Artificial Intelligence in Medical Education

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ABSTRACT

Objective: To explore the understanding of medical students regarding the integration of AI in medical education.
Study Design: Mixed methods, explanatory sequential study.
Place and Duration of the Study: This study was conducted from March to May 2024 at the CMH Medical College, Lahore, Pakistan.
Methodology: A total of 152 undergraduate medical students were recruited. Quantitative surveys were used to measure AI-related attitudes and awareness of the students through a Likert scale, while in-depth insights into challenges and educational impact were obtained through open-ended questions. SPSS version 27 was used for the analysis of quantitative and Nvivo-11 for qualitative data.
Results: The study consisted of 152 participants. Most of them 139 (95.9%) had good knowledge about AI and expressed positive views. The majority believed that AI improves medical concepts, patient outcomes, and healthcare delivery, and helps in early disease detection. They agreed that AI will be effective in education 114 (75%) and will have a positive impact on learning experience 111 (73%) and future medical practice 94 (62%), so, it should be mandatory in medical education 90 (59%). Around half of the participants perceived potential job displacement and ethical dilemmas as a challenge due to AI in the future. Major themes emerging from qualitative data were AI-related challenges, topics of interest, and future expectations.
Conclusion: The study showed positive views and attitudes towards AI integration in medical education. Participants highlighted various benefits and perceived challenges including ethical concerns and resource limitations. As medical education advances, this subject needs to be studied more for its successful integration into medical education for better results.

Key Words: Understanding, Awareness, Artificial intelligence, Medical education, Medical students.

INTRODUCTION

Artificial intelligence (AI) is notoriously difficult to define and comprehend. Council of Europe 2021 defines it as a set of sciences, beliefs, and technologies whose aim is to produce human cognitive abilities by a machine to help solve complicated tasks formerly performed by humans.[1] The use of AI in medicine began in the twenty-first century, and it is now rapidly expanding. The traditional medical curriculum is undergoing a significant transformation as a result of the integration of computer-based decision support systems in medical education.[2]

The end users' understanding and attitudes are key psychological factors that influence their acceptance and adoption of such technology. Many non-medical and medical specialities are already having impactful outcomes due to this technology.[3] There is a growing need for AI technology literacy in medical education due to the rising interface between digital data science, emerging AI technologies, and healthcare.

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The potential advantages of adopting AI in medical education e.g. its ability to engage in higher-order cognitive functions, such as problem-solving, decision-making, reasoning, and perceiving have been highlighted by several researches. But this is not without roadblocks, such as technological difficulties, faculty development, ethical dilemmas, and others.[4] Little is known about how the use of such technology throughout medical education will affect students' abilities such as critical thinking, clinical decision-making, and the use of new technologies at the workplace.[5,6]

The first step in this regard is to do a needs assessment and understand whether students want AI to be integrated into medical education, how they interact with it, and what benefits or obstacles they perceive.[7] Understanding the attitudes, and preferences of medical students while using this technology is the most important factor for it to be successful in medical education.[8,9] Lastly, there has not been much research to ascertain which particular AI tools and study topics or areas Pakistani medical students want to learn when it comes to AI in medical education. The study aimed to fill in these knowledge gaps, by exploring the understanding of undergraduate medical students of the authors' medical college through online surveys / questionnaires on the integration of AI into medical education, perceived challenges, preferred AI tools/study topics, and perceived benefits and impact on future skills. This will help institutions develop better strategies for its integration to maximise advantages for quality outcomes.[10] Based on the subject, the research

question was that how do medical students view the role and influence of AI in medical education and practice?

METHODOLOGY

The study was conducted from March to May 2024 at the CMH Medical College, Lahore, Pakistan, recruiting a total of 152 medical students after obtaining ethical approval (ERB# 01-2024). To guarantee variety and complete representation, participants were chosen from both genders, different years (2nd – 5th), and academic backgrounds. The study's pragmatist paradigm recognised that teachers' understanding of students' perceptions of AI can help them develop practical, effective implementation strategies that are not only theoretical but also useful in clinical or educational settings.[11] Inclusion criteria were undergraduate medical students of either gender of MBBS/BDS while postgraduate medical students were excluded. The Cochran (WHO) sample size calculator was used to determine the sample size, aiming for a 5% margin of error, 95% confidence level, and assuming a 50% response distribution among participants. This assumption was based on previous studies, which reported that roughly 50% of students surveyed believed that they had a solid understanding of AI.[12] The survey questions were developed using frequently asked questions from earlier surveys conducted in Canada and other countries, and validated through expert review, pilot study, and reliability calculation (Cronbach alpha score-0.90). A stratified random sampling technique was used, ensuring the representation of students from different genders, academic disciplines, and years. This helped reduce sampling error, and provided equal opportunity for all participants, helping the applicability of results to the larger group of students.

