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Radiologists and Medical Students' Perception and Attitude Towards AI Use in Radiology

Rasha Nadeem Ahmed[1] , Nu'as Waleed Ahmed[2], Ghufran Mohammed Thanoon[2]

[1]Assistant Professor, Dept. of Surgery, Faculty of Medicine, Ninevah University.
[2] Students, College of Medicine, Ninevah University.
The site of study conduction: The study was conducted in Mosul City/ Iraq.
Corresponding Author:
Rasha Nadeem Ahmed
Assistant professor at Ninevah University/ College of Medicine.
E mail: rashana04.rn@gmail.com, rasha.ahmed@uoninevah.edu.iq
0000-0001-5235-5119
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Abstract:

Background: Artificial intelligence (AI) is a developing technology that has a great impact on various aspects, application of AI in healthcare has drawn a significant attention worldwide. Within radiology, the ongoing integration of AI holds great potential for improving medical imaging and helping in the detection of precise abnormalities, opening new field of enhancement and carrying a lot of concerns that will be discussed.

Aim of the study: Is to explore the knowledge and acceptance of the radiologists and medical students upon AI technology and measure the significant differences between these two generations and what are the potential benefits and major concerns.

Martial and methods: Cross-sectional prospective descriptive study, based on online questionnaire.

Results: The study involved 158 individuals, among them, 42 were identified as radiologists, while 116 were medical students, 85.7% of the studied sample comprised highly experienced radiologists with more than 10 years of expertise in their field. Diagnostic radiology emerged as the primary specialty within the vast majority of this studied sample. The other participants encompass students ranging from the 2nd to the 6th stages of their education, alongside recently graduated individuals. Most of these students possess a level of familiarity, ranging from moderate to extensive. The majority within both the radiologist and student groups indicated a moderate level of familiarity with AI concepts, also concepts of AI seem widely accepted overall. Radiologists primarily see potential benefits of AI in medical decision support, aiming to enhance the quality and efficiency of diagnostic radiology.

Conclusion: AI is set to transform healthcare, particularly in radiology, by enhancing diagnostics. Concerns exist about its effects on jobs, privacy, and the personal touch in care. Medical students lack AI knowledge, pointing to the need for better AI education in medical training through practical experience and ongoing learning.

Introduction Artificial intelligence (AI) is a developing technology that has a great impact on various aspects (1)which all can be used to aid human beings perform better function in different fields including the field of health care (2–4). The application of AI in healthcare has drawn a significant attention worldwide (5). Within radiology, the ongoing integration of AI holds great potential for improving medical imaging and helping in the detection of precise abnormalities (6)it helps radiologists with their daily practice which can be performed faster and more efficiently with the aid of AI. (7). Hence, Artificial intelligence (AI) and machine learning (ML) have become some of the most highly discussed topics in radiology, with about 800 related publications in 2017 alone. (8).

AI found its fertile ground for flourishing, and rapid growing in this field, which can help radiologists in the detection of abnormalities by analysing patterns and features in images that may not be easily visible to the human eye, and highlighting potential areas of concerns then characterising these areas. It also has a beneficial role in monitoring and evaluating treatment responses(7,9). Hence, it is better for radiologists to adopt this technology to pursuit the new world and keep up to date for driving the next phase of AI adoption, that would carry a high improvement potentials for the future of radiology field(10)
Choosing radiology as a specialty is preferred for many medical students due to various factors(8) many studies discussed these factors and it's believed that the rational and technical advancement of the specialty, work environment, the help they can provide to the patients and the overall controllable lifestyle.(11–13)On the other hand, there's an overall decline in the number of radiology residency applications in the last decade which reached its lowest in 2015 in the United States that was most likely multifactorial(12,14), Moreover, many studies demonstrated that AI emergence has a negative impact on medical students' choice of radiology as a specialty (15,16)

Modern AI systems in radiology typically rely on machine learning and deep learning algorithms that are trained and tested on a large number of annotated radiological images (17), but there are some challenges and limitations when these are being applied like the availability of enough data, rare findings, regulations and ethical issues, and most importantly the concerns of legal responsibility (10) the rising concern of replacement is not yet proved as the European society of radiology stated that AI will not replace radiologists rather it will increase workflow efficiency and enrich their value and importance. It's worth noted that other specialties will also be impacted by ai such as pathology, oncology, ophthalmology, dermatology and others (8) the aim of the study is to explore the knowledge and acceptance of the radiologists and medical students upon AI technology and measure the significant differences between these two generations and what are the potential benefits and major concerns.

