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Exploring the Knowledge, Attitudes, and Practices of Radiographers Regarding the Use of Artificial Intelligence in CT in Selected Private Hospitals in KZN

Nondumiso Praise Zuma, Timika Mewalall, Thandokuhle Emmanuel Khoza

Department of Radiography, Durban University of Technology, Durban, South Africa

Email address:

Nondumiso833@gmail.com (Nondumiso Praise Zuma)

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Abstract: Artificial Intelligence (AI) has become increasingly important to daily lives. AI has introduced several algorithms in Computed Tomography (CT) which allow for improved image quality at a low dose. These systems execute tasks that are normally done by a human (Radiographers). Hence Radiographers need to have adequate knowledge of these AI applications. Previous studies reveal that Radiographers lack knowledge of the AI and its algorithms that are used in CT, which has been identified as a problem because limited information is passed on to students and trainees. The aim of this study was to explore Radiographers' knowledge, attitudes, and practices toward the use of AI in CT. The research was conducted in selected private hospitals in Kwa-Zulu Natal in which semi-structured and in-depth face to face interviews using open-ended questions were used to collect data from 10 participants. Three main themes generated from the study's theoretical framework were used for data analysis, namely knowledge, attitudes, and practices. Findings in this study indicate that Radiographers lack knowledge of AI and its algorithms that are used in CT. Their lack of knowledge is a result of a lack of training and education. Findings also suggest that a lack of knowledge contributes to uncertainty about the potential impact of AI implementation. However, Radiographers demonstrated interest in wanting to gain more information. Radiographers that participated in this study demonstrated a lack of knowledge, but also an interest in learning more about AI. This, therefore, necessitates collaboration between educational institutes and professional organizations to develop structured training programs for Radiographers.

Keywords: Artificial Intelligence, Computed Tomography, Algorithms, Radiation, Radiographers

1. Introduction

The concept of artificial intelligence is becoming increasingly important in every aspect of modern medicine. This trend started in the middle of the 20th century by using advanced digital datasets and algorithms which now in the 21st century, allow one to critically evaluate the human body and pathologies using Computed Tomography (CT) [1]. CT is the computerized acquisition of images using x-rays, ionizing radiation, algorithms, and various software programs that help visualize the body's different densities of tissues and anatomy [2]. AI has introduced several algorithms in CT, which result in improved image quality at a low radiation dose by automating and optimizing data acquisition operations, such as patient positioning and acquisition parameter settings [3].

The field of radiography is heavily reliant on technologies that are progressively advancing; hence it has been at the forefront of technological advancements. This, therefore, means that the field requires practitioners (radiographers and radiologists) to have advanced practical and critical thinking abilities to optimize image acquisition methods and manage the patient care pathway appropriately [4]. Whilst recent technology advancements have aided patient diagnosis and treatment, they have also influenced and transformed Radiography practice and the roles of Radiographers.

Radiographers have accepted AI and its technologies into

their practice, which some may believe have resulted in a loss of key roles, responsibilities, and the ability to make autonomous decisions, which influences their attitudes towards the application of AI [4]. A positive value of increased digitization and automation brought about by AI has been an increase in efficiency and throughput within imaging departments. However, evidence suggests that increased patient workloads and examination speeds may have negatively influenced Radiographer morale, role satisfaction, and attitudes [5]. This is due to professional leaders and employers failing to assess the influence of AI technologies on professional and workplace cultures and role adaptation. A study conducted in 2020 aimed to assess how the Radiographer role might develop and change in response to the evolving capabilities of intelligent technologies [4]. Part of the conclusion is that at first glance, AI appears to threaten the role of the Radiographer. However, its widespread adoption and implementation also present significant opportunities for better autonomy and self-definition.

