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A Nordic survey on artificial intelligence in the radiography profession – Is the profession ready for a culture change?

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ABSTRACT

Introduction: The impact of artificial intelligence (AI) on the radiography profession remains uncertain. Although AI has been increasingly used in clinical radiography, the perspectives of the radiography professionals in Nordic countries have yet to be examined. The primary aim was to examine views of Nordic radiographers 'on AI, with focus on perspectives, engagement, and knowledge of AI.
Methods: Radiographers from Denmark, Norway, Sweden, Iceland, Greenland, and the Faroe Island were invited through social media platforms to participate in an online survey from March to June 2023. The survey encompassed 29-items and included 4 sections a) demographics, b) barriers and enablers on AI, c) perspectives and experiences of AI and d) knowledge of AI in radiography. Edgars Schein's model of organizational culture was employed to analyse Nordic radiographers' perspectives on AI.
Results: Overall, a total of 421 respondents participated in the survey. A majority were positive/somewhat positive towards AI in radiography e.g., 77.9 % (n = 342) thought that AI would have a positive effect on the profession, and 26% thought that AI would reduce the administrative workload. Most radiographers agreed or strongly agreed that clinicians may have access to AI generated reports (76.8 %, n = 297). Nevertheless, a total of 86 (20.1%) agree or somewhat agreed that AI a potential risk for radiography.
Conclusion: Nordic radiographers are generally positive towards AI, yet uncertainties regarding its implementation persist. The findings underscore the importance of understanding these challenges for the responsible integration of AI systems. Carefully weighing the expected influence of AI against key incentives will support a seamless integration of AI for the benefit not just of the patients, but also of the radiography profession.
Implications for practice: Understanding incentives factors and barriers can help address uncertainties during implementation of AI in clinical practice.

Introduction

Stakeholders, politicians, and early adopters have proclaimed artificial intelligence (AI) to be the answer to many healthcare challenges, including being a factor that may help the shortage of staff in radiology departments. AI is an advanced technology that involves various techniques and approaches, by using computer programs/algorithms to perform advanced tasks that traditionally have required human brain and intelligence. The use of AI has been increasing in recent years in imaging departments and continues to do so. In radiology, AI has been studied in various settings especially in breast cancer.[1–3] Several radiography studies have been

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performed within a broad field, ranging from e.g. cardiology, oncology, and orthopaedics.[4–17] Despite several advantages of AI, including public support for sharing images/information,[18,19] positive attitudes among healthcare professionals,[20,21] increased diagnostic accuracy,[22] automation of processes and real time processing[20,22] and lower task orders such as patient registration,[17] there are also disadvantages. These include little or no integration of AI in the academic curriculum,[20,21,23] lack of knowledge about AI,[20,24] lack of data input, guidelines or recommendations,[25] and less confidence in using an AI-generated imaging report.[26] In recent years, several studies have been published addressing radiographers' knowledge about AI, with many perspectives,[6,7,14,27–31] but none have addressed this from a culture perspective.

Can an identification of current culture positively impact some or all of the challenges connected to AI systems? Up to 70% of all transformations fail, perhaps because "*culture eats strategy for breakfast*" as stated by Peter Drucker in 2006.[32] Edgar Schein's model of "*organizational culture*" has three levels; 1) artefacts, 2) beliefs and values, and 3) underlying assumptions,[33] all visualised as an iceberg (Fig. 1). All levels affect how individuals act and think, making them important to organisations. Radiographers' perception on AI can be explored using the Edgar Schein's iceberg model of culture. In this context, the radiography culture is perceived as an organisational culture. Artefacts relate to elements of norms, values, and practices (e.g., measurable outcomes of clinical practice). Schein's second level refers to stated beliefs or strategies, and these values can guide the individual behaviour (e.g., guidelines, ethical standards). The third level consists of the underlying assumptions and refers to the unspoken; thoughts or feelings within the organization. By investigating these three levels, an understanding and insight into the complex radiography profession across hospitals and countries may be gained. Using this model, we will attempt to explore how the radiography professional culture impacts AI in clinical practice, addressing not only what they explicitly express but also the deeper cultural and contextual influences shaping their opinion.

The primary purpose of this study was to examine the views of Nordic radiographers on AI. Specifically, the study aimed to explore radiographers' perspectives, engagement, experiences, and knowledge of AI.

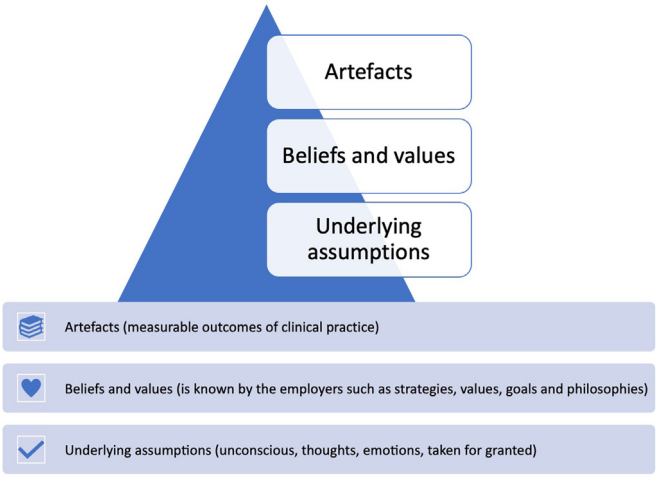

Figure 1. Interpretaiton of Edgar Scheins Iceberg model.