Material and Method: An online questionnaire was crafted using a Google Form, tailored based on insights from a thorough literature review and expert opinions. The intended participants were radiologists, medical students, and recent graduates. This questionnaire was disseminated through medical student and physician social media groups over a span of four weeks, resulting in 158 respondents—42 were radiologists, and 116 were either medical students or recent graduates. Prior to this, a pilot study was conducted to ensure the questionnaire's validity; it operates on a single-blinded basis. This study is characterized as a cross-sectional prospective descriptive study.

Furthermore, ethical clearance was secured from the College of Medicine's Ethical Committee at Ninevah University.

Statistical analysis: The data was saved using Microsoft Excel 2016 and analyzed through IBM SPSS Statistics 28. The analysis involved presenting the data in terms of frequency and percentage distributions.

Results: The study involved 158 individuals who agreed to participate (with an acceptance rate of 95.1%). Among them, 42 were identified as radiologists, while 116 were either medical students or individuals who had recently graduated from medical school.

Among the participants in the study, 85.7% of the studied sample comprised highly experienced radiologists with more than 10 years of expertise in their field. These professionals predominantly operate within general hospitals or private clinics, where the technological equipment facilities are typically described as average. Diagnostic radiology emerged as the primary specialty within the vast majority of this studied sample. Furthermore, the predominant focus of the participating radiologists involves working with ultrasound machines, followed by MRI and CT scan usage

(Table 1).

The participants encompass students ranging from the 2nd to the 6th stages of their education, alongside recently graduated individuals. The greatest concentration was observed among those in the final stages of their education and among the recently graduated cohort. Most of these students possess a level of familiarity, ranging from moderate to extensive, with medical radiology. Surprisingly, over half of the studied sample indicated that they do not envision pursuing a career in radiology. Refer to the accompanying table for detailed statistics. (Table 2).

Table (1): Profile Of Radiologists: Experience, Subspecialties, Imaging Modalities, And Workplace Facilities."

Characteristics	N	Percentage
Years Of Experience		
More Than 10 Years	36	85.7
Less Than 10 Years	4	9.5
Less Than 5 Years	2	4.8
Type Of Facility They Work In		
General Hospital	34	95.2
Private Clinic	24	57.1
University	9	21.4
Facility Supplies Of Technological Equipment		
Highly Supplied	5	12
Average	34	81
Low Supplied	3	7
Radiologists' Subspecialty		
Diagnostic Radiology	39	92.8
Interventional Radiology	2	4.7
Nuclear Medicine	2	4.7
Musculoskeletal Imaging	2	4.7
Cardiovascular Interventional Technology (CVIT)	1	2.4
The Most Imaging Modalities They Work With		
Ultrasound	34	95.2
CT	20	47.6
MRI	22	52.3
Fluoroscopy	7	16.6

Table (2): A comprehensive breakdown of students' grades, familiarity with Artificial Intelligence (AI), and their indicated preferences for future career.

