Original Article

Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Saudi Arabia

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Abstract

Background: Artificial intelligence (AI) is advancing rapidly across fields, including healthcare, where it is being adopted for diagnostics and patient management. However, research on Saudi Arabian healthcare professionals' understanding and perceptions of AI remains limited. **Objectives:** This study aims to assess the knowledge, attitude, and practices (KAP) regarding AI among medical students, interns, and residents, identifying educational gaps and perceptions of AI's future in medicine. **Methods:** A cross-sectional survey was conducted in Riyadh, Saudi Arabia, targeting medical students, interns, and residents. An online questionnaire collected demographic information, as well as participants' knowledge and attitudes towards AI, and their experience with its applications in medicine. Responses were analyzed statistically for any associations. **Results:** Of 374 responses, 98.4% were aware of AI, though only 50.5% could identify AI subtypes, and 48.9% understood its medical applications. Formal AI education was lacking for 59.4%, despite 81.8% recognizing AI's importance in diagnosis. Concerns about AI's impact on jobs were noted by 77.8%. While 62.6% had used AI in practice, 66.6% found it beneficial. **Conclusion:** High awareness of AI contrasts with gaps in specific knowledge and formal training. Positive attitudes are tempered by job security concerns. Findings suggest the need for a structured AI curriculum in medical education to improve comprehension and application in healthcare.

Keywords: Artificial intelligence, attitude, doctor, intern, knowledge, medical student, practice

Introduction

Artificial intelligence (AI) represents a field of computer science focused on creating systems that enable machines to perform tasks typically requiring human intelligence. These tasks go beyond simple preprogrammed instructions and include problem-solving, analyzing visual and auditory data (such as object and speech recognition), and learning from experience to make decisions.[1]

The extensive advancement of AI has allowed for drastic improvements in the medical field. AI is currently used to diagnose patients, plan treatments, and improve all aspects of patient care. Beyond the medical field, AI is playing an increasingly substantial role in the education and training of future healthcare professionals.[2]

Evaluating the knowledge, attitude, and practices (KAP) of healthcare professionals toward AI is essential. Many well-known evaluation methodologies can be used, including standardized surveys, validated questionnaires, and structured interviews. Most of these evaluations measure awareness, usefulness, trust, and readiness for implementation. By understanding these elements, trainers and decision makers can direct training programs, refine implementation strategies, and ensure that AI is integrated into healthcare practice according to professionals' skills and patient needs.[3] This is especially relevant within the

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Received: 05-11-2024 **Revised:** 10-12-2024
Accepted: 13-12-2024 **Published:** 25-04-2025

Access this article online

Quick Response Code:

Website: http://journals.lww.com/JFMPC

DOI: 10.4103/jfmpc.jfmpc_1812_24

How to cite this article: Alabbad FA, Almeneessier AS, Alshalan MH, Aljarba MN. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Saudi Arabia. J Family Med Prim Care 2025;14:1459-64.

Saudi Arabian healthcare context, where the adoption of AI aligns with national goals for healthcare modernization and technological innovation.

There are limited global studies examining the attitudes or knowledge of doctors and medical students regarding AI. For example, two studies from Syria and Pakistan focused on these cohorts.[4,5] Other studies have examined medical students in Oman, Jordan, and Palestine.[2,3,6] Certain studies also focused on specific medical fields such as medicine, pediatrics, emergency and trauma surgery, radiology, and otolaryngology.[1,7-11]

In Saudi Arabia, few studies have been conducted on this topic; some targeted healthcare employees,[12,13] while others targeted medical students.[14,15] Across these studies, there is a common theme of a lack of knowledge but a generally positive perception of AI.

To our knowledge, limited research has been done in Saudi Arabia on physicians and medical students. Therefore, the aim of this study was to further explore the depth of awareness and perceptions that doctors and medical students in Saudi Arabia have about AI and its application. In addition, we are exploring awareness of how AI is currently being used in practice in Saudi Arabian medicine.

Materials and Methods

Study design, participants, and setting

A cross-sectional study was carried out, targeting both male and female residents, interns, and medical students at King Saud University Medical City (KSUMC) in Riyadh, Saudi Arabia. The research took place at KSUMC, encompassing King Khalid University Hospital (KKUH), King Abdulaziz University Hospital (KAUH), and the Dental Hospital. The target population included Saudi residents, interns, and medical students aged eighteen and older who were currently enrolled or working at these medical facilities. The medical students were from the College of Medicine at King Saud University, while the residents were from various medical colleges throughout Saudi Arabia, contributing to a diverse range of educational backgrounds.