Materials and methods

Data were captured and stored using the Research Electronic Data Capture (RedCap) hosted by the Open Patient Data Explorative network at the University of Southern Denmark.[34,35]

Ethical approval

The local National Data Protection Agency and the Research Ethics Committee at the University of Southern Denmark approved the study (ID number 22–5848). Before the survey started, respondents were informed of the study's purpose and were asked to provide consent for participation.

Consent was obtained by ticking an agreement check box at the beginning of the survey.

Survey

This is a cross-sectional online survey. Eligible study participants were radiographers or radiographer students. A description of the methodology and pilot is presented in depth in a part one.[31] Overall, the 29-item survey was conducted over a 12-week period in 2022 and distributed using social media to Nordic radiographers (Denmark, Norway, Finland, Sweden, Greenland, Iceland, and the Faroe Islands). The survey language was English, and it was possible for the participants to omit questions. Data from Greenland, Iceland and the Faroe Islands were collapsed to provide anonymity, due to low number of respondents. The overall population of radiographers in Denmark including the Faroe Islands and Greenland, Norway, Finland and Iceland is 2500,[36] 2800,[37] 3000,[38] 113,[39] respectively. The number is not available from Sweeden.

The survey included 4 sections; a) demographics, b) barriers, c) perspectives and experience, and d) knowledge. This study includes demographics (age, gender country) and 7- items from part C and part D. The respondents were asked questions on how they perceived that AI would affect the radiography profession; when AI would be implemented into daily clinical practice; AI's trustworthiness, price, time consumption; legal responsibilities of AI systems; level of AI testing; AI's influence on the Radiography profession; as well as incentives motivational and barriers towards AI. In depth description of the method can be found in part 1 of the survey.[31]

Qualitative analysis

All data from the open-ended section of the survey were analysed in main themes categorised from the participants responses. The open-ended survey responses were used to enhance, refine, and confirm findings from the survey's quantitative data.[40] The two main open-ended questions were focused on incentives and barriers when working with AI in radiography.

Furthermore, the open-ended responses were applied to Edgar Schein's Iceberg model by analysing and categorising the free text responses using the three levels; artefacts, beliefs, and underlying assumptions.[33] Using this model, it was possible to analyse explicit (visible) and implicit (hidden) aspects of the participants answers which will help to gain a more nuanced understanding of the radiographers' view on AI.

Statistical analysis

Descriptive statistics were performed to present the demographics of respondents. All analyses were performed in STATA version 18 BE (College Station, TX, USA). Tables and figures were produced using Microsoft Excel for Mac (version 16.78).

Results

A total of 586 respondents started the survey, however as the survey progressed, increasing drop-out rates were observed. The items included had a mean participation rate of 421 respondents (range 372–434), with 294 (range 243–304) females (73.7%), and 127 males (range 111–130) (26.7%). Of the 421 respondents, 274 were from Denmark (65.1%), 86 from Norway (20.4%), 17 from Finland (4.0%), and 12 from Sweden (2.9%), while Iceland, Greenland and the Faroe Islands were collapsed to provide anonymity (n = 32, 7.6%). The response rate was estimated to include 4.9% of the Nordic radiographers.

The overall mean age was 37 years (S.D 11.8, range 20–70), however the mean age was lower in the last 5 items due to drop-out (mean = 35 years, S.D. 11.2, range 20–65).

AI and future influence on the radiography profession

Table 1 shows how radiographers think AI will affect the profession in the future. A total of 54.2% (n = 228) expect that AI will reduce waiting time for radiology reports, and 48% (n = 202) thought that AI would have a positive effect on the profession, 43.9% (n = 183) thought AI will create a new specialised role for radiographers, and only 26,6% (n = 112) thought AI would reduce administrative workload.

The item ended with an open-ended option, of which 3 of the respondents included comments regarding workload; "*AI can make the radiographers work more effective, saving time*", "*AI will increase the need for IT* support *and administratio*n", and "*AI will increase accumulated radiation as it get too easy for ED (emergency department) doctors to want an exam, and without having to wait for an answer. It removes the thought of - do I need this exam?*".

Fig. 2 indicates that 84.3% (n = 370) agreed or strongly agreed that AI can assure high image quality, and 77.9% (n = 342) of the radiographers agreed or strongly agreed that AI would significantly impact the profession, and also 74.5% (n = 327) agreed that AI can help reduce image artefacts. However, they did not express fear of a decrease in numbers of radiographers as 63.9% (n = 276) disagreed or strongly disagreed that AI would reduce the need for radiographers. A total of 31% (n = 135) recognised that AI is already used on a daily basis in clinical practice (Fig. 3), and only 4.8% (n = 21) thought that significant time will elapse before AI is implemented into daily clinical practice.

