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Knowledge and attitude of Egyptian medical students towards artificial intelligence application in medical practice: A national cross-sectional study

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Abstract

Background

The rapid advancement of artificial intelligence (AI) has significantly impacted various fields, including medicine. As AI integration in medicine expands, medical students and professionals need to develop a comprehensive understanding of its applications. This study aimed to explore the knowledge and attitude of undergraduate Egyptian medical students regarding artificial intelligence application in medical practice.

Methods

A national cross-sectional study was conducted during the spring semester of 2024/2025 among undergraduate medical students from seven Egyptian medical schools. Participants were recruited using convenience sampling. Data was collected via a validated structured web-based questionnaire distributed through social media to assess students' demographics, knowledge, and attitudes toward AI applications in medical practice.

Results

This study included 1438 medical students with a mean age of 20.3 years (± 1.9 years). Overall, 55.3% demonstrated good knowledge and 66.8% showed a positive attitude toward AI applications in medical practice. Good knowledge was significantly higher among students in higher academic years (3rd year AOR = 1.88, P = 0.006; 4th year AOR = 2.02, P = 0.007; 5th year AOR = 1.86, P = 0.034) and among those reporting peers and mentors (AOR = 1.35, P = 0.017), scientific papers and books (AOR = 1.71, P < 0.001), training courses (AOR = 1.43, P = 0.004), and mass media (AOR = 1.32, P = 0.036) as their main sources of AI information. A positive attitude toward AI was significantly more common among male students (AOR = 1.50, P = 0.001), 4th-year students (AOR = 1.97, P = 0.014), and those willing to enroll in an AI course (AOR = 1.30, P = 0.039). YouTube was perceived as the most valuable social media source for AI-related information (90.4%), followed by Telegram (86.6%) and WhatsApp (65.2%).

Conclusions

Although the Egyptian medical students recognize the inevitability of AI and are willing to learn, they are currently navigating this transition without adequate institutional guidance. To bridge the gap, medical schools must formalize AI education to integrate technical literacy and ethical reasoning directly into the core curriculum.

INTRODUCTION

The integration of artificial intelligence (AI) into healthcare is rapidly transforming the landscape of medicine and medical education. AI applications now extend across diagnostic imaging, electronic health records, clinical decision support systems, and even surgical procedures, promising to enhance diagnostic accuracy, improve treatment outcomes, and streamline workflows [1]. As AI continues to evolve, it is crucial that future healthcare professionals—particularly medical students—are adequately prepared to work alongside such technologies [2]. This preparation requires not only technical knowledge but also a foundational understanding of the ethical, practical, and clinical implications of AI in medicine [3, 4].

Despite growing global interest, studies have revealed variable levels of awareness, attitudes, and readiness among medical students regarding the role of AI in clinical practice. In many settings, students report limited formal education or training on AI, leading to gaps in both knowledge and confidence in using such technologies in the future [5, 6]. Moreover, attitudes toward AI are often shaped by media influence, perceived threats to job security, and misconceptions about the capabilities and limitations of machine learning systems [2, 7]. These factors contribute to the importance of systematically assessing the knowledge, attitudes, and practices (KAP) of medical students regarding AI.

Despite a growing body of local literature exploring AI in medical education [7–11], significant knowledge gaps persist. Previous research in Egypt has been constrained by regional focus, modest sample sizes, or heterogeneous cohorts that dilute the specific perspectives of medical undergraduates. This study transcends these limitations by conducting a rigorous national reassessment. By employing a large, representative sample and robust multivariable analysis, we provide the definitive evidence base required to inform future medical curricula in the AI era.

This study aims to explore the knowledge and attitude of undergraduate medical students across Egypt regarding artificial intelligence in medical practice. By conducting a national cross-sectional survey across various medical faculties, this research seeks to identify current educational gaps and student concerns about AI tools. The findings are expected to guide educators, policymakers, and stakeholders in enhancing AI-related competencies within undergraduate medical curricula and fostering a generation of digitally literate physicians.

METHODS

Study design, setting and participants:

A Cross-sectional study was conducted among university undergraduate medical students in Egypt during the spring semester of the academic year 2024/ 2025. The study included medical students from conveniently selected seven Egyptian medical schools of the following Egyptian universities: Mansour, New Mansoura, National Mansoura, Delta, Hours, Tanta, and Port Said Universities. The inclusion criteria were medical students at all medical levels, including medical interns. The exclusion criteria included students who did not consent to participate.

