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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE FUTURE OF RADIOGRAPHER CAREER IN SAUDI ARABIA

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ABSTRACT

The emergence of artificial intelligence (AI) technologies in the health care imaging domain has heightened discourse regarding the responsibilities and role of radiologists, thereby bringing this issue to the fore. On the other hand, the extent to which this kind of equipment will alter the radiographer's job has not been much discussed. To examine the potential effects of AI on the radiography job, this study assesses current process and cross-maps potential areas for automation, such as procedure organizing, picture capture, and processing images. We also draw attention to the advantages that AI offers, such as improved patient care, greater technology skills, elevated cross-modality learning and teamwork, and an extension of radiographer duties into AI-supported picture auditing and reporting roles. For the purpose of incorporating AI systems into medical imaging, radiologists are crucial because they serve as a liaison between people and technological advances. Studies have looked at the knowledge, beliefs, and attitudes of Saudi Arabian radiology professionals towards AI to investigate how radiologists react toward AI in radiology and to find out their opinions about AI in the future of radiology.

الخلاصة

تسبب إدخال تقنيات الذكاء الاصطناعي في مجال التصوير الطبي بالرعاية الصحية إلى زيادة النقاش المتعلق بمسؤوليات وأدوار تقنيي الأشعة, مما أدى إلى تسليط الضوء على هذه القضية. ومن ناحية أخرى, فإن مدى تأثير هذا النوع من التقنيات على وظيفة فني الأشعة لم تتم مناقشته كثيرًا. بالتالي, تقوم هذه الدراسة بتقييم العملية الحالية ورسم خرائط شاملة للمجالات المحتملة للأتمتة, مثل تنظيم الإجراءات والتقاط الصور ومعالجة الصور التي بدورها قد تؤثر وظائف تقنيي التصوير الشعاعي بإستخدامها للذكاء الاصطناعي. نلفت الانتباه أيضًا إلى المزايا التي يقدمها الذكاء الاصطناعي, مثل تحسين رعاية المرضى, وزيادة المهارات التكنولوجية, والتعلم المتعدد الأساليب والعمل الجماعي, وتوسيع نطاق واجبات المصور الشعاعي لتشمل أدوار تدقيق الصور وإعداد التقارير المدعومة بالذكاء الاصطناعي. لغرض دمج أنظمة الذكاء الاصطناعي في التصوير الطبي, يلعب تقنيي الأشعة دورًا حاسمًا لأنهم يعملون كحلقة وصل بين المرضى والتقدم التكنولوجي. بحثت الدراسات في معرفة ومعتقدات ومواقف متخصصي الأشعة السعوديين تجاه الذكاء الاصطناعي للتحقيق في كيفية تفاعل أطباء الأشعة تجاه الذكاء الاصطناعي في الأشعة ومعرفة آرائهم حول الذكاء الاصطناعي في مستقبل الأشعة.

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1. INTRODUCTION

The term artificial intelligence (AI) refers to a broad range of topics, including machines that can perform tasks that would normally require human intelligence and their theory development [1]. AI is swiftly transitioning from an experimental phase to an implementation phase in a number of industries, including healthcare [2]. The term "AI" refers to the fields of study and invention that make use of computers to mimic, extend, or even improve human intelligence. The advancement in information technology, algorithms, data analysis, and brain science are all closely related to AI [3]. In a best-case scenario, AI algorithms will give radiologists a new tool, akin to a "second pair of eyes", adding another perspective on cases and enhancing competence and diagnosis accuracy. This is the equivalent of a radiologist seeking a second opinion on a case from a trusted colleague [4]. Because AI is being adopted in this area, radiological workers also need to adapt further to the incorporation of AI and imaging for medical purposes. Innovative equipment should be used to improve medical procedures and imaging because patients will gain advantages from high-quality research and therapy [5].

Radiologists communicate with other members of their profession, referring doctors, and patients using specific vocabulary to explain radiographic appearances in detail in the imaging reports. Radiologists need to become familiar with the fundamental ideas and vocabulary of AI technology as it develops and eventually enters the clinical workflow. AI and machine learning (ML)-related advancements in medicine and, more specifically, radiology, are ongoing [6]. Owing to the simple fact that radiography is among the industries that generates the greatest volume of digital data [7], which results in increased work pressure for experts and radiologists, AI technologies for radiology applications have recently grown in favor among healthcare providers [8]. Consequently, there is a growing need for technologies to be created that can handle some of the workload [9].

