practitioners, yeah. And that really will help in with regards to the reporting of the images"* (participant 1, Head of Screening).

For diagnostic medical imaging, the participants thought that AI was helping reporting radiographers to build **more confidence in their daily tasks and to reduce the negative effects of workforce shortages**. There seemed to be hope that AI will help radiographers to **improve their overall work-life balance**, by giving them more time to perform professional duties, for example, training and research, reducing demands to do on their own time at home.

> *"AI will reduce the non-documented overtime going on to make the service run"* (participant 3, Head of Radiotherapy Physics).

Category 2: improved workflows

The participants noted that AI is helping to **optimise workflows** since it reduces some repetitive tasks. Participants said that AI is helping to **maximise patient attendance**, for example, by employing probability booking strategies in screening programmes, and also giving radiotherapy professionals the opportunity to **achieve adaptive radiotherapy for patients**. AI was also regarded as **reducing the time needed for tasks**, for example diagnostic reporting and radiotherapy contouring of organs-at-risk.

> *"I think the operational one, the probability booking…if you're really bringing it down on a granular level, can help you to maximise attendance"* (participant 1, Head of Screening).

> *"If you're from a radiographer's perspective, it's more about workflow and efficiency in the workflow"* (participant 4, reporting radiographer).

> *"Less risk for repetitive strain due to hours of contouring"* (participant 5, Consultant Radiotherapy Physicist).

> *"It will certainly help with the time of the image reporting"* (participant 1, Head of Screening).

> *"But that is another level because if you do that, it will help the correct positioning. That means you have fewer repeats of your images"* (participant 1, Head of Screening).

> *"We will achieve adaptive radiotherapy using auto-contouring and auto-planning, while saving time"* (participant 3, Head of Radiotherapy Physics).

Category 3: patient safety and care

Participants described that **AI was enhancing patient safety**, reducing the number of repeat biopsies, and resulted in reduced radiation doses received by patients:

> *"…there potentially will be the development to support you in taking the biopsies so that you avoid the repeat biopsies because you don't have enough tissue sample"* (participant 1, Head of Screening).

> *"And the way I see MR radiographers developing is they need to be more aligned in terms of safety and doing that initial constant consultation with patients and making sure that they…I almost see them like conductors in an orchestra"* (participant 2, Lead MRI radiographer).

"If you're thinking from a radiographer reporting or a radiologist, it's what's going to help them improve or reduce any sort of errors" (participant 4, reporting radiographer).

"So, it is…you know…from a sort of population-wide dose reduction strategy, then…then it would be useful for that" (participant 3, Head of Radiotherapy Physics).

"…it's a way of establishing, you know…a way of knowing that you've got reproducible contours and therefore, you can have more certainty in what doses particular organs are having" (participant 3, Head of Radiotherapy Physics).

With respect to **positive effects for patient care**:

"…gives the patient a better experience, whether that means that their scan is faster, they get to be scanned on time, and the whole experience is faster" (participant 2, Lead MRI radiographer).

"…but at the end of the day, their report is available, and their treatment is more responsive. So that we have a more responsive health service" (participant 2, Lead MRI radiographer).

Category 4: leadership and education

Participants noted that AI gives radiographers **further opportunity to lead clinical tasks and care for patients and also supports their role in education of the team and teamwork**:

"The leadership for AI from a radiographic standpoint is huge, because if we don't lead it, then it's going to fragment" (participant 2, Lead MRI radiographer).

"… you know, in a multidisciplinary team you get discussion about all… "include this, don't include that"…and you can…people can explain why that is a good or a bad idea in a particular case" (participant 3, Head of Radiotherapy Physics).

"So, I think it will help. It can accelerate and support training of those who are new into the field" (participant 1, Head of Screening).

