Artificial Intelligence (AI) in Radiology – Trainees want more

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Abstract

Aim

This study aims to understand the attitudes of UK radiology trainees towards AI in Radiology, in particular assessing the demand for AI education. This could help guide implementation of AI teaching in radiology training programmes especially in light of its introduction to the Royal College of Radiologists curriculum.

Materials and Methods

A survey, which ran over a period of 2 months, was created in the Google Forms platform and distributed via email to all United Kingdom (UK) training programmes.

Results

The survey was completed by 149 trainee radiologists with at least 1 response from all UK training programmes. 83.7% were interested in AI use in Radiology but 71.4% had no experience of working with AI. 79.9% would like to be involved in AI based projects. Almost all (98.7%) felt that AI should be taught during their training, yet only 1 respondent stated that their training programme had implemented AI teaching. Respondents indicated that basic understanding, implementation and critical appraisal of AI software should be prioritized in teaching. 74.2% of trainees agreed that AI would enhance the job of diagnostic radiologists in the next 20 years. The main concerns raised were IT/Implementation and ethical/regulatory issues.

Conclusion

Despite current limited availability of AI-based activities and teaching within UK training programmes, UK trainees' attitudes towards AI are mostly positive with many showing interest in being involved with AI-based projects, activities and teaching.

Introduction

Artificial Intelligence (AI) is a rapidly developing field, garnering significant interest in healthcare particularly the field of radiology. This technology could disrupt, transform and potentially revolutionise medical imaging.[1,2] AI has been introduced to the 2021 Royal College of Radiologists (RCR) curriculum[3], emphasising its growing influence within radiology and its importance to radiology trainees in the United Kingdom (UK). However, in discussions regarding AI and radiology, the potential impact of AI on radiologists' future careers features prominently, including whether radiology was the correct career choice.[4,5,6]

The attitudes of trainees towards AI in radiology have been reviewed in several countries and in different specialty groups. Regional surveys done in France[7], Germany[5] and Switzerland[4] have examined the perception of AI in radiology amongst medical students, radiology trainees or radiologists. These studies showed mostly optimistic views with some scepticism from medical students. A national survey conducted in Singapore also showed growing optimism.[6]

A survey of radiologists conducted by the European Society of Radiology (ESR) showed a generally positive attitude towards AI adoption in radiology.[8] However, there was no documented survey assessing the views of UK radiology trainees towards AI, in particular looking at teaching and availability of opportunities within training. Current UK radiology trainees will most likely be impacted by AI in their practice and it will be important to prepare trainees adequately for their future careers.[9,10] Understanding their views could help guide the implementation of AI teaching in UK radiology training programmes, which could have a significant influence on the successful implementation of AI in radiology.

Members of the Radiology Academic Network for Trainees (RADIANT) set out to understand the attitudes of radiology trainees towards AI. The survey was aimed at assessing the level of demand for AI education, the learning needs of radiology trainees with respect to AI, previous experience with AI and the impact on the career of a radiologist.

Materials and methods

An online pilot survey was designed with input from a radiology consultant mentor and 5 trainees who are part of RADIANT. It was created in the Google Forms platform and the pilot was done amongst 8 trainees in the Norwich radiology training programme. The feedback was used to develop the final survey. The survey was distributed via email with the help of UK radiology training programme directors, RADIANT committee members and regional representatives, and Junior Radiology Forum representatives. The survey ran over a period of 2 months (11/07/21 to 19/09/21) and all 37 training programmes in England, Wales, Scotland and Northern Ireland were targeted. The Royal College of Radiologists 2020 census stated as of September 2020 there were 1760 trainees.[11]

The web-based survey contained 18 questions (Appendix A). Participants were asked 4 demographic questions (gender, stage of training, training programme and whether they are contracted to work full time) and 14 questions relating to AI in radiology. All the data in the survey was anonymous and the respondent was not required to provide any email addresses.

Ethics committee approval was not required as the study was voluntary among radiology professionals, did not concern health information and all data was handled anonymously. The

authors applied The Health Research Authority decision tool which confirmed ethics approval was not required for this study.[12]

Results

A total of 149 trainee radiologists responded. Most respondents were at the ST1 (26.2%; n=39), ST2 (23.5%, n=35) or ST5 (22.8%, n=34) stage of training. The remaining 41 trainees were in the ST3 (16), ST4 (17) and ST6 (8) training stage. 42.2% (n=63) of respondents were female. The majority were full-time trainees (83.2%, n=124). There was at least 1 response from each of the 37 UK training programmes.