For many decades AI has always been portrayed in movies as Robots or something that is beyond the reach of humankind, especially from the Radiological point of view [2]. Currently, Radiography has implemented advances such as algorithms to allow for short scan times at low doses of CT. However, studies assessing how much Radiographers know about it and how it will impact the Radiographers are lacking [4]. In Africa, studies showed that in the recent COVID-19 pandemic, AI algorithms have played a role in quicker diagnosis in CT, but yet again the Radiographer's knowledge of this algorithm was not explored [7]. A South African study that was conducted only analyses the impact that AI will have on the knowledge or expertise of Radiographers and radiologists, but it does not explore what the Radiographers know about AI and how they feel about it [8]. This, therefore, concludes that no significant studies assessing Radiographers' knowledge and attitudes towards AI, have been conducted in South Africa. According to Dr Hans Woznitza when considering AI algorithms that determine radiation dose and scan time, the delivery of that dose of radiation to the patient remains the Radiographers' responsibility but there remains a lack of studies that assess Radiographers' knowledge of these algorithms and a few that have been conducted confirm lack of knowledge [9]. This, therefore, opens a gap between Radiographers' knowledge of AI algorithms and their responsibility to reduce patient doses using these algorithms. The study primarily aims to fill that gap as it assesses South African Radiographers' knowledge and perceptions of the use of AI in CT. The study made use of the KAP (Knowledge, Attitudes, and Practices) model as the theoretical framework. This allowed researchers to assess Radiographers' knowledge of the use of AI in CT, their attitudes towards it, and how this affects their practices. To the best of the authors' knowledge, this is the first KAP study that assesses Radiographers' knowledge and perceptions of the use of AI in CT.

2. Method

2.1. Ethical Considerations

The Durban University of Technology's Research Ethics Committee approved the study (reference number: BIREC 057/21). All methods and protocols were performed in accordance with the research ethics committee's guidelines and regulations. Permissions were obtained from the head of the Radiography department (HOD) and radiography gatekeepers in all the hospitals (HODs). A brief outline of the study emphasizing the risks and benefits thereof was accompanied by an informed consent form which was given to all participants.

2.2. Research Design

A qualitative methodology design with a case study approach was employed in this study which allowed the researchers to obtain an in-depth understanding/ experience of the Radiographers' knowledge, attitudes, and practices concerning the use of AI in CT.

2.3. Sampling Technique

A non-probability sampling method using purposive sampling was used to select CT Radiographers from selected KZN private hospitals in which a total of 10 eligible participants were interviewed. The sample size was determined by data saturation when no new information was coming forth. A few Radiographers are CT trained, therefore limiting the sample size.

2.4. Methods of Data Collection

An announcement about the aims of the study was made at a departmental staff meeting, and the contact details of the researchers were shared with potential participants. For those who were interested, a meeting was set up for the interview at their preferred time slot.

A letter of information about the study and the consent to sign agreeing to participate in the study were given to participants before collecting data. The entire process was clearly explained to the participants to alert them that participation was voluntary and that their personal information would be kept private. Semi-structured face-to-face and in-depth interviews using open-ended questions were used to collect data from participants. Moreover, COVID-19 rules and protocols were followed.

2.5. Data Analysis

The researchers used Thematic Analysis to analyse data. This involved open coding of the data manually by the researchers. The researchers transcribed the raw data to generate the initial codes through the process of open coding. The audio recordings were periodically referred to, along with the written notes for clarity. The researcher generated codes that were related and compared with each other to generate categories, subsequently leading to the emergence

of major themes and subthemes.

3. Findings and Discussions

3.1. Demographics of Participants

A total of 10 Radiographers who met the inclusion criteria participated, with only 2 males, highlighting female dominance in the sample. Participants were Radiographers from two private hospitals in Kwa Zulu Natal. Participants' distribution of race is as follows: 3 Blacks, 2 Whites, and 5 Indians, with their ages ranging from 27 to 50 years old. Participants were all Radiographers with considerable experience in CT of more than 5 years.

Three themes emerged from the thematic analysis (Table 1) with an aid of the KAP model. The KAP model states that knowledge influences an individual's attitude which in turn influences practices and behavior [10]. KAP elements establish an individual's knowledge, attitudes, and practice toward a phenomenon. Knowledge as a KAP element allowed the researchers to determine how much Radiographers know about AI, attitudes being how they feel about AI, and finally, practices being their daily operations of AI and how their knowledge and attitudes impact these operations [11]. Table 1 below presents the emerged themes and their subthemes.

