



# Research Paper

## Knowledge and Attitude Towards Medical Ethics of Artificial Intelligence Among Healthcare Workers in Egypt

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## ABSTRACT

**Background:** Hospital care data can be leveraged to benefit patients through various technological advancements in the artificial intelligence (AI) era. This will ultimately lead to improved outcomes and more efficient services. The purpose of our study was to assess physicians' opinions and knowledge regarding the ethical application of AI in Medicine in Fayoum, Egypt.

**Methods:** We conducted a cross-sectional survey among doctors and nurses working at Fayoum Hospitals. A standardized, validated questionnaire assessing knowledge, attitudes, and medical ethics related to AI was administered in both Arabic and English. The study was conducted from July 2024 to December 2024, spanning six months.

**Results:** Approximately one-fourth of participants thought that AI would help provide medical assistance in underserved areas, whereas 24% believed that it would be more useful in biopharmaceutical, 18% felt that it would be more useful in making diagnosis, 14% believed that it would be helpful in social awareness program, 11% believed that it would be useful in direct treatment and 7% believed that it would help make treatment decision. There was a statistically significant difference between the study groups in their knowledge and attitudes regarding the medical ethics of Artificial Intelligence. Physicians had higher knowledge scores than nurses ( $p=0.032$ ). There was a statistically significant difference between the study groups. Physicians had a higher attitude score than nurses ( $p=0.026$ ). Healthcare workers in medical departments had higher Knowledge scores than those in surgical departments ( $p=0.031$ ) and higher attitude scores than those in surgical departments ( $p=0.025$ ).

**Conclusion:** Healthcare workers showed positive attitudes but moderate knowledge about the ethical use of AI. Physicians and those in medical departments scored higher, highlighting the need for targeted education to support the responsible integration of AI in healthcare.

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## Introduction

In recent years, the healthcare systems of many countries have begun to utilize patient data to enhance the standard of care. In this era of rapid technological advancement, several technologies have the potential to use hospital care data in ways that are most beneficial to patients (Athavale et al., 2020). Significant progress has also been made in fields such as medical science, forensic dentistry, DNA analysis, and education, further demonstrating the potential of data-driven approaches in healthcare [1].

The use of artificial intelligence (AI) in risk stratification, genomics, imaging and diagnosis, precision medicine, drug discovery, surgery, and forensic science as part of criminal investigations (including crime scene reconstruction, DNA evidence, and forensic odontology) has increased with recent advances in medicine. AI has also been instrumental in supporting clinical decision-making [2].

One concern with AI is the potential for inaccuracy. Human bias already exists and may affect AI outcomes, as all datasets used by AI systems to generate results are human-generated [3].

Other risks of AI use in medicine include discrimination and human rights abuses. Independent study findings suggest that the application of AI could lead to a higher frequency of stops and searches by law enforcement for some groups of people than for others, thereby depriving citizens of the principles of justice and equity [4]. Among the ethical concerns with AI are informed consent, safety and transparency, algorithmic bias and fairness, efficacy, liability, data protection and privacy, cybersecurity, and intellectual property regulations [5].

The goal of our study is to examine healthcare personnel in Fayoum, Egypt, regarding their knowledge and attitudes toward the medical applications and ethical considerations of artificial intelligence, as well as the factors influencing these attitudes.

## Materials and Methods

### Study Design and Setting

Our study aims to investigate the factors that impact the knowledge and attitudes of Egyptian healthcare personnel regarding the medical application and ethics of artificial intelligence in Fayoum.

At Fayoum Hospitals, a cross-sectional descriptive study was conducted. The study was conducted from July 2024 to December 2024, spanning six months.

The study included 400 participants, comprising 200 physicians and 200 nurses.

### The size of the sample

We used the Statulator Inc. Calculator to determine the sample size. The study required a sample size of 400 participants to estimate the mean with a 95% confidence interval and a 5% margin of error, given a population of 8,000 healthcare workers and an assumed population standard deviation of 0.517 for the mean scores of knowledge, favorable attitudes, and practices.

### Study Tools

This study used a self-administered, structured, closed-ended questionnaire developed for the stated objectives. The questionnaire was designed based on a comprehensive literature review to assess knowledge and attitudes regarding AI.