Sampling and recruitment

The sample size was calculated using Cochran's formula with a 95% confidence interval, a 5% margin of error, and an estimated population proportion of 0.5, leading to a required sample size of 385. Participants were recruited through an online survey distributed via Google Forms.

Procedure, data collection, and ethical approval

KAP domains were selected for their ability to comprehensively assess healthcare professionals' readiness to adopt AI. These domains are widely used in similar research because they collectively provide a holistic view of factors influencing the integration of new technologies in healthcare.

Data were collected using an online questionnaire adapted from a previous study on AI KAP among medical professionals, with modifications to suit the Saudi population.[4] The questionnaire included sections on demographics, knowledge of AI, attitudes towards AI, and practices involving AI in medical settings. It was tested for validity and showed good psychometrics (the internal consistency of each subscale, with coefficients of 0.795 for knowledge, 0.702 for practice, and 0.663 for attitude).

The survey included an informed consent statement, and participants provided consent by clicking a link before accessing the survey. The survey took approximately 3 minutes to complete, and responses were collected anonymously to ensure confidentiality.

The study was approved by the Institutional Review Board (IRB) of the King Saud University of Research Board (Ref. No. 24/1156/IRB. March 2024).

Measurements

Knowledge of AI

This section contains five questions assessing general knowledge of artificial intelligence: its types, uses in medicine, and integration into medical education and postgraduate training. Yes was rated as one, and No was rated as zero for statistical purposes. A total score of three or greater indicates good knowledge.

Attitude toward AI

This part has six questions exploring attitudes toward AI. These questions cover AI's importance in medicine, its role in diagnosis, training, evaluation, and whether there are concerns about AI taking over physicians' roles or adding burdens to and increasing errors in their practices. For purposes of statistical analysis, the options were rated as Neutral, Disagree, or Strongly Disagree = zero; Agree or Strongly Agree = one. A score of four or above indicates a positive attitude toward AI.

Practice with AI

This part includes four questions regarding the active use of AI in practice. Each question focused on whether the physician used AI in practice, how easy it was to apply, how it helped in making work easier, and how effective it was. For statistical purposes, responses were rated as Yes = one; No, Never Applied or Maybe = zero. A score of two or greater indicates good use in practice.

Statistical analysis

Statistical analysis was done using SPSS version 28 (IBM Co., Armonk, NY, USA). Numerical data were presented as the mean and standard deviation (SD). Categorical data were presented as the frequency and percentage and analyzed using the Chi-square test or exact test as appropriate. Pearson's correlation coefficient was calculated to estimate the degree of correlation between two quantitative variables. Logistic regression analyses were performed to assess different factors associated with poor knowledge, attitude and practice. A two-tailed P value < 0.05 was considered statistically significant.

Results

A total of 58 residents, 166 interns, and 150 medical students responded to our survey, the majority of whom (73.8%) were in the 21 to 25 age group, with a male predominance representing 74.1%. More than two-thirds of medical students (76.7%) were in their third year. Among the residents, 58.6% were training in family medicine and 25.9% were internal medicine residents. In addition, 29.3% and 44.8% of the residents were in R1 and R2 levels, respectively [Table 1].

Table 1: Respondents' demographic data

Item	*n*=374
Age (years)	
≤20	13 (3.5%)
21 to 25	276 (73.8%)
26 to 35	85 (22.7%)
Gender	
Male	277 (74.1%)
Female	97 (25.9%)
Qualification	
Medical student	150 (40.1%)
Medical intern	166 (44.4%)
Resident	58 (15.5%)
Students' academic level	(*n*=150)
2nd year medical student	27 (18%)
3rd year medical student	115 (76.7%)
4th year medical student	4 (2.7%)
5th year medical student	4 (2.7%)
Department	(*n*=58)
Family Medicine	34 (58.6%)
Internal Medicine	15 (25.9%)
Others	9 (15.5%)
Residents' training level	(*n*=58)
R1	17 (29.3%)
R2	26 (44.8%)
R3	11 (19%)
R4	4 (6.9%)

Table 2: Knowledge, Attitude, and Practices of AI
Table 2.1. Respondents' knowledge regarding artificial intelligence (*n*=374)