Sample Size calculation:

The minimum sample size was calculated using OpenEpi Version 3.01. At a 78.3% prevalence of good knowledge among medical students about AI [7], a confidence level of 95%, an alpha error of 0.05 and power of 0.80; a total of 262 medical students were required. Adding 20% of this number to compensate for response failure, the final minimum sample size was about 315 medical students. This careful calculation guarantees that our results are statistically sound and accurately represent the target population.

Sampling strategy:

Participants were recruited from all medical faculties across Egypt using convenience sampling techniques. Data collection was conducted through an online questionnaire hosted on Google Forms. The survey link was initially shared with student representatives and active members of academic and extracurricular groups within various medical faculties. The survey link was disseminated through the official WhatsApp groups encompassing all academic grades within each participating faculty, ensuring broad and structured coverage of the target student population. Periodic reminders were subsequently sent through the same channels to encourage participation, particularly among students who had not yet responded, with the aim of enhancing the overall response rate. No incentives were provided for participation, ensuring that responses were voluntary and unbiased.

Study tools

The study used a web-based validated questionnaire available in English developed based on existing scientific publications [7, 11–14].

The questionnaire comprised 28 items distributed across five parts: The first part: demographic characteristics of the participants including age, gender, and academic level (3 items). The second part: students' sources of information about AI application in medicine and their desire to register for courses about AI in medical practice (2 items). The third: students' knowledge regarding AI in medical practice (6 items). The fourth part: students' attitude regarding AI in medical practice (16 items). The fifth part: students' opinion about the valuable social media sources for information on AI applications in medicine (1 item).

To ensure the instrument's conceptual rigor, content validity was established through an evaluation by a jury of five independent experts in Public Health and Medical education. The panel assessed each item for relevance and clarity using a four-point Likert scale. A Content Validity Index (CVI) was subsequently calculated at both the item (I-CVI) and scale (S-CVI) levels to quantify expert agreement. This quantitative validation ensured the questionnaire was methodologically robust and culturally adapted for the study population. A detailed version of the complete questionnaire, including all knowledge and attitude items, is provided in Supplementary File 1.

Statistical analysis:

The collected data was coded, processed and analyzed using IBM SPSS program (Version 22) for windows. Categorical data were presented as the frequency and percentage and analyzed using the Chi-square test. Numerical data were presented as the mean and standard deviation (SD). For questions related to knowledge, a score of “1” was assigned if the answer was yes, while “0” was assigned if the answer was no or not sure. All six items were then summed up to calculate the total knowledge score (6 points). Participants were considered to have good knowledge level if they have > 50% of total awareness score. Scores for each of the items in the attitude section ranged from “0” strongly disagree, disagree and neutral to “1” for strongly agree and agree (reversed coding for attitude item 10 to item 16). Subsequently, the total attitude score was calculated by summing all items (16 points). Participants were considered to have positive attitude level if they have > 50% of total attitude score. Logistic regression analysis was performed to assess different factors associated with poor awareness and attitude. A two-tailed *P* value < 0.05 was considered statistically significant.

RESULTS

Participants’ demographics

This study included 1438 medical students with a mean age of 20.3 years (± 1.9 years). More than half of the participants were males (58.9%), while females constituted 41.1%. Students from all academic levels were included; about one-third were first-level students (32.3%), followed by second-level (21.8%) and third-level (21.1%) students. The remaining participants were fairly distributed across the higher academic years (Table 1).

Table 1
Sociodemographic characteristics of studied medical students and their sources of information about AI, Egypt 2025 (n = 1438).

Demographic characteristics	N	%
Age		
17–19 years	577	40.1%
20–22 years	663	46.1%
23–25 years	198	13.8%
Mean ± SD (min – max)	20.3 ± 1.9 years (17–25)	
Gender		
Male	847	58.9%
Female	591	41.1%
Academic level		
1st level	465	32.3%
2nd level	313	21.8%
3rd level	305	21.2%
4th level	151	10.5%
5th level	91	6.3%
Interns	113	7.9%
What are your sources of information about AI applications in medicine?*		
Social media	1260	87.6%
Peers/Colleagues/Mentors	1060	73.7%
Webinars/lectures /Conferences	928	64.5%
Scientific papers and books	812	56.5%
Educational Curriculum	785	54.6%
Training Course	634	44.1%
Mass media	336	23.4%
Are you willing to register for a course about AI applications in medical practice?		
Yes	797	55.4%
*students' responses are not mutually exclusive		

Demographic characteristics	N	%
Age		
No/ not sure	641	44.6%
*students' responses are not mutually exclusive		

Social media was the most frequently reported source of information about AI applications in medicine (87.6%), followed by peers/mentors (73.7%) and webinars or conferences (64.5%). Moreover, more than half of the students (55.4%) expressed willingness to register for a course on AI in medical practice (Table 1).