The awareness and attitude questionnaire was designed based on a comprehensive review of the existing literature on knowledge and perceptions of artificial intelligence. Two independent researchers developed the questionnaire, and any differences in their input were resolved through discussion. Academic faculty members reviewed and validated the content. To ensure linguistic accuracy, the questionnaire was translated into Arabic by a bilingual specialist and then back-translated into English by another bilingual team. A pilot test was carried out with 10% of the intended sample to assess clarity and feasibility. Content validity was evaluated by experts in the field, including experienced physicians and other relevant professionals. Reliability testing revealed Cronbach's alpha coefficients of 0.79 and 0.77 for the awareness and attitude sections, respectively.

The questionnaire consisted of four sections. The first section addressed sociodemographic characteristics, including age, gender, type of healthcare worker, and work department. The second, third, and fourth sections included variables on awareness, attitudes towards AI, and knowledge and attitudes regarding the medical ethics of AI.

### Data Analysis

The data were analyzed using the Statistical Package for the Social Sciences (SPSS) software for Windows 7 (version 22). The One-Sample Kolmogorov-Smirnov test was used to assess normality

in each research group's quantitative data before selecting inferential statistical tests. A Student's t-test was used to compare two independent quantitative datasets. The relationship between quantitative parametric variables was examined using the bivariate Pearson correlation test. The significance cutoff was set at  $p < 0.05$ .

### Human Ethics and Consent to Participate

The Research Ethics Committee in the Faculty of Medicine at Fayoum University reviewed and approved this study (approved code: R727) in compliance with the guidelines and regulations for medical practice and the Helsinki Declaration. Verbal consent was obtained from the healthcare workers participating in the study after an explanation of the study's aim. No personally identifying information was collected. We ensured that all data remained non-identifiable and accessible only by the lead investigator. All information was kept strictly confidential.

### Results

**Table 1** shows that there were no statistically significant differences between physicians' and Nurses' demographic characteristics, including age, sex, and department of work. It indicated a proper match between the study groups.

**Figure 1** illustrates the various domains in which participants believed AI would be helpful. Approximately one-fourth of participants thought that AI would be useful in providing medical assistance in underserved areas, whereas 24% felt that it would be more useful in biopharmaceutical, 18% believed that it would be more helpful in making diagnosis, 14% believed that it would be useful in social awareness

**Table 1.** Demographic characters in different groups.

Variables	physician (n=200)		Nurse (n=200)		p-value
Age (years)					
Mean /SD	33.5	7.8	31.6	7.2	0.9
Sex					
Male	138	69%	166	63%	0.5
Female	62	31%	74	37%	
Department					
Medical	64	32%	60	29.3%	0.8
Surgical	136	68%	140	70.7%	

program, 11% thought that it would be useful in direct treatment and 7% believed that it would help make treatment decision.

**Table 2** presents the bivariate associations between AI knowledge and attitude and other sociodemographic variables among healthcare workers in Fayoum. There was a statistically significant difference between the study groups. Physicians had higher knowledge scores than nurses ( $p=0.032$ ). Physicians had the highest attitude score compared to nurses ( $p=0.041$ ). Healthcare workers in medical departments had higher attitude scores than those in surgical departments.

**Table 3** presents the bivariate associations between artificial intelligence knowledge and attitude scores and other sociodemographic variables among healthcare workers in Fayoum. Physicians had higher knowledge scores than nurses ( $p=0.032$ ). There was a statistically significant difference between the study groups. Physicians had a higher attitude score than nurses ( $p=0.026$ ). Healthcare workers in medical departments had higher Knowledge scores than those in surgical departments ( $p=0.031$ ) and higher attitude scores than those in surgical departments ( $p=0.025$ ).

**Figure 2** shows that physicians had significantly higher knowledge and attitude scores regarding AI medical ethics than nurses. This difference may be due to physicians' greater exposure to AI in clinical decision-making and more frequent access to ethics training.

### Discussion

Currently, the healthcare sector is using artificial intelligence (AI) as a key tool for technological

**Table 2.** The bivariate association of AI knowledge and attitude, with other sociodemographic variables among healthcare workers.