Experience and interest in AI

Most respondents (83.9%; n=125) were somewhat interested or very interested in AI use in radiology. However, 71.1% (n=106) had no experience of working with AI in their practice. Respondents who did have experience of working with AI indicated in the free-text box that they had used Brainomix, RAPID software, Syngovia vessel analysis, automated lung detection software or CT colonography polyp finder in their practice. Most would like to be involved in AI based research (56.4%, n=84) or audits (51.7%, n=77), Figure 1A.

Respondents were most likely to have attended an AI-based talk at a conference (53.7%, n=80) and read AI-based research articles, journals or blogs (46.3%, n=69), Figure 1B.

Education and training

Respondents indicated that basic understanding (86.4%, n=128), implementation (72.1%, n=107) and critical appraisal of AI software (52.4%, n=78) should be prioritized in AI teaching, Figure 2A.

Most trainees (59.2%, n=87) preferred AI teaching to be delivered at a deanery level, Figure 2B. A deanery is a NHS regional organisation that coordinates and organises postgraduate medical education and training within a given region. Other popular options for delivery of teaching were local training programme led teaching (46.9%, n=69), RCR webinars (47.0%, n=70) and an accredited qualification (41.5%, n=61).

Almost all respondents (98.7%) felt that AI should be taught during their training, with 79.2% (n=118) indicating that AI should be taught during the ST1 to ST3 years, Figure 2C. Yet only 1 respondent stated that their training programme had implemented teaching on AI. Few (12.8%; n=19) indicated that their training programme had a lead AI radiologist.

AI in practice

Most trainees responded that AI would be used in regular radiology practice in the next 5 to 10 years; 34% (n=50) in the next 5 years and 43.5% (n=64) in the next 10 years. Furthermore, 74.2% (n=109) of trainees agree that AI will improve and enhance the job of diagnostic radiologists in the next 20 years. Most (70.1%, n=103) indicated that AI with high diagnostic accuracy should not independently evaluate and report radiological images without human input.

The main concerns raised about AI in radiology were IT/Implementation (87.1%, n=128) and ethical/regulatory issues (74.8%, n=110), Figure 3. A little under half of respondents (47.6%, n=70) indicated that the possibility of replacing the job of radiologists was one of their top concerns (47.6%, n=70). There were 14 free text responses which covered themes including concern regarding implementation, deskilling of radiologists, lack of training opportunities and

communication between radiologists and clinicians. However, only 12.8% (n=19) of respondents said that AI would make them less likely to apply for radiology specialty training today.

Discussion

This first pan-UK survey of radiology trainees has demonstrated that there is strong support for further formal training, support and involvement with AI. Respondents included trainees from all training stages and all areas of the UK.

Most trainees (71%) had no experience of working with AI in their practice. Despite this lack of exposure, 83.7% of respondents were interested or very interested regarding AI use in radiology. This suggests that while there is significant interest in AI there is limited opportunity available for most radiology trainees to engage with this. A survey done in Saudi Arabia also showed radiology trainees being interested in the applications of AI but limited available resources within training.[13] In the survey conducted by the ESR all respondents felt radiologists need to be involved with the implementation of AI in radiology.[8] Radiology trainees may represent a potentially large untapped resource for those who are currently involved in the development and research of AI. A survey done in Europe of radiologists and radiology trainees showed that limited knowledge of AI was related to increased levels of fear about AI in radiology whereas higher levels of knowledge was related to positive attitudes towards AI.[10]

Positive attitudes could therefore improve clinical adoption of AI, underpinning the importance of integrating AI teaching into the radiology curriculum. This could also be extended to medical students. Surveys have shown that medical students have higher levels of concern regarding AI and radiology compared to radiology trainees and that it deter them from applying to the specialty.[14,15] However, educating medical students about AI in radiology may help to alleviate their concerns.