Medical Students' knowledge and attitudes toward AI in medical practice

As shown in Table 2, 55.3% of medical students demonstrated good knowledge about AI in medical practice, while 44.7% showed poor knowledge. In addition, two-thirds of the participants (66.8%) had a positive attitude, compared with 33.2% showing a negative attitude. Students' responses to knowledge and attitude questions are found in the Online Resource. The detailed distributions of students' knowledge and attitudes toward AI applications in medical practice are provided in Supplementary File 2.

Table 2
Distribution of studied medical students according to their knowledge and attitude toward AI applications in medical practice, Egypt 2025 (n = 1438).

Studied parameter		N	%
Students' Knowledge level	Good	795	55.3%
	Poor	643	44.7%
Students' attitude level	Positive	960	66.8%
	Negative	478	33.2%

Determinants of AI Knowledge Among Medical Students

Table 3 presents the associations between students' knowledge of AI and their demographic characteristics. Univariate analysis indicated a significant association between knowledge level and academic level (p = 0.034). Multivariate logistic regression revealed that students in the 2nd, 3rd, 4th, and 5th years had significantly higher odds of good knowledge compared to interns (AOR = 1.75; 95% CI: 1.11–2.76; AOR = 1.88; 95% CI: 1.19–2.96; AOR = 2.02; 95% CI: 1.22–3.36; and AOR = 1.86; 95% CI: 1.05–3.31, respectively). However, students in the 1st level did not show any significant difference. Regarding sources of information about AI applications in medical practice, univariate analysis showed that most

of information sources were significantly associated with good knowledge level. Moreover, multivariate analysis showed that good knowledge was significantly higher among students reported peers and mentors (AOR = 1.35; 95% CI: 1.06–1.73) and scientific papers and books (AOR = 1.71; 95% CI: 1.33–2.21) as sources of information about AI. In addition, students reported training courses and mass media as sources of information had significant good knowledge compared to non-users of these sources (AOR = 1.43; 95% CI: 1.12–1.82 and AOR = 1.32; 95% CI: 1.02–1.72 respectively) (Table 3).

Table 3
Univariate and multivariate analysis of factors associated with medical students' knowledge about AI applications in medical practice, Egypt 2025. (n = 1438).

Demographic characteristics		Knowledge about AI in medical practice		P value [a]	AOR (95%CI) P value [b]
		Poor (n = 643) N (%)	Good (n = 795) N (%)		
Age	**17–19 years**	262 (45.4%)	315 (54.6%)	0.059	-
	20–22 years	279 (42.1%)	384 (57.9%)		
	23–25 years	102 (51.5%)	96 (48.5%)		
Gender	**Male**	370 (43.7%)	477 (56.3%)	0.346	-
	Female	273 (46.2%)	318 (53.8%)		
Academic year	**1st level**	216 (46.5%)	249 (53.5%)	0.034	1.40 (0.90–2.16) P = 0.134
	2nd level	133 (42.5%)	180 (57.5%)		1.75 (1.11–2.76) **P = 0.015**
	3rd level	125 (41.0%)	180 (59.0%)		1.88 (1.19–2.96) **P = 0.006**
	4th level	63 (41.7%)	88 (58.3%)		2.02 (1.22–3.36) **P = 0.007**