Priorities for implementation

Table 2 shows how important radiographers perceived regulation and rules for AI systems to be, as 52.5% (n = 190) reported they found it most important or important that the system has been approved for clinical use by regulatory bodies.

Understanding incentives

A total of 383 respondents indicated which motivational factors would influence them the most to begin working with AI systems (Table 3), 32.6% (n = 125) valued respect from peers and further 27.2% (n = 104) valued increasing their level of knowledge on AI. In the connected free text option, 4 respondents provided an alternative motivational option; "*As a teacher in radiography AI is not very relevant*", "*Provide quicker MRI scans*", "*Potentially much higher image quality when applied correctly*", "*I am not sure what the most important factor of AI could be, since my knowledge of the subject is limited*".

Fig. 5 shows radiographers think that AI generated reports should be available to clinicians as 76.8% (n = 297) agree or strongly agree. When asked if AI generated reports should be available to patients' opinions were divided with 51.2% (n = 198) disagreed or strongly disagreed and 48.8% (n = 189) agreed or strongly agreed.

Radiographers' confidence in working with AI system(s)

In total 386 respondents provided an answer to the question on how confident they were working with AI in their current clinical practice, of whom 7.8% (n = 30) were not confident, 30.1% (n = 116) were confident, 11.1% (n = 43) were very confident, and 51% (n = 197) did not use AI in clinical practice.

A total of 426 respondents answered the question "*who should be held liable in case of AI misdiagnosis*", of whom 15.7% (n = 67) responded the company behind the AI solution, 27% (n = 115) the radiologist/reporting radiographer, 1.2% (n = 5) the radiographer, 20.2% (n = 86) the head of hospital or head of department, 20.9% (n = 89) did not know, and 15% (n = 64) believed that all the options were responsible.

Perceived disadvantages of AI use

Radiographers perceived few barriers to AI (Fig. 4) including the cost to purchase and the cost to train radiographers in AI, as 55.4% (n = 238) reported to agree or strongly agree that AI purchase is

Table 1
Perspective on the future of AI in radiography, multiple answers allow (n = 421).

Which of the following do you think will have the biggest influence on the radiography profession within the next 10 years?	Respondents (n = 421)	%	Females %)	Males (%)	p-value
AI will reduce waiting time for radiology reports	228	54.2	149 (65.4)	79 (34.6)	0.001
AI will affect the radiographic profession positively	202	48.0	131 (64.8)	71 (35.2)	0.001
AI will create new specialized roles for radiographers	185	43.9	128 (69.2)	57 (30.8)	0.181
AI will expand and develop the radiographic profession	150	35.8	108 (72.3)	41 (27.7)	0.852
AI will reduce administrative work	112	26.6	74 (66.7)	37 (33.3)	0.101
AI will handle booking of radiology appointments	54	12.8	33 (61.1)	21 (38.9)	0.041
AI will negatively affect career opportunities for radiographers[a]	32	7.6	22 (71)	9 (30)	0.805
AI will positively affect career opportunities for radiographers	57	13.5	39 (68.4)	18 (31.6)	0.425
Dont know[a]	43	10.2	24 (57.1)	18 (42.9)	0.017
Other[a]	40	9.5	25 (64.1)	14 (35.9)	0.201
AI will increase administrative work	29	6.9	19 (65.5)	10 (34.5)	0.360
AI will increase the number of patient complaints	30	5,1	20 (66.7)	(10 (33.3)	0.431
AI will not affect my work	20	4.8	12 (60.0)	8 (40.0)	0.187
AI will affect the radiographic profession negatively	18	4.2	11 (64.7)	6 (35.3)	0.441

[a] Notice that there were some of the respondents who preferred not to disclose their gender.