With regards to teaching only 1 trainee reported that their training programme has definitively implemented teaching on AI in their training programme despite almost all (98.7%) indicating that AI should be taught during training. A systematic review looking at training opportunities of AI in radiology demonstrated that most AI training are short, standalone sessions and while professional institutions and companies are active in offering training, academic institutes show limited involvement.[16] The review suggests there is a need to develop AI training in a way that is integrated into the radiology curriculum. Another study similarly found there are few examples of formal integration of AI teaching into radiology training, with the authors piloting a course at their institution with positive feedback.[17] A well-planned curriculum with formal integration could provide trainees with the tools to become more involved in AI in radiology. A curriculum and plan could be discussed amongst trainee representatives, RCR tutors, training programme directors and the heads of the Schools of Radiology in order to decide on the volume of teaching required and ensure it does not negatively impact on other important areas of the radiology curriculum. Discussions at speciality trainee meetings, which occur regionally and include all the stated roles above could help implementation of AI teaching and provide uniformity and collaboration within a region. The survey has been highlighted to the RCR AI interest group and to the RCR Medical Director, Education and Training and may be able to provide further guidance.

Three of the areas to consider with respect to AI teaching are: when to provide teaching, how to provide teaching and what to teach.

With regards to when to teach 79% felt AI should be taught during ST1-ST3. However, this may be a challenge to training programmes, with junior radiology trainees already having to learn a large volume of new information.

The most popular options for the delivery of teaching in order of preference were deanery led teaching, training programme led teaching and RCR webinars. AI expertise may not be available in all training programmes and thus the benefit of deanery led teaching would be the sharing of resources. Bringing together multiple programmes could encourage collaboration amongst trainees and consultants within a region. Supplementation with RCR webinars or Radiology - Integrated Training Initiative (RITI) online modules could provide teaching from experts that the college have access to on a national basis, covering areas that the college feel are important to training. This would help provide access to trainees who may not have teaching available locally. Local AI leads could also help develop teaching locally. One future prospect could be incorporating AI into the delivery of teaching itself which could for example, allowing for customised education for trainees by tracking and analysing a learners progress.[18]

Our survey highlighted 3 areas which trainees think teaching should focus on: basic understanding, implementation and critical appraisal of AI software. The top 2 concerns around AI were implementation and ethics as opposed to the replacement of jobs. Managerial, legal and ethical topics are often side-lined in current AI training.[16] A survey conducted in Australia and New Zealand amongst ophthalmologists, radiologists and dermatologist demonstrated that ethical and legal aspects of AI in medicine ranked second as a topic needing to be covered in AI training [19], showing similarity to our survey findings. This suggests that it would be important to appropriately address these points in AI teaching and training. Although ethics was considered one of the top 2 concerns, it ranked lower with regards to topics which

be taught. This discrepancy relates to the response options offered and the grouping of topics in Figure 3 compared to Figure 2A.

Our survey had a number of limitations including a self-selected population and a limited number of respondents, which partly could be due to some hospitals blocking access to google forms. The survey design had limitations with regards to the scope of response options, despite the inclusion of some open ended and free text questions. The survey tried to provide a general overview which restricted the ability to gain detailed views on each of the areas of AI in radiology. The use of a survey could also be considered a limitation as it provides an opinion at a single point in time and may provide a simplified version of respondents' views. A further limitation of this study includes that data was solely collected in the UK. Results might not be applicable to other countries with different student curricula and health care systems. The responses represent the opinions of trainees who may have limited knowledge of AI, and should be interpreted with this in mind.

In conclusion, the attitudes of UK radiology trainees are positive towards AI with most interested in participating in AI-based projects and activities. UK trainees also show a clear interest in AI teaching within radiology training, with our survey providing some insight into how trainees may want this implemented.

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FIGURE CAPTIONS

Figure 1. Trainee radiologists' involvement in AI based projects and activities. A: Participants were asked to indicate their involvement in AI projects, and to tick all that apply. **B:** Participants were asked whether they engaged in the listed activities in the last 5 years, and to tick all that apply. *Abbreviations*: AI, artificial intelligence; QIP, Quality Improvement Project

Figure 2. Respondents' views on AI teaching in radiology. A: Respondents were asked which aspects of AI in Radiology would be most important to prioritise in teaching, and to choose 3 options. **B**: Participants were asked their preference for delivery of teaching of AI, and to choose up to 3 options. **C**: Respondents were asked when AI in Radiology should be taught, and to tick all that apply.