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group

Demographic characteristics		Knowledge about AI in medical practice		P value [a]	AOR (95%CI)
		Poor (n = 643)	Good (n = 795)		P value [b]
		N (%)	N (%)		
	5th level	40 (44.0%)	51 (56.0%)		1.86 (1.05–3.31) **P = 0.034**
	Interns	66 (58.4%)	47 (41.6%)		1 (r)
What are your sources of information about AI applications in medicine?					
Social media	**Yes**	557 (44.2%)	703 (55.8%)	0.302	-
	No	86 (48.3%)	92 (51.7%)		
Peers/Colleagues/ Mentors	**Yes**	442 (41.7%)	618 (58.3%)	< 0.001	1.35 (1.06–1.73) **P = 0.017**
	No	201 (53.2%)	177 (46.8%)		1 (r)
Webinars/Lectures /Conferences	**Yes**	380 (40.9%)	548 (59.1%)	< 0.001	0.965 (0.74–1.27) P = 0.796
	No	263 (51.6%)	247 (48.4%)		1 (r)
Scientific papers and books	**Yes**	299 (36.8%)	513 (63.2%)	< 0.001	1.71 (1.33–2.21) **P < 0.001**
	No	344 (55.0%)	282 (45.0%)		1 (r)
Educational Curriculum	**Yes**	306 (39.0%)	479 (61.0%)	< 0.001	1.12 (0.86–1.46)

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group

Demographic characteristics		Knowledge about AI in medical practice		P value [a]	AOR (95%CI)
		Poor (n = 643) N (%)	Good (n = 795) N (%)		P value [b]
					P = 0.401
	No	337 (51.6%)	316 (48.4%)		1 (r)
Training Course	**Yes**	231 (36.4%)	403 (63.6%)	< 0.001	1.43 (1.12–1.82) **P = 0.004**
	No	412 (51.2%)	392 (48.8%)		1 (r)
Mass media	**Yes**	125 (37.2%)	211 (62.8%)	0.002	1.32 (1.02–1.72) **P = 0.036**
	No	518 (47.0%)	584 (53.0%)		1 (r)
Are you willing to register for a course about AI applications in medical practice?	**Yes**	341 (42.8%)	456 (57.2%)	0.238	-
	No	74 (45.7%)	88 (54.3%)		
	Not sure	228 (47.6%)	251 (52.4%)		

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group

Determinants of attitudes toward AI among medical students

Table 4 shows the association between attitudes of medical students toward AI applications in medical practice and their personal characteristics. Univariate analysis showed a significant association between both students' gender and academic level and their attitude toward AI applications in medical practice. Multivariate analysis showed that male students have significant positive attitude compared to female students (AOR = 1.50; 95% CI: 1.19–1.90). Additionally, 4th-level students were more likely to show a positive attitude compared with interns (AOR = 1.97; 95% CI: 1.15–3.36). Furthermore, students willing to

enroll in an AI course were significantly more likely to hold a positive attitude (AOR = 1.30; 95% CI: 1.01–1.66) (Table 4).

Table 4
Univariate and multivariate analysis of factors associated with medical students' attitude toward AI applications in medical practice, Egypt 2025. (n = 1438).

Demographic characteristics		Attitude toward AI in medical practice		P value [a]	AOR (95%CI)
		Negative (n = 478) N (%)	Positive (n = 960) N (%)		P value [b]
Age	17–19 years	182 (31.5%)	395 (68.5%)	0.125	-
	20–22 years	218 (32.9%)	445 (67.1%)		
	23–25 years	78 (39.4%)	120 (60.6%)		
Gender	Male	254 (30.0%)	593 (70.0%)	0.002	1.50 (1.19–1.90) **P = 0.001**
	Female	224 (37.9%)	367 (62.1%)		1 (r)
Academic level	1st level	144 (31.0%)	321 (69.1%)	0.031	1.46 (0.94–2.27) P = 0.093
	2nd level	102 (32.6%)	211 (67.4%)		1.32 (0.84–2.10) P = 0.231
	3rd level	113 (37.0%)	192 (63.0%)		1.15 (0.73–1.81) P = 0.558
	4th level	38 (25.2%)	113 (74.8%)		1.97 (1.15–3.36) **P = 0.014**
	5th level	33 (36.3%)	58 (63.7%)		1.35 (0.755–

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group.

