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Research Article

Knowledge, perceptions, and expectations of Artificial intelligence in radiography practice: A global radiography workforce survey

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ABSTRACT

Background: Artificial Intelligence (AI) technologies have already started impacting clinical practice across various settings worldwide, including the radiography profession. This study is aimed at exploring a world-wide view on AI technologies in relation to knowledge, perceptions, and expectations of radiography professionals.

Methods: An online survey (hosted on Qualtrics) on key AI concepts was open to radiography professionals worldwide (August 1st to December 31st 2020). The survey sought both quantitative and qualitative data on topical issues relating to knowledge, perceptions, and expectations in relation to AI implementation in radiography practice. Data obtained was analysed using the Statistical Package for Social Sciences (SPSS) (v.26) and the six-phase thematic analysis approach.

Results: A total of 314 valid responses were obtained with a fair geographical distribution. Of the respondents, 54.1% (157/290) were from North America and were predominantly clinical practicing radiographers (60.5%, 190/314). Our findings broadly relate to different perceived benefits and misgivings/shortcomings of AI implementation in radiography practice. The benefits relate to enhanced workflows and optimised workstreams while the misgivings/shortcomings revolve around de-skilling and impact on patient-centred care due to over-reliance on advanced technology following AI implementation.

Discussion: Artificial intelligence is a tool but to operate optimally it requires human input and validation. Radiographers working at the interface between technology and the patient are key stakeholders in AI implementation. Lack of training and of transparency of AI tools create a mixed response of radiographers when they discuss their perceived benefits and challenges. It is also possible that their responses are nuanced by different regional and geographical contexts when it comes to AI deployment. Irrespective of geography, there is still a lot to be done about formalised AI training for radiographers worldwide. This is a vital step to ensure safe and effective AI implementation, adoption, and faster integration into clinical practice by healthcare workers including radiographers.

Conclusion: Advancement of AI technologies and implementation should be accompanied by proportional training of end-users in radiography and beyond. There are many benefits of AI-enabled radiography workflows and improvement on efficiencies but equally there will be widespread disruption of traditional roles and patient-centred care, which can be managed by a well-educated and well-informed workforce.

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RÉSUMÉ

Contexte: Les technologies d'intelligence artificielle (IA) ont déjà commencé à avoir une incidence sur la pratique clinique dans divers contextes à travers le monde, y compris sur la profession de radiographe. Cette étude vise à explorer un point de vue mondial sur les technologies d'IA en relation avec les connaissances, les perceptions et les attentes des professionnels de la radiographie.

Méthodologie: Une enquête en ligne sur Qualtrics portant sur les concepts clés de l'IA était ouverte aux professionnels de la radiographie du monde entier (du 1er août au 31 décembre 2020). L'enquête visait à obtenir des données quantitatives et qualitatives sur des questions d'actualité relatives aux connaissances, aux perceptions et aux attentes concernant la mise en œuvre de l'IA dans la pratique de la radiographie. Les données obtenues ont été analysées à l'aide du Statistical Package for Social Sciences (SPSS) (v.26) et de l'approche d'analyse thématique en six phases.

Résultats: Un total de 314 réponses valides a été obtenu avec une distribution géographique équitable. Parmi les répondants, 54,1 % (157/290) étaient originaires d'Amérique du Nord et étaient principalement des radiographes cliniciens (60,5 %, 190/314). Nos conclusions portent sur les différents avantages et défis perçus de la mise en œuvre de l'IA dans la pratique de la radiographie. Les avantages concernent l'amélioration des flux de travail et l'optimisation des flux de travail, tandis que les défis tournent autour de la déqualification et de l'incidence sur les soins centrés sur le patient en raison d'une dépendance excessive à l'égard des technologies de pointe après la mise en œuvre de l'IA.

Discussion: L'intelligence artificielle est un outil, mais pour fonctionner de manière optimale, elle nécessite l'intervention et la validation de l'homme. Les radiographes qui travaillent à l'interface entre la technologie et le patient sont des acteurs clés de la mise en œuvre de l'IA. Le manque de formation et de transparence des outils d'IA suscite une réponse mitigée des radiographes lorsqu'ils discutent des avantages et des défis qu'ils perçoivent. Il est également possible que leurs réponses soient nuancées par les différents contextes régionaux et géographiques en matière de déploiement de l'IA. Indépendamment de la géographie, il y a encore beaucoup à faire en matière de formation formelle à l'IA pour les radiographes du monde entier. Il s'agit d'une étape essentielle pour garantir une mise en œuvre sûre et efficace de l'IA, son adoption et son intégration plus rapide dans la pratique clinique par les travailleurs de la santé, y compris les radiographes.

Conclusion: L'avancement des technologies d'IA et leur mise en œuvre devraient s'accompagner d'une formation proportionnelle des utilisateurs finaux en radiographie et au-delà. Les avantages des flux de travail de radiographie assistée par ordinateur et l'amélioration de l'efficacité sont nombreux, mais il y aura également une perturbation généralisée des rôles traditionnels et des soins centrés sur le patient, qui peuvent être gérés par une main-d'œuvre bien formée et bien informée.

Keywords: Artificial intelligence; Radiography; Global Surveys; Workforce Development; Education

Introduction

Artificial intelligence (AI) is a computer science term to describe the use of computer intelligence to perform human tasks [1]. Previously, AI technologies were used mainly by computer scientists and generally inaccessible to a wider audience due the slower speed of processors, lack of understanding of neural networks and insufficient data for testing different hypotheses [2]. Nevertheless, AI has now progressively been adopted in different settings, including healthcare. Healthcare professionals working in medical imaging, such as radiologists and radiographers, are experiencing a surge of AI applications being adopted in clinical practice, [3,4] without them always having the necessary education and training to fully comprehend their benefits and risks [1,2,5,6]. Furthermore, the necessary regulatory and governance frameworks for the safe use of AI tools are still under development and refinement [5,6].