Characteristics	**N**	**Percentage**
Stage They Are In		
2nd Stage	**2**	**1.7**
3rd Stage	**3**	**2.6**
4th Stage	**14**	**12.1**
5th Stage	**39**	**33.6**
6th Stage	**24**	**20.7**
Recently Graduated	**34**	**29.3**
How Familiar They Are With Radiology		
Very Familiar	**10**	**8.6**
Familiar	**37**	**31.9**
Somewhat Familiar	**53**	**45.7**
Unfamiliar	**15**	**12.9**
Very Unfamiliar	**1**	**0.9**
Do They Consider Radiology As Future Career		
First Choice	**9**	**7.8**
Second Choice	**14**	**12.1**
Third Choice	**26**	**22.4**
Don't Consider It	**67**	**57.8**

Table 2: Medical students' demographic characteristics

Understanding and experience:

The majority within both the radiologist and student groups indicated a moderate level of familiarity with AI concepts, while only a minority in each group demonstrated an above-average or excellent understanding of AI. Approximately 73.8% of radiologists reported having experienced the use of AI in radiology, with more than half describing their experience as good or very good.

Remarkably, the collected data reveals that radiologists received a higher rate of training in AI. However, this training was limited within both groups, reflected in the low perception rates regarding AI concepts expressed by both cohorts. For a detailed representation of understanding and experience, refer to Table 3.

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Table (3): Understanding and experience of AI.

Table 3	Understanding And Experience			
	Radiologists		Medical Students	
	N	Percentage	N	Percentage
Familiarity With The Concept Of AI				
Low	7	16.7	19	16.4
Below Average	13	31	32	27.6
Average	15	35.7	43	37
Above Average	5	11.9	13	11.2
Excellent	2	4.8	9	7.8
Personal Experience Using AI Tools (In Your Practice For Radiologist)				
Yes	11	26.2	52	44.8
No	31	73.8	64	55.1
If Yes, What Was The Experience Like?				
Very Good	2	18.2	15	28.8
Good	4	36.3	30	57.6
Undecided	5	45.5	5	9.6
Bad	0	0	2	3.8
Very Bad	0	0	0	0
Receiving Training Or Education On AI				
Yes	10	23.8	13	11.1
No	32	76.2	103	88.9
If Yes, How Was Your Perception And Understanding Of AI				
Very Well	1	10	4	30.7
Well	5	50	4	30.7
Neutral	4	40	2	15.4
Bad	0	0	2	15.4
Very Bad	0	0	1	7.6
Awareness With The Applications Of AI In Radiology				
Yes	24	57.1	29	25
No	9	21.4	50	43.1
Maybe	9	21.4	37	31.9

Table 3: Understanding and experience

Acceptance and benefits:

The concepts of AI seem widely accepted overall, with only a minority from both groups (radiologists and students) expressing opposition to the general perception of AI in radiology.

Additionally, the vast majority from both groups (radiologists and students) agreed that the use of AI in radiology represents a positive development.

Radiologists primarily see potential benefits in decision support, aiming to enhance the quality and efficiency of diagnostic radiology. Conversely, students foresee advantages in faster diagnosis and treatment by managing large datasets, improving diagnostic radiology's quality and efficiency, and augmenting research. Both groups view the future potential of AI as a tool rather than a replacement for humans. Furthermore, a significant proportion of students believe that AI's future potential lies in aiding diagnosis through the utilization of patient data.

The prevailing opinion among the largest proportion of both study groups is that trust in AI algorithms used in radiology requires more time and evidence. Interestingly, no radiologists and only a minority (1.7%) of students trust AI more than humans. For a comprehensive overview of acceptance and benefits, refer to Table 4.

Table (4)Acceptance and benefits of AI .

Table 4	Acceptance And Benefits			
	Radiologists		Medical Students	
	N	Percentage	N	Percentage
The Overall Perceptions Of AI In Radiology				
Strongly Support	4	9.5	12	10.3
Support	12	28.6	50	43.1
Neutral	23	54.8	39	33.6
Oppose	3	7.1	10	8.6
Strongly Oppose	0	0	5	4.3
Is It Positive Or Negative Development				
Positive	35	83.3	101	87.1
Negative	7	16.7	15	12.9
The Potential Benefits				
Improved Accuracy	14	33.3	54	46.5
Enhanced Efficiency	14	33.3	56	48.2
Faster Diagnosis & Treatment	20	47.6	69	59.5
Decision Support	28	66.6	50	43.1
Workflow Optimization	13	30.9	27	23.2
The Particular Benefits Of AI In Specific Areas				
Improving Patients Care	10	23.8	31	26.7
Research Enhancing	18	42.8	58	50
Improvement In Radiotherapy	7	16.6	43	37