Table 1. *Table of Themes.*

CATEGORY	THEME	SUBTHEMES
KNOWLEDGE	UNDERSTANDING OF AI	TECHNIQUE SOURCE OF INFORMATION
ATTITUDES	ACCEPTANCE	INITIATIVE
PRACTICES	TRAINING	FEASIBILITY

3.2. The Knowledge of Radiographers on AI

Knowledge is the first element of the KAP model, encompassing all the experiences, skilled insight as well as information consisting of both practical and theoretical knowledge gathered over time and can be used as a guide that may be incorporated into new experiences and information [12]. In this study, Knowledge entails how much Radiographers know about AI applications in CT. Findings indicate that Radiographers lack understanding of AI in general and in relation to CT. Only 2 of the participants were able to adequately describe the use of AI in CT and how it helps them as Radiographers.

"CT can get a thread in 360 degrees acquiring different slices within seconds. That itself is artificial intelligence. It is more advancing now and the fact that pixels reconstruct themselves using algorithms shows artificial intelligence. There are multiple tubes and multiple detectors that convert impulses into images and that right there is artificial intelligence. We are using it every day and it's there for us to easily work"–Participant 6.

One of the participants was familiar with the AI algorithms used in CT but was not aware that they are part of AI because it requires human input.

"Algorithms are there but we set the protocols so although it is there and it is available it's telling us what can be used for that certain CT scanner, we are still inputting the information for a particular protocol… So yes, it is where I know what the parameters of these algorithms are for, and I, know how to use them but as a specialist, we are the ones that input that data for a specific protocol. so I don't think that's AI" – Participant 1.

Of the participants, 2 demonstrated an understanding of AI. However, their understanding was that AI only helps Radiologists.

"My general idea is that a computer uses an algorithm to analyze the images, determines pathology, and creates a report for radiologists. – Participant 2.

"There's not so much I know but I know there is that one CAD program I think it's a computer application design that the radiologists sometimes use, so they put that on specific cancer that they are not 100% sure what type of cancer it is, and they can use those programs to program AI things to depict what is actually happening, but I don't know really know too much about it" - Participant 4.

While the rest of the participants lacked a general and technical understanding of AI and its use in CT. it was also noted that these participants were unaware of the ongoing applications of AI in CT. This is in keeping with the findings from an international study where it was clearly stated that Radiographers and Radiologists lack knowledge of the technical applications of artificial intelligence in CT [5]. Another study conducted in Ghana revealed that Radiographers stated that they did not know anything about AI [13]. Most of the interviewees had never seen or heard of AI before, thus they could only speculate on its potential applicability in clinical practice. Furthermore, a lack of knowledge and reservations about AI tends to produce misinformation and misunderstanding about the AI tool. This is also evident in the current study.

"When I hear someone talks about AI in radiology, I am expecting to see robots in the department"- Participant 2.

A lack of knowledge/technical expertise, expensive equipment, and cyber threats were recognized as potential barriers affecting the implementation of AI in Radiology in Ghana.

When participants were asked if they had obtained any form of training and education on the use of AI in CT. They stated that they had not received any formal training, including 2 that had demonstrated extensive knowledge of AI and its applications in CT as they stated that it was self-taught.

"I did learn a little about artificial intelligence at the university approximately eight or nine years ago as people were preaching about the upcoming evolution of it. So, I did know about it but not in-depth until I went to CT and found out more by myself. So, most of it is self-taught."- Participant 6.

A similar response is noted in two studies by Abuzaid [5, 6], where, when participants were asked how their existing information about AI was developed, most of the participants stated that it was self-taught whilst others totally had no idea

of what AI was. Contrary to this, studies by Botwe *et al.* reveal that some participants did receive some sort of education, and this generated a positive attitude towards AI [14].

Most of the studies conducted reveal a significant Radiographers' lack of knowledge of AI amongst radiographers [6] whilst on the other hand emphasis is put on the importance of acquiring adequate knowledge for successful implementation. Dr. Hans Woznita stressed the need for putting confidence in the AI evidence-based and knowing the AI system: "We need to be empowered with extensive evidence to influence our decision-making and to ensure our practice isn't compromised".

