ORIGINAL ARTICLE

Radiographers' perspectives on the impact of Artificial Intelligence use on their future roles: A Qualitative Study

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ABSTRACT

Introduction: The advent of artificially intelligent systems in the field of medical imaging has attracted a lot of attention and sparked a lot of discussion regarding the future roles of radiographers. It is widely believed that Artificial Intelligence (AI) will revolutionize the entire medical imaging field in the near future and alter the current practice of radiographers.

Aim: The aim of the study was to explore Zimbabwean radiographers' perspectives on the impact of AI use on their future roles.

Methods: A qualitative explorative design employing in-depth interviews to explore the perceptions of radiographers towards AI use in medical imaging. The study recruited 10 participants and the study was conducted at 5 hospitals in Harare, 2 government and 3 private hospitals. The interview data was then analyzed using thematic analysis according to Braun and Clarke.

Results: Four themes emerged from the interview data. The themes include; Reduce roles of radiographers, Elimination of human errors, Expansion of knowledge and AI will promote radiography.

Conclusion: Radiographers must be trained and have underpinning knowledge of AI. This study recommends that AI use should be included in the curriculum of radiography students.

INTRODUCTION

Artificial Intelligence (AI) systems integrated into healthcare have transformedpractice while also improving patient care. Artificial intelligence is a branch of computer science that aims to automate processes that would ordinarily need human intelligence, such as vision, speech recognition, decision-making, and so on[1]. Artificial intelligence is divided into two subsets: machine learning (ML) and

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Keywords: Artificial Intelligence, radiographers, future roles, perspectives, medical imaging

This article is available online at: http://www.mjz.co.zm, http://ajol.info/index.php/mjz, doi: https://doi.org/10.55320/mjz.49.3.1148
The Medical Journal of Zambia, ISSN 0047-651X, is published by the Zambia Medical Association

deep learning (DL). Machine learning entails teaching algorithms to solve problems on their own via pattern recognition. For example, ML algorithms can be trained to detect tuberculosis in lung images[2]. Neural networks with artificial neurons fashioned after the human brain are used in deep learning solutions. These networks have more hidden layers than linear algorithms and can extract more information. Deep learning techniques are commonly employed to recreate and improve the quality of medical images. The development of universal health coverage globally is greatly facilitated by the adoption of AI. This involves enhanced clinical care, better diagnosis, and health research[3]. Nonetheless, a crucial question that concerns many healthcare workers globally is how severe will be the impact of AI on their professional roles[4].

Studies have been done to solicit the perceptions of radiographers on AI in medical imaging globally[5-8]. Medical imaging is heavily reliant on technology; without it, radiographers would be unable to gather diagnostic images or provide therapy [6]. Therefore, the introduction of AI systems has spurred much discussion and controversy about the role and duties of radiographers and radiologists[9]. Artificial Intelligence is coming to stay, and it's transforming the way radiographers work. Because of the increased focus on AI in radiology, several experts believe that AI may eventually replace humans[8]. A large number of radiographers are concerned about AI-related errors, job displacement, and income reductions[10]. These ideas raise the question of whether AI-based systems will eventually replace radiographers or if they will augment their work rather than completely replace them. Nevertheless, AI has the potential to help radiographers practice their vocation more effectively. It will eventually affect radiographers' duties, leading to expanded practices; yet, past research suggests that it will improve the practice and open up new prospects while not completely changing radiographers' basic roles[10]. Radiographers, on the other hand, are concerned about the possible negative influence AI will have on their workforce[8]. Radiographers operate as a link between AI technology and patients.

In the African context, digital radiology and AI have been considered too expensive or too sophisticated to use, and their adoption until now is still very limited. Zimbabwe like other African countries faces shortage of imaging equipment, personnel expertise, infrastructure, data-rights frameworks, and AI public policies[11]. Additionally, the quality of electricity, water and telecommunications has had a negative impact on the rapid adoption of AI technologies[12]. Subsequently, these technologies are mostly confined to the private sector [13]. However, in public hospitals where the equipment may be available, there is underutilization. Consequently, despite the opportunities AI brings, Zimbabwe may not be able to take full advantage[14]. According to the researcher's knowledge, there is no study that has been done to solicit Zimbabwean radiographers' views on the impact of AI. The goal of this study was, therefore, to explore Zimbabwean radiographers' perspectives on the impact of AI use on their future roles. Findings from this study will offer insights into radiographers' attitudes about AI and understanding their degree of confidence in working alongside it in the near future. Additionally, it helps determine whether AI affects radiographers' career objectives. Indeed, the only way to safely achieve the optimal integration of AI into clinical imaging is through appropriate education of the current and future workforce, as well as active involvement of radiographers in AI future developments [15].