Key theme: challenges

Category 1: workforce changes

The participants expressed the opinion that there may be a **potential workforce loss**, with employers choosing to **employ fewer radiographers**. Another concern was related to the potential risk of radiographers being **deskilled due to the automation** that AI will bring in clinical practice, and they indicated the need to maintain human workforce skills, particularly human intuition.

The participants expressed concerns that **radiographers may feel devalued** due to AI advancements, which may lead to **decreased self-esteem** within the workforce. They thought that the **roles of radiographers would change** due to AI adoption, and that radiographers would be required to oversee AI tasks or manage / curate data, which could also potentially result in **loss of creativity or autonomy with implications for the retention of staff**:

"… so, the worry is…what does that mean for us…the potential loss of highly skilled staff" (participant 1, Head of Screening).

"…a lot of it is incredibly laborious and it's about…unfortunately, some of the work initially has to be done by radiographers within the hub because the radiographers understand the imaging pathway and they understand what's required for imaging" (participant 2, Lead MRI radiographer).

"…but undoubtedly, AI threatens our role. But it has been, you know…I think the thing what I tell my radiographers is that…you know…it's almost what do you expect? You're working with technology; technology will always be clever in the… …we are… it's driving change all the time" (participant 2, Lead MRI radiographer).

"…the critical thing is that with technology, and AI being a big part of that, what's happening at the moment is radiographers feel devalued" (participant 2, Lead MRI radiographer).

"…a lot of their time is taken up with quite boring data management and just data curation, looking at…you know…and it's…it almost feels like a waste to me, a waste of their creativity" (participant 4, reporting radiographer).

Category 2: AI governance

Participants explained that data issues can **prevent organisations from agreeing to share data with AI companies with concern about intellectual property conflicts and patient consent.** They thought that organisations do not immediately benefit in a tangible way from providing local data to AI companies, and this was seen as a barrier. Participants highlighted the **challenging and time-consuming information governance (IG) requirements and processes regarding data protection within their organisations**, including the understandable need for enhanced cybersecurity measures, data protection, and optimal data de-identification and re-identification of data:

"… it's, you know…as the contouring is…as is cloud-based, going through all the IG, you know…permissions to be able to…it's not just sending data to the cloud, but then receiving data back from the cloud…" (participant 3, Head of Radiotherapy Physics).

"…we're now trying to get our patient public involvement with that, with our …center…so that's still something that I'm still working my way through, because I'm still not completely comfortable that the patients are fully aware of what is happening with their data" (participant 5, Consultant Radiotherapy Physicist).

"Where I think the problem lies… at the moment… is, so that is in the pipeline…but if you deliver a population-based screening program, you can't use any AI. There are [sic] so many really interesting AI software which is out there, which looks promising. In order to deliver this for screening program, it has to be

signed off by the National Screening Committee" (participant 1, Head of Screening).

They felt that organisations should create new consent forms, where patients are well-informed about the use of their data and have the **right to opt-out if they decide**, even though this might be a barrier to AI-based workflows.

The notion of **explainability** was also noted as an important challenge, with the participants positing that Picture Archiving Communication System (PACS) teams need to understand how AI algorithms work and the reasoning behind their decision-making, so the ''black box'' effect is eliminated. **A lack of clarity with respect to the legal responsibility of end-users** was also discussed as a challenge in the arena of AI governance.

''…from our IT point of view, and our governance team, they just want reassurance that the imaging is normalized, sent up to the AI servers, re-identified correctly, and, you know…patient's data isn't lost" (participant 4, reporting radiographer).

''And then, we have the final issue around patient consent, kind of patient opt out of the system being read by an AI provision…and they just want human. That's going to be incredibly challenging for us because we…as I say…on our PACS system, we've run a pull system. So, to stop it pulling automatically is going to be a nightmare if a patient wishes their images not to be looked at by an AI unit" (participant 4, reporting radiographer).

''…each person will be responsible for different elements, but the people that are using it, the end user, have to know when it's not right" (participant 4, reporting radiographer).

