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Exploring Artificial Intelligence Role in Enhancing Medical Education for Future Physicians

Mohi Ud Din[1*], Muhammad Ali[2], Saira[2], Ifra Naeem[2], Ayman Mahmood[2] and Ali Raza[2]

[1]Department of Community Medicine, Aziz Fatimah Medical and Dental College, Faisalabad, Pakistan
[2]Aziz Fatimah Medical and Dental College, Faisalabad, Pakistan

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Corresponding Author:
Mohi Ud Din
Department of Community Medicine, Aziz Fatimah Medical and Dental College, Faisalabad, Pakistan
dr.md89@outlook.com

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ABSTRACT

Artificial intelligence (AI) has the potential to completely transform medical education by improving learning outcomes through data-driven insights, simulation, and individualized instruction. **Objectives:** To determine the impact of Artificial Intelligence on Medical Education and medical students' willingness and readiness to use it. **Methods:** An analytical cross-sectional study was conducted among medical students at a private medical institute. Ethical approval and informed consent were taken. The questionnaire was distributed through social media platforms. Mann-Whitney U test was performed, mean + SD was taken and Pearson correlation was used to assess mean rank distributions, higher means among variables, and significant associations. A p-value of <0.05 was considered statistically significant. **Results:** Higher mean ranks by the Mann-Whitney U test in all perception-related questions indicated a tendency for higher values in males than females. The mean + SD of perception score was 3.63 ± 0.66 and the willingness was 3.48 + 0.69 which showed a positive perception and willingness to use AI. ANOVA was employed with the most significant association, enabling doctors to make correct decisions. Pearson correlation between readiness for AI and their perceptions, and willingness to use AI showed a strong positive correlation between them with p values significant at <0.01 level. **Conclusions:** It was concluded that AI could revolutionize medical education by enhancing learning, and clinical decision-making, and supplementing traditional teaching methods. A significant positive correlation was found between AI readiness, perceptions, and willingness to use it, recognizing its role in shaping future medical practice.

INTRODUCTION

Although AI was first introduced in 1950, early limitations in its modelling hindered its acceptance and use in medicine. Overcoming these early challenges, AI, particularly deep learning, began making significant strides in healthcare around the early 2000s [1]. Today, AI systems can analyze complex algorithms and apply self-learning techniques, opening new possibilities for clinical practice [2]. AI has gained significant adoption in recent years, with expanding applications in healthcare. On the other hand, the acceptance of AI-driven healthcare solutions is still sluggish in developing countries like Pakistan. Artificial intelligence has been broadly applied lately because its usage in the medical field has increased [3]. A multi-method approach is essential to identify the challenges that may arise with the integration of AI in healthcare. AI applications will not replace doctors but will take over many tasks currently performed by physicians and create new roles in healthcare. Medical students and physicians need to understand the fundamental principles of AI to adapt to these changes effectively [4]. In AI healthcare applications, interest is now entering a boom. In radiology, nowadays, there exist AI applications utilizing deep learning methodologies, which perform effectively [5]. With AI innovations coming into play to impact practice, increased interest in training active and future doctors in the technology is being enthused [6]. Medical students' knowledge about AI is unknown and perception is yet to be determined [7]. This study will help to answer questions regarding the perception of medical students on credibility and reliance on artificial intelligence in the medical field.

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The development of the medical AI industry will depend on the students' views on medical AI which should be understood in great depth by medical experts [8]. Although in terms of medical AI much has been advanced technically, the use of this type of study is to analyze the views of medical students on the advancement of artificial intelligence in the field of medicine. This study explores how much medical students know and perceive AI and its implications and determines the knowledge of current practices of AI. Despite the growing integration of AI in healthcare, there is limited research on medical students' perceptions regarding AI's role in clinical practice, especially in developing countries like Pakistan.

Despite the increasing integration of artificial intelligence (AI) into healthcare and medical education worldwide, evidence regarding medical students' perceptions, willingness, and readiness to adopt AI remains limited in developing countries such as Pakistan. Furthermore, little is known about how students' computer literacy and preparedness influence their acceptance of AI in medical training. Addressing this knowledge gap is essential for designing educational strategies that facilitate the effective incorporation of AI into medical curricula. Therefore, this study aimed to assess medical students' perceptions, willingness, and readiness to use AI in medical education and to explore the relationship between AI readiness, perceptions, and willingness to adopt AI in future medical practice.