METHODS

Study design

An exploratory qualitative study with radiographers at five Harare hospitals in HMP was carried out from January 15 to February 20 2022. This design was preferred because it provided in-depth information about radiographers' viewpoints and allowed them to properly examine their thoughts on AI.

Research setting and population

The study was carried out in Harare Metropolitan Province in north-eastern Zimbabwe. It includes Harare, the nation's capital and largest city, which has 1,558,000 people [16].They are three central hospitals namely Parirenyatwa Group of Hospitals, Sally Mugabe Central Hospital and Chitungwiza Central Hospital all with fully-fledged radiology departments. There are also a number of state-of-the-art private hospitals providing radiology services. In fact, most of the latest technologies in medical imaging technologies are mostly confined to the private sector[13].The population of the study includes all radiographers registered with the Allied Health Practitioners Council of Zimbabwe (AHPCZ). A total of 257 radiographers are registered with the AHPZ, and 125 work and stay in HMP as at January 2022.

Sample size and sampling technique

In-depth interviews, according to the literature, require a sample size of 10-15 patients to achieve data saturation assuming the population integrity in recruiting study participants[17]. In the current study, data saturation was reached at participant number ten. The objective of qualitative data is to lessen discovery failure, just as quantitative data aims to reduce estimation error, hence when data saturation has been achieved it becomes pointless to keep on recruiting more study participants. The study included all the radiographers registered with the AHPCZ and with a minimum of 3 years of clinical experience. Purposive sampling was employed to select the participants. This sampling method was used because it is based on the researcher's judgment in relation to the issue, that is, with knowledge of the topic, the researcher can decide that this is the best candidate for the research [17].The hospitals were also selected by purposive sampling. The private hospitals with the most sophisticated radiology equipment were selected.

Data collection tool

The interview guide is informed by the literature[5,6,8]. The objectives of the study were used to create the questions. Two radiography lectures both with PhDs were asked to evaluate and suggest improvements to the interview questions. Thereafter a pilot study was carried out. The pilot study allowed us to test the suitability of the questions and to provide some initial suggestions on the feasibility of the study. Also, it enabled us to obtain experience in conducting in-depth, semi-structured interviews and to building rapport with the participants. The pilot study used 5 radiographers, one from each sampled hospital. The information gathered was used to further modify the interview questions. The radiographers who took part in the pilot study were not included in the final sample of the main study. The final interview guide documented the demographic characteristics of the participants (Section A). Section B had open-ended questions which included; (a) "*In your view, how do you think AI is going to impact your everyday practice?* (b) "*In your opinion do you think AI will replace radiographers in the near future?*

Data collection procedure

Face-to-face in-depth interviews were used to gather information from radiographers. The Zimbabwe Ministry of Health and Child Care (MoHCC) and WHO guidelines on COVID-19 were adhered to. Radiographers were given an information letter that briefly described the research and its goal, as well as a consent letter to sign if they understood and agreed to participate in the study. The interviews took place in each center's x-ray department, but they were done when the department was less crowded. The interviews were recorded using Voice Recorder by quality apps© (Android Version 3.19) and lasted an average of 30 minutes. The interviews were manually transcribed verbatim.

Data Analysis

The interview data was then analyzed using thematic analysis according to Braun and Clarke [18].The goal of thematic analysis was to find important or interesting patterns in the data, or themes, and use these themes to address the research

questions.The following steps summarize how thematic analysis was carried out:

i. The researcher initially became acquainted with the data, which was accomplished by translating audio to text and reading through and taking initial notes.

ii. The researcher then coded the data, which involved highlighting areas of the data that included phrases and sentences and creating shorthand labels or codes to explain their content.

iii. The researcher next moved on to producing themes, which entailed looking over the codes that had been developed, identifying trends, and coming up with themes.

iv. The next step was for the researcher to go over the topics and make sure they were valuable and correct.

v. Define the themes. The original data was compared to the created themes to see if the themes were present in the data.

vi. The final step was the write up of the analysis of the data and reporting the findings

Trustworthiness of study

Credibility, dependability, conformability, and transferability as proposed by Lincoln and Guba [19] were used to warrant the trustworthiness of this study. Firstly, to achieve credibility, the researcher utilized a technique in which the data, interpretations, and results were shared with the participants (Member checks). As a result, participants were able to clarify their objectives, fix errors, and provide extra information as needed. Furthermore, space triangulation was done [20]. Data was collected from radiographers working at 5 different radiology departments both in private and public practice. Secondly, the study's context was established in depth in order to ensure transferability (Thick description), and a full description of the data was provided so that readers can draw comparisons to other settings based on as much information as possible. Lastly, an audit trail, or documentation of data, methods, and research-related decisions, was done to guarantee the dependability of this study[21].