277 *Abbreviations*: AI, artificial intelligence; RCR, Royal College of Radiologists; R-ITI, Radiology - Integrated

278 Training Initiative; ST, Specialty Training; CCT, Certificate of Completion of Training

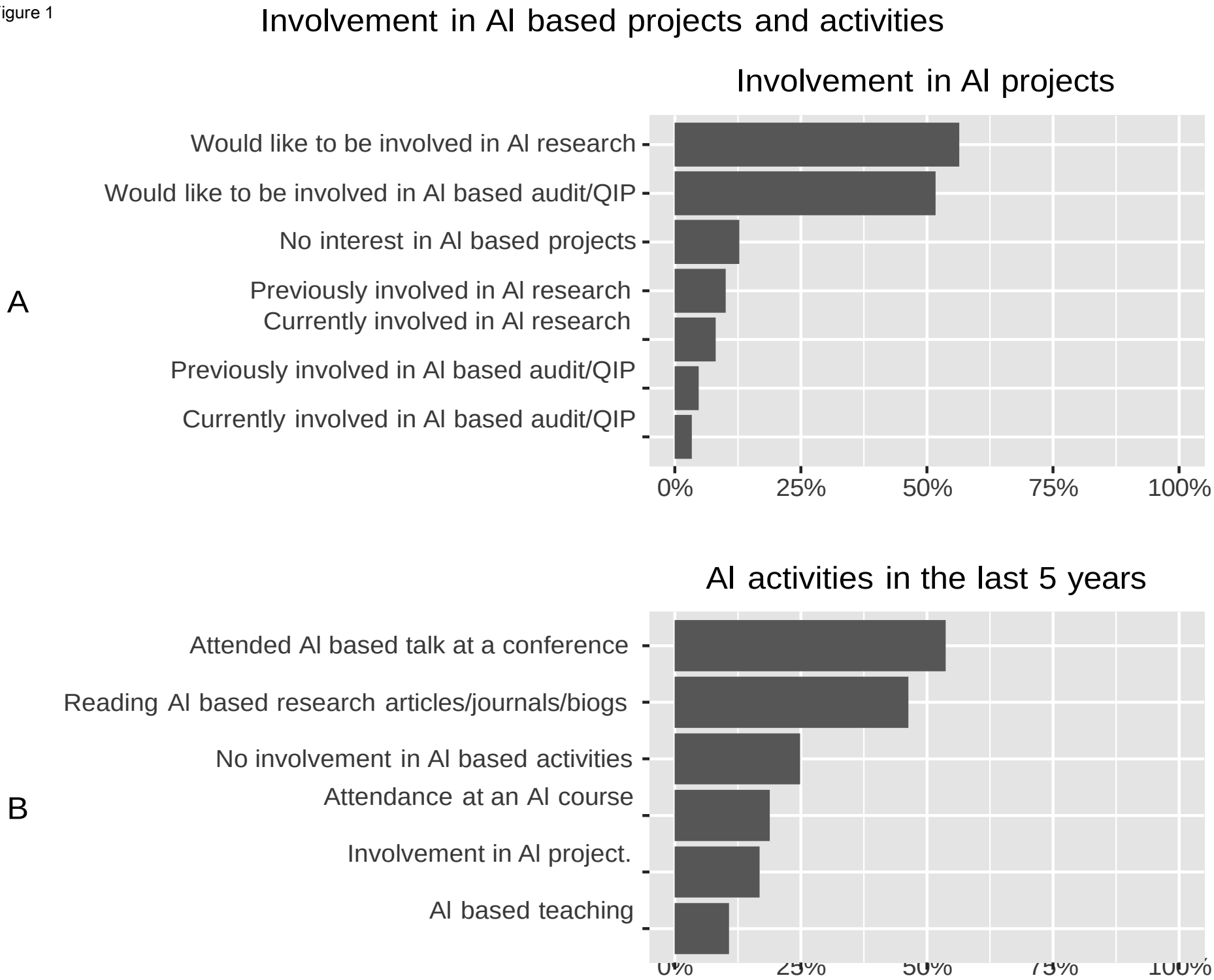
279 **Figure 3. Radiology trainees' top concerns about AI.** Participants were asked to choose their top 3

280 concerns. Abbreviations: AI, artificial intelligence; IT, information technology