Demographic characteristics		Attitude toward AI in medical practice		P value [a]	AOR (95%CI)
		Negative (n = 478) N (%)	Positive (n = 960) N (%)		P value [b]
					2.41) P = 0.312
	Interns	48 (42.5%)	65 (57.5%)		1 (r)
What are your sources of information about AI applications in medicine?					
Social media	**Yes**	406 (32.2%)	854 (67.8%)	0.029	1.38 (0.98–1.93) P = 0.063
	No	72 (40.4%)	106 (59.6%)		1 (r)
Peers/Colleagues/ Mentors	**Yes**	337 (31.8%)	723 (68.2%)	0.051	1.11 (0.852–1.44) P = 0.447
	No	141 (37.3%)	237 (62.7%)		1 (r)
Webinars/Lectures /Conferences	**Yes**	284 (30.6%)	644 (69.4%)	0.004	1.20 (0.90–1.60) P = 0.212
	No	194 (38.0%)	316 (62.0%)		1 (r)
Scientific papers and books	**Yes**	246 (30.3%)	566 (69.7%)	0.007	1.08 (0.82–1.41) P = 0.580
	No	232 (37.1%)	394 (62.9%)		1 (r)
Educational Curriculum	**Yes**	235 (29.9%)	550 (70.1%)	0.004	1.14 (0.86–1.51)

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group.

Demographic characteristics		Attitude toward AI in medical practice		P value [a]	AOR (95%CI)
		Negative (n = 478) N (%)	Positive (n = 960) N (%)		P value [b]
					P = 0.363
	No	243 (37.2%)	410 (62.8%)		1 (r)
Training Course	**Yes**	183 (28.9%)	451 (71.1%)	0.002	1.18 (0.91–1.53) P = 0.207
	No	295 (36.7%)	509 (63.3%)		1 (r)
Mass media	**Yes**	92 (27.4%)	244 (72.6%)	0.009	1.28 (0.97–1.70) P = 0.088
	No	386 (35.0%)	716 (65.0%)		1 (r)
Are you willing to register for a course about AI applications in medical practice?	**Yes**	231 (29.0%)	566 (71.0%)	< 0.001	1.30 (1.01–1.66) **P = 0.039**
	No	73 (45.1%)	89 (54.9%)		0.74 (0.51–1.07) P = 0.112
	Not sure	174 (36.3%)	305 (63.7%)		1 (r)

[a]: for chi square test, [b]: binary logistic regression, AOR: adjusted odds ratio, CI: confidence interval, (r): reference group.

Medical students' preferred social media sources for AI information

Concerning the participants' opinions about the valuable social media sources for information on AI applications in medicine; YouTube was perceived as the most valuable social media source for AI-related

information (90.4%), followed by Telegram channels (86.6%) and WhatsApp groups (65.2%). On the other, Twitter (32.6%) and LinkedIn (33.8%) were the least valued platforms, (Fig. 1).

DISCUSSION

Egyptian medical students recognize the inevitability of AI and are willing to learn, yet they are currently crossing this transition without adequate institutional guidance. The findings reveal a significant disconnect between student demand and institutional supply: while the majority of students advocated for AI inclusion in their training, most felt unprepared by their current education, driving them toward an 'informal curriculum' dominated by social media. Although the overall prevalence of 'Good Knowledge' was 55.3%, the detailed analysis shows discrepancy between the level of knowledge of the tools and models of AI. Results show that while 90.8% of students knew what AI was and 90.1% knew about Generative AI (genAI) tools like ChatGPT and DeepSeek, only 48.1% knew about Machine Learning and only 38.1% knew about Deep Learning. This suggests that student knowledge is currently superficial. The reliance on informal digital platforms while increasing surface-level awareness of user-facing tools, fails to provide the deep technical knowledge and critical appraisal skills necessary for future practice. Consequently, to bridge this gap, medical schools must formalize AI education, moving beyond elective courses to integrate technical literacy and ethical reasoning directly into the core curriculum

Globally, awareness of visible tools is high. A multinational study found that 99% of Swedish medical students were aware of genAI chatbots [15]. In India, nearly 93.6% of students were aware of AI in medical science, and 65.23% had used AI in some form [16]. An Egyptian study conducted across multiple institutions specifically assessed knowledge of genAI. While 61.5% of the students had a satisfactory general knowledge about genAI, and a majority were familiar with various genAI tools (70.4%), only 29.8% knew what deep learning or machine learning was. These results confirms that the disparity observed in our study is a prevalent issue among Egyptian medical students [11].

Similarly, a study conducted among medical students in Sudan showed that 84.3% had a basic understanding of AI, yet only 32.7% had knowledge of Machine Learning (ML) and Deep Learning (DL) [17]. The scarcity of knowledge regarding ML and DL (38.1% to 48.1%) stems directly from the limited or nonexistent formal instruction provided in medical schools on these foundational topics. For instance, 76% of medical students in Mashhad, Iran, reported receiving no AI training [18]. Similarly, over 80% of students in Sudan had never been taught about AI in medical schools [17]. The prevalence of low technical literacy suggests that current medical education is failing to keep pace with technological advancements.