Ethical considerations

The study was carried out according to the declaration of Helsinki.To warrant that ethics were upheld, approval was sought from the five hospitals. Overall, ethical approval was given by the Medical Research Council of Zimbabwe (MRCZ/B/2275). The participants received an informational letter about the investigation as well as a consent letter from the researcher. The study's purpose and significance were explained to all of the participants. The participants were not harmed as a result of the exploitation of their data. The participants were informed that their information would be kept private by the researcher.

RESULTS

Demographics

A total of 10 practicing radiographers responded to the interviews. There were 7 males and 3 females. Six participants worked in the private sector while 4 worked in the public sector. Five participants were in the age group 21-30, while 4 were in the age group 31-40. Only 1 participant was above 40 years old. Regarding work experience, 4 radiographers had 5 years and below, while 4 had between 6 and 10 years, and 2 had 10 years and above. Concerning the grade in the department, 4 were basic radiographers, 3 senior radiographers, 2 principal radiographers and 1 chief radiographer. All the diagnostic participants indicated that they were aware of AI. Table 1 gives a summary of the demographic characteristics of the interview participants

Table 1: Demographic characteristics of the participants.

Participant	Gender		Age (Years)			Position	Institution		Work experience (Years)		
	M	*F*	*21-30*	*31-40*	*>40*		*Private*	*Public*	*<5*	*6-10*	*>10*
A	*X*		*X*			*SR*	*X*		*X*		
B	*X*		*X*			*SR*	*X*			*X*	
C	*X*				*X*	*CR*		*X*			*X*
D	*X*			*X*		*PR*	*X*			*X*	
E		*X*		*X*		*SR*		*X*		*X*	
F	*X*					*R*	*X*		*X*		
G	*X*		*X*			*R*		*X*	*X*		
H		*X*	*X*			*R*		*X*		*X*	
I		*X*		*X*		*PR*	*X*				*X*
J	*X*		*X*			*R*	*X*		*X*		

Radiographers' perspectives on the impact of AI use on their future roles

Figure 1-4 illustrates the themes, subthemes and exemplary quoted that emerged from the interview data.