Category 3: AI implementation

The participants highlighted the need to have **IT teams that can support AI implementation** and ensure that IT requirements have been addressed prior to implementation. These processes were regarded negatively as **time-consuming and difficult.** They thought that AI tools should be integrated into clinical workflows and the PACS and RIS systems of the organisation. Having **many different vendors of imaging equipment in departments posed challenges** to the process.

''So, in the first instance, yes, we need to look at workflows. We also need to look at workflows within this, within the scanning day itself, and the patient handling" (participant 2, Lead MRI radiographer).

''So, when we're looking at AI deployment, the first thing they really need to do before they involve any clinicians is speak to the IT team and PACS team" (participant 4, reporting radiographer).

''From the radiographers' point of view, you know, those that use the MR/CT equipment, if we can get the AI on board on those machines, that'd be great to help them through their workflow and management. The only snag is we've got several manufacturers for our CT scanners. If we had one manufacturer for all, that'd be great" (participant 4, reporting radiographer).

Although participants thought that it was important to ensure that organisational AI strategy is informed by the potential benefits of AI, they were aware that indication of clear benefits of AI in practice is **limited by current lack of real-world evidence**. They thought that the implementation of systems provides an opportunity for the collation of evidence.

''…so that your governance is in place and that you're working in a very… that you have a standard operating procedure and you work in a very…very organised way to understand…first of all, whether this is something that's going to be useful, because it just seems…you know, if you go to any conference now, there's always a massive, huge, huge amount" (participant 2, Lead MRI radiographer).

''So, if you would have one overarching approval body to then say…look, we have signed this off, that's fine. But that takes a long time" (participant 1, Head of Screening).

Category 4: AI validation

Participants also noted some challenges associated with **time-consuming processes of validation of AI tools** in medical imaging and radiotherapy. They noted challenges arising from **algorithmic bias**, which may result in variations of the AI models related to the data that trained the model. They also indicated challenges associated with the need to **employ different validation strategies** to evaluate different AI models, and the **difficulty with evaluating the outcome produced by AI tools**. According to participants, this is further exacerbated by the **potential risk of AI models** not correctly prioritising the various pathologies, alerting the wrong people, or even **failing**.

''If you are using screening in London and screening in Scotland in a different place, the populations are very different. So, you have to ensure that whatever AI tool you're using to support you has been trained properly" (participant 1, Head of Screening).

''So, there has to be more evaluation, more prospective clinical studies or clinical trials. And you can imagine with the different available tools out there, others for brain MRI, others for chest x-ray, others for chest CT, others for knee, you know, x-ray of the knee. There will be a lot of time" (participant 4, reporting radiographer).

''So, that's the key thing that we're going to have to get radiographers and radiologists used to knowing when things can potentially go wrong" (participant 4, reporting radiographer).

Category 5: patient safety and care

Participants spoke about the need to **maintain or exceed the quality of patient care post AI implementation** in comparison to prior, all agreed there was an imperative to keep **patients at the centre** of service provision. They shared thoughts that radiographers should be reminded to always act to optimise the patient experience in the advancing AI era.

"For our patients in oncology, I want to make sure that they still have the best experience and that they don't feel rushed and that they are still our priority" (participant 2, MRI Lead radiographer).

"If we're looking at a system where the human does one look and then the AI does another, we're changing the care" (participant 4, reporting radiographer).

Participants were concerned that the speed of service achieved with AI meant that radiographers might have **less time to spend with the patient in the future**. Their experiences were resulting in concerns about increased speed leading to **potentially compromised patient safety during examinations.**

"What I do not want to see, what I absolutely will not tolerate is a patient being unsupervised in an MRI scanner. And I know that happens from time to time. And I will not have that. So, whatever happens, the patient will be observed and be in contact with at all times, by a safely trained professional" (participant 2, MRI Lead radiographer).