METHODS

An analytical cross-sectional study was conducted among medical students at a private medical institute. A simple random sampling technique was used to collect data from a sample size of 207 students i.e. 46-1st year, 48-2nd year, 47-3rd year, 32-4th year, 34-Final year. 1st, 2nd, 3rd, 4th, and Final year medical students are included. The study duration was 6 months i.e. from June 2024 to November 2024. Ethical approval was taken from the Aziz Fatimah Medical and Dental College, Faisalabad with reference number IEC/308-24. Informed consent was taken beforehand. A validated questionnaire was adopted from a study after obtaining the author's consent and an extensive literature review [9]. Cronbach's coefficient of at least 0.7 was used to assess the internal consistency of the questionnaire. Starting from asking questions on socio-demographics, in the next section there were questions on students' AI perceptions from strongly disagree to strongly agree. In the next two sections, there were questions regarding the impact of AI on medical Education, willingness to use it, and readiness for AI. After that, the possible effects of AI in medicine were assessed which concluded the questionnaire. Likert scale scoring was done from 1 to 5, mean + SD was taken, the Mann-Whitney U test was used, and mean ranks were calculated within the gender variable. Mann-Whitney U Test was employed instead of the t-test since the data collected was ordinal (Likert Scale) rather than interval or ratio. Also, it evaluates median ranks between 2 independent groups without positing the normality of distribution. Also, the Pearson correlation was used and a p-value of <0.05 was considered statistically significant. The data were collected through Google Forms, and the survey was distributed via social media. While cost-efficient, it might have introduced some self-selection bias. Students who were more active on social media or had a greater interest in AI-related topics may have been more inclined to respond positively. To overcome these limitations, the study worked with a random sampling of the entire student population. The Statistical Package for the Social Sciences (SPSS) Version 25.0 was considered to analyze the data.

RESULTS

By using a simple random sampling technique, the total sample size was 207. Among them, 91 (44%) were male and 116 (56%) were female. Most participants were day scholars, 154 (74.4%) and belonged to urban areas, 170 (82.1%). The computer literacy level of most students was literate, 113 (54.6%); while competent was 69 (33.3%) students and proficient was 25 (12.1%) students. Most of the medical students 'sometimes' 131 (63.3%) and 'always' 65 (31.4%) used computer technology for learning while 11 (5.3%) never used it. Most participants 179 (86.5%) had never received any training in artificial intelligence while 28 (13.5%) had received such training. AI should be embedded into the MBBS curriculum, which should also consist of the structured introduction of courses presenting AI fundamentals and clinical AI tools. Medical colleges should partner with tech institutes to launch an AI certification program. Significant p-values show significant differences between the perception levels of male and female, while higher mean ranks in all perception questions indicated a tendency for higher values in male. The perception score and willingness to use AI had means of 3.63 ± 0.66 and $3.48 + 0.69$ respectively, indicating a positive attitude towards AI among students. Associations between gender and the perception of students towards A.I. and willingness to use A.I. on a Likert scale, the Mann-Whitney U test was employed as shown in Table 1.

Table 1: Mean Rank Gender Distribution with AI Perception (n=207)

Students' Perceptions Towards AI	Gender		Mean Rank	p-value	Mean ± SD
AI will play an important role in healthcare	Male	91	119.66	<0.001**	3.63 ± 0.66
	Female	116	91.72		
Some specific specialities will be wiped out by AI in healthcare	Male	91	111.38	0.090	
	Female	116	98.21		

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I understand basic AI principles and Terminologies	Male	91	112.93	0.040*	
	Female	116	96.99		
All medical students should receive AI teaching	Male	91	118.07	0.001**	
	Female	116	92.97		
At the end of my medical degree, I will be confident working with AI tools	Male	91	115.18	0.010*	
	Female	116	95.23		
Impact of AI and Willingness to Use It					
AI systems will have a positive impacton medical education	Male	91	119.66	0.010*	3.48 ± 0.69
	Female	116	91.72		
Integrating AI into medical educationwill aid the learning process	Male	91	109.32	0.190	
	Female	116	99.82		
AI will replace my future role as a physician	Male	91	108.96	0.270	
	Female	116	100.11		
I support the use of AI in medical education	Male	91	109.47	0.210	
	Female	116	99.71		

*p-value was significant at <0.05 level. ** p-value was significant at <0.01 level.

The high perception and the preeminent willingness of male students towards AI could have been due to several factors; i.e., in certain developing countries including Pakistan, most probably male students are more exposed to technology from childhood, while females are more often restrained by traditional gender. Some specialties are more vulnerable than others from AI e.g., radiology and pathology, and their specialists ought to be trained to work with AI rather than against it. The total mean score was 3.38 + 0.64 which showed a good readiness of medical students toward AI in enhancing medical education as shown in table 2.