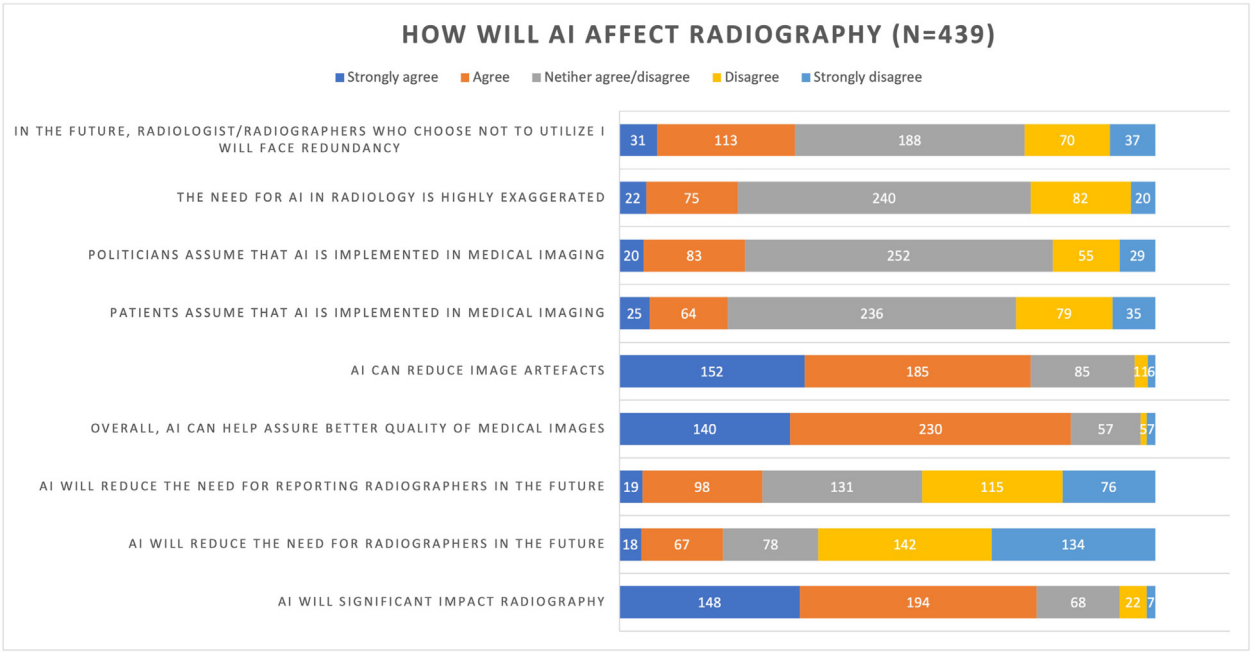

Figure 2. How AI will affect the radiography profession (N = 439).

expensive. Furthermore, 8.8% (n = 38) consider use of AI as a difficult task. However, a potential barrier is an increase in incidental findings, as a total of 31.2% (n = 134) consider this to be problematic.

The respondents were asked to state what they perceived as the disadvantages when implementing AI, and Table 4 shows a cultural analysis with selected open-ended responses. Overall, 301 respondents replied, of which 9% (n = 27) reported no disadvantages, and 9.6% (n = 29) did not know.

A total of 11.3% (n = 34) reported they feared misdiagnosis or incidental findings, for example;

> "*AI will diagnose too many incidental non-significant findings*", "*the non-confident that people will have in AI*", "*AI could be trusted too much, if it's results are not double checked by a human*", and "*Ethical dilemmas if the pathology is pointed out immediately, should the patient or referring doctor get the results before the radiologist*".

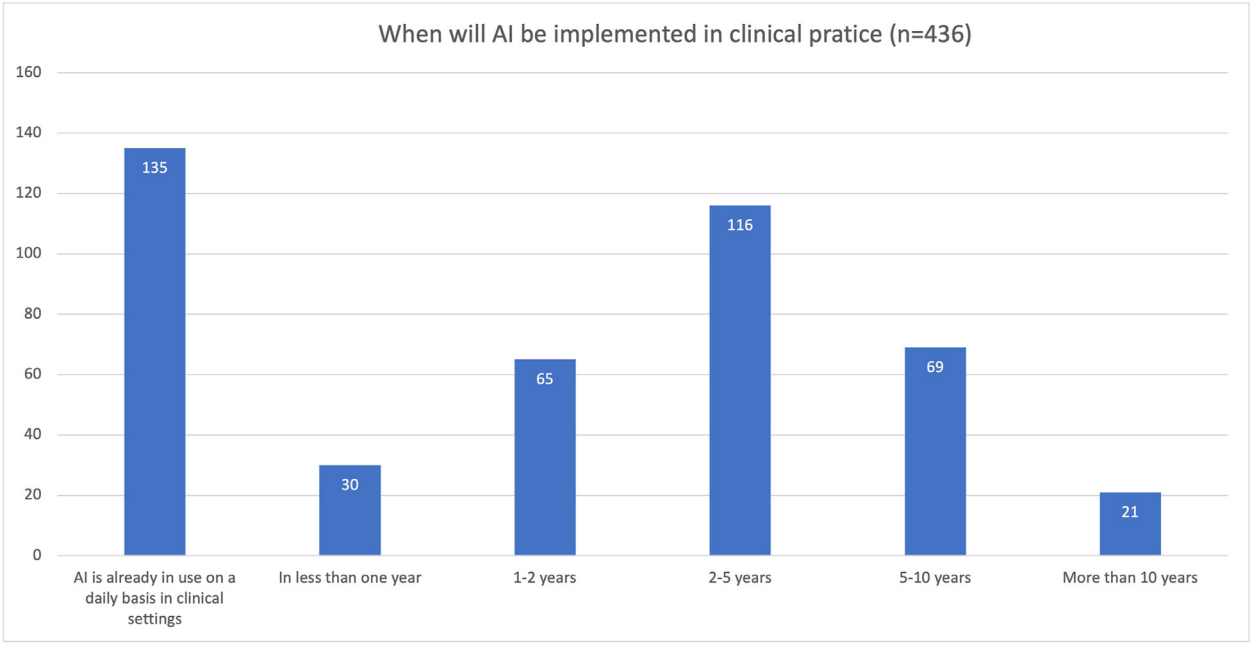

Figure 3. Radiographers views on when AI will be implemented into clinical practice (N = 436).