Regarding the predictors of knowledge, our multivariate analysis shows that students in the 2nd, 3rd, 4th, and 5th years had significantly higher odds of good knowledge compared to Interns (e.g., 4th level AOR = 2.02). Interns may be overwhelmed with clinical duties and may be disconnected from recent technological trends compared to students still in classrooms. Earlier years students might be exposed to newer theoretical modules or have more time for self-study. Also, they may be required to finish tasks

related to their study that is might be facilitated using AI applications, what might improve their knowledge. A study at Ain Shams University noted that early-year students were often more enthusiastic to fill AI surveys compared to final-year students in other referenced studies [8][7]. Similarly, a Sudanese study found lower knowledge among the 6th grade (OR = 0.234, 95% CI: 0.096–0.572) and 4th grade (OR = 0.366, 95% CI: 0.157–0.857) relative to the 1st grade [17]. On the other hand, studies involving medical students at Ain Shams and Cairo Universities explicitly reported no association between academic level and their knowledge or attitudes towards AI [8, 10]. These contradictory results may be partially justified that AI literacy might be heavily influenced by exposure and experience rather than mere academic year advancement, a point supported by our finding that high-quality exposure (scientific papers/training courses) was key, regardless of the study phase. This finding was supported by findings from Cairo University medical students where higher awareness and perception scores were significantly higher among students who received any courses about AI [10].

Regarding the sources of knowledge, our results show that social media (87.6%) was the leading source of information, far outpacing the official educational curriculum (54.6%). Specifically, YouTube (90.4%) was the most used platform followed by telegram channels (86.6%). However, regression analysis shows that knowledge gained varied according to the quality of the source of information. Students who relied on scientific papers and books were 1.71 times more likely to have good knowledge. Also, those who attended training courses were 1.43 times more likely. On the other hand, social media was not a significant predictor of good knowledge in the final multivariate model. This highlights the fact that passive consumption of information on social media might increase awareness, but only the active engagement with scientific literature, training courses, peers and mentors can improve actual knowledge.

Consistently, Studies across Egyptian universities corroborate the significant gap in formal teaching. For instance, in a study on genAI among Egyptian students, a minority reported that they had courses to learn genAI or were taught genAI in medical curricula (23.9% and 29.6%, respectively) [11][10]. Similarly, a separate study on medical students and house officers in Egypt found that the majority (84.8%) had never attended any courses about AI, and approximately 70.4% reported never having been taught about AI in their undergraduate studies [7].

This pattern is not unique to Egypt; studies internationally show similar reliance on informal sources. For example, in a study among medical students in Mashhad, Iran, 76% reported receiving no training related to AI [18]. Also, another study found that 72% of medical students in Medical College of Georgia, USA had gained awareness about AI through media and social networks [19][18]. This reliance on informal digital platforms serves as a substitute that, while increasing surface-level awareness of user-facing tools, fails to provide the deep technical knowledge and critical appraisal skills necessary for future practice. Also, when the formal curriculum is lacking, students are exposed to misinformation, which hinders their understanding of AI's limitations and ethical considerations. Also, complex technical subjects cannot be adequately mastered through brief videos or social media posts.

Regarding the attitude, results reveal that two-thirds of medical students (66.8%) had an overall positive attitude toward AI. The highest consensus was found in statements regarding efficiency, such as AI's ability to 'improve medicine in general' (84.3%) and 'speed up rapid diagnosis' (78.4%). Also, 70.5% of students agreed that AI should be included in the curriculum, only 43% felt their current education prepares them for an AI-driven future.

Consistent results regarding the positive attitude of students have been reported. A survey indicated that most medical students (88.8%) stated that it helps them make more accurate decisions [18][17]. In a Swedish survey, 71% of responders agreed or strongly agreed that AI will improve medicine [15]. A study at Northern Border University (NBU) in Saudi Arabia found that most students believed AI could facilitate easier access to medical information (80.71%), enhance decision-making (56.24%), and reduce human errors (59.06%) in diagnosis and treatment [20].