Variables	Knowledge Score	P value	Attitude Score	P value
Age	0.048	0.362	0.056	0.292
<b>Gender</b>				
Male	4.3 ± 1.8	0.109	5.4 ± 1.6	0.176
Female	4.1 ± 1.8		5.1 ± 1.9	
<b>Healthcare workers</b>				
Physician	4.4	0.032*	5.5	0.041*
Nurse	4.0	4.3		
<b>Departments</b>				
Medical	3.7	0.030*	5.1	0.824
Surgical	4.2		5.3	

International Journal of Medical Toxicology & Forensic Medicine

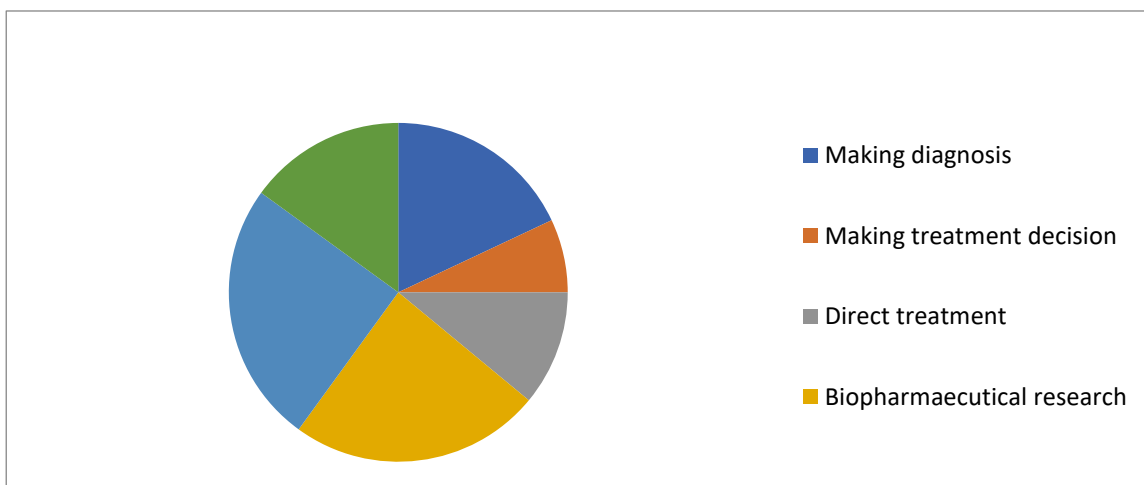
**Table 3.** The bivariate association of Knowledge and Attitude Scores of Medical Ethics of Artificial Intelligence with other sociodemographic variables among healthcare workers in Fayoum.

Variables	Knowledge Score	P value	Attitude Score	P value
Age	0.048	0.362	0.056	0.292
<b>Gender</b>				
Male	0.25 ± 0.49	0.624	0.23 ± 0.52	0.60
Female	0.26 ± 0.62		0.24 ± 0.45	
<b>Healthcare workers</b>				
Physicians	4.4± 0.29	0.032*	5.3± 0.39	0.026*
Nurses	3.3± 0.32		4.2± 0.2	
<b>Department</b>				
Medical	0.27± 0.01	0.031*	0.23	0.025*
Surgical	0.46± 0.09		0.40	

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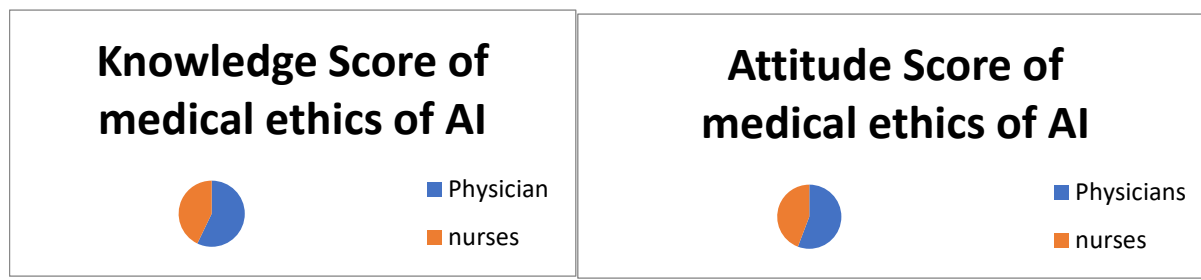
advancement [6]. The development of machine learning techniques has facilitated the growth of AI applications in healthcare, the availability of large datasets for training AI models, and improvements in

processing capacity. A subset of artificial intelligence known as machine learning has had a significant impact, enabling computers to recognize and learn from data patterns, thereby improving their predictive and



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**Figure 1.** Knowledge and attitude towards medical use.