AI has already started impacting clinical practice globally, across various settings including the reporting of diagnostic images at the clinic with promise for greater impact in the future. For example, validated AI technologies are enhancing radiologist reporting in some mammography screening facilities in the UK [7]. Similarly, Lauritzen and colleagues [8] recently demonstrated the potential of AI usage for population-based breast screening, in their study, AI has aided workload reduction by over three-fifths while avoiding false-positive findings by over 25% among radiologists. Thus, the concurrent use of AI-enhanced breast imaging with specialists, promises a more efficient, effective, and patient-centric care [9,10]. Recently, some AI tools have been optimised for COVID-19 detection and management [11,12,55] following the surge in chest imaging examinations in the pandemic [13,14]. Other AI technologies have influenced clinical workflows (e.g., radiotherapy treatment planning) in varied settings including resource-limited environments [15] and have modified research projects by performing mechanistic tasks, allowing researchers to focus more on where critical reflection and decision making was needed [16,17].

Radiographers are increasingly becoming aware of the applications, risks, and benefits of AI technologies and how these may impact their practice but also their future education and research priorities. Most of the research publications in the field of AI for radiography, while exerting great enthusiasm, remain opinion pieces and commentaries[42–53]. The American Society of Radiologic Technologists (ASRT), International Society of Radiographer and Radiological Technologists (ISRRT), European Federation of Radiography Societies (EFRS) and the Society and College of Radiographers (SCoR) in the UK have all published relevant statements in relation to the impact of AI in radiography practice [18,19]. The AI working group of the Society and College of Radiographers have further provided specific recommendations for radiography clinical practice,

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Table 1
Demographic distribution of respondents.

Variables	Groups	Frequency (n)	Percentage (%)
Age Range (yrs) ($n = 314$)	18-25	30	9.6
	26-35	92	29.3
	36-45	73	23.2
	46-55	74	23.6
	56-65	37	11.8
	>65	8	2.5
Gender ($n = 314$)	Male	143	45.5
	Female	169	53.8
	Prefer not to say	2	0.6
Current Role ($n = 314$)	Assistant Practitioner Radiographer	3	1.0
	Radiography Student	12	3.8
	Clinical Practicing Radiographer	190	60.5
	Research Radiographer	6	1.9
	Advanced Practitioner/Consultant Radiographer	19	6.1
	PhD Student Radiographer	7	2.2
	Professional body Representative	14	4.5
	Academic in Radiography	32	10.2
	Industry Partner	2	0.6
	Others*	29	9.2
Years of experience ($n = 314$)	0–2	37	11.8
	3–5	41	13.1
	6–10	107	34.1
	11–20	65	20.7
	>20	51	16.2
Region of current practice ($n = 290$)	Not practicing radiography	13	4.1
	Africa	28	9.6
	Australia	7	2.4
	Asia	69	23.8
	Europe	27	9.3
	North America	157	54.1
	South America	2	0.7
AI usage in daily practice ($n = 314$)	Yes	81	25.8
	No	170	54.1
	Not sure	54	17.2

*Included respondents with the following titles: Retired chief of radiography, Executive Director, Certified Medical Dosimetrist, Clinical Instructor, Chief Technical Advisor, Radiographer/radiology Manager.

education, research, and key partnerships required for the smooth and safe adoption of AI tools within medical imaging teams [6].

Education and training of healthcare practitioners on AI is vital for a successful implementation in practice because these are the agents who carry the clinical adoption of AI forward [20]. Different national surveys [21–29] about the understanding of AI by radiographers and their perception of these new tools have been published across different countries. However, given the different stages of AI implementation across different countries, there is currently no collective evidence at a global level in relation to the challenges and opportunities presented by the AI revolution to the Radiography community as a whole. The aim of this work, based on a pilot project led by City University London, is to provide a world-wide view on AI technologies in relation to knowledge, perceptions, and expectations of radiographers working across various settings. Findings from this study could provide an insight to regional differences in terms of expectations, knowledge, and level of skills of the workforce, helping to formulate a globally-informed, integrated guidance for a customised implementation of AI in radiography practice.

Methods

Study design and setting

This was an exploratory cross-sectional study designed to recruit participants globally through a snowball sampling approach [30]. This approach is recommended when no sampling frame can be constructed [31]. The study used a survey approach, designed to obtain both qualitative (open-ended) and quantitative (closed-type) responses [32].

Research instrument development and distribution

Institutional ethics approval was obtained from the City, University of London School of Health Sciences Research

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Ethics Committee (Reference number: Ethics ETH1920-0591). Gatekeepers' (essential mediators to help advertise our study to potential participants) approval was obtained from the International Society of Radiographers and Radiological Technologists (ISRRT).

The survey instrument (Appendix 1) was developed by a group of expert radiography academics (CM, ST, RK) based on current literature [1,5] and topical issues relating to the implementation of AI in radiography practice. It was also peer-reviewed by other academics and experts from different fields of radiography education and policy (TA, DK, DN). The research instrument comprised of both closed and open-ended questions, which were grouped into three main sections relating to: (a) participants' demographic information, (b) knowledge/perceptions/experiences and (c) expectations from the implementation and use of AI in radiography practice. A broad spectrum of stakeholders including but not limited to professional body regulators, students, and practitioners in clinical, academic and industry from across the globe were considered as potential participants, truly reflective of the radiography community, and therefore appropriate to access this survey. Filter questions at the start of the survey ensured only eligible participants, with a radiography background, were answering the questions of this survey. Survey responses were not forced to allow easy transition to the next question and throughout, in case participants were uncertain about a question and needed to move to the other ones.

The survey was hosted on the Qualtrics™ online survey platform (Qualtrics, Provo, UT) for easier distribution and for facilitating preliminary data analysis. Prior to distribution, the survey was piloted by the research team and purposively selected stakeholders (practising radiographers, graduate students, and professional body representatives). This process is required to ensure the face and content validity of the research instrument [36] as well as to confirm compatibility and ease of use on a range of devices (e.g., computers and mobile phones). The link to the online survey was shared amongst the regional directorate of the ISRRT to their membership globally. The survey was first launched on August 1st, 2020, and the data collection period lasted until December 31st, 2020. A reminder email was sent by the gatekeepers mid-way during the data collection period, a well-established technique to increase the response rate in online surveys [33].

Data analysis

Preliminary data analysis was automatically performed on Qualtrics, to allow for early detection of trends. Data from the survey was then downloaded into the Statistical Package for Social Sciences (SPSS) version 26.0 for Windows (SPSS Inc., IBM, New York, USA) for further analyses. The obtained data was then cleaned to remove partially complete responses and prepared for analyses using the following pre-determined strategies; inclusion of only participant responses which were more than 75% complete, to allow for optimal, holistic interpretation of results and removal of duplicate responses determined through internet protocol (IP) addresses. In addition, test responses which were considered invalid were therefore excluded.