Handling Large Data Sets	**17**	**40.4**	**57**	**49.1**
Improving The Quality &Efficiency Of Diagnostic Radiology	**25**	**59.5**	**60**	**51.8**
The Potential Future Benefits				
Capabilities In Clinical Decision-Making	**11**	**26.2**	**36**	**31**
Using Patient Information To Reach Diagnoses	**12**	**28.5**	**49**	**42.2**
Establishing Prognosis And Treatment Plan	**11**	**26.2**	**39**	**33.6**
Will Always Be A Tool Rather Than Human Replacement	**29**	**69**	**47**	**40.5**
Level Of Trust In AI Algorithms				
Don't Trust At All	**3**	**7.1**	**10**	**8.6**
Needs More Time And Evidence To Trust It	**24**	**57.1**	**48**	**41.3**
Undecided	**6**	**14.3**	**30**	**25.8**
It Can Give Trusted Results	**9**	**21.4**	**26**	**22.4**
Trust It More Than Human	**0**	**0**	**2**	**1.7**

Table 4: Acceptance and benefits

Concerns and challenges: Radiologists express concerns primarily about the potential dependence on operators when using AI (They fear that AI systems may not function optimally without consistent input, monitoring, or guidance from skilled operators or radiologists), while students are worried about a perceived lack of empathy in its utilization. Both groups share the belief that the decrease in available jobs will affect specific medical specialties more than the general job market, with radiology anticipated to be the most affected by AI's entry into the field. A significant majority of both radiologists and students voice apprehensions about ethical, legal, and privacy issues related to AI's use. Moreover, they express uncertainty regarding patients' cooperation and the acceptance of this emerging technology in radiology, table 5 shows concerns and challenges.

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Table (5): Concerns and challenges of AI.

Table 5	Concerns And Challenges			
	Radiologists		Medical Students	
	N	Percentage	N	Percentage
Concerns And Challenges About Integration Of AI In Radiology				
Long Time Education	9	21.4	41	35.3
Impact On Physicians' Job Market	18	42.8	38	32.7
Operator Dependency	21	50	45	38.7
Increased Procedural Time	8	19	20	17.2
Poor Performance In Unexpected Situations	15	35.7	43	37
Lack Of Empathy	12	28.5	47	40.5
Will AI Reduce Number Of Jobs Available For				
Most Physicians	5	11.9	39	33.6
Certain Medical Specialties More Than Others	37	88.1	77	66.3
Which Specialty Will Be Mostly Affected				
Radiology	25	59.5	71	61.2
Pathology	6	14.2	7	6
Oncology	5	11.9	15	12.9
Surgery	3	7.1	17	14.6
Internal Medicine	3	7.1	6	5.1
Any Ethical Or Legal Worries About AI Use				
Yes	11	26.2	23	19.8
No	6	14.2	44	37.9
Maybe	25	59.5	49	42.2
Any Privacy Problems About AI Use				
Yes	20	49.6	53	45.6
No	4	9.5	36	31
I'm Not Sure	18	42.8	27	23.2
Will Patients Be Cooperative And Accept This Technology				
Yes	14	33.3	45	38.7
No	5	11.9	14	12.1
I'm Not Sure	23	54.7	57	49.2

Discussion: The world has been transformed by artificial intelligence, and healthcare is undergoing a swift revolution, employing AI across various aspects such as screening, diagnosis, and treatment..(18,19)

Understanding and experience

The integration of AI concepts into medical education is purported to be pivotal for the revolutionization of the field and for preparation of physicians that can cope with the future challenges of merging technologies.(19,20)

The majority of our sample demonstrates a robust understanding of AI concepts, with 83.4% of radiologists and 81% of students displaying familiarity. This contrasts sharply with Sit et al.'s study, which reported a similar understanding among only 44.6% of participants. (3).Various studies have consistently shown that over 65% of respondents are acquainted with clinical AI concepts(21,22), yet a mere 10% to 30% of radiologists have utilized clinical AI in their practice, aligning closely with our survey findings.(16,23–26)