Deep learning (DL), a further element of ML scenarios, has demonstrated enormous potential in the analysis of medical images. DL is based on convolutional neural networks that are deep [10, 11]. The reason why DL is so well-liked nowadays is that they achieve fantastic results even at human performance levels [12]. Examples of excellent practices include classifying chest radiographs for triage [13] or pathological processes [14, 15]. depending on abnormalities or disease processes. Others include diagnosing diabetic retinopathy and related eye illnesses with promising outcomes and dermatologists classifying skin cancer with proficiency comparable to human efforts [16, 17]. One medical field that may be most impacted by AI, which replaces radiology specialists, is considered to be radiology [18]. Recently, AI researchers have expressed concern that radiologists may soon be forced to supervise DL or lose their jobs [19].

Opinions of radiologists toward the use of AI in radiology and diagnostics are scare among radiologists all over the world and especially in Saudi Arabia. Therefore, we conducted this literature review to gather different opinions and investigate the behavior of radiologists in Saudi Arabia regarding AI in radiology.

2. APPLICATIONS OF AI IN RADIOGRAPHY

Despite the focus in publications being on evaluating AI with regard to interpreting medical pictures, there are a number of other areas where it will directly affect the function and profession of the radiographer [20]. Different uses of AI in radiology are present including the following:

2.1 Pre-examination assessment

One essential aspect of radiographers' work is their interaction with patients prior to, during, and following their examination procedure. This contact includes verifying identity, verifying that the sought examination is appropriate, and walking the patient through the process. AI technologies may be capable to assist with automated referral vetting, sense-checking clinical indications and choosing the correct imaging tools or method to be employed, in addition to confirming the patient's records through the use of the medical record. However, they are unlikely to completely replace direct interactions between patients and healthcare professionals. AI has the ability to retrieve, ingest, and generate data and information from multiple patient data websites more efficiently than a human radiographer, which presents a natural environment for efficiency improvements. Radiographer supervision and caution are required to ensure that ML choices correspond to reality and that patient information from electronic medical records are not tampered with [21].

2.2 Examination planning

Prior to any imaging modality takes a picture, radiologists are responsible for ensuring that the subject is sitting correctly and, if needed, that vein access is available for the administration of contrast. During CT and MR exams, the patient's place within the gantry or bore is assessed using the scout views (topogram), after which slice/volume or sequence establishing is completed. Non-isocentric patient positioning errors can result in increased patient dose with CT scans and poorer image quality. Although research suggests that isocentric placement, scout picture interpreting, MR plane calculations, and volume calculations are all tasks that AI systems may be capable of automating, this is still an essential part of the

radiographer's job [21, 22].

2.3 Image acquisition

It is crucial for radiographers to select the best imaging protocol according to the area of concern, clinical issue, and patient appearance, but research suggests that this is not always the case within or between hospitals, imaging modalities, or sites [23–26]. New study implies that procedure selection may be automatable as a result [27]. For mammography [28], T and positron emission tomography/CT [29, 30], as well as MR time reduction [31], there are a multitude of AI-driven dose reduction techniques that offer prospects for quicker image acquisition and higher patient throughput. Automated procedures to assist radiologists with technical recollection via automated picture evaluation [32] and attenuation correction [32] are also ready for application [33]. Importantly, ultrasound is a field where investigation excellence has historically been seen as worker- rather than technology-dependent, but there are now opportunities for AI to improve the capture of images. Sonographers will also be able to produce high-quality ultrasound examination reports with a lower error rate by utilizing automated AI ultrasound placing and measurement devices that use AI-driven controlled fetal indicates and kidney function assessment [34, 35], moreover, image quality evaluation [36].

2.4 Image processing

Since many years ago, it has been possible to automate the post-processing of CT, MR, and nuclear medicine investigations, which shortens examination times overall and increases patient throughput. These activities might be carried out at much higher speeds and scales by more recent AI systems, potentially enabling image super-resolution and instantaneous automated segmentation of organs of interest [37]. Early research also suggests that it may be possible to produce CT scans from an MRI scan or vice versa, doing away with the requirement for an additional imaging procedure completely [38].

3. OPPORTUNITIES FOR RADIOGRAPHERS

The coming wave of AI-driven diagnostic imaging equipment will undoubtedly have a profound effect on the practice of radiography across methods as well as the duties of radiographers. The radiography industry, on the other hand, is utilized for transformation and has always welcomed new technologies, particularly when the greatest enhancement of patient satisfaction brought about by technological advancement can be convincingly shown and ethically consistent with radiographers' commitment to provide superior treat-

ment. Radiographers need to respect the primary ethical principle of patient care while also being prepared for the fresh possibilities that these changes will bring. While there are currently few results from qualitative studies showing the clinical effect at scale, the rate of development and technological advances in the field of AI indicate that AI-driven solutions will be prevalent [39].