In contrast, results showed that nearly 42% agreed that AI could threaten their future careers, and 72% believed AI lacks the empathy required for patient care. Similarly, 53.41% of students in a study in Saudi Arabia were concerned that AI would reduce employment opportunities for doctors and other healthcare workers [20]. Also, in a Swedish study, one-third of medical students felt frightened about an increased use of AI in medicine, and 37% of responders agreed or strongly agreed that they would exclude some fields of medicine because of AI [15]. Moreover, 73.7% of students in an Iranian study stated that AI diminished the value of the medical profession [18]. This indicates that while students accept AI as an inevitable and useful tool, they had significant suspicions about its role in displacing the 'human element' of medicine.

The absence of emotions and empathy is reported as a major disadvantage of AI by most participants in some studies. A study analyzing anxiety toward genAI found that the Mistrust construct (related to concerns about AI reducing the human role) received the highest level of agreement among participants [21]. In an Egyptian survey, one student commented on their worry that "AI extensive use will decrease emotions and efficient communication with patients and pose ethical concerns" [8]. Over half of the students in the NBU study agreed that AI negatively impacts the relationship between patients and healthcare professionals (51.53%) and weakens the trust (55.29%) that is crucial to this relationship [20]. Moreover, although AI can have important benefits, its use and applications may also induce anxiety, psychological strain, technostress, and other negative impacts on mental health, as supported by previous research [22–24]

Regarding gender and its association with knowledge or attitude. Results also observe a digital gender gap, with male students showing significantly higher odds of a positive attitude (AOR = 1.50) compared to females, but such gap was not observed regarding knowledge. In agreement, a statistically significant difference in positive attitude proportion between males (16.4%) and females (9.8%) with males being about two times (AOR = 1.80, 95% CI 1.30–2.49) more likely to have a positive attitude toward AI compared to females was reported in another Egyptian study [7]. However, the literature regarding gender and AI literacy remains varied and context dependent. A multicenter Egyptian study specifically

on genAI found that males demonstrated significantly higher knowledge than females [11]. Contrasting to that, a study from Sudan reported a contrasting profile where females are referenced as having higher odds of good knowledge (Male AOR: 0.630, 95% CI: 0.425 0.932). Meanwhile, other studies including medical students at Ain Shams and Cairo Universities found no correlation between the students' sex (gender) and their knowledge and attitudes towards AI [8, 10]. Also, a pilot descriptive study on anxiety regarding genAI among medical students in Jordan found no significant differences in fear, anxiety, mistrust, or ethics scores between the sexes [21]. The fact that female students in our cohort possessed equal knowledge to their male peers indicates that educational barriers are lowering. However, the presence of a "positive attitude" gap suggests that female students may still feel culturally or professionally alienated from the technical aspects of AI, viewing it as a "male-dominated" domain despite being equally competent. This aligns a recent research that suggested that gender gaps in algorithmic literacy were frequently driven by lower self-efficacy rather than a lack of actual skill [25].

Strengths and Limitations:

While this study is limited by its cross-sectional design, reliance on self-reported data, and restriction to a single country, which may introduce social desirability and selection biases, it demonstrates significant methodological superiority over comparable regional research through its robust national sample of 1,438 undergraduate medical students. Its distinct contributions include the inclusion of medical interns —highlighting the "clinical overwhelm" phenomenon where knowledge plateaus or regresses during the transition to practice, the distinction between superficial tool familiarity and deep technical literacy, and the use of multivariate regression to empirically prove that while social media is the dominant information source, only rigorous academic engagement (scientific papers and training courses) significantly predicts actual knowledge, offering more actionable pedagogical insights than smaller, purely descriptive studies.

CONCLUSION

The current cross-sectional study revealed that Egyptian medical students recognize the inevitability of AI and are willing to learn, but they are currently navigating this transition without adequate institutional guidance. The reliance on social media as a primary educator is a substitute that fails to provide deep technical knowledge. To bridge the gap, medical schools must formalize AI education, moving beyond elective courses to integrate technical literacy and ethical reasoning directly into the core curriculum.

DECLARATIONS

Ethics Approval Declaration

The study protocol was approved by the Institutional Review Board (IRB) of Delta faculty of medicine (code number: R.2505005 on 25th May 2025).

Human Ethics and Consent to Participate declarations

Participation in the study was voluntary and there were no consequences for nonparticipation. Informed consent was obtained from all participants, and it was embedded in the heading of the questionnaire informing participants that agreeing to participate in the survey is not mandatory and it counts as consent to use the data for research purposes. The participants' anonymity and privacy were respected at all levels of the study. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Competing interests

The authors declare that they have no competing interests**.**

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Authors' contributions

ME identified the research gap and prepared the study protocol and questionnaire. NE calculated the sample size. AME, along with the other authors, assisted in distributing the questionnaire and collecting the data. Data analysis, interpretation, and drafting of the original manuscript were performed by ME, NSF, NE and AAE. The final manuscript was critically reviewed and approved by ME, AMH, AT, and NSF.