Descriptive statistics was used to interpret the results in terms of absolute numbers and frequencies. Thematic analysis was employed for generation of themes from all the free text comments received in the open ended questions. The Braun and Clarke's [34] six-phase approach to thematic analysis was employed, briefly this included: (1) Familiarising ourselves with the data; (2) Generating initial codes; (3) Searching for themes; (4) Reviewing themes; (5) Defining and naming themes; (6) Producing the report. Two senior researchers (RK and CM) coded the free text comments independently and searched for initial themes. These were reviewed together with the first author (TNA) and subthemes and final themes agreed.

Results

Demographics

Within the five months of data collection period, a total of 400 responses were obtained. Following the data cleaning exercise, a total of 314 valid responses were obtained with 290 of these reporting the country or geographical region of current practice. Table 1. presents detailed demographic information of the participants. Of the respondents, 54.1% (157/290) were from North America and were predominantly clinical practicing radiographers (60.5%, 190/314) in their current role. Most respondents were in the 26–35 year range (29.3%, 92/314) and female (53.8%, 169/314). More than half (54.1%, 170/314) of respondents reported having no daily use of AI or its related technologies in their current roles. Of these respondents, 34.1% (107/314) have 6-10 years radiography practice experience.

AI implementation and usage: knowledge, skills and confidence in AI and workforce training requirements

A proportion of the respondents agree ($n = 76$, 26.2%) or somewhat agree ($n = 70$, 24.1%) that they feel well prepared to implement new AI technologies and innovations in daily practice. Of the respondents, 31.4% ($n = 91$) are somewhat confident in using AI technologies or innovations in their daily practice while 44.1% ($n = 128$) feel somewhat confident with AI terminologies. Some respondents disagree (82, 28.3%) or strongly disagree (55, 19.0%) that there is enough AI training opportunities currently available for radiographers. Thus, most respondents agree ($n = 120$, 41.4%) or strongly agree ($n = 81$, 27.9%) that the teaching of AI technologies should be included in the radiography teaching curriculum (Table 2).

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Table 2
Cross-tabulation of participants' response.

Question/ Statements	Continent	Response, n (%)							Total Response rate
		Strongly agree	Agree	Somewhat agree	Neither	Somewhat disagree	Disagree	Strongly disagree	
AI will change the daily clinical practice for radiographers	Africa	12 (4.1)	11 (3.8)	3 (1.0)	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	28 (9.7)
	Australia	3 (1.0)	3 (1.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	17 (5.9)	37 (12.8)	8 (2.8)	4 (1.4)	2 (0.7)	1 (0.3)	0 (0.0)	69 (23.8)
	Europe	5 (1.7)	14 (4.8)	6 (2.1)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	27 (9.3)
	N. America	43 (14.8)	49 (16.9)	43 (14.8)	18 (6.2)	1 (0.3)	3 (1.0)	0 (0.0)	157 (54.1)
	S. America	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**80 (27.6)**	**116 (40.0)**	**61 (21.0)**	**25 (8.6)**	**4 (1.4)**	**4 (1.4)**	**0 (0.0)**	**290 (100.0)**
AI will reduce the workload of the radiographer	Africa	5 (1.7)	9 (3.1)	10 (3.4)	2 (0.7)	0 (0.0)	1 (0.3)	1 (0.3)	28 (9.7)
	Australia	0 (0.0)	3 (1.0)	2 (0.7)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	13 (4.5)	34 (11.7)	18 (6.2)	3 (1.0)	1 (0.3)	0 (0.0)	0 (0.0)	69 (23.8)
	Europe	3 (1.0)	5 (1.7)	12 (4.1)	3 (1.0)	2 (0.7)	2 (0.7)	0 (0.0)	27 (9.3)
	N. America	18 (6.2)	16 (5.5)	52 (17.9)	39 (13.4)	15 (5.2)	12 (4.1)	5 (1.7)	157 (54.1)
	S. America	0 (0.0)	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**39 (13.4)**	**68 (23.4)**	**95 (32.8)**	**49 (16.9)**	**18 (6.2)**	**15 (5.2)**	**6 (2.1)**	**290 (100.0)**
AI will ensure more consistent patient safety standards for radiography	Africa	7 (2.4)	13 (4.5)	3 (1.0)	3 (1.0)	1 (0.3)	0 (0.0)	1 (0.3)	28 (9.7)
	Australia	2 (0.7)	3 (1.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	9 (3.1)	41 (14.1)	15 (5.2)	2 (0.7)	1 (0.3)	1 (0.3)	0 (0.0)	69 (23.8)
	Europe	3 (1.0)	14 (4.8)	6 (2.1)	2 (0.7)	0 (0.0)	2 (0.7)	0 (0.0)	27 (9.3)
	N. America	16 (5.5)	47 (16.2)	48 (16.6)	27 (9.3)	8 (2.8)	9 (3.1)	2 (0.7)	157 (54.1)
	S. America	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**38 (13.1)**	**119 (41.0)**	**74 (25.5)**	**34 (11.7)**	**10 (3.4)**	**12 (4.1)**	**3 (1.0)**	**290 (100.0)**
AI will improve image quality consistency in radiography	Africa	6 (2.1)	15 (5.2)	5 (1.7)	1 (0.3)	0 (0.0)	1 (0.3)	0 (0.0)	28 (9.7)
	Australia	2 (0.7)	4 (1.4)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	11 (3.8)	42 (14.5)	10 (3.4)	5 (1.7)	1 (0.3)	0 (0.0)	0 (0.0)	69 (23.8)
	Europe	1 (0.3)	18 (6.2)	5 (1.7)	1 (0.3)	1 (0.3)	1 (0.3)	0 (0.0)	27 (9.3)
	N. America	27 (9.3)	57 (19.7)	47 (16.2)	16 (5.5)	6 (2.1)	3 (1.0)	1 (0.3)	157 (54.1)
	S. America	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**48 (16.6)**	**137 (47.2)**	**68 (23.4)**	**23 (7.9)**	**8 (2.8)**	**5 (1.7)**	**1 (0.3)**	**290 (100.0)**
The patients will accept the use of AI in their care without any problems.	Africa	2 (0.7)	6 (2.1)	12 (4.1)	4 (1.4)	2 (0.7)	1 (0.3)	1 (0.3)	28 (9.7)
	Australia	0 (0.0)	0 (0.0)	4 (1.4)	2 (0.7)	0 (0.0)	1 (0.30	0 (0.0)	7 (2.4)
	Asia	3 (1.0)	27 (9.3)	19 (6.6)	18 (6.2)	1 (0.3)	1 (0.3)	0 (0.0)	69 (23.8)
	Europe	2 (0.7)	7 (2.4)	8 (2.8)	7 (2.4)	1 (0.3)	1 (0.3)	1 (0.3)	27 (9.3)
	N. America	8 (2.8)	24 (8.3)	37 (12.8)	28 (9.7)	31 (10.7)	19 (6.6)	10 (3.4)	157 (54.1)
	S. America	0 (0.0)	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**15 (5.2)**	**65 (22.4)**	**81 (27.9)**	**59 (20.3)**	**35 (12.1)**	**23 (7.9)**	**12 (4.1)**	**290 (100.0)**
AI will offer more consistency in patient care.	Africa	5 (1.7)	12 (4.1)	8 (2.8)	1 (0.3)	1 (0.3)	0 (0.0)	1 (0.3)	28 (9.7)
	Australia	2 (0.7)	1 (0.3)	3 (1.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	2 (0.7)	41 (14.1)	13 (4.5)	5 (1.7)	7 (2.4)	1 (0.3)	0 (0.0)	69 (23.8)
	Europe	3 (1.0)	8 (2.8)	9 (3.1)	5 (1.7)	1 (0.3)	0 (0.0)	1 (0.3)	27 (9.3)
	N. America	12 (4.1)	38 (13.1)	34 (11.7)	33 (11.4)	21 (7.2)	15 (5.2)	4 (1.4)	157 (54.1)
	S. America	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**25 (8.6)**	**101 (34.8)**	**67 (23.1)**	**45 (15.5)**	**30 (10.3)**	**16 (5.5)**	**6 (2.1)**	**290 (100.0)**
The implementation of AI will make the radiography profession more attractive to me.	Africa	6 (2.1)	9 (3.1)	8 (2.8)	4 (1.4)	0 (0.0)	0 (0.0)	1 (0.3)	28 (9.7)