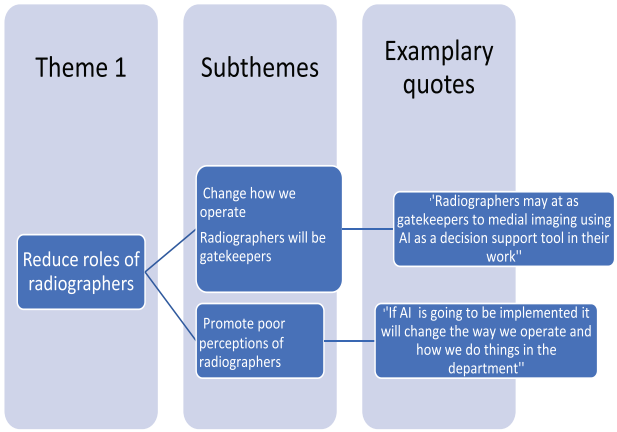

Figure 1: First theme and subthemes

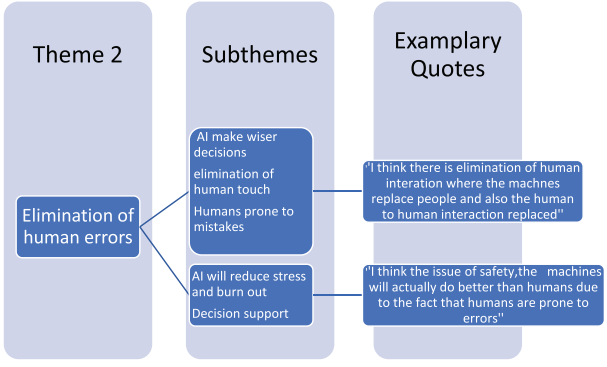

Figure 2: Second theme and its subthemes

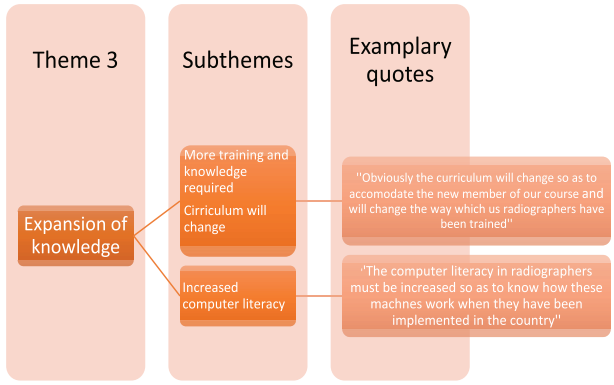

Figure 3: Third theme and subthemes

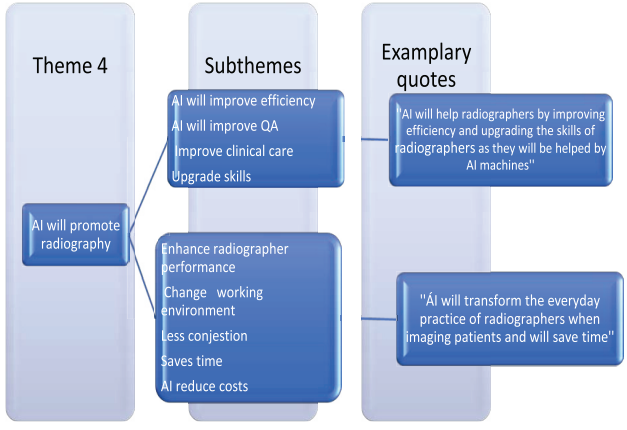

Figure 4: Fourth theme and subthemes

For this objective 'The anticipated changes to radiographers' roles due to AI' there are four emerging themes namely: Reduce roles of radiographers, Elimination of human errors, Expansion of knowledge and AI will promote radiography.

Theme 1: Reduce roles of radiographers

The first theme which is reduce roles of radiographers has subthemes which are change how we operate, Radiographers will be gatekeepers and promotion of poor perceptions of radiographers. The participants thought that since this is a new technology AI will review and change the tasks of the radiographers and more investigations and knowledge into AI technology should be of main concern before accommodating the technology. The participants argued that it will change the way they

operate and will promote poor perceptions of radiographers.This was supported by participant E who said it will change how we operate as radiographers. As shown by the passage below;

'Yes*, it's going to change the way we operate as radiographers, it will have an impact on how things are done in the department, it will have an impact on our roles as radiographers'* (Participant E:F:R)

Another participant was also in support of participant E:F:R when he thought that radiographers will be just gatekeepers because all their decision-making will be done by machines only. As exemplified by the extract below;

'I think Radiographers will act as caretakers of the imaging equipment. However, they will be using AI to support the decisions they make when they do their work" (Participant D:M;R)

However participant A:M:R was not in support of this as they thought that none will change just that the radiographers will be obligated to have additional knowledge. This is illustrated by the extract below;

"*Inmyopinion, not much will change, but radiographers will need to increase their knowledge to understand how AI works"*(Participant A:M:R).

Theme 2: Elimination of human errors

The other theme was the elimination of human errors which has the subthemes AI make a wiser decision, elimination of human touch, humans prone to mistakes, AI will reduce stress and burnout, and decision support. The majority of the participants argued that AI would advance the efficiency of clinical practice by eliminating human errors. The passage below supports this;

'*I think there is the elimination of human touch or human interaction when the machines replace people and also human to human interaction will be replaced by the machines due to the fact that humans have limitations"* (Participant A:M:R)

Another participant, F echoed the same sentiments by saying that humans are prone to mistakes and machines are not prone to errors, unlike humans.