Item	No	Yes
Do you know what artificial intelligence is?	6 (1.6%)	368 (98.4%)
Are you aware of the subtypes of AI, such as machine learning and deep learning?	185 (49.5%)	189 (50.5%)
Do you know about any application of AI in the medical field?	191 (51.1%)	183 (48.9%)
Have you ever been taught about artificial intelligence in medical school?	222 (59.4%)	152 (40.6%)
If you are a postgraduate, does your training include a curriculum regarding AI?	204 (54.5%)	27 (7.2%)
Applications of AI in the medical field		
Assessing diagnosis	306 (81.8%)	
Making diagnosis	198 (52.9%)	
Assessing management	266 (71.1%)	
Providing management	202 (54.0%)	

Most respondents (98.4%) had knowledge of AI, with around half (50.5%) being aware of AI subtypes like machine learning and deep learning, and 48.9% knowing about its applications in the medical field. Only 40.6% had been taught about AI in medical school, while just 7.2% of postgraduates had AI training in their curriculum.

Regarding attitude, 81.8% agreed that AI aids in early diagnosis and disease assessment, while 79.7% believed AI is essential in the medical field, and 75.9% supported its inclusion in medical and specialist training. However, some answers showed concerns about AI potentially replacing physicians or increasing burdens and errors.

In terms of practice, 62.6% had applied AI in their field, with 52.1% finding it easy to use, 68.2% stating it simplified tasks, and 66.6% finding it beneficial in their specialty [Table 2].

Most respondents (77.8%) demonstrated poor knowledge and attitude toward AI with a mean score of 2.46 ± 1.19 for knowledge and 3.43 ± 1.31 for attitude. Conversely, most participants showed good practice (67.6%) with a mean score of 3.39 ± 1.58 [Table 3].

According to Pearson's correlation analysis, there was a significant positive correlation between knowledge score and each attitude ($r = 0.202$, $P < 0.001$) and practice scores ($r = 0.261$, $P < 0.001$) and between attitude and practice scores ($r = 0.279$, $P < 0.001$) [Table 4].

Demographics had a significant relationship with KAP levels. Regarding knowledge, respondents aged 21–25 years (91.6%) and medical students (78.3%) demonstrated significantly greater awareness than those from other groups ($P < 0.001$). Concerning attitudes, males were more favorable toward AI ($P = 0.015$). Lastly, there was a significant association between age and practice levels, with respondents aged 21 to 25 years (78.3%) and medical students (46.6%) demonstrating better practice ($P = 0.010$ and $P = 0.001$, respectively) [Table 5].

Discussion

The results of our study provide an understanding of the knowledge, attitude, and practice of artificial intelligence among residents, interns, and medical students at King Saud University Medical City (KSUMC). Most respondents expressed familiarity with AI, yet a substantial portion struggled to identify specific AI subtypes such as machine learning or fully understand their potential medical applications. There appears to be a significant gap between general awareness and specific knowledge of AI subtypes and their applications.

Most responders reported a lack of formal education on AI, and very few postgraduate learners reported exposure to any structured AI curriculum. This raises an issue that aligns with results from similar studies that were conducted in other regions, including Saudi Arabia. For instance, a study in India (Kalaimani *et al.*, 2023)[16] found that many lacked formal education on AI applications, although they had a high awareness of AI. Another

Table 2.2. Respondents' attitude regarding artificial intelligence (*n*=374)

Item	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Do you believe AI is essential in medical field?	2 (0.5%)	14 (3.7%)	60 (16%)	183 (48.9%)	115 (30.7%)
Do you think AI should be included in curriculum in medical school as well as specialist training?	4 (1.1%)	18 (4.8%)	68 (18.2%)	172 (46%)	112 (29.9%)
Do you think that AI aids practitioner in early diagnosis and assessment of severity of diseases?	3 (0.8%)	13 (3.5%)	52 (13.9%)	199 (53.2%)	107 (28.6%)
Do you believe that AI will replace physicians in future?	127 (34%)	146 (39%)	60 (16%)	31 (8.3%)	10 (2.7%)
Do you believe AI would be a burden for practitioners?	39 (10.4%)	159 (42.5%)	122 (32.6%)	40 (10.7%)	14 (3.7%)
Do you believe AI would increase the percentage of errors in diagnosis?	27 (7.2%)	128 (34.2%)	135 (36.1%)	67 (17.9%)	17 (4.5%)
According to you, what might be the reason for the reduced utilization of AI in the medical field in Saudi Arabia?					
Lack of interest			146 (39%)		
Lack of awareness			232 (62%)		
Lack of proper training			262 (70.1%)		
Lack of proper teaching in medical school			179 (47.9%)		
Lack of financial resources			111 (29.7%)		
Lack of technological advancement			172 (46%)		