The majority of our sample shows a solid grasp and familiarity with AI concepts, with 83.4% of radiologists and 81% of students understanding these concepts, I n contrast to Sit et al.'s study where only 44.6% had a similar understanding.(3)

When it comes to AI education, a notable portion of our sample—76.25% of radiologists and 88.9% of students—reported a lack of received training, a trend mirrored in Sit et al.'s findings where only a minority (9.1%) had undergone such training. This glaring absence suggests an evident unpreparedness in navigating AI, underscoring the potential urgency of incorporating AI training into both undergraduate and postgraduate medical programs. This aligns with Sit et al.'s study, where a majority (78.1%) advocated for AI training as an indispensable element of a medical degree..(3)

Acceptance and benefits:

In our research sample, an overwhelming majority—83.3% of radiologists and 87.1% of students—view the integration of AI in radiology as a positive advancement. They anticipate its potential to significantly benefit patient care by improving accurate diagnosis, treatment efficacy, aiding medical decision-making, and bolstering research endeavors. Nearly same level of the agreement are noted in previous literature investigating the perception and anticipation of AI future in medical field in general and in radiology in special(3,9)

Trust in AI holds various perspectives. The absence of trust in AI might hinder its development and postpone its crucial role in delivering healthcare to patients. Conversely, excessive trust may pose a dangerous drawback, especially in life-threatening conditions.(27). Clinician trust in AI can stem from various factors including human factors like familiarity, education, attitudes toward technology, past experiences, and AI related factors like operational safety, transparency, data privacy, and the specific capabilities of the system within their field. All these elements contribute to the level of trust clinicians and healthcare providers place in AI.(27,28)

In this study, the highest proportion of radiologists (41.3%) and a significant part of medical students (57.1%) across both groups believe that trust in AI algorithms applied in radiology necessitates additional time and evidence. Notably, none of the radiologists and only a small

minority (1.7%) of students place more trust in AI than in human expertise. this align will with the findings of previous literature in certain ways, for example in Juravle et al the people showed low trust in Ai diagnosis especially when relating to health care of high risk or life threatening diseases. (29) In a multicentric study done in UK medical students (Sits et al.) the students reported a lack of confidence in application of AI.(3) radiologists in other hand expressed cautions on the responsibilities handled by the radiologists regarding the outcome of using AI as well the legal as well ethical prospective as manifested in a study handled by European society of radiology on Impact of artificial intelligence on radiology(9)

Concerns and challenges: The current study reveals a consensus that the specialty most profoundly impacted by AI application is radiology, acknowledged by both radiologists (59.5%) and students (61.2%). .Over half of the students sampled are disinclined to pursue radiology as a future career due to concerns about potential AI replacement, in contrast to a mere 18% of students in Hoek et al.'s study and 49.2% in Sit et al.'s study(3,30). Previous research, such as Hoek t et al., underscores the palpable influence of AI in radiology, with radiologists, surgeons, and students concurring that AI could supplant diagnostic radiology, possibly leading to a future in interventional radiology as the primary focus(30).

Conclusion: Artificial intelligence is set to play a crucial role in the future of healthcare, particularly in radiology. While radiologists and medical students see its potential to enhance diagnostics, they also have concerns about its impact on jobs, patient privacy, and the human aspect of healthcare. The study reveals a significant gap in medical students' familiarity with AI in radiology, emphasizing the need to incorporate comprehensive AI education into medical curricula. This should include practical experiences, workshops, and ongoing learning to equip future doctors with the necessary AI skills.

Author contribution:

Each author made an equal contribution to both the content and drafting of the article.

Declaration of competing interest

There is no conflict of interest to disclose.

Abbreviation:

AI: Artificial intelligence .
CT : computed tomography.
MRI: magnetic resonance imaging.
(ML)machine learning.

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