Category 6: funding

The participants relayed that it had **been hard and often time-consuming to secure funding for AI solutions**. They stressed that even when funding is available, it is difficult to secure **long-term funding for AI projects**. In addition, they said it can be **difficult to define AI systems' cost-effectiveness,** and this has been exacerbated by some **hidden costs associated with AI tools**.

"… So, we applied for a grant and that was given to us and at that point we were assessing which systems to purchase and everything had a cost associated with it" (participant 5, Consultant Radiotherapy Physicist).

"… there has been talk about getting an auto-contouring solution for the network, but as with these things, getting funding and approvals…everything's so slow" (participant 5, Consultant Radiotherapy Physicist).

"…and so, therefore, one of my challenges is converting that into a business case to support… because you support the introduction of this software… because a lot of it is software as a service. So, you get charged per patient" (participant 3, Head of Radiotherapy Physics).

Category 7: leadership and education

The **need for specific AI education/training** was highlighted by the participants who considered it vital for radiographers to understand the processes behind algorithmic training and the performance of AI tools. In addition, they thought that **AI education should also focus on teaching staff how to lead others in an AI environment**.

"… but also think we need to recognise for training and development of staff" (participant 5, Consultant Radiotherapy Physicist).

"But the leadership has to be cohesive as well. And I'm quite…that's what worries me…as I'm not quite sure how to do it. And I need support and guidance as an MR Lead" (participant 2, MRI Lead radiographer).

Category 8: AI research

Participants noted that it is **challenging to create a research basis for AI**. They considered a range of **methodological inconsistencies** that exist in AI research, which may lead to different outcomes in the same research field. They also felt that **time-consuming processes and approvals** were preventing professionals from conducting research projects in AI:

'… and this is where the real test is. So, at the moment, we have very few of these prospective trials. The retrospective ones, yes, they can be massaged in a way" (participant 1, Head of Screening).

"… you need this screening research approval and this…that delays this. But it also…I think it can…it can stop people wanting to do research" (participant 1, Head of Screening).

Overall needs for the clinical adoption of AI

Researchers noted that some categories were identified both as challenges and needs by the participants. The participants were therefore asked to indicate their needs and wishes for a successful and ideal AI adoption in medical imaging and radiotherapy.

The content analysis showed that those needs and wishes could be aligned to the categories first coded as challenges. Hence, it appeared that participants were seeking to mitigate those challenges for AI adopters in the future (Table 2).

Discussion

The findings of this study demonstrate that potential changes in the workforce due to AI were regarded by the participants to be both a challenge and a benefit. There were mixed perceptions noted on the impact of AI on the skills and knowledge of medical imaging and radiotherapy professionals. There were tensions between thoughts that AI will help to upskill some staff but also that AI automation might eventually lead to the workforce having reduced skills in other areas.

These conflicted opinions are reflected in previous studies, where medical students showed a positive attitude toward AI in their field [40], but a range of attitudes were reported among AI experts involved in AI regulation or development in healthcare [41]. Radiologists appear to be less concerned about AI reducing their skills, compared to radiographers [42]. The above findings reflect some differences in the way that different professions perceive AI in relation to their roles and knowledge, and this could also be attributed to differences in access to AI-specific training that potentially reduces or boosts self-confidence [43]. Different levels of AI education may have an important influence on individuals within a profession, and among different professions. This may justify the fact that AI

Table 2
Main themes and categories on benefits, challenges, and needs for AI adoption derived from content analysis.