Categorical data are presented as frequency (%)

Table 2.3. Respondents' practice regarding artificial intelligence

Item	*n*=374
Have you ever applied AI technology in any field?	
No	140 (37.4%)
Yes	234 (62.6%)
Was it easy for you to apply AI in the medical field?	
No	26 (7%)
Yes	195 (52.1%)
Never used	153 (40.9%)
Did AI make your task easy?	
No	7 (1.9%)
Yes	255 (68.2%)
Never applied	112 (29.9%)
Do you think using AI is helpful in your specialty?	
No	14 (3.7%)
Yes	249 (66.6%)
Maybe	111 (29.7%)
Do you think physician role is important in application and evaluation of AI in medical field?	
Disagree	5 (1.3%)
Neutral	35 (9.4%)
Agree	148 (39.6%)
Strongly agree	186 (49.7%)

Categorical data are presented as frequency (%)

Table 3: Total knowledge, attitude, and practice of artificial intelligence scores

Item	Category	Frequency (*n*=374)	Percentage (%)	Score
Knowledge	Poor	291	77.8%	2.46±1.19
	Good	83	22.2%	
Attitude	Poor	291	77.8%	3.43±1.31
	Good	83	22.2%	
Practice	Poor	121	32.4%	3.39±1.58
	Good	253	67.6%	

study done in Syria by Swed *et al.* (2022)[4] reported that healthcare providers lacked formal AI training, noting the need for structured AI education. Similarly, a survey conducted in Saudi Arabia by Faroog *et al.* (2024)[15] highlighted the significance of incorporating AI education into the medical curriculum. The findings revealed a limited understanding of AI among medical students, primarily attributed to the absence of structured AI education within their standard training. In contrast to regions that implemented AI training earlier with well-established guidelines and faculty development programs, the relative lack of formal AI education among Saudi respondents may stem from the rapid evolution of AI technologies, limited understanding of their educational potential, and the ongoing process of integrating AI into the national medical curriculum. These global findings of the lack of education in AI emphasize the gap in AI education and the need for AI education across different regions and specialties.

Even with these educational deficiencies, the overall attitude regarding AI was positive among the respondents. A strong endorsement of AI's significance in enhancing diagnostic precision and patient care has emerged, reflecting a wide-ranging appreciation of its clinical potential. However, many respondents still expressed negative attitudes. This result of positive perceptions coexisting with negative attitudes reflects the concerns among healthcare providers regarding AI's impact on healthcare providers' occupations. Similar doubts have been observed in a study done in Sudan by Jaber Amin *et al.* (2024),[17] which found that healthcare providers expressed concerns regarding AI potentially compromising their clinical judgment or replaces certain medical roles. which reinforce that these feelings are not isolated, but part of a larger cultural and professional dialogue on how AI will redefine traditional clinical roles. Another study conducted in private clinics in Saudi Arabia by Serbaya *et al.* (2024)[18] showed similar results of concern about AI replacing their jobs, even though they had an optimistic attitude. The coexistence of positive

attitudes toward AI's potential benefits and concerns regarding its impact on physicians' roles could reflect both cultural and professional nuances within the Saudi healthcare setting. While professionals acknowledge AI's potential to improve efficiency, accuracy, and patient outcomes, they also fear losing clinical autonomy, compromising the physician-patient bond, and ceding decision-making authority. Addressing this tension requires open communication, clear guidelines, and reassurance that AI is meant to support, not replace, the physician's role.

The actual implementation of AI in practice is an interesting idea; as many participants have started incorporating AI tools into their clinical practices, showing their willingness to adopt modern technologies and recognize their practical utility. This result aligns with the findings in a study conducted in Pakistan by Ahmed *et al.* (2022),[5] which found a growing trend in the adoption of AI in clinical practice, especially in diagnostic imaging and patient management.