(*continued on next page*)

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Table 2 (*continued*)

Question/ Statements	Continent	Response, n (%)							Total Response rate
		Strongly agree	Agree	Somewhat agree	Neither	Somewhat disagree	Disagree	Strongly disagree	
	Australia	1 (0.3)	3 (1.0)	1 (0.3)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	8 (2.8)	42 (14.5)	13 (4.5)	3 (1.0)	2 (0.7)	0 (0.0)	1 (0.3)	69 (23.8)
	Europe	3 (1.0)	8 (2.8)	2 (0.7)	8 (2.8)	2 (0.7)	4 (1.4)	0 (0.0)	27 (9.3)
	N. America	8 (2.8)	22 (7.5)	17 (5.9)	67 (23.1)	16 (5.5)	12 (4.1)	15 (5.2)	157 (54.1)
	S. America	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**26 (9.0)**	**86 (29.7)**	**41 (41.1)**	**84 (29.0)**	**20 (6.9)**	**16 (5.5)**	**17 (5.9)**	**290 (100.0)**
The implementation of AI will be a threat to the radiography profession.	Africa	1 (0.3)	2 (0.7)	10 (3.4)	1 (0.3)	3 (1.0)	8 (2.8)	3 (1.0)	28 (9.7)
	Australia	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)	1 (0.3)	3 (1.0)	1 (0.3)	7 (2.4)
	Asia	7 (2.4)	20 (6.9)	12 (4.1)	7 (2.4)	6 (2.1)	15 (5.2)	2 (0.7)	69 (23.8)
	Europe	2 (0.7)	1 (0.3)	2 (0.7)	5 (1.7)	7 (2.4)	7 (2.4)	3 (1.0)	27 (9.3)
	N. America	10 (3.4)	21 (7.2)	30 (10.3)	35 (12.1)	26 (9.0)	24 (8.3)	11 (3.8)	157 (54.1)
	S. America	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**20 (6.9)**	**45 (15.5)**	**54 (18.6)**	**51 (17.6)**	**43 (14.8)**	**57 (19.7)**	**20 (6.9)**	**290 (100.0)**
I feel well prepared to implement new AI technologies and innovations in my daily practice.	Africa	6 (2.1)	6 (2.1)	6 (2.1)	2 (0.7)	3 (1.0)	3 (1.0)	2 (0.7)	28 (9.7)
	Australia	0 (0.0)	3 (1.0)	3 (1.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	6 (2.1)	33 (11.4)	17 (5.9)	9 (3.1)	1 (0.3)	2 (0.7)	0 (0.0)	69 (23.8)
	Europe	4 (1.4)	7 (2.4)	5 (1.7)	4 (1.4)	2 (0.7)	5 (1.7)	0 (0.0)	27 (9.3)
	N. America	7 (2.4)	25 (8.6)	39 (13.4)	36 (12.4)	19 (6.6)	22 (7.6)	9 (3.1)	157 (54.1)
	S. America	0 (0.0)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**23 (7.9)**	**76 (26.2)**	**70 (24.1)**	**52 (17.9)**	**25 (8.6)**	**32 (11.0)**	**11 (3.8)**	**290 (100.0)**
There is enough training on AI currently available for radiographers.	Africa	1 (0.3)	3 (1.0)	2 (0.7)	2 (0.7)	3 (1.0)	6 (2.1)	11 (3.8)	28 (9.7)
	Australia	0 (0.0)	0 (0.0)	0 (0.0)	1 (0.3)	2 (0.7)	3 (1.0)	1 (0.3)	7 (2.4)
	Asia	1 (0.3)	17 (5.9)	12 (4.1)	5 (1.7)	12 (4.1)	15 (5.2)	6 (2.1)	69 (23.8)
	Europe	2 (0.7)	1 (0.3)	1 (0.3)	3 (1.0)	6 (2.1)	8 (2.8)	6 (2.1)	27 (9.3)
	N. America	1 (0.3)	5 (1.7)	6 (2.1)	42 (14.5)	22 (7.6)	50 (17.2)	31 (10.7)	157 (54.1)
	S. America	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**5 (1.7)**	**27 (9.3)**	**21 (7.2)**	**54 (18.6)**	**45 (15.5)**	**82 (28.3)**	**55 (19.0)**	**290 (100.0)**
AI technology teaching should be included in the radiography curriculum at universities.	Africa	14 (4.8)	12 (4.1)	2 (0.7)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	28 (9.7)
	Australia	4 (1.4)	3 (1.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (2.4)
	Asia	20 (6.9)	32 (11.0)	11 (3.8)	2 (0.7)	1 (0.3)	0 (0.0)	1 (0.3)	69 (23.8)
	Europe	12 (4.1)	7 (2.4)	4 (1.4)	2 (0.7)	0 (0.0)	1 (0.3)	0 (0.0)	27 (9.3)
	N. America	30 (10.3)	65 (22.4)	39 (13.4)	15 (5.2)	3 (1.0)	2 (0.7)	3 (1.0)	157 (54.1)
	S. America	1 (0.3)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.7)
Total		**81 (27.9)**	**120 (41.4)**	**56 (19.3)**	**19 (6.6)**	**4 (1.4)**	**3 (1.0)**	**4 (1.4)**	**290 (100.0)**
Question/Statements	**Continent**	**Response, n (%)**							**Total**
		Very Confident	**Confident enough**	**Somewhat Confident**	**Not Confident at all**	**Not currently using AI in my practice**			
How confident are you in using AI technologies or innovations, if implemented in your daily practice?	Africa	3 (1.0)	7 (2.4)	11 (3.8)	2 (0.7)	5 (1.7)			28 (9.7)