Benefits	Challenges
Workforce changes Advance knowledge, acquire new skills, more confidence in daily tasks, improve their overall work-life balance	**Workforce changes** Potential workforce loss, deskilling due to automation, decreased self-esteem, loss of creativity and autonomy, retention of staff
Improved workflows Maximise patient attendance, reduce time needed for tasks, achieve adaptive radiotherapy, optimise workflows	**AI governance** Data issues on patient consent, challenging IG requirements, lack of explainability, lack of clarity about legal responsibility
Patient safety and care Enhanced patient safety, positive effects for patient care	**AI implementation** Time-consuming IT processes, challenges of having different vendors onsite, lack of real-world evidence
Leadership and education Opportunity to lead clinical tasks, advanced role in education of teams	**AI validation** Algorithmic bias, time-consuming validation processes, potential risk of AI failures
	Patient safety and care Potentially compromised patient safety, potentially less time to spend with patients
	Funding Challenges to secure funding for AI solutions, difficult to define cost-effectiveness, hidden costs associated with AI tools
	Leadership and education Challenges on specific AI training, difficulties on how to teach staff to lead in AI environments
	AI research Challenges to create a research basis, methodological inconsistencies, time-consuming approvals

Needs
AI education Radiographers need to be trained, need to establish ground truth
AI leadership Empower radiographers to become leaders
Patient safety and care Improve patient experience, prioritise patient safety
AI ethics Patient consent, data protection, explainability, diverse data
Workforce Embrace technology, support staff, new career pathways

education has been listed as a top priority among radiographers [30].

Regarding the fear of a potential loss of workforce, it is important to note that the future of medical imaging could bring an increasing volume of work/expectations of patients/carers with respect to person-centred care, high level of complex examinations, high acuity of patients treated with multiple long-term conditions, to name just a few examples of increasing case complexity and healthcare demands [44,45]. The size of workforce required to keep up with demand, even with the implementation of AI, is likely to increase for frontline patient-facing staff.

Our findings also demonstrate that AI solutions should help reporting radiographers, since there is a documented shortage in the workforce [46]. Also, AI could benefit reporting radiographers by enhancing their self-confidence in decision-making, especially when under increased workload, similar to previous studies [43]. Of course, the effect on decision-making is related to the level of confidence/expertise of the individual. Recent research has shown that UK reporting radiographers, although confident enough when using AI tools, can further benefit from explainable AI tools that allow their trust to build [43]. Consequently, it is imperative to empower staff to embrace these new technologies and cultivate an environment of adaptability to the new, ongoing advancements within our field.

This study noted that medical imaging and radiotherapy professionals have concerns about the governance of AI technologies in clinical practice. The great need to ensure rigorous data protection policies when managing and using patient data in conjunction with AI tools has been documented in the literature [16], and confirmed within our study sample. For the above reasons, professional bodies and learned societies around the globe have started to introduce specific guidance regarding management of data when using AI solutions. For instance, The Royal Australian and New Zealand College of Radiologists have already asked leadership from designated clinical information officers in all clinical settings using AI tools [47]. Clear regulation is needed to put more sophisticated methods of data protection in place [48], provide patients with information regarding clinician – AI collaborations and data sharing [49], and mitigate cybersecurity-related risks in medical imaging using both detection and prevention techniques [50].

We also found that participants believe that AI adoption could contribute to better patient outcomes. This could be due to enhanced patient safety during medical imaging examinations, reduced radiation dose received by the patient, more accurate and faster diagnosis, and reduced number of biopsies [51,52] – all of which will also improve patient experience [6]. Indeed, there is growing evidence that AI can enhance patient safety in healthcare more generally [53,54], but equally that rigorous governance policies on AI tools are needed to ensure safety and increase staff acceptability [55].

Patient care and safety is paramount when using AI tools in healthcare, alongside clinical effectiveness [56]. AI implementation appears to be raising several challenges, mainly due to the need for standardisation, clear regulation, and seamless integration into clinical workflows. Potential solutions for these challenges include the establishment of multidisciplinary AI teams to guide collaborative work [57] developing local frameworks of practice, and empowering clinical staff to innovate for better clinical services for both the patients and staff [12].