'I think AI would improve decision making in the diagnosis of patients because from what I see, machines are very accurate and they are not prone to errors unlike the humans and will surely transform the everyday practice in the radiography field in a good way" (Participant F:M:R)

However another participant (Participant H:F:R) was saying otherwise, the machines are the ones that are prone to mistakes because they are not accurate. As summarized by the quote below;

"*There is the likelihood of mistakes caused by AI-enabled radiography devices. AI also may limit patients' rights to privacy and information disclosure*"

Theme 3: Expansion of knowledge

The third theme is expansion of knowledge which has the subthemes more training and knowledge required, curriculum will change and increased computer literacy. Radiographers believed that before implementing AI, there was a pressing need to increase user literacy of it through education and training. This was supported by Participant A:M:R as demonstrated by the quote below;

'*The computer literacy of radiographers must be improved so as to know how these machines work when they have been implemented in the country. This means the way that radiographers are trained now will be slightly changed"* (Participant A:M:R)

Another participant (C:M:R) is also in support of participant A:M:R as the participant was supporting that radiographers need to have more knowledge so as to know how these AI systems function. This is illustrated by the quote below;

"*AI will change the way radiographers are educated and trained, so that when AI is implemented in the future, they will have adequate knowledge"* (Participant C:M:R)

Participant G:M:R urged that AI must be included in the core curriculum of radiographers so as to increase the knowledge of radiographers. This is illustrated by the quote below;

'*AI should be included in the curriculum of medical students and radiography students also so that they prepare to embrace this technology'* (Participant G:M:R)

Theme 4: AI will promote radiography

The fourth theme is AI will promote radiography and has subthemes which are AI will improve efficiency, AI will improve QA, Improve clinical care, upgrade skills, enhance radiographer's role, change working environment, less congestion, saves time and AI reduces costs. Radiographers believed that AI will improve clinical practice and increase patient care. AI is welcome since it will increase patient safety, diagnostic medical service efficiency, and accuracy. This is illustrated by the quote below by participant F:M:R;

"*In my humble view, adoption of AI will result in an advancement of radiography practice, increase efficiency and also improve quality control procedures, both of which are essential for better clinical care"*(Participant F:M:R)

This was argued by participant G:M:R who said AI must not be trusted as the results by machines will be untrusted. This is exemplified by the extract below;

'*Can the results of AI be considered accurate? Imagine if patients were told that AI has been used for their diagnosis and treatment, they would need to verify accuracy because most people do not trust the help from a machine"* (Participant G:M:R).

DISCUSSION

This study sought to explore Zimbabwean radiographers' perspectives on the impact of AI use on their future roles. According to the researcher's knowledge, this is the first qualitative study to explore the perspectives of Zimbabwean radiographers. Furthermore, the majority of the studies on the viewpoints of radiographers in the literature used a quantitative design[5,6,7]. The current study used a qualitative approach, employing in-depth interviews that gave a wealth of information on radiographers' perceptions of AI because the questions were open-ended.The results of this study will help shed light on how radiographers feel about AI and how confident they will be working with AI in the near future.It is also important because it helps determine whether AI influences the career goals of radiographers. Certainly, the safest integration of AI into clinical imaging can only be achieved through appropriate education of the current and future workforce and the active participation of radiographers in future AI breakthroughs[15].

The radiographers in this study had a generally positive opinion of AI's prospective benefits. This is comparable to a study conducted by Botwe *et al.,*[6]in which the majority of participants predicted that AI would have a beneficial impact on patients and that AI technology would improve radiography practice and quality assurance for fast diagnosis. Similarly in this study, some of participants expected AI to increase efficiency by reducing human error, hence increasing quality assurance and clinical treatment. This is also similar to a study conducted by Ryan *et al.,*[22], in which the majority of participants expected AI to have a good influence on patients and that radiographers should be involved in AI implementation. In terms of AI's positive influence, the majority of the participants in this study stated that AI may be a useful tool for radiographers to make their jobs easier and reduce radiation exposure levels.

In contrast to findings of this study, Sarwar *et al.,*[23] discovered that people over 40 were more favorable about AI than those under 40.Despite some respondents' acceptance of AI, they were concerned about the potential negative impact AI might have on their workforce. They claimed that because of the knowledge gap, the acceptance of AI in Zimbabwe will result in job losses and render radiography education programs obsolete. This point of debate among the participants is unsurprising, given that there has been much discussion on how AI will lead

to the mechanization of professions and the widespread replacement of the human workforce. However, this could be a result of what happened to Dark room assistants with the advent of digital radiography. In Zimbabwe darkroom assistants who were employed by public hospitals to process radiographic films were rendered obsolete by the introduction of digital radiography equipment. This perception of job insecurity has been reported another study [6]. Some radiographers were very concerned about job losses as a result of AI implementation, and they also expressed concerns about a lack of knowledge, which is similar to this study. The radiographers expressed greater concern about a lack of knowledge on how these AI systems work if they are implemented here in Zimbabwe. Some study participants also stated that AI was not fit for Zimbabwe since these technologies would lead to diagnostic medical errors, given the margins of error inherent with all mechanical systems. This appears to be a faulty perception, and it is similar to a study conducted by Sarwar *et al.,*[23]. However, a recent meta-analysis found that AI tools are trustworthy. The disparity between the perception and the literature could be attributed to a lack of understanding of AI technologies' operations and functionalities. A couple of the participants felt that the entire concept of AI technology should be reconsidered and that there was an urgent need to improve awareness among radiographers through education, training, and continual professional development.