3.3. Attitudes of Radiographers Toward AI

Attitude is the second attribute of the KAP model. This element looks at how participants feel about a phenomenon. This study looked at how Radiographers feel about the use of AI in CT. The participants were asked how they feel about the implementation of AI. The few who demonstrated an adequate understanding of AI, stated that they were happy with the implementation of AI and that it makes their jobs easier. Participants went on to give an insight into how much AI has improved the Radiology field, specifically CT as it has advanced to produce good quality images at a low dose and with a short scan acquisition time. This following excerpt further demonstrated an appreciation of AI:

"We used to scan on thin slices, meaning on 0,25 mm, and that means the machine is moving slow and emitting more radiation and end up scanning for example a brain for like 4 minutes. Imagine how much radiation is emitted in that 4 minutes because it is radiating continuously. But now with Artificial intelligence, you can scan on thick slices 5mm then you can reconstruct to thin slices using the AI algorithms. So, AI allows for good image quality at a reduced dose -Participant 6.

The rest of the participants demonstrated concerns regarding their roles as Radiographers as well as minimized patient interaction. They further stated that they would appreciate AI if it does not completely take over their roles and does not minimize patient interaction.

I don't think it would be good to have AI completely involved, I don't think I would be comfortable with that because I need to talk to my patient and know what is wrong as well as provide assurance to my patient."- Participant 1.

"I don't mind the implementation of AI as I feel I could learn the system. But it must not minimize my interaction with the patient" – participant 9.

These responses are commensurate with the findings of a study conducted in Ghana in which most respondents agreed that diagnostic decision-making should be a shared responsibility between the AI algorithms and Radiographers [15]. In Contrary to this, studies by Swara et al. [16] reveal that participants stated that diagnostic decision-making should predominantly remain a human task and AI can function as a supporting tool. Two of the participants stated that the contributing factor to being unaware of the ongoing applications is feasibility as they do not feel that a third-world country such as South Africa would be able to fund such technology.

"I don't see it as impossible because the technology is changing rapidly, but we are a third world country, so we are not there yet" – participant 5.

It is true that third-world countries are suffering financially. However, Radiographers are not aware that AI applications are already taking place. AI at a prominent level can be claimed to have been a part of image technology in some way for decades [4]. The Automatic Exposure Detection (AED) established in the 1980s was the first example in general radiography practice. Thus, it has already been present for quite some time.

Other participants also demonstrated some positivity despite their lack of knowledge. This is emphasized by their act of initiative towards gaining information as they engage in social media platforms that talk about AI.

"Actually, I was on a podcast last night where they spoke about artificial intelligence"-Participant 1.

"I would be happy to experience it. I am not sure if it's going to directly help me or not but it's nice to know what's out there than being ignorant. So, I would be open to the chance to see how it works, because the only time you can really tell how you feel about something is when you get to try it out, but we are not there yet so yeah"- Participant 7.

This means that obtaining education and training on AI will generate a positive attitude as numerous studies emphasize this [17]. Another study conducted in Singapore [18] reveals that participants showed appreciation of the implementation of AI and its algorithms and were motivated to advance their knowledge and to become involved in related research, despite their lack of knowledge.

3.4. Practices

In the 'KAP model' Practices is the last attribute which looks at how knowledge and attitudes towards a phenomenon affect practices/operations. In this study on how Radiographers' knowledge of AI and their attitudes towards it influence their daily applications of AI in CT. Participants were asked how AI influenced their daily practices. One of the participants stated that AI has had a positive impact on their daily operation in CT, as the new advanced CT scanners have AI algorithms that allow for very quick scans with high-quality images at a low dose.

"I am sure you are aware that Ct stands for computed tomography and it's the ability to get a thread in 360 degrees acquiring different slices within seconds. That itself is artificial intelligence. It's more advancing now and the fact of pixels reconstructing themselves shows artificial intelligence to me. Previously we had to do only x-rays to find out more of what was wrong with the patient but now we have CT. There are multiple detectors that convert impulses into images and that right there is artificial intelligence. We are using it every day and it's there for us to easily work"-Participant 6.