4. ENHANCED CROSS-MODALITY AND EDUCATIONAL OPPORTUNITIES WITH AN AI FOCUS

Staffing needs will change as a result of enhanced service efficiencies brought about by growing automation. The current state of modality-specific work planning, low cross-modality competency, and constrained job mobility is unlikely to endure. It is to be expected that all radiographers will acquire a range of method and technology-interfacing skills as we proceed toward even greater demands on patients and continuous rises in the need for visualization to support illness assessment, therapy, and follow-up. If AI is going to play a major role in all imaging procedures in the future, then it may be reasonable to expect recent graduates of radiography programs to possess the bare minimum of competencies to oversee and run image collection across the spectrum of imaging modalities, thereby increasing workforce adaptability. Pre-registration radiography initiatives ought to additionally guarantee that graduates understand the fundamentals of AI and its subsets of ML and DL so as to handle them safely and to the fullest extent possible [21]. It is noteworthy that the Topol Review (2019) contends that in addition to requiring healthcare companies to offer opportunities for current staff members to enhance their abilities in order to guarantee comparable information to support adaptation to technology and the required modifications to work actions and atmosphere at work, these alterations to education must be put into effect by 2024. Further training in the statistical foundations of AI systems will also be required to guarantee that radiologists possess the essential evaluation abilities required for AI results in the medical domain. Leadership positions are also expected to drive processes for change management during the implementation and continual upkeep of vendor-specific systems [39].

5. RADIOGRAPHER REPORTING

For over two decades, stating images for diagnosis by properly licensed radiographers has been acknowledged as a role growth in the United Kingdom. Although the main topics of this activity are extension radiography and mammography, data indicates that authorized radiographers with the right support can improve radiologist focusing for a range of imag-

ing techniques [40]. The increase in stating radiographer employees was highlighted in the CQC Radiology Review (2018) and the Cancer Workforce Plan (2017) as being essential to enabling earlier identification of cancer, faster turnaround times for screening for cancer, and the resolution of stating delays [21]. The importance of reporting radiographers was acknowledged in these reports. However, the radiology community is still worried. In order to alleviate residual worries and potentially save costs compared to a single radiologist or radiographer interpreting imaging studies, remedies for AI and radiographer double reading of certain a great deal of modalities, such as chest radiography, CT lung screening, and screening mammography, should be developed [41]. Given this, there's an opportunity to look into places where there are backlogs in reporting or workforce issues, research the viability of radiographer-led, AI-supported reporting offerings, and develop implementation plans for easy, widespread adoption. Furthermore, reporting radiographers can address the issue of autoreporting and an inability to provide certain imaging research by delaying the development of AI-powered triage and review processes for typical images. This is because, according to IR(ME)R, all imaging testing will still need human review and documentation, even if an AI system shows a display is "normal" [39].

6. AUDIT OF AI SYSTEMS

European medical device laws (MDR 2017/745) mandate that quality control inspections be performed on all automated equipment, and reporting radiologists will play a bigger part in routinely auditing and reviewing the results and conclusions of AI image assessment systems [42]. Radiographers must seize this chance to take ownership of the process and possibly create systems in the future to assess the level of parity—or lack thereof—between AI and people perception of images through AI audits and reviews. A proportion of AI automated situations are probably going to need some kind of "peer-review" or post-decision check in order to determine the sensitivity, specificity, and accuracy of the system. It is crucial and should not be disregarded that educational programs and continuing professional development (CPD) support the evolving needs of radiographer employees and how they adjust to new, powered by AI services. To direct and develop such chances, radiologists must, however, possess a high level of understanding in science regarding the functioning and operation of AI systems [39].

7. PERCEPTIONS TOWARDS THE USE OF AI IN RADIOGRAPHY WORLDWIDE

The knowledge, attitudes, and perceptions toward the use of AI in radiography are scare among different radiologists as shown by studies conducted at different centers worldwide. Some studies showed that the radiologists have advance technological knowledge toward AI [43, 44], however, other studies showed the limited knowledge [45]. Regarding the attitude, some people agree that AI in radiology will shows improvement in safety and efficacy of the patients [46, 47]. However, the perceptions toward AI differed across studies, as some radiologists had some concerns and fear about the use if AI and that it would replace radiologists [46], some studies showed mixed feelings of familiarity and confidence [46], while others showed the confidence in the safety and importance of AI in radiology [48].