(*continued on next page*)

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Table 2 (*continued*)

Question/ Statements	Continent	Response, n (%)						Total Response rate
		Strongly agree	Agree	Somewhat agree	Neither	Somewhat disagree	Disagree	Strongly disagree	
	Australia	1 (0.3)	1 (0.3)	1 (0.3)	1 (0.3)	3 (1.0)			7 (2.4)
	Asia	7 (2.4)	24 (8.3)	26 (9.0)	5 (1.7)	7 (2.4)			69 (23.8)
	Europe	4 (1.4)	8 (2.8)	6 (2.1)	3 (1.0)	6 (2.1)			27 (9.3)
	N. America	17 (5.9)	29 (10.0)	46 (15.9)	21 (7.2)	44 (15.2)			157 (54.1)
	S. America	0 (0.0)	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)			2 (0.7)
Total		**32 (11.0)**	**69 (23.8)**	**91 (31.4)**	**32 (11.0)**	**66 (22.8)**			**290 (100.0)**
Do you feel confident with the underlying terminology of AI (algorithms, deep learning, neural networks, computer aided-detection diagnosis, data mining, etc)?	Africa	3 (1.0)	8 (2.8)	15 (5.2)	2 (0.7)	0 (0.0)			28 (9.7)
	Australia	0 (0.0)	4 (1.4)	2 (0.7)	1 (0.3)	0 (0.0)			7 (2.4)
	Asia	6 (2.1)	21 (7.2)	31 (10.7)	11 (3.8)	0 (0.0)			69 (23.8)
	Europe	3 (1.0)	7 (2.4)	10 (3.4)	7 (2.4)	0 (0.0)			27 (9.3)
	N. America	12 (4.1)	29 (10.0)	70 (24.1)	46 (15.9)	0 (0.0)			157 (54.1)
	S. America	0 (0.0)	1 (0.3)	0 (0.0)	1 (0.3)	0 (0.0)			2 (0.7)
Total		**24 (8.3)**	**70 (24.1)**	**128 (44.1)**	**68 (23.4)**	**0 (0.0)**			**290 (100.0)**

n = north, S= south, Response percentages may exceed or not add up to 100% due to decimal place rounding.

Radiographer expectations from AI: Perceived future impact of AI on clinical radiography practice and careers and acceptance in patient care

Most respondents supported [strongly agree (n = 80, 27.6%) and agree (n = 116, 40.0%)] that AI will change daily clinical radiography practice. Of note, only 2.8% (n = 8) of respondents disagreed to this view. Majority of respondents somewhat agree (n = 95, 32.8%) that AI will reduce the workload of the radiography workforce while only few (n = 6, 2.1%) strongly disagreed. Respondents from Asia (n = 41, 14.1%) and North America (n = 47, 16.2%) form the majority of respondents to agree that AI will ensure more consistent patient safety standards in clinical radiography practice, while 41.0% (n = 119) of respondents, globally, are in agreement. Of note, majority of respondents are from Asia and North America. A large proportion of respondents (over 67%) feel as though AI will change their daily practice, however, about half of respondents also think AI will not improve image quality and consistency in the clinical practice of radiography. Of the respondents, 29.7% (n = 86) agree while 29.0% (n = 84) neither agree nor disagree that the implementation of AI will make the radiography profession more attractive to them. Furthermore, 27.9% (n = 81) somewhat agree that patients will accept the use of AI in their care without problems, with greater proportions of respondents from Asia (19, 6.6%) and North America (37,12.8%) supporting this, while only 12.1% (n = 25) somewhat disagree. Furthermore, a large proportion (n = 101, 34.8%) of respondents agree that the implementation and use of AI technologies will offer more consistency in patient care (detailed information about these results can be found in Table 2).

Themes emerging from the thematic analysis

Two primary themes emerged from the thematic analysis of the free text comments: "benefits of AI" and "misgivings and shortcomings of AI" . The content of the two themes are outlined below with quotations illustrating each of them and in Tables 3 and 4 for clarity.

Theme 1: benefits of AI

Participants acknowledged a number of perceived benefits that AI could provide. For instance, many highlighted how workflow and workstreams could potentially be enhanced by its introduction. In particular, areas mentioned include: increased speed and throughput, streamlining of services and simplified workloads:

"It provides an opportunity for radiographers to change how they work and the services that they provide. An aim should be to improve the efficiency and accuracy of diagnosis, reducing any waits in the system and allowing prompt diagnosis so that people don't have to wait long periods of time for a diagnosis or treatment."