International Journal of  
Medical Toxicology & Forensic Medicine

**Figure 2.** Knowledge and attitude towards medical ethics of AI among Physicians nurses.

decision-making capabilities. AI's ability to enhance healthcare workers' skills and enhance patient outcomes has been demonstrated through its application in medical imaging, disease detection, and therapy optimization [7].

These significant advancements highlight AI's revolutionary potential and signal a paradigm shift in the conception and provision of healthcare [8].

This study was the first that we were aware of regarding the attitudes and knowledge of Egyptian healthcare professionals on the application of artificial intelligence in medicine and medical ethics.

The research revealed that healthcare professionals in Fayoum, Egypt, hold positive attitudes and have a good understanding of AI. Regarding knowledge and attitudes toward medical applications, the majority of healthcare professionals believed that AI would benefit their work. This result aligns with a study that found 81.8% of participants agreed that AI is critical in medicine and 82.6% supported teaching AI in medical schools [9].

The research revealed that 24% of healthcare workers believed AI would be more effective in biopharmaceuticals, and 18% believed it would be more useful for diagnosis. This is consistent with a study in Saudi Arabia that reported that 23% of participants recognized AI's utility in biopharmaceutical research and 26% in diagnosis [10].

This is consistent with the Pakistan study, which reported that 74.4% of participants acknowledged AI's importance in modern diagnostics and highlighted AI's role in reducing diagnostic errors, with 66.6% agreement [11].

The study revealed that approximately one-fourth of participants believed AI would be useful in delivering medical assistance. This aligns with the dental study, which stated that AI enhances dental practice but does not replace the roles of dental assistants or orthodontists, who remain critical for

personalized care and ethical oversight [12].

The study revealed that 14% of participants believed that AI would be helpful in social awareness programs. This result is inconsistent with a study in Pakistan, which reported that 70.3% of participants thought that AI would pose greater ethical challenges in healthcare. Similarly, 73.3% of participants believed that AI would raise new social challenges [13].

Among the study population, 11% believed it would be helpful for direct treatment, while 7% thought it would aid treatment decision-making; these findings indicate that AI cannot replace doctors. This result agrees with the study, which reported that AI cannot replace doctors, as the patient–doctor relationship cannot be fully completed without the sympathy and empathy that AI has not yet achieved. In complex cases, doctors' expertise is still required to integrate the patient's history, examination, and laboratory results to create a comprehensive plan [14].

This result contrasts with previous studies, which found that 59.5% of participants in Pakistan feared AI would replace healthcare jobs. In contrast, a study in Saudi Arabia reported that 58% of healthcare workers were concerned about job displacement [10], [13].

The study revealed statistically significant differences in knowledge and attitude scores among healthcare worker groups. Physicians exhibited significantly higher knowledge ( $p = 0.032$ ) and attitude scores ( $p = 0.026$ – $0.041$ ) compared to nurses. Furthermore, healthcare workers in medical departments demonstrated significantly greater knowledge ( $p = 0.031$ ) and more positive attitudes ( $p = 0.025$ ) than their counterparts in surgical departments.

## Conclusion

This study reveals that healthcare workers in Fayoum, Egypt, generally hold positive attitudes and possess moderate knowledge regarding the ethical use of artificial intelligence (AI) in medicine. Physicians demonstrated higher knowledge and attitude scores

compared to nurses, and healthcare workers in medical departments showed greater awareness than those in surgical departments. Despite the growing integration of AI into healthcare, there remains a need for targeted educational initiatives to further enhance healthcare workers' understanding of AI's ethical applications and to ensure its responsible and effective use in clinical practice.

## Acknowledgment

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## Declarations

### Human Ethics and Consent to Participate

Approved by the Fayoum University Faculty of Medicine Research Ethics Committee. (approved code, R727). In compliance with the guidelines and regulations for medical practice and the Helsinki declaration. Verbal consent was obtained from the healthcare workers participating in the study after an explanation of the study's aim. No personally identifying information was collected. We ensured that all data remained non-identifiable and accessible only by the lead investigator. All information was kept strictly confidential.