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Figures

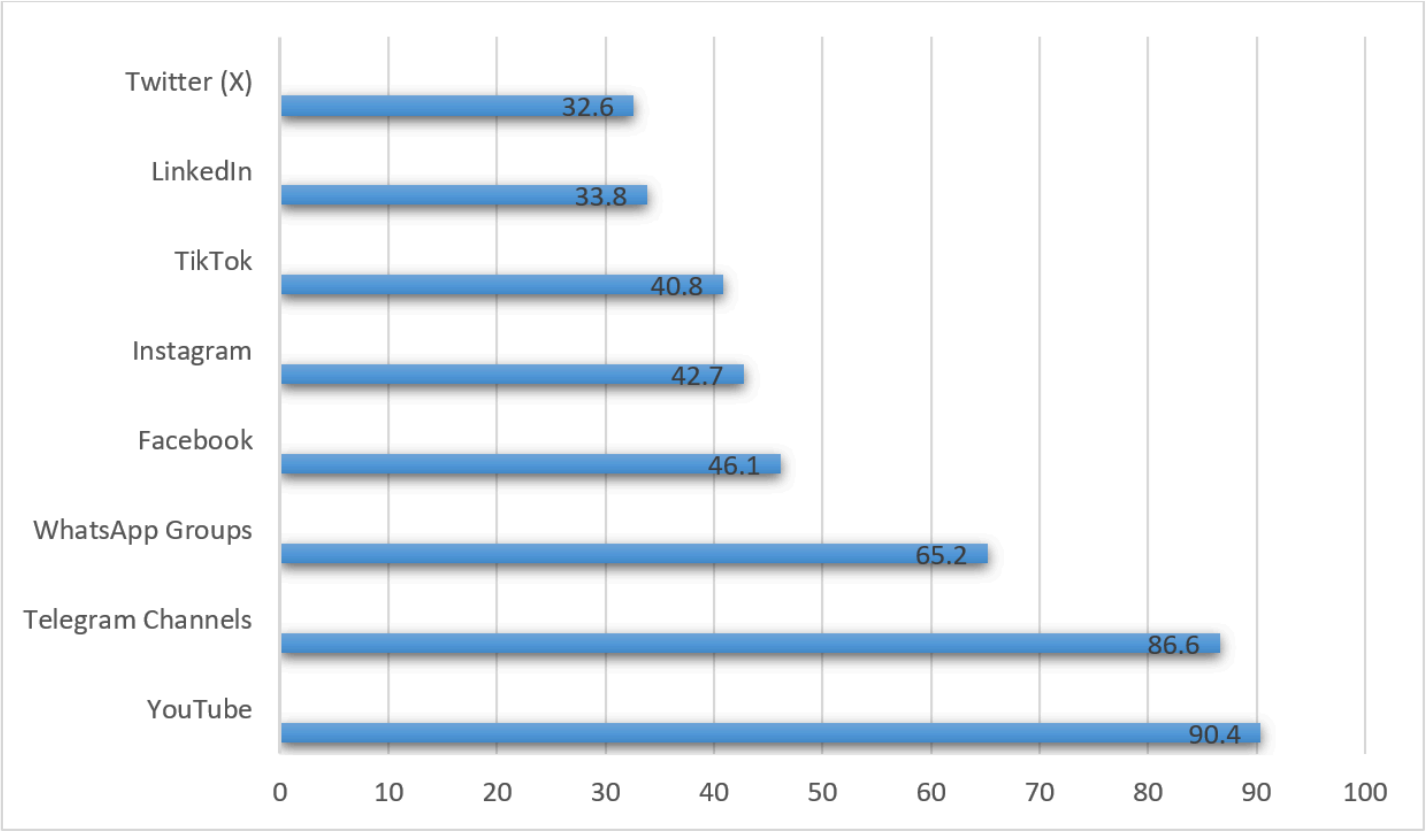


Figure 1

Distribution of studied students according to their opinion about the valuable social media sources for information on AI applications in medicine (n=1438)

Supplementary Files

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