In addition, medical imaging and radiotherapy professionals need to actively involve patients in AI-related procedures, since some patients express concerns about AI reducing human connection and empathy [58]. These concerns are also shared among cancer patients, around the use of AI in radiotherapy treatments and the potential for decreased patient-provider interactions [59]. In similar contexts, healthcare professionals will need to provide clear explanations in order to build trust [60], co-produce AI-enabled interventions with public contributors with lived experiences and follow a patient and public involvement approach when adopting AI solutions, to meet the patients' real needs and reflect their varied experiences [61].

Medical imaging and radiotherapy professionals who already work with AI in their clinical practice highlighted the need to thoroughly evaluate any new AI tools in terms of their clinical usefulness. This assessment needs to be longitudinal [62] and ensure that AI solutions address specific clinical problems, have a positive impact on patients, and align with the product's intended purpose [10]. Approval processes and requirements for an organisation to implement AI solutions were also noted as challenges in this study, since these are often time-consuming and resource-intensive procedures. This may involve alignment with the guidance issued for any software used as medical devices, approvals from the U.S. Food and Drug Administration (FDA), the Medicines and Healthcare Products Regulatory Agency (MHRA), the British Standards Institute (BSI), and many more [63]. In the UK, the NHS England is preparing an AI Deployment Platform, to help organisations accelerate the time needed for deployment, make deployment more scalable, align with regulations, and also create transparency for patients [64].

Recent research corroborates that healthcare stakeholders must bring implementation methodology science into these processes, to systematically improve AI implementation [65]. Similarly, the development and use of an AI implementation quality framework has been highly recommended [66]. Furthermore, according to our results, there is a need to ensure that AI is seamlessly integrated into existing workflows, and one way to achieve this is to encourage longstanding collaborations between AI vendors and local PACS teams. This has already been stressed in the literature, to facilitate adoption [67], curate large datasets, and accelerate translation of research into practice [68].

Limitations

The small sample size of this study balanced against the short-time scale for data collection limits the generalisability of the findings, as the sample does not include the whole medical imaging and radiotherapy ecosystem. There were no radiologists or oncologist participants, although these professionals were included in the initial sample who was approached to participate in our study. Work pressures and staffing shortages meant that some of these healthcare professionals, although happy to contribute to our survey [29], might have been unavailable for an interview. However, the participants who took part all have over 20 years of clinical experience which enabled a wealth of expertise, before AI started to make an appearance in clinical settings, therefore could offer a more rounded approach. Furthermore, there are currently very few clinical practitioners with real-life experience of AI implementation and this sample captures some of the most experienced of them in the UK. However, selection of experienced practitioners only might have introduced further biases.

The researchers' views and expectations on the topic may have inadvertently introduced interpretation bias during data analysis and reporting, although member checking was employed post coding of data.

Conclusion

This small-scale in-depth study explored the emerging perspectives of medical imaging and radiotherapy professionals who are now using AI in their clinical practice. Participants spoke about the challenges and benefits when using AI-based solutions; the findings suggest that AI implementation in clinical practice can potentially bring both positive and negative outcomes to the medical imaging and radiotherapy workforce. The multidisciplinary teams that power AI ecosystems need to be aware of the challenges and benefits of AI implementation and prepare for these as the adoption of AI will likely become more widespread at pace. Participants were keen to suggest means to mitigate those challenges for AI adopters in the future. Wider-scale research is needed to explore the topic as AI implementation in clinical practice becomes more widespread.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmir.2024.101797.

CRediT authorship contribution statement

Nikolaos Stogiannos: Writing – original draft, Data curation. **Tracy O'Regan:** Formal analysis, Validation. **Erica Scurr:** Investigation. **Lia Litosseliti:** Investigation. **Michael Pogose:** Investigation. **Hugh Harvey:** Investigation. **Amrita Kumar:** Investigation. **Rizwan Malik:** Investigation. **Anna Barnes:** Investigation. **Mark F McEntee:** Conceptualization, Methodology. **Christina Malamateniou:** Conceptualization, Methodology.

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