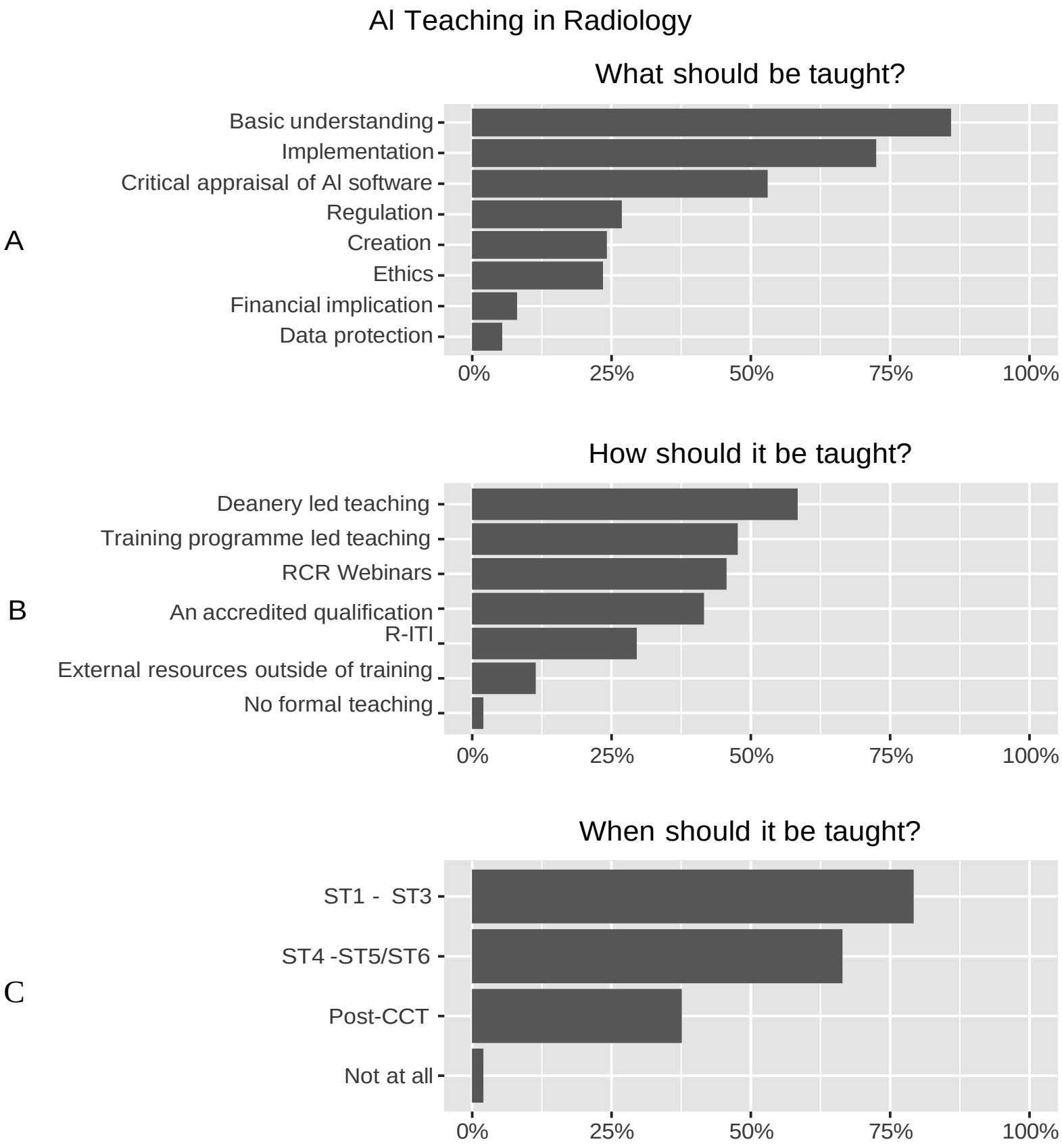
281

282 **Appendix A.** Survey of radiology trainees attitudes towards AI.