The majority of respondents to the ASRT 2019 study [46] (North America) anticipated AI-enabled improvements in patient safety and quality, however they were concerned about the profession's patient care-related aspects deteriorating. Following the adoption of AI-enhanced technology, Botwe and colleagues [44, 49] found that the African radiography workforce had comparable strong favorable perceptions of the benefits of AI for quality, safety, and efficiency of the radiographers' workload and dosage reduction.

The 2019 ASRT survey [46] revealed varying degrees of trust and familiarity with AI features. On the other hand, according to the results of the AI survey conducted throughout Africa (n = 1020), 69.1% of participants had a basic understanding of programming and coding, making them better suited to apply AI tools and acquire transferable skills [44].

A nationwide survey of the Irish radiography workforce revealed a resoundingly favourable attitude toward the use of AI in clinical settings to raise standards. It is important to note that even while processes and volumes may accelerate after the deployment of AI, structural problems with excessive imaging requests and greater patient throughput can necessitate long-term fixes [47].

Over 70% of respondents to this survey, according to Akudjedu et al.'s [48] study, report feeling very, sufficiently, or somewhat confident about using AI in their daily work. However, 22.8% of participants report not currently using AI, and 11% report having no confidence at all in using AI technologies. This highlights the disparity between theoretical and applied AI answers.

Rainey et al. [45], carried out an investigation of radiographers in the UK revealed that the workforce lacks the necessary training, expertise, confidence, and skills to fully integrate AI into their daily work.

Due to increased professional and industry networks and interactions, radiologists reportedly have better access to knowledge about AI, according to Chen et al. [43]. It is

more difficult for radiographers to acquire the requisite skills in AI since there are less information sources, connections to the business, and funding options available to them. Only a small portion of the 1041 radiologists who were the subject of a comprehensive survey by Huisman et al [50] who were unaware of AI approaches. The majority's familiarity with AI, whether basic or developed, was associated with a more positive outlook toward the technology, improving the likelihood that it will be used clinically and accepted by the workforce. From acceptance of the apparent inevitable to a joyful eagerness for such change, it appears that AI receptivity might vary [43]. There are higher degrees of positive, active acceptance and involvement as the workforce becomes more educated about AI.

A joint statement from the International Society of Radiographer and Radiological Technologists (ISRRT) and the European Federation of Radiographer Societies (2020) (5) states that radiographers must take an active role in the design, creation, execution, and clinical evaluation of the AI applications. These initiatives ought to focus on the most pressing clinical issues and challenges by providing sufficient training for the workforce, both current and prospective. The Society and College of Radiographers' AI advice document [51] emphasized the importance of AI education, clinical practice advancement, prospective research promotion, and the development of strong alliances with the broader AI ecosystem. In order to bring "actual practice" and "best practice" closer to one another, in particular, radiography requires radiographers to remain professionally up to date on continuing changes to the proof base and advances in technology [52].

Radiographers and radiologists in the Middle East and India expressed some concerns about job security in a survey conducted by Abuzaid et al. [53]. The majority of interviewees thought AI will endanger or interfere with the practice of radiography. Similar to this, 61.3% of respondents to a poll conducted by Botwe and colleagues [44] believe that rather than being an aid, AI could replace radiographers' jobs and harm the field in Africa. There was no agreement, according to research from North America [46] that AI will harm career prospects. More optimistic perspectives on the profession's future emerged from the ASRT study. According to the same survey, the number of medical radiation technologists (or MRTs, as they are known in the USA) would remain constant. The varying points of view could be attributed to a number of things, such as: (a) a level of technological competence and AI knowledge; (b) years of expertise applying AI in clinical settings, which provides a more objective and impartial perspective that is unaffected by individual opinions; (c) the legal framework of radiography in the healthcare sector and the power of imaging professional organizations to influence both practice and policy; and (d) contexts of culture in the setting of health care.

8. PERCEPTIONS TOWARDS THE USE OF AI IN RADIOGRAPHY IN SAUDI ARABIA

Moreover, different knowledge levels and attitudes were observed among radiologists in Saudi Arabia. Some studies showed good knowledge of radiologists in AI and ML use in radiography [54, 55], while other authors showed low levels of knowledge toward AI [56]. Some respondents believed in the role of AI in the advancement of radiography in Saudi Arabia in addition to decreasing the workload and the ability to receive more patients [54, 57], others were concerned about the possible errors of interpretation by AI [58–60], and others had fear about being replaced by AI technologies [55, 61].