[***Clinical practicing radiographer-143v***]

In addition, participants also stated the positive impact AI could have on overall patient care and how it could enhance and improve this area. Participants highlighted the increased opportunity to focus on the patient, for instance the engagement, contact and management. Participants appreciated this could also increase patient satisfaction.

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Table 3
Themes relating to benefits of AI in clinical radiography practice.

Codes/Labels	Subthemes	Final Theme
Reduced wait times	**Enhanced Workflow**	**Benefits of AI**
Reduced work loads		
Increased speed		
Increased throughput		
Increased systems performance		
Better scheduling of work		
Increased efficiency		
Improved service		
Standardisation of processes		
Simplifying workload		
Reduce errors		
Consistent examinations		
Cost effective		
Time saving		
Increased patient care	**Enhanced Patient care**	
Increased patient contact		
Increased patient engagement		
Increased patient management		
Increased patient interaction		
More focused time with patients		
Patient satisfaction		
Aids diagnosis	**Enhanced technology**	
Improved image quality		
Improved image acquisition		
Improved image processing		
Increased precision		
Better optimisation		
Radiation dose reduction		
Advanced automation		
Increased digital technology		
Reduces post processing		
Increased storage / memory		
More information		
Increased role development	**Enhanced professional development**	
Increased knowledge		
Increased capabilities		
Increased skills set		
Increased role and focus on patient needs		
More reporting radiographer prospects		
Developing skills in technologies		

Table 4
Themes relating to misgivings and shortcomings of AI in clinical radiography practice.

Codes/Labels	Subthemes	Final Theme
Lack of critical thinking	**Professional de-skilling**	**Misgivings & shortcomings of AI**
Lack of radiographer creativity		
Dependence on AI		
Lack of familiarisation with technology		
Button pushers – loss of identity		
Not coping with the advancement		
Slower development compared to faster AI development		
Laziness and complacency		
Loss of radiographic skills		
Carelessness		
Human skill drop / forgotten basic principles		
Lack of analysis / adaptability		
Incompetence		
Job security	**Uncertainty in workforce**	
Unemployment		
Poor career opportunities		
Staff reductions		
Reduce job demands		
Reduced capacity in manpower		
Reduced number of radiographer roles		
Reduced number of radiologists		
Radiographers not needed		
AI taking over		
Technology focussed	**Reduced sense of humanity**	
Reduced human involvement		
Loss of human empathy		
Profession will be computer based not human based		
Loss of holistic care		
Loss of personalised care		
Focus on digital – reduces patient care/bedside manner		
Less human connection		
Cannot develop a bond		

"Opportunity to enhance practice, give over routine tasks to AI and for us to spend more quality time with patients in patient care and support - opportunity to better serve our patients"

[Clinical practicing radiographer-R82a]

"AI will take over the machine aspect of radiography and radiographers can focus more on the human aspect: AI take over the sciences of case and radiographers can spend more time on the art of care"

[Academic in Radiography-R109u]

Moreover, participants agreed that the adoption of AI would also enhance and upgrade current radiographic technology which in turn would be advantageous; in particular aiding diagnosis, detecting abnormalities, improving image quality, image acquisition and better management of patient data:

"It may assist in diagnosis, and I can see it being very useful for record-keeping and being patient history"

[Clinical practicing radiographer-R82a]

"With the growth of AI, there will be a significant improvement in the image acquisition, image processing and diagnosis that will result in the overall development of our healthcare delivery to our patients."

[Clinical practicing radiographer-R80p]

Finally, in terms of their own role as radiography practitioners, participants identified the potential professional development opportunities with the arrival of AI could bestow, in particular increasing skills, knowledge and capabilities:

"I feel it would help radiographers, in educating and integrating the knowledge base and quest for knowledge and comparing evidence-based practice."

[Research Radiographer-R13u]

"There will be higher demand of advanced technological skills."

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[Professional Body representative-R209g]

Theme 2: misgivings and shortcomings of AI

Interestingly, although participants highlighted the increased skills and knowledge as stated above, there were also concerns by some participants that embracing AI could negatively impact on the role of the radiography practitioner with particular reference to de-skilling due to the increased reliance and dependence of the advanced technology. In addition, some felt that the introduction of AI could also encourage the loss of basic radiography principles and capabilities.

"Dependence on the AI program all the time might lead to incompetence as they are not trying hard to learn"

[Clinical practicing radiographer- R23i]

"I think radiographers will be more 'button pushers' and critical thinking skills may be diminished due to automation, a reduction in technical ability due to more automation"

[Radiographer student-R301n]

Moreover, participants raised concerns towards the uncertainty of the workforce if AI was acquired. Majority acknowledged areas such as job security, threat to career development / opportunities and reduced job demand were causing them to feel disconcerted:

"It may serve as a threat to future radiographers because some employers may choose not to hire additional radiographers because their current workforce is already supported by AI."

[Clinical practicing radiographer-R279h]

"Unemployment – as every organization is looking to replace the minimum qualified individuals with AI robots which can do similar work with much more efficiency."

[Clinical practicing radiographer-R20m]

Finally opposing views were evident in the comments particularly surrounding patient contact. Some participants as mentioned earlier acknowledged the increased focus on the patient. Yet some participants felt that AI could be unfavourable as it would reduce the human involvement, interaction, connection, thus loss of patient centred care due to the digital / technological advancement. In addition, AI could decrease the quality of work that radiography practitioners provide toward the patient, due to loss of empathy:

"Patient care/bedside manner will deteriorate. We will be focussed on digital results rather than the actual patient holistically"

[Academic in Radiography-R6y]

"Quality of work may alter because AI has no sense of humanity, no feelings how our patients feel on the procedure we take "

[Professional body representative-R2c]

Discussion

Clinical Radiography practice is a quickly evolving field in terms of technological developments. Researchers and academics in the field have started to embark on different research studies, including workforce surveys to inform future policy, education and practice locally [19,21] and to gauge the opinions of the Radiography community regarding the emergence and integration of AI in practice. Radiography is a highly technology-enabled profession where the challenges and pitfalls of introducing new skills/innovations are shared worldwide. This study assessed the knowledge, perceptions, and expectations of the global Radiography community in relation to the emergence and integration of AI in practice. Our findings broadly relate to benefits and challenges of AI. The benefits relate to enhanced workflow and workstreams while the challenges revolve around de-skilling and loss of human elements of patient care due to the increased reliance on advanced technology following AI implementation. Our findings further reflect trends reported in the literature that the global Radiography workforce is youthful, with more female radiographers as reported previously in the UK workforce surveys [35] and in the survey in Africa [22,27].