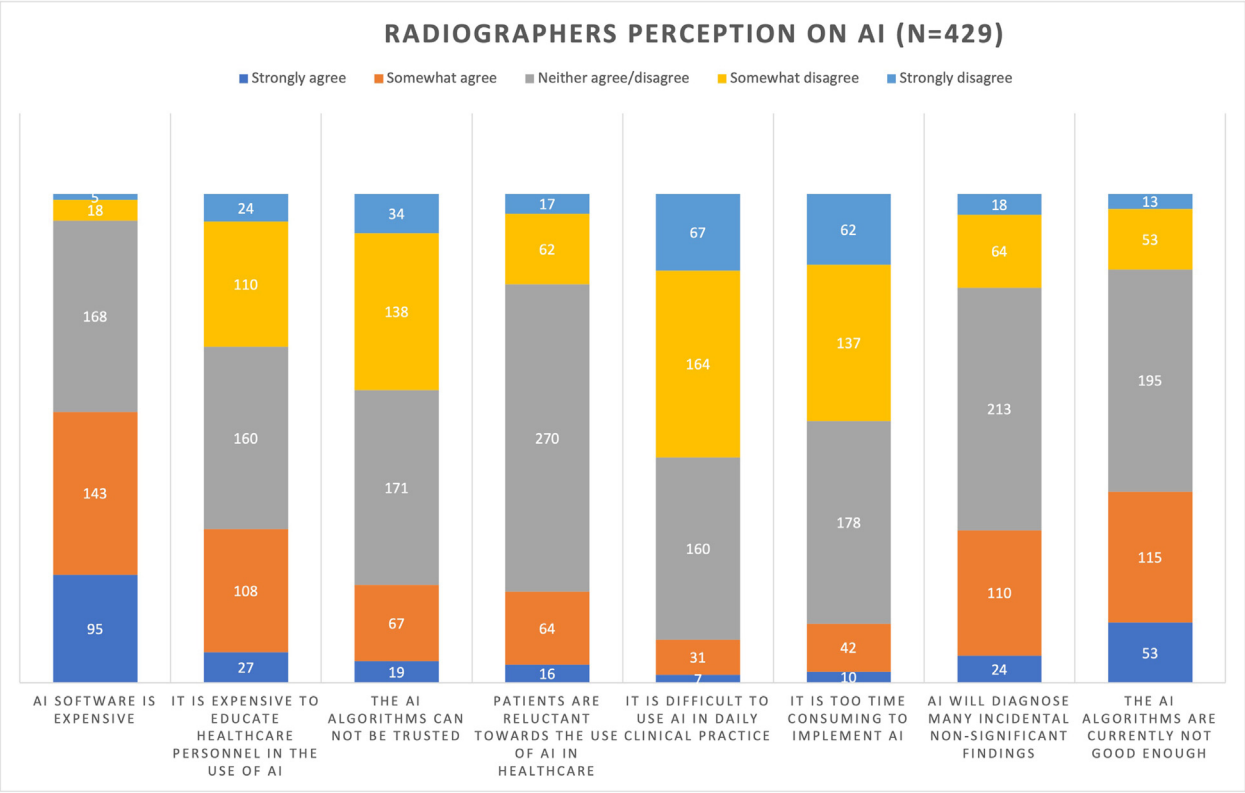

Figure 4. Radiographers perception on AI (N = 429).

Perceived benefits of AI use

There were also positive statements on diagnosis e.g.:

"*More accurate diagnosing for patients", better mage quality/patient dose/exam/reporting", "the radiologist can have more time to do other invasive procedures" "Young doctors will get a big help", "emergency doctors can get a quick assessment with AI, supported by full reading at a later date for non-urgent patients*".

Education, understanding, and knowledge about AI systems were themes that concerned many radiographers to varying degree, e.g.:

"*As with most new forms of technological automatization the possibilities of users becoming too reliant and non-sceptical to errors are worth considering", "The lack of AI lessons in radiography curricula", "Radiographers and radiologists knowing less because 'AI' is fixing it for them".*

Economy, cost and resources are concerning radiographers with 28 replies, for example;

"*Too segmented products, difficult to prioritize what AI tools to buy", "cost and staff education are going to hinder many hospitals from getting onboard", "… from a radiotherapy point of view, it requires quite some resources to implement in a larger scale than it is now".*

Table 2
Ranking from 1 (most important) to 5 (least important) on AI validation and testing in clinical departments.

Variable(s)	Number of respondents (%)					
	Most important				Least important	Total number of respondent (%)
	1	2	3	4	5	
I expect the system to be approved for clinical use by regulatory bodies	107 (29.9)	83 (23.2)	50 (14.0)	59 (16.5)	59 (16.5)	358 (100)
I expect that scientific evidence demonstrating the efficacy or safety of the system has been published	125 (35.3)	101 (28.5)	51 (14.4)	55 (15.5)	22 (6.2)	354 (100)
I expect the system to be tested at my workplace before it is released for clinical use	63 (17.1)	77 (20.9)	95 (25.8)	61 (16.6)	72 (19.6)	368 (100)
I expect the system to have been tested at other sites in the Healthcare system	35 (9.6)	64 (17.5)	104 (28.5)	99 (27.1)	63 (17.3)	365 (100)
I expect the system to be approved for clinical use by hospital management	60 (15.5)	56 (14.4)	72 (18.6)	71 (18.3)	129 (33.3)	388 (100)

Table 3
Shows motivational factors for AI (only one choice was allowed).