Table 2: Medical Students' Readiness for AI (n=207)

Medical Students' Readiness for AI 'I Can'	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Mean ± SD	Total Mean Score
Define the basic concepts of data science	1	38	79	72	17	3.32 + 0.88	3.38 + 0.64
Explain how AI systems are taught	4	56	80	54	13	3.08 + 0.97	
Analyze AI input data in healthcare	2	42	88	59	16	3.22 + 0.89	
Articulate the significance of data collection and analysis by AI	2	33	85	74	13	3.3 + 0.84	
Use AI information with my medical knowledge.	2	23	95	69	18	3.38 + 0.83	
See AI being an excellent tool for teaching	2	12	65	119	19	3.63 + 0.77	
Explain what are the merits and demerits of these AI technologies	2	16	77	88	24	3.56 + 0.83	
Think of the opportunities and threats that AI technology can present	1	16	75	93	22	3.57 + 0.8	
Say something about the limitations of AI technology	4	20	78	82	23	3.48 + 0.88	

Medical institutions can enhance AI readiness by including computer skills & AI-related courses in the First MBBS Curriculum and through Faculty development programs that will impart AI literacy to both faculty and students. Also, the implication revealed that students positively perceive AI for decision-making (p=0.006) and for easing drug accessibility (p=0.02) while on the other hand muttering about patient confidentiality and doctor-patient relationship being threatened by AI. AI developers need to ensure that patient data is encrypted against undue access. The training needs to focus more on AI aiding doctor-patient communication instead of replacing it. Although students had moderate AI competency, practical strategies stand to better transcend the gap between theoretical AI knowledge and its practical application by including AI-assisted cases in clinical rotations and also providing internships in AI-driven healthcare startups to advance hands-on skill development. Mean + SD and associations between the computer literacy level of students i.e. literate=1 (n=113), competent=2 (n=69), proficient=3 (n=25), and possible effects of AI in medicine by using ANOVA as shown in table 3.

Table 3: Association Between Computer Literacy and Effects of AI (n=207)

Possible Effects of AI in the Medicine	Computer literacy level	Mean ± SD	95% Confidence Interval	p-value
AI may discourage the confidentiality of the Medical Profession	1	3.5 + 0.92	3.41–3.66	0.440
	2	3.64 + 0.82		

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	3	3.40 + 1.08		
AI will increase trust of people in Medicine	1	3.31 + 0.92	3.24–3.49	0.170
	2	3.35 + 0.87		
	3	3.68 + 0.8		
It may ease the patient's access to Medicine	1	3.6 + 0.82	3.51–3.74	0.020*
	2	3.52 + 0.87		
	3	4.04 + 0.79		
AI may discourage the Doctor-Patient relationship	1	3.53 + 1.04	3.45–3.72	0.690
	2	3.65 + 0.85		
	3	3.64 + 1.03		
It may enable Doctors to make more accurate decisions	1	3.57 + 0.8	3.51–3.74	0.006*
	2	3.55 + 0.87		
	3	4.12 + 0.73		
It may increase the confidence of the Patient	1	3.42 + 0.86	3.35–3.59	0.540
	2	3.48 + 0.85		
	3	3.64 + 0.99		
Discourage the Doctor's Efforts	1	3.47 + 1.08	3.39–3.67	0.240
	2	3.7 + 0.93		
	3	3.36 + 1.11		

Pearson correlation was calculated to assess the relationship between AI readiness among medical students and their perceptions and willingness to use AI. Correlation coefficients of 0.697, and 0.642 alongside p-values of less than 0.001 (significant at <0.001 level) point toward a strong positive correlation. This means that with an increase in AI readiness on the part of the students, there tends to be an increase in positive perceptions and willingness to use AI in medical education as shown in table 4.