## Conflicts of Interest

The authors report no competing interests.

## Funding

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## References

- [1] Athavale J, Baldovin A, Graefe R, Paulitsch M, Rosales R. AI and reliability trends in safety-critical autonomous systems on ground and air. In: Proceedings of the 50th Annual IEEE/IFIP International Conference on Dependable Systems and Networks Workshops (DSN-W); 2020. p. 74–77. [DOI: 10.1109/DSN-W50199.2020.00024]
- [2] Alzou'bi S, Alshibl H, Al-Ma'aitah M. Artificial intelligence in law enforcement: a review. *Int J Adv Inf Technol.* 2014;4(4):1–7. [DOI: 10.5121/ijait.2014.4401]
- [3] Oliva A, Grassi S, Vetrugno G, Rossi R, Della Morte G, Pinchi V, et al. Management of medico-legal risks in the digital health era: a scoping review. *Front Med (Lausanne).* 2021;8:735402. [DOI: 10.3389/fmed.2021.735402]
- [4] Hino A, Fahey R. Artificial intelligence and human rights: the impact on equality and justice. *J Law Technol Policy.* 2020;2020(1):67–89. [Link]
- [5] Gerke S, Minssen T, Cohen G. Ethical and legal challenges of artificial intelligence-driven healthcare. In: Bohr A, Memarzadeh K, editors. *Artificial Intelligence in Healthcare.* Cambridge (MA): Academic Press; 2020. p. 295–336. [DOI: 10.1016/B978-0-12-818438-7.00018-6]
- [6] Sit C, Srinivasan R, Amlani A. Attitudes and perceptions of UK medical students towards artificial intelligence and radiology: a multicenter survey. *Insights Imaging.* 2020;11(1):14. [DOI: 10.1186/s13244-019-0830-7]
- [7] Syed W, Basil A, Al-Rawi M. Assessment of awareness, perceptions, and opinions towards artificial intelligence among healthcare students in Riyadh, Saudi Arabia. *Medicina (Kaunas).* 2023;59(5):828. [DOI: 10.3390/medicina59050828]
- [8] Diprose W, Buist N. Artificial intelligence in medicine: humans need not apply? *N Z Med J.* 2016;129(1434):73–6. [Link]
- [9] Amin MH, Elmahi MA, Abdelmonim GA, Fadlalmoula GA, Amin JH, Awad MH, et al. Knowledge, attitude, and practice of artificial intelligence among medical students in Sudan: a cross-sectional study. *Ann Med Surg (Lond).* 2024;86(7):3917–23. [DOI: 10.1097/MS9.0000000000002070]
- [10] Alghamdi SA, Alashban Y. Medical science students' attitudes and perceptions of artificial intelligence in healthcare: a national study conducted in Saudi Arabia. *J Radiat Res Appl Sci.* 2024;17(1):100815. [DOI: 10.1016/j.jrras.2023.100815]
- [11] Ahmed Z, Bhinder KK, Tariq A, et al. Knowledge, attitude, and practice of artificial intelligence among doctors and medical students in Pakistan: a cross-sectional online survey. *Ann Med Surg (Lond).* 2022;76:103493. [DOI: 10.1016/j.amsu.2022.103493]
- [12] Surovková J, Haluzová S, Strunga M, et al. The new role of the dental assistant and nurse in the age of advanced artificial intelligence in telehealth

orthodontic care with dental monitoring: preliminary report. *Appl Sci (Basel)*. 2023;13(8):5212. [DOI: [10.3390/app13085212](https://doi.org/10.3390/app13085212)]

[13] Habib MM, Hoodbhoy Z, Siddiqui MAR. Knowledge, attitudes, and perceptions of healthcare students and professionals on the use of artificial intelligence in healthcare in Pakistan. *PLoS Digit*

*Health*. 2024;3(5):e0000443. [DOI: [10.1371/journal.pdig.0000443](https://doi.org/10.1371/journal.pdig.0000443)]

[14] Krittanawong C. The rise of artificial intelligence and the uncertain future for physicians. *Eur J Intern Med*. 2018;48:e13–e14. [DOI: [10.1016/j.ejim.2017.06.017](https://doi.org/10.1016/j.ejim.2017.06.017)]