What is the most important factor that could motivate you to work with AI?	Respondents (n = 383)	%
Respect and recognition from other radiographers	125	32.6
Increasing my knowledge and skills	104	27.2
New challenges	44	11.5
Higher salary	28	7.3
Nothing	20	5.2
Less radiation exposure to radiographers	13	3.4
Opportunities for education or access to courses	11	2.9
Better possibilities for flexible working hours	11	2.9
Being an attractve employee	9	2.4
Less evening/night/weekend shifts	6	1.6
Increased responsibilities	5	1.3
Other	4	1.0
Respect and recognition from management	2	0.5
Respect and recognition from radiologists	1	0.3
Less patient contact	0	0

Accountability

Who is responsible? Many radiographers were concerned about responsibility, and many perspectives were provided. The answers are characterised by uncertainty of responsibility, e.g.;

"*That in case of AI failure the radiographers might get blamed", "If something fails by using AI it's going to be hard to blame someone specific", "all the legal questions regarding liability, must be defined and answered, as well as any legislation that encourages implementation*".

Impact on radiography profession

Will the radiography profession suffer? A total of 22.6% (n = 68) of the respondents had concerns about radiographers becoming redundant with AI systems. Radiographers responded with a mix of anticipation to work with the new technology and a bit of scepticism.

"*Radiographers will lose their critical view because of automation. Also, they will have less knowledge about how to correct errors and adjust parameters manually if needed", "Work might become more monotonous", "radiographers don't recognise that they need to educate themselves in this, and I believe they don't know that this is already implemented on many CT scanners and as aid for radiologists in mammography-reporting*", "*The profession of radiography is becoming less attractive".*

Conversely, many also saw AI as an advantage for the radiography profession.

"*I mainly see positive effects of AI for the healthcare sector as a whole", "Better workflow", "I do not think that AI can replace radiographers, in relation to X-rays, but it requires that it can be adapted into clinical practice*".

Reduction in care was a topic that 9.0% (n = 27) of the radiographers had both positive and negative views on.

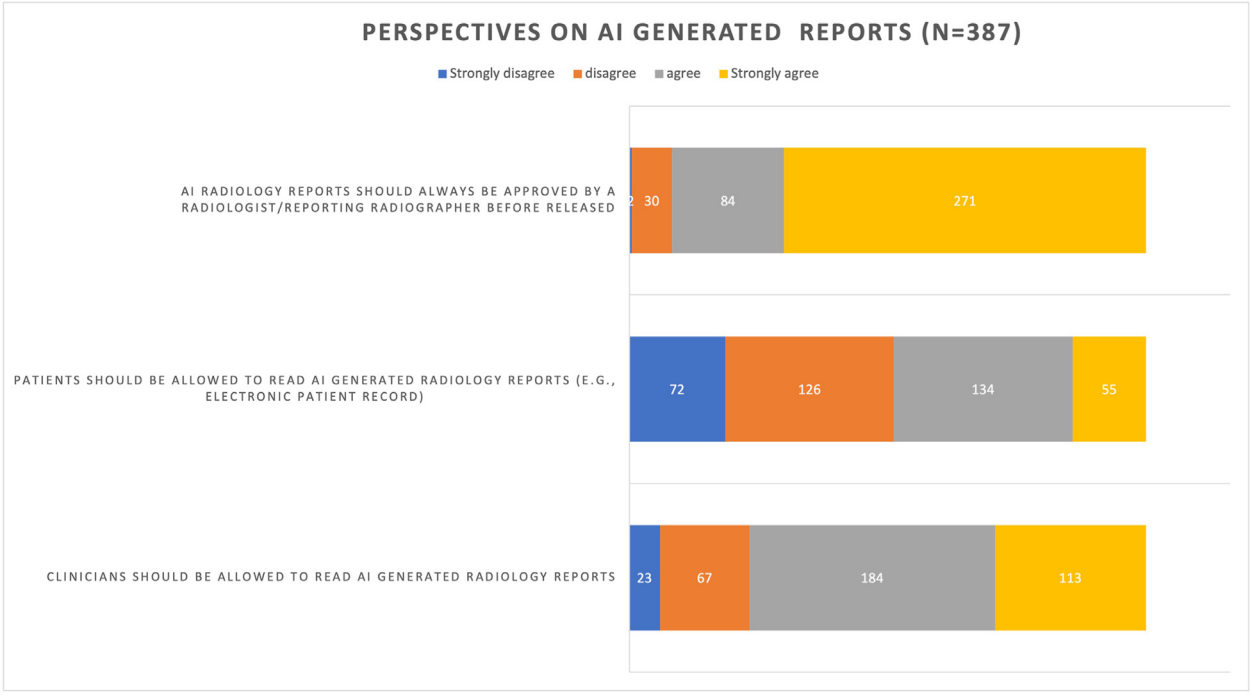

Figure 5. Perspectives on AI generated reports (N = 387).