In this study, some participants also expressed the hypothetical but unproven belief that incorporating AI will limit the work of the radiographer. However, as supporting tools, these specialists would still be necessary to approve the outcomes of AI systems, according to the literature, and would instead create new professions and improve career opportunities in medical imaging [6]. Some responders in prior studies, voiced worry that the adoption of AI tools could lead to unethical use of patient data for commercial gain [6]. This study is similar in that some respondents voiced ethical reservations about the use of AI in medical imaging. This belief could be based on the fact that current AI systems require patient data for the purpose of training DL algorithms to automate deep tasks. Hence, if data truthfulness and ethical measures have not adhered to patient information may be misused [24].

The findings allow for us to say participants agreed that, given the various benefits, AI was unquestionably the best technology for application in Zimbabwe. They were convinced that AI will lead to a number of advancements and expansions in the field of medical imaging. A misconception arose about the likelihood of reduced the professional–patient interaction, which some feared would have an impact on the psychological components of care. This is comparable to a study done in Saudi Arabia [25]. One participant stated that AI lacks empathy and will diminish radiographer-patient connection, resulting in no patient-radiographer rapport. This assertion is rather flawed, as AI will not eliminate the opportunities for radiographer–patient connection that helps in assessing a patient's psychological state (e.g., pain level) and tailoring care to counteract any anomalous feelings[5]. The radiographer, on the other hand, works in close proximity to the patient. Patients would still need to be positioned by a radiographer for a technique that allows the radiographer to speak with the patient prior to the examination. The radiographer must pay attention to the patient's psychological condition in order to comprehend the various emotional states and provide patient-centered care for better outcomes[5].

When it comes to the elements that can influence the application of AI in medical imaging, the majority of respondents in past research agreed that a lack of adequate cyber security measures and a lack of understanding about the rise of AI technology are key barriers[8]. Furthermore, the majority of respondents said that the expensive cost of AI systems would limit their use. Technological developments in healthcare have already proven to be a barrier to Africa's healthcare system[2]. Economic challenges frequently result in broken equipment as

a result of poor maintenance, and this is likely to be the case with AI. The cost of implementation and maintenance of AI may be prohibitively expensive for developing countries, further lagging them behind in terms of healthcare improvement. Similarly to this study, the majority of respondents were concerned about the country's financial crisis, and they stated that using AI to the country's economic burden would be tough. Participants expressed concern about Zimbabwe's weak equipment maintenance culture, which some believe may make AI a less viable technology for Africa. Poor equipment preservation, poor-quality management systems, and outmoded medical equipment are among the infrastructural concerns identified by studies on medical equipment infrastructure in the West African sub-region [26]. One person, on the other hand, saw AI as a vital tool in medical imaging, just as it is in other professions.

CONCLUSION

The radiographers who participated in this study had a favourable view of the potential benefits of AI in medical imaging. There were enthusiastic about the idea of incorporating AI into medical imaging practice in Zimbabwe, and they believed that it is an essential tool that must be adopted. However, they did not hesitate to raise certain concerns, including the cost of the technology, the impact on the workforce, AI-related blunders, ethical and legal regulatory considerations that may result from data insecurity, and a lack of knowledge/technical expertise. For a successful application of AI in Zimbabwe, African radiographers, imaging professional bodies, AI manufacturers/vendors, policymakers, and all stakeholders, including the Zimbabwean government, must work together to resolve end users' concerns about AI in medical imaging.

RECOMMENDATIONS

- The study found that radiographers in Zimbabwe would need more education on the technology and assurance of their job security.
- Recommend that AI should be included in the curriculum of current and future radiographers so that they will be aware and know how AI works.
- In a low resource setting such as Zimbabwe, where there is a shortage in imaging equipment, personnel expertise, infrastructure, data-rights frameworks, and public policies there is the need to assess the concerns of the radiographers in, particular, to address these anxieties before these implementations are in place.

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