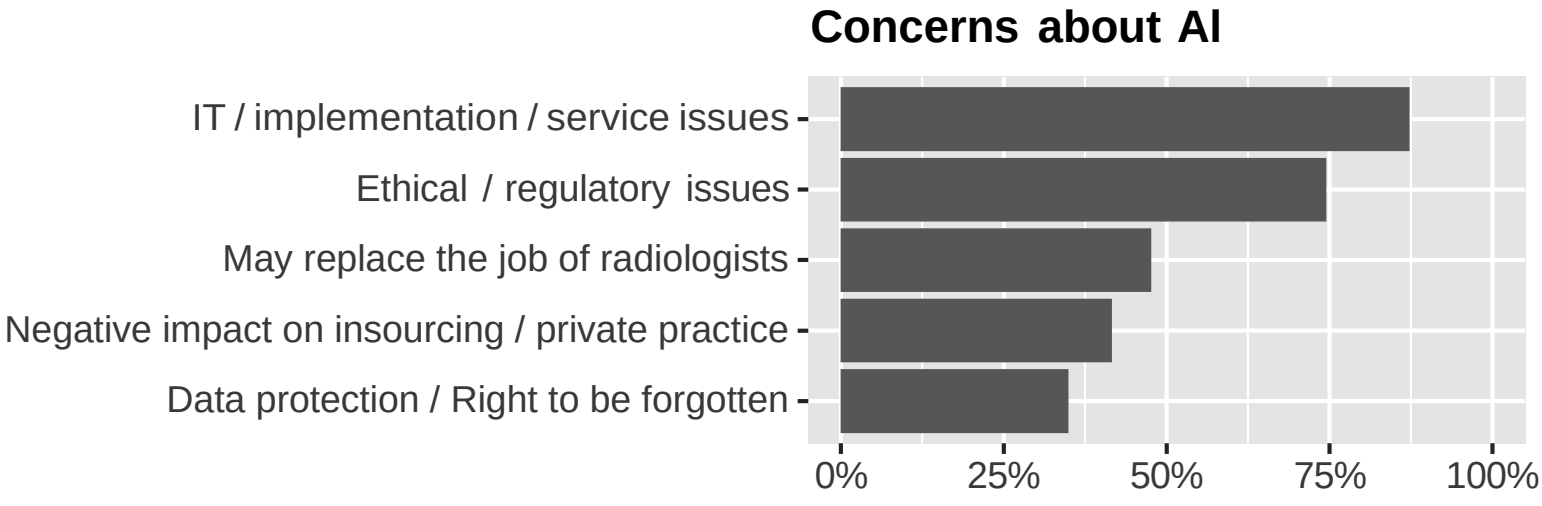
Revised Figure 1



Revised Figure 2



Revised Figure 3



Radiology Trainees attitudes towards Artificial Intelligence (AI) in Clinical Radiology and its implementation in training and the curriculum.

AI and machine learning are emerging and exciting technologies that are rapidly gaining importance within the field of radiology. So much so that it is included within the new RCR curriculum which states:

"Trainees are expected to keep up to date and to embrace and evaluate emerging technologies such as Artificial Intelligence (AI), Machine Learning, Deep Learning and Radiomics, where these act as an adjunct to imaging analysis and interpretation. AI tools are being developed to assist with diagnostic assessments and trainees should be prepared to adapt these tools into clinical practice once validated."

This survey will help us gain a better understanding of UK Radiology trainee's attitudes towards AI and its place within training.

Thank you for filling out this survey and for your time.

* Required

1. What is your gender? *

Mark only one oval.

- ◯ Female
- ◯ Male
- ◯ Non-binary

2. What is your stage of training? *

Mark only one oval.

- ST1
- ST2
- ST3
- ST4
- ST5
- ST6

3. How often are you contracted to work? *

Mark only one oval.

- Full time
- Less than full time

4. Which training programme are you based in? (Please select from drop down list) *

Mark only one oval.

- East Midlands - North (Nottingham)
- East Midlands - South (Leicester)
- East of England - Cambridge
- East of England - Essex, Beds and Herts
- East of England - Norwich
- KSS - Kent
- KSS - Surrey
- KSS - Sussex
- London (North Central & East) - Royal Free
- London (North Central & East) - St Barts & the Royal London
- London (North Central & East) - University College Hospital
- London (North West) - Chelsea and Westminster
- London (North West) - Imperial
- London (North West) - Northwick Park
- London (South) - Guy's & St Thomas
- London (South) - King's College
- London (South) - St George's
- North East - Northern Radiology
- Northern Ireland
- North West - Manchester
- North West - Mersey
- Scotland - East (Dundee)
- Scotland - North (Aberdeen)
- Scotland - South East (Edinburgh)
- Scotland - West (Glasgow)
- South West - Severn (Bristol)
- South West - Peninsula & Plymouth
- Thames Valley - Oxford
- Wales - North Wales
- Wales - South Wales
- Wessex - Portsmouth
- Wessex - Southampton