AI implementation and usage: Perceived Impact on the radiography practice

Radiography is a profession that operates on the interface between technology and patient care, focusing equally on both. In this survey, most participants agreed that AI will change radiographers' daily practice and reduce radiographers' workload. In contrast, about half of respondents also think AI will not improve image quality and consistency in the clinical practice of radiography, regardless of regional resource availability. These findings are consistent with the 2019 ASRT survey [18] (North America), where most respondents were expecting to see AI-enabled improvement on patient safety and quality, although they were worried about deterioration of the patient care aspects of the profession**.** Of note, majority of the respondents in our study were from Asia ($n = 41$, 14.1%) and North America ($n = 47$, 16.2%) where AI implementation is already at an advanced stage, so this might have skewed the results [21,22,27]. Subsequent surveys in different regions of the world also corroborate these perceptions [21–29]. For example, Botwe and colleagues [21,22] observed similarly strong positive perceptions of the African radiography workforce in relation to benefits of AI for quality, safety, and efficiency of the radiographers' workload and dose reduction following the introduction of AI-enhanced technologies. Alelyani et al. [23] surveyed radiographers and radiologists in Saudi Arabia in a range of aspects related to AI implementation and 71% believe that AI will contribute to create high quality imaging. A similar national study [24] conducted among the Irish Radiography workforce reported a strong positive attitude towards AI implementation in the clinical settings to improve quality. It is worth noting that although workflows and volumes might become faster following AI implementation, systemic issues around over-requesting of imaging and increased patient throughput may require long-term solutions.

It is possible that these views are influenced by the current literature regarding AI in radiography practice, where there is the notion that AI will transform the healthcare sector, partic-

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ularly diagnosis and medical imaging [3,8–12]. In the Alelyani et al. [23] survey, 63.4% of the respondents believed that their knowledge about AI is based on what is published in the media. Given the lack of formal training in AI as an innovative technology, [2–4,6] it is easy to assume that the perceptions the workforce has regarding AI are not evidence-based or derived from formal education. Additionally, a lack of appreciation of the different operational aspects of radiography AI will affect, beyond report and image interpretation, adds to the uncertainty. For example, the recent study by Ng and colleagues [54] that explored the perceptions and expectations of AI among Singaporean radiographers reported that participants envisioned several applications across different phases of clinical workflows including order vetting, patient positioning, language translation, and artefact removal. Thus, scientifically sound, prospective studies are needed to provide the necessary evidence base to support these findings within radiography practice.

Perceived knowledge, skills and confidence in the use of AI

An aggregate of over 70% of the respondents in this survey feel confident in using AI in daily practice (very, confident enough or somewhat confident), nevertheless a total of 22.8% of participants don't use AI in current practice and 11% state they are not confident at all in using AI technologies. This demonstrates variability in responses in relation to AI theoretical knowledge and practical applications of AI. The answers to our survey showed an overall lack of understanding of AI-specific language used in radiology. This shows that, while a considerable proportion of the worldwide radiography community expressed willingness to accept and adopt AI in practice, they however lack the theoretical knowledge or experience to do so. Similar results were found by Rainey et al. [25], who surveyed UK radiographers stating that the workforce does not have enough skills, knowledge, confidence nor training for full integration of AI in clinical practice. This finding agrees with other similar studies from the United Arab Emirates [26] and the United States of America [18]. Of note, findings of the 2019 ASRT survey [18] reported mixed levels of confidence and familiarity with AI features. In contrast, the findings from the African-wide AI survey [22] ($n = 1020$) reported 69.1% of respondents having basic coding and programming skills, therefore more equipped to develop transferable skills and implement AI tools. However, the question was not directly asking if the respondents were confident in using AI in daily practice, therefore comparisons interpretations must be cautiously done. Furthermore, all of these studies assessed self-reported confidence but not competence in using AI; given the lack of formalised education one would expect that competence levels would follow knowledge and understanding. The mismatch between theory and practice is certainly worrying and may result in erroneous use of AI tools in practice, with implications for patient outcomes and customised formal training of radiographers in AI is urgently needed.

Chen et al. [37] reported that radiologists have greater access to AI knowledge due to greater professional and industry networks and interactions. In the case of radiographers, the sources of information, industry links and opportunities to get funding for AI training are narrower, which makes it harder for these professionals to obtain the necessary knowledge in AI**.** Huisman et al. [29] conducted a large survey on 1041 radiologists and only a minority of the respondents was not aware of AI techniques. The majority had basic or advanced knowledge in AI, and this was associated with a more positive attitude towards AI, therefore improved chances of clinical adoption and receptivity by the workforce. It seems that AI receptivity can vary from acceptance of the perceived inevitability to a positive enthusiasm for such change [37]. The more educated the workforce is regarding AI, the more levels of positive, active acceptance and engagement are seen.

A joint statement of the International Society of Radiographer and Radiological Technologists (ISRRT) and the European Federation of Radiographer Societies (2020), declared that is critical for radiographers to play an active role in the planning, developing, implementation and clinical validation of the AI applications [19]. These efforts should address the most pressing clinical issues and challenges and the way to achieve this is through appropriate education of the current and future workforce. The Society and College of Radiographers guidance for AI [6] also stressed the need for education on AI, advancing clinical practice, promoting prospective research, and forging strong partnerships with the wider AI ecosystem. It is vital for radiographers to remain professionally updated regarding continuous changes to the evidence base and technological advances, particularly in radiography, to bring the "actual practice" closer to the "best practice" [38].

Job security, professional uncertainty and future of the profession

Interestingly, almost 40% of respondents in this survey consider that the implementation of AI will make the profession more attractive for them; however, this survey also found that respondents reported the uncertainty in the future of the profession and the professional de-skilling due to over-reliance on AI-enhanced technologies. The fear that the machines will "take over", reducing the professional value, job demand and roles is shared by a considerable part of the workforce. The professional roles of the radiography professionals vary globally and there is different uptake of AI in different modalities within the same country, therefore divergent opinions are expected [24].