Table 4: Correlation between knowledge, attitude, and practice of artificial intelligence scores

Item		Knowledge	Attitude
Attitude	*r*	0.202	
	P	<0.001	
Practice	*r*	0.261	0.279
	P	<0.001	<0.001

r: Pearson's correlation coefficient, Statistical significance at $P<0.05$

Higher degrees of AI knowledge and competence are correlated with greater practical application of AI tools and a more positive attitude, as shown by our correlation analysis of knowledge, attitude, and practice. These findings are consistent with the results demonstrated by Ahmed *et al.*[5] (2022) and Jaber Amin *et al.* (2024),[17] who both found that a better attitude and more frequent usage of AI in clinical practice is related to higher AI education.

Nevertheless, using AI in clinical practice remains early as there are still many obstacles to overcome when using AI, particularly inadequate awareness (62%) and training (70.1%). This aligns with the results of a study done by Aboalshamat *et al.* (2022)[19] to assess the level of readiness of medical and dental professionals to adopt AI for Saudi Arabia's Vision 2030. All over the world, similar issues have been noted and documented, which proves that not only Saudi Arabia but also many countries are facing these difficulties. It highlights the necessity of a uniform AI education framework for medical curricula to support healthcare providers.

Limitations of the study

This study has some limitations. The first one being that the sampling was conducted at a single facility, which introduces the risk of sampling bias and limits the generalizability of the findings to all healthcare workers in Saudi Arabia. To obtain a more accurate representation, future studies should encompass a wider range of facilities and diverse subgroups within the population. Second, data collection relied on self-reported responses, which

Table 5: The relation between respondents' demographics and their knowledge, attitude, and practice levels of AI

Item	Knowledge		*P*	Attitude		*P*	Practice		*P*
	Poor (*n*=291)	Good (*n*=83)		Poor (*n*=291)	Good (*n*=83)		Poor (*n*=121)	Good (*n*=253)	
Age (years)									
≤20	8	5	<0.001	8	5	0.261	4	9	0.010
21 to 25	200	76		219	57		78	198	
26 to 35	83	2		64	21		39	46	
Gender									
Male	213	64	0.473	207	70	0.015	86	191	0.362
Female	78	19		84	13		35	62	
Qualification									
Medical intern	150	16	<0.001	137	29	0.135	66	100	0.001
Medical student	85	65		110	40		32	118	
Resident	56	2		44	14		23	35	
Students' academic level	(*n*=85)	(*n*=65)		(*n*=110)	(*n*=40)		(*n*=32)	(*n*=118)	
2nd year medical student	25	2	<0.001	21	6	0.652	5	22	0.964
3rd year medical student	53	62		82	33		25	90	
4th year medical student	4	0		4	0		1	3	
5th year medical student	3	1		3	1		1	3	
Department	(*n*=56)	(*n*=2)		(*n*=44)	(*n*=14)		(*n*=23)	(*n*=35)	
Family Medicine	32	2	0.691	27	7	0.759	14	20	0.360
Internal Medicine	15	0		11	4		4	11	
Others	9	0		6	3		5	4	
Residents' training level	(*n*=56)	(*n*=2)		(*n*=44)	(*n*=14)		(*n*=23)	(*n*=35)	
R1	16	1	0.560	14	3	0.899	5	12	0.585
R2	26	0		19	7		11	15	
R3	10	1		8	3		6	5	
R4	4	0		3	1		1	3	

Statistical significance at $P<0.05$

can introduce biases. Response bias, where participants may provide answers they perceive as desirable or expected, could have influenced the accuracy of the findings. For example, participants may have provided answers that they felt were more socially acceptable rather than reflecting their true feelings, resulting in social desirability bias. In addition, self-reported responses depend on respondents' ability to accurately recall and evaluate their own KAP, which may lead to inaccuracies or overestimation of their competencies. Lastly, the cross-sectional nature of this study limits the ability to infer causality. Longitudinal studies are needed to better explore trends and changes in awareness over time.

Conclusion

The study highlights a significant gap between general awareness of AI and specific knowledge of its subtypes and applications among healthcare professionals at KSUMC. Despite high overall familiarity with AI, formal education on AI remains lacking, aligning with global trends in various regions. While respondents acknowledge AI's potential in healthcare, concerns about its impact on clinical roles persist. The practical implementation of AI is growing, with many finding it beneficial in their specialty, though its adoption is still in the early stages due to insufficient awareness and training. These findings underscore the need for structured AI education in medical curricula to better equip future healthcare providers.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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