Table 4
Open-ended statements analysed inspired by Edgar Scheins Culture theory (Artefacts, Beliefs and Values, and Underlying assumptions).

Free text responses	*It could lead to false diagnosis"*	*Incidental findings*	*It is not very safe yet*	*wild west' situation with AI industry*	*AI algorithms are nowhere near the level of precise or error-free*	*The fear of the black box*	*Should not be implemented too fast, must be thoroughly tested*	*Losing the human touch with patients*	*Less communication with the patients can result in complaints*	*Less waiting tme*	*Better worflow*
Artefact	Potential false outcome	High number of incidential findings	Potential negative impact on diagnosis	AI firms priorities information level, and act as sole determiners on quality	Algorithm use is premature technology	Inability to understand and/or explan how the algorithms work	Need for testing before implementation	The use of AI in imaging	AI will reduce patient care and communiication	AI can reduce waiting time	AI will be integrated in radiography
Belief	AI can make mistakes	AI can assist in identification of findings	Safety concern present	When AI is believed to withhold information it creates unreliable environment	Current AI is a black box	Belief that AI algorithms are unprecise	Relying highly on AI-reports can provide incorrect diagnosis	AI replaces the patient care	Communication is essential during radiography	Reduced waiting time improves patient experience	AI reduces burden of responsibilities for radiographers
Underlying assumption	AI is not 100% reliable	AI ability in detection is greather than the human eye	Perception on lack of accuracy or reliability	AI firms have a dominant posistion in determining quality and standards	Assuming that AI algorithms are not being used effectively in imaging	Challenging for users to understand how decisions are made or actions are taken	Risk of overreliance on AI, and devaluing radiograher profession	The patient care is crucial and compromise is not warranted.	Lack of communication and care will lower patient experience and safety	Patient satisfaciton is influenced by a short waiting time	AI can handle specific tasks and provide a better workflow for radogaphers

"*Losing the human touch with patients*", "*Less communication with the patient that can result in more complaints from patients*", "*Less waiting time for patients*",

There were concerns about the quality of the AI algorithms with 14.6% (n = 44) respondents.

"*Premature technologies used wrongly thus creating dangerous situations we do not really understand*", "*The fear of the black box, that we cannot explain exactly what is happening*"," *Should not be implemented too fast, must be thoroughly tested*", "*the human touch within radiology and radiography must remain*".

Culture

The application of Edgar Schein's Iceberg model to responses from radiographers are seen in Table 4 and showed multi-layered insights, including fear of AI leading to potential false diagnosis, and a "wild west" situation with AI industry. The participants were concerned about safety and reliability of the AI algorithms "current AI is a black box" and emphasizing a need for systematic and detailed testing before implementation. Beneath the surface, hidden beliefs were present, such as the fear of losing the human touch and concerns about patient complaints. At the deepest level, the underlying assumptions, the respondents understood the importance of patient care, and expressed reservation about overreliance on AI and devaluation of the radiography profession.

Discussion

There seems to be agreement amongst radiographers that AI will significantly impact the profession. Radiographers have embraced automated technology as a key attribute in their professional role, and a concern is whether it is a threat that will diminish core skills and responsibilities within the profession.[41] We found several concerns regarding the acquisition of AI systems such as (mis)diagnosis, patient safety, quality assurance, radiation dose and trustworthiness of the AI algorithm, which correlates with the findings of a similar survey study.[17] A total of 37.1% of respondents expressed concerns about the risk of redundancy, which was also reported from 23.2% respondents in an African study,[6] and 41.2% in an Irish study.[30] Interestingly, we found no concerns in the open-ended responses advocating for patient privacy or data sharing, as previously reported in an Australian study.[17] Perhaps the more stringent fully adapted patient privacy protection legislation as seen in the Nordic countries may explain why respondents of the current survey did not perceive GDPR as a concern.

Overall, the value of AI was found to be positive and especially with potential connected to beneficial patient safety, diagnostic accuracy, and workflow. Key barriers seem to reflect a lack of prioritisation of education, despite a clear need from the profession and the current political focus on AI in medical imaging. AI is popular within radiography, e.g. in a study amongst African radiographers it was found that 82% were positive about AI, a study performed amongst Irish radiographers found that 83% were positive about AI,[7] and 86% of included Middle Eastern radiographers were positive about AI.[28] The same positivity was reported amongst medical students from Malaysia with 87.4%,[23] and 88% with regard to UK medical students.[29] These reports align with the findings from the current study, where 77.9% where positive about the progress and advancement of AI. This study includes a range of attitudes and concerns about AI in clinical practice, highlighting both benefits and challenges. The participating radiographers

understand what challenges relate to a disintegrated use of AI and report a need for education and training. Lack of education in AI can be a potential barrier for implementation of AI in hospital settings, as our findings report a current fear amongst participants that AI will affect the profession negatively e.g. less critical thinking is needed, as well as a perceived risk of implementation of premature algorithm, and of expert technical knowledge to no longer be valued. Loss of fundamental skills in professional knowledge is a critical concern. Therefore, when implementing AI, it is crucial to understand how radiographers' knowledge and skills can be redirected towards new areas. This may be a paradigm shift similar to when the profession went from analogue to digital imaging. Radiography is an "always changing profession" with new technology as a core value.