Another concern expressed by the respondents was the reduced sense of humanity and the focus on digital results rather than the patient. Although there are many radiography domains already using AI in clinical practice, [3] the promise of full autonomous AI tools that can mimic radiographers' tasks is still far from clinical routines. Perhaps these fears emanate from pre-conceived ideas, bold, unfounded declarations from some technology "influencers", historical experience from the industrial revolution or even from other industries (the driverless car, for example) and are not, certainly, evidence-based. Despite the initial concerns, where around a third of the respondents in this survey believed AI would be a threat to the profession, participants in our survey reported that AI would enhance profes-

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sional development with the creation of new roles and job descriptions resulting from the introduction of AI tools into clinical practice. The workforce believes that AI could overall have beneficial effects and a positive impact in clinical practice. This is particularly important for student radiographers and newly qualified professionals and the future of AI-enabled radiography would certainly impact the future recruitment of students and new radiographers to the profession [39].

The uncertainty over careers due to AI is a common theme to other studies as well. Abuzaid et al. [26] surveyed radiographers and radiologists in the Middle East and India and identified some reservations regarding job security. Most participants felt that AI will threaten or disrupt the radiography practice. Similarly, 61.3% of respondents surveyed by Botwe and colleagues [22] are of the view that AI could replace radiographers' jobs and negatively affect the radiography profession in Africa, rather than being an assistive tool. However, findings from the North America [18] indicate that there was no consensus that AI will negatively impact the professional prospects. Additional views from the ASRT survey regarding the future of the profession were more positive. The same survey suggested that staffing levels of medical radiation technologists (or MRTs, as radiographers are called in the USA) would remain the same. The varying perspectives might relate to different factors such as: (a) the levels of AI awareness and of digital literacy, (b) years of experience with AI integrated in clinical practice, which allows a more realistic and balanced view, that cannot be swayed by personal opinions, (c) constitutional position of radiography within healthcare and status of radiography professional bodies to influence policy and practice and (d) cultural contexts in relation to healthcare priorities.

Radiologists tend to view AI technology as affording an opportunity for professional development, whereas radiographers were more reticent, highlighting the possible threat which AI posed to their roles [37]. However, Husmein et al. [29] states that fear of replacement by AI still exists amongst the radiologists (39%), but an open attitude towards AI can be inferred from their survey, which links knowledge and training in AI with a more positive attitude towards it. It is likely that with wider availability of formal education in AI for radiographers, enhanced AI transparency and explainability radiographers' views towards AI will become more favourable. Of note, Yang and colleagues [40] concluded in a scoping review that the replacement of radiologists by AI is considered unlikely and the stakeholders identified the need for training and education.

Lack of AI education and training for radiographers: a common denominator for many problems

Respondents indicated that AI should be included in the radiography training curriculum at universities and reported that, currently, there aren't enough AI training opportunities available for the radiography workforce. There was consensus about this across all continents surveyed in this study; and this finding was in line with previous other regional studies [19,21] to suggest that radiographers should have formal education and more training in AI. Rainey and colleagues [25] observed that the highest the academic qualification of a radiographer, the greater the understanding and better use of AI technologies. The demands for technological knowledge and patient care understanding, both of which define a radiographer's role are conveyed through theory and practice. Training is essential for radiographers to enable them to think on their feet and to facilitate patient safety, patient care and service efficiency using AI tools. Thus, training should be provided in an undergraduate and postgraduate setting to equip the radiography workforce for the rapidly evolving roles [25]. The Topol review [20] recommends that education and training in computer sciences and digital technologies should be integrated in undergraduate curricula for all healthcare professionals, as this is critical to successfully implement AI tools into daily practice. However, understanding how to implement AI in healthcare practice is still in its early stages of development [41] and it varies greatly across different regions or countries. The education systems also vary across the world and the levels of AI education or available training are significantly different across different regions. The staff and patient receptiveness, cultural norms, demographics of the radiography workforce, available budget and legal frameworks and standards from North America are significantly different from the ones in Asia or Africa [18,21–29]. Irrespective of local contexts, every country should aim to equip their healthcare workforce, including radiographers, with the necessary knowledge, skills, and attitude to thrive in the digital present and future of healthcare.

Recommendations for practice, research, and education

The need for more training and education is vital to successfully implement AI into clinical practice, with these views being shared globally by all key AI ecosystem stakeholders. Lack of understanding may lead to uncertainty in how to make sense of AI as it relates to radiography practice/careers, and thus education is needed in order to build the proficiency necessary to appreciate future directions. AI education and training opportunities for radiographers are limited and thus, suggestions for industries and higher education institutes to develop such bespoke programmes to support the learning of the workforce is encouraged. Furthermore, time-critical, prospective, radiography-led research is required to fully understand the radiographers' role and involvement in the development, deployment, and implementation of AI technologies for clinical radiography practice and to help them grasp the vast applications of AI within their area of work. This research will also help develop the necessary evidence base to improve AI-enabled radiography practice for the benefit of the patients (patient experience) and staff (staff wellbeing).

Limitations of the study

Despite statistical power considerations, to the best of the authors' knowledge, this study is the first attempt at exploring the experiences and expectations of the global radiography community in relation to AI implementation in practice.

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Whilst the overall sample size cannot be seen as representative of the size of the radiography workforce at a global level, this study managed to get a rate of responses from most geographical areas, where radiographers work and practice. Language barriers, COVID-19 workloads on clinical practitioners and academics and the lack of basic AI training might have contributed to the final number of survey participants. The sample, although not representative, remains relevant to the global radiography community and gives some unique insights of local variations related to AI implementation in radiography. Surveys are also limited, unlike interviews in-depth participant perspectives cannot be obtained to provide understanding of how each respondent interpreted the questions in the research instrument in relation to local contexts.

Conclusion

Radiographers are key in the integration of AI in clinical practice, working on the interface between technology and patient care, to facilitate a smooth transition for the benefit of the patients. As both theoretical knowledge and clinical uptake of AI in radiography are still under development, opinions of radiographers globally appear divided. It is imperative for radiographers to receive appropriate education and training to enable them to play a central role in transforming clinical practice using AI and leading research in this field to continue improving patient experience and outcomes.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmir.2022.11.016.

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