The rest of the participants were not able to describe the impact of AI on their daily practices due to being unaware of the present applications of AI in CT.

AI innovations that are currently in use for CT imaging are support tools to be used for imaging, which means that a Radiographers' presence is still particularly important [19]. Furthermore, a Radiographer must have a sufficient understanding of AI techniques and applications to be able to review the decisions made by AI algorithms, as well as when and why a human end-user overrode it. This is also information that Radiographers must have to participate in, create, and develop AI workflows. Additionally, it will allow them to have a role in quality assurance and quality control in AI-powered software or hardware. Moreover, they should still maintain their fundamental knowledge of imaging principles to be able to serve as AI technology validators, hence their roles as Radiographers are not compromised, but improved and eased.

4. Conclusion

While AI may initially appear to challenge the role of the Radiographer, its prevalent adoption and implementation also provide superior opportunities for greater autonomy and self-definition if the profession satisfactorily prepares and adapts to the inevitable changes in role and culture. Artificial Intelligence has already begun to infiltrate the field of Radiography. Consequently, there is a pressing need to develop relevant AI principles and applications in educational curricula to prepare the Radiographic workforce for a future with AI, as well as to launch prospective research projects for the design, validation, application, and assessment of AI tools to build a vital evidence base.

The findings in this study clearly indicate that most Radiographers lack knowledge of the AI and its algorithms that are used in CT to improve image quality at low doses. It is also evident that some Radiographers have a misunderstanding of AI as they are not aware that some AI applications are already place in daily practice. This, therefore, generated uncertainty about the implementation of AI as one participant pointed out that South Africa is a third-world country therefore these innovations are far. While the majority demonstrated a lack of knowledge, only a few Radiographers had adequate knowledge and awareness of the ongoing applications of AI. They further stated that they had not received any formal training on the use of AI in CT, which means that they are self-taught.

In terms of attitudes, most Radiographers demonstrated positivity mixed with uncertainty due their lack of knowledge. However, concerns regarding patient interaction and their roles as Radiographers were raised, as they stated that they would not appreciate AI if it took over completely. Whilst the minority was completely positive that AI is there to ease their jobs and it turned out to be only a few participants that demonstrated knowledge. This shows that how much a Radiographer knew about AI had a significant impact on their attitudes. However, participants demonstrated a willingness towards being educated about AI, as they stated that they are willing to accept courses and be actively engaged in any developments pertaining to AI in CT. A few participants who demonstrated knowledge of AI were positive that AI helps ease their daily operations in CT and that further advancements will not harm but improve their working environment. Despite the significant lack of knowledge noted in this study, participants are still able to keep the workflow going in CT. However technical expertise in their operations is lacking, which further results in limited information being passed on to the students and trainees.

5. Recommendations

1) The South African education system along with health care management must become more dynamic, flexible, and adaptive to keep up with the ever-changing evidence base of AI. This can be accomplished in a variety of ways which may include incorporating AI into the curriculum along with its principles and applications, this will help bridge the gap in extant knowledge identified in this study.
2) Radiographers must engage with AI as a powerful tool that can minimize inefficiencies; standardize operations, and assist growth with high-quality data input, the correct validation processes, and a regulatory framework. This will also enhance their knowledge and generate positive attitudes for efficient practice. Given the growing demand for medical imaging and radiation treatments, it may even be utilized to overcome staffing shortages, allowing more time and space for truly person-centered care.

5.1. Recommendations for Future Researchers

1) More quantitative studies with a larger sample size to be conducted in public health facilities.
2) Radiographers to be part of the research committee.

5.2. Limitations and Strengths

1) The study consisted of interviews hence it allowed for the limitation of ambiguity and biasness to be present.
2) It is a qualitative study with smaller sample size.
3) The paper's strength is that it may raise awareness and attention of knowledge, attitudes, and practices of Radiographers about AI used in CT. it also provided solutions for improving Radiographers' knowledge of AI.

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