Culture is often difficult to address or handle and is just something that we are surrounded by that affect us, or that we affect during our everyday work. The presented statements highlight concerns about the implementation of AI. On one hand, the respondents are positive and can see the benefits such as reduced waiting time, improved image processing and better workflow, and on the negative side concerns about black box, decrease in diagnostic accuracy, and loss of critical thinking. A present need expressed by radiographers is to be included in the implementation process, and this seems to be ubiquitous. The radiographers are unwilling to lose the human touch in radiography, and quality of care is still a core value for the participating Nordic radiographers.

Furthermore, the profound concerns were expressed by respondents concerning overreliance on AI and its potential impact on the erosion of the radiography profession. The visible culture, such as fear of false diagnosis and uncertainty of the AI industry, needs attention. The respondents hidden beliefs – especially regarding communication and loss of human touch highlight the importance of the radiography as a patient centred profession. While the respondents acknowledge the benefits of AI such as improved workflow and reduced waiting time, we found that a delicate balance is needed when starting to work with AI. Similar findings are seen when investigating other new aspects of radiography, e.g. radiographers' perspective on research where many expressed positive attitudes towards research, but also reported a lack of skills.[42–45] Importantly, a strong evidence-based culture needs to embrace actual clinical practice.[44]

The respondents expressed concern about the impact of AI on the radiography profession, despite its potential benefits. These concerns include the risk of misdiagnosis, legal responsibility, and uncertainty related to algorithms. They also highlighted worries about the.

Loss of human touch and interaction, potentially leading to in decrease in patient care quality and shift away from patient centred care. However, radiographers acknowledge the advantages of AI, such as enhanced efficiency and less waiting times.

It is evident that the integration of AI into radiography practice need to be approached cautiously, as AI tools are currently still under development and need continuous adjustments. Many radiographers may be hesitant to fully embrace AI, but collaboration with specialised colleagues could facilitate acceptance. Edgar Schein's Iceberg theory is relevant, as it reveals the importance of understanding the deeper beliefs and assumptions underlying cultural changes can help accompany AI implementation. By addressing cultural artifacts, beliefs and assumptions radiographers can foster a sense of readiness and confidence in adaption of AI into daily practice.

Moreover, to openly discuss concerns about AI, radiographers will be able to build trust among peers and with patients. By establishing communication pathways and feedback systems to improve uncertainty about AI. Together with ongoing education and training opportunities radiographers can obtain skills and knowledge to effectively utilise AI tools in daily practice. An active approach to facilitate implementation of AI into radiography practice will lay the foundation for continuously cultural changes during technological advancements.

Strength and limitations

This study has some limitations inherent to online survey research. Firstly, the design was a cross-sectional study, and therefore there is a potential response bias as the survey may predominantly capture the opinions of respondents with interest in the survey theme, AI. Secondly, drop-outs or respondents stopping before reaching the end of the survey provides a challenge for all survey studies. We experienced a drop-out rate throughout the survey, which is to be expected due to the length of the survey and because the survey language was in English. An average of 30% drop out is normal.[46] One study found that 10% of participants is expected to dropout straightaway, followed by an additional 2% drop out per 100 survey items included.[47] This aligns with the drop-out rate of this study. Furthermore, the survey language was English, and it was possible for the participants to omit questions. However, it is a possibility of linguistic bias due to language barriers. But more or less most Scandinavian people speaks, write and understand English very well.

Furthermore online surveys have a lower response rate compared to paper-based surveys.[48] Thirdly, AI is currently not an integral part of the radiography education in the Nordic countries, and a potential limitation is therefore lack of awareness regarding the integration of AI. Furthermore, the findings need to be validated in other studies for reproducibility, and there is a risk that these findings will increase or decrease simultaneously with the increasing implementation of AI. The study represents a small sample of all Nordic radiographers. Nevertheless, it is a significant strength that this study has the highest number of respondents investigating radiographers' perspectives on AI. Furthermore, this study also presents as a mixed method with both quantitative numbers and qualitative statements.

Conclusion

In conclusion, Nordic radiographers exhibit an overall positive attitude toward AI, expressing an interest in its integration and the simultaneous development of the radiography profession. They anticipate the strongest influence of AI will be on new advanced roles of radiographers. Nevertheless, apprehensions exist, particularly concerning knowledge gaps and potential loss of fundamental skills. Key motivators for engagement with AI include gaining professional recognition from peers and advancing their skills and knowledge in their professional field. Edgar Schein's organizational model can help understand barriers and recommendations for implementation of AI in clinical practice, e.g. by performing a thoroughly analysis of the cultural underlying assumptions. The current study highlights that radiographers are getting ready for a culture change, as long as they continue to have a focus on the human touch.

Author contribution

MRP led the project, applied for research ethical approval, and wrote the first draft. All authors contributed substantially to the design of the questionnaire and progress of the project. All authors read and approved the final manuscript.

Conflict of interest statement

The authors have no conflict of interest to declare.

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