Mirza et al. [56] observed that radiology residents receive little exposure to AI and have insufficient understanding predicts low acceptance of AI in radiology. Furthermore, less than 8% of respondents' institutions have varying degrees of AI usage. On the other hand, most of the participants showed an interest in learning AI. Other regional and global studies have examined exposure to and awareness of AI in radiology. 42% of participants in a research by Khafaji et al. comprising Only 6.5% of the 154 radiology residents from the Saudi Board of Radiology who took classes in AI and ML and 4% of them had knowledge in AI and admitted to being familiar with AI in medical imaging [54]. Khafaji et al. reported that a significant portion of radiology residents felt that AI would lessen the workload in the field of radiology [54], while Qurashi et al. [55] stated that over half of radiology staff are worried about the detrimental effects of AI on their field of work.

In a separate nationwide study conducted by Alelyani et al. [62], it was discovered that, out of 714 participants from a variety of radiology-related occupations, 61% had heard of AI in medical imaging, but only 24% had done or were presently doing studies on the topic. However, a second investigation conducted by Qurashi et al. [55] that examined the opinions of 224 participants from various radiology-related jobs towards the deployment of AI discovered that the majority (83%) claimed to be familiar with ML and AI concepts. However, just a small percentage (18%) have been exposed to or have used AI, lamenting the lack of training in formal curricula. According to Abuzaid et al. [53], Saudi Arabian radiologists have difficulty obtaining the education and training they need in AI, and there aren't enough educational opportunities available to support the application of AI.

Qurashi et al. [55] stated that there is a low level of trust among radiologists in the idea of using ML to analyze data for decision-making. This finding's possible cause could be related to worries about patients' own danger when it comes to AI-based interpretation [58]. The literature suggests that although AI can assist with real-time handling of workflows, people should still be in charge of final image interpretation and the prioritization of urgent exams [59], both of which are supported by radiologists and medical students [63, 64]. Since radiologists are obligated to spot potential flaws in AI-based inter-

pretations, the possibility of AI errors could give rise to legal concerns [60]. If radiologists have to review every interpretation, the advantages of AI-based interpretation might be considerably reduced, especially given the increase in images that they must examine. The amount and complexity of reports may rise as more data is created in the future, making the issue worse even with AI support.

Hakami et al. [65] found that 8.8% of students who listed radiology as one of the best three career options claim to be knowledgeable about the field. Furthermore, 10.9% of students who listed radiology as a component of their top three choices for careers strongly agree that they understand how AI would be used in the imaging field. In a related survey administered in April 2019 to three different colleges in Riyadh, Saudi Arabia, five questions about AI were used to assess participants' knowledge. Nearly half of the participants said they understood AI well, but only 22% of the questions had responded correctly on average [61]. It has been demonstrated that prior extensive radiologic exposure and a high degree of knowledge and comprehension of AI reduce anxiety toward AI [66].

According to a recent research done in Riyadh in 2020, half of the students thought that AI would eventually remove the necessity for radiologists [61]. a number of radiologists who are optimistic about the future of AI-assisted radiology, there has been debate about the possible displacement of radiologists due to improved productivity and a resulting decrease in demand for employees due to AI [19].

Aldhafeeri [57] revealed that 90.6% of respondents believed AI to be the discipline's future, with the majority of respondents (73.3%) aware that it is an emerging trend in medical imaging. The majority of participants (72.8%) said that AI may be a useful tool to make their duties as radiographers easier in terms of its positive impact. The MRI technician will examine more people as a result of this outcome. The majority of responders (65.4%) were in support of using AI to improve image quality and dosage. The majority of radiologists (66.3%) said that the introduction of AI in radiology departments will enable them to conduct research and be effective. It's noteworthy that radiographers' opinions on the effects of AI were more strongly connected with educational level than with age or years of experience. This could be explained by the fact that, despite being terminated long ago, diploma curricula still lacked computer science courses, but curricula for bachelor's degrees and higher include courses on computers and programming. This suggests that radiographers should receive training appropriate to their degree of education. These results, however, do not agree with those of earlier research [44, 49]. The geographic and socioeconomic origins of the present and other respondents may contribute to an explanation of the variations seen in this study.

9. CONCLUSION

AI use in radiology is an uprising trend worldwide that we can't deny, therefore it should be incorporated and accurately used in radiology to help radiologists perform better without replacing their roles. Saudi Arabian radiologists are excited about using AI in medical imaging. The incorporation of AI in medical imaging is, however, fraught with worries about job security. The adoption of AI in medical imaging in Saudi Arabia may be challenging, as it was with earlier transformative and revolutionary technologies. Stakeholders should address the significant barriers to the effective deployment of AI, including a lack of expertise, regulatory rules, and support systems.

CONFLICT OF INTEREST

None

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