Table 4: Correlation between AI Readiness with Perception and Willingness

Variables		r*	p-value
Medical Students' Readiness for AI	Perceptions Towards AI	0.697	<0.001*
	Impact of AI and Willingness	0.642	<0.001*

*p-value is significant at <0.01 level

DISCUSSION

Positive perception and willingness among students toward AI's role in enhancing medical education were seen, with male showing more perception levels and willingness than female. Medical students' readiness towards AI was seemingly good with a higher mean found giving value to AI in education and research purposes, while also enabling doctors to make more accurate decisions. The correlation between medical students' readiness and their perceptions and willingness was found to be statistically significant. Research done by Stöhr *et al.*, showed statistically significant differences in gender perceptions of AI with male showing more optimism towards AI than female similar to the results of our study [10]. A study done by Sit et al., showed that the majority of students thought that AI teaching would benefit their careers, similar to our study results. The similarity may be due to the same study population i.e. medical students in both studies [11]. A study done by Park *et al.*, showed that similar to our study, the majority of participants agreed about the future role of AI in the medical field [12]. Research done by Yüzbaşıoğlu *et al.*, showed that students' knowledge regarding AI was less while in our study, students' knowledge was sufficient [13]. The difference may be due to dental students in other studies and also due to a very large sample size as compared to our study. A study done by Ahmed *et al.*, showed that the majority of participants thought to include AI in medical teaching, similar to the results of our study [14]. A study done by Swed *et al.*, showed that most participants do not understand AI and its significance in the medical field which is different from the results of our study, which may be due to population demographic differences and also due to a larger sample size [15]. A study done by Civaner *et al.*, showed that about half percentage of the participants thought that because of AI, there would be unemployment as it could replace many jobs, similar to our study results where although the result was not significant of this variable, many participants were having same worries [9]. A study done by AlZaabi *et al.*, showed that participants were not worried about AI taking over physicians' jobs and creating unemployment which is different from the results of our study [16]. Therefore, in most of the studies, the perception of medical students towards AI was positive. However, in a few studies, if still they were not aware or had less perception of AI, they were willing to get more knowledge and increase their perception of it. Research done by Labrague *et al.*, showed that participants had moderate readiness for AI acceptance which is less as compared to our study participants and the difference may be due to the medical vs nurses' population that only about 1/10th of participants

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which can have an impact on lower readiness in nurses [17]. A study done by Boilla *et al.*, showed ants had received AI training which is similar to our results, while in contrast, those participants had low AI familiarity as compared to our study [18]. Also, the study conducted by Allam *et al.*, showed that less than 10% of participants received AI training, which is almost similar to our results [19]. Research done by Wood *et al.*, showed that participants had a favorable attitude toward AI similar to our study but their AI literacy level is less as compared to our study [8]. A study done by Banerjee *et al.*, showed that participants agreed that AI would improve research and training like in our study results but different in their opinion regarding improving the diagnostics of physicians as in our study results [20]. The most significant effect perceived by medical students in our study was to enable doctors to make more accurate decisions on an AI basis which is similar to the research done by Giordano *et al.*, which showed that AI may help overcome decision-making limitations [21]. Research done by Patil *et al.*, showed many advantages of AI and among them, one would be enhanced patient access to healthcare, similar to our study results [22]. Research done by Jackson *et al.*, showed that medical students perceive AI as an assisted healthcare technology by improving diagnosis and reducing errors, similar to our study results which may be due to a similar sample population and socio-demographics [23]. Since this is a cross-sectional study, it restricts any chances of deriving causality. Longitudinal designs would be more suitable to capture the change in students' attitudes over time. The fact that the study was limited to a single private medical college may further limit the generalizability of findings to other contexts with different curricula, resources, or levels of AI integration. In overcoming these limitations, future research could therefore include multiple universities.

This study has several limitations. First, its cross-sectional design prevents the establishment of causal relationships between AI readiness, perceptions, and willingness to use AI. Second, data were collected from a single private medical institution, which may limit the generalizability of the findings to students from other academic settings. Third, the use of an online self-reported questionnaire may have introduced response and self-selection biases. Future studies should include larger and more diverse samples from multiple medical colleges and universities, employ longitudinal designs to evaluate changes in perceptions over time, and assess the effectiveness of structured AI training programs in improving students' knowledge, readiness, and practical application of AI in medical education

CONCLUSIONS

It was concluded that AI could revolutionize medical education through enhancement of learning, clinical decision-making, and supplementing traditional teaching methods. Students exhibited a positive perception of AI, recognizing its role in shaping future medical practice and improving diagnostic accuracy and patient management. Although the study depicts the enthusiasm of students, it has also highlighted that there is no formal training on AI, with most students lacking prior structured exposure to it. Medical curricula should contain structured AI courses, AI-assisted case studies, and interdisciplinary collaborations with technology experts in the future to build the bridge between artificial intelligence knowledge to application.

Authors' Contribution

Conceptualization: MA, S
Methodology: MUD, IN, AM, AR
Formal analysis: MUD, S
Writing and Drafting: MUD, MA, IN, AR
Review and Editing: MUD, MA, IN, AR

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

All the authors declare no conflict of interest.

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