- West Midlands - Birmingham
- West Midlands - North Staffordshire
- Yorkshire and the Humber - Hull & East Yorkshire
- Yorkshire and the Humber - Leeds
- Yorkshire and the Humber - Sheffield

5. If your training scheme was not available in the list above, please enter it below:

_____

6. I would rate my interest of AI use in Radiology as: *

Mark only one oval.

- Very interested
- Somewhat interested
- Neutral
- Somewhat uninterested
- Very uninterested

7. Have you had experience of working with AI in your practice? *

Mark only one oval.

- Yes
- No
- Maybe

8. If YES or MAYBE please state what AI you have used in your practice:

_____

9. In the last 5 years have you engaged in any of the following activities? (Tick all that apply). *

Check all that apply.

- [ ] Attendance at an AI course
- [ ] AI based talk at a conference
- [ ] Reading AI based research articles/journals/blogs
- [ ] Involvement in AI project.
- [ ] AI based teaching
- [ ] No involvement in AI based activities

10. Involvement in an AI projects (tick all that apply) *

Check all that apply.

- [ ] Previously involved in AI research
- [ ] Currently involved in AI research
- [ ] Would like to be involved in AI research
- [ ] Previously involved in AI based audit/QIP
- [ ] Currently involved in AI based audit/QIP
- [ ] Would like to be involved in AI based audit/QIP
- [ ] No interest in AI based projects

11. My training programme has a lead AI radiologist *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

12. AI in Radiology should be taught during (tick all that apply): *

Check all that apply.

- [ ] ST1 - ST3
- [ ] ST4 -ST5/ST6
- [ ] Post-CCT
- [ ] Not at all

13. My training programme has currently implemented teaching on AI *

Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Not sure

14. My preference for delivery of teaching of AI would be via (Choose up to 3): *

Check all that apply.

- ☐ R-ITI
- ☐ RCR Webinars
- ☐ Deanery led teaching
- ☐ Training programme led teaching
- ☐ An accredited qualification
- ☐ No formal teaching
- ☐ External resources outside of training
- ☐ Other: _____

15. Which aspects of AI in Radiology do you feel would be most important to prioritise in teaching. (Choose 3) *

Check all that apply.

- ☐ Basic understanding
- ☐ Creation
- ☐ Implementation
- ☐ Regulation
- ☐ Financial implication
- ☐ Ethics
- ☐ Critical appraisal of AI software
- ☐ Data protection

16. If you were applying for clinical radiology subspecialty training today, would AI make you: *

Mark only one oval.

- More likely to apply
- Not affect my decsicion to apply
- Less likely to apply

17. In the next 20 years AI will improve / enhance the job of diagnostic radiologists *

Mark only one oval.

- Strongly disagree
- Disagree
- Slightly disagree
- Neutral
- Slightly agree
- Agree
- Strongly agree

18. When do you expect to see AI being regularly used in radiology practice *

Mark only one oval.

- Now
- 5 years
- 10 years
- 25 years
- Over 25 years
- Never

19. Concerns about AI (Choose top 3): *

Check all that apply.

- [ ] May replace the job of radiologists
- [ ] IT / implementation / service issues
- [ ] Ethical / regulatory issues
- [ ] Negative impact on insourcing / private practice
- [ ] Data protection / Right to be forgotten
- [ ] Other: _____

20. AI with a high diagnostic accuracy should independently evaluate and report radiological images without human input. *

Mark only one oval.

- ◯ Strongly disagree
- ◯ Disagree
- ◯ Slightly disagree
- ◯ Neutral
- ◯ Slightly agree
- ◯ Agree
- ◯ Strongly agree

Declaration of interests

☒The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Highlights

- Most UK trainees surveyed (83.7%) were interested in AI use in Radiology
- 79.9%, would like to be involved in AI based projects.
- Almost all respondents felt that AI should be taught during their training,
- Only 1 respondent stated that their training programme had implemented AI teaching.
- Main concerns raised were IT/Implementation and ethical/regulatory issues