Quantitative surveys using Likert scales, with 1 indicating strongly disagree (SD), 2 disagree (D), 3 neutral, 4 agree (A), and 5 indicating strongly agree (SA), were employed. The online survey investigated demographics, prior exposure to AI, awareness / understanding / attitudes towards AI, and perceived benefits and challenges of its integration into medical education. Open-ended questions were provided with a purposive sample of survey respondents to delve deeper into their experiences and perspectives. These further explored their AI-related understanding, topics of interest, concerns, and future hopes regarding AI integration in the medical field. Responses were collected through a questionnaire designed on Google Forms and shared through Email, and WhatsApp. Measures were taken to protect the confidentiality and anonymity of consenting participants who had the option to withdraw at any point without consequences. Forms did not collect any personally identifiable information such as emails, names or IP addresses.

A pilot study was conducted on 10 responses for the tool's reliability before conducting full research which showed good results (Cronbach alpha score-0.90). Quantitative data were analysed using the Statistical Package for Social Science version 27. Descriptive statistics such as mean, median, mode, and standard deviation were calculated, to summarise quantitative data. A p-value of <0.05 calculated through the Chi-square test for association was considered significant.

Thematic analysis was done using the Nvivo-11 for coding and categorisation of qualitative data using participants' words in open-ended questions, providing an organised way to investigate how medical students view AI. Understanding the wider ramifications of AI in medical education was aided by the themes that have been extracted. The study maintained a high degree of transparency and rigour by employing Nvivo, which enhanced the thematic analysis's legitimacy. Additionally, it made it possible for this mixed-methods study to more effectively integrate qualitative and quantitative data and to provide a comprehensive understanding of the participants' perceptions.[13]

RESULTS

The study consisted of 152 medical students. The survey questionnaire was divided into different categories such as knowledge and awareness (5 questions), attitude (3 questions), perceptions (9 questions), and opinions (5 questions). Of those students who completed the questionnaires, 52 (34.2%) were males and 100 (65.8%) were females. The participants who made-up the study sample were selected from different years of medical education. The samples include 60 (39.5%) participants from the 2nd year, 72 (47.4%) from the 3rd year, 8 (5.3%) from the 4th year, and 12 (7.9%) from the 5th year. Ninety-two (60.5%) students were from MBBS, 58 (38.2%) from BDS, and 2 (1.3%) were from Allied health sciences. Their demographic characteristics and AI-related knowledge are shown in Table I.

In the first part of this study, the knowledge of students about AI was explored. Most of the students 139 (95.9%) had good AI-related knowledge. Around half of the participants thought that AI-generated feedback was valuable, contributed to their learning, and helped them manage their study time effectively. Addressing to questions on current AI learning in the curriculum and the availability of resources, the majority of the students either remained neutral-41 (27%) and 56 (37%)-or disagreed-85 (56%) and 49 (32%)-for both questions, respectively. A p-value was calculated through the Chi-square test for the association of students' knowledge with gender, educational year, or academic discipline which was not found to be statistically significant (considering p-value <0.05 as significant, Table I).

Table I: Participants' knowledge of AI.

Baseline characteristics	Knowledge category		*p-value
	Poor (n = 6)	Good (n = 139)	
Gender, n (%)			0.981
Male	2 (1.4%)	47 (32.4%)	
Female	4 (2.7%)	92 (63.5%)	
Medical field, n (%)			0.370
MBBS	2 (1.4%)	84 (57.9%)	
BDS	4 (2.7%)	53 (36.6%)	
Allied	0%	2 (1.4%%)	
Year of education, n (%)			0.551
2nd Year	4 (2.7%)	55 (37.9%)	
3rd Year	2 (1.4%)	64 (44%)	
4th Year	0%	8 (5.5%)	
5th Year	0%	12 (8%)	

Chi-square test was applied for p-value.

Table II: Participants' Likert responses on AI in medical education (scale 1-5).

Survey	Mean	Median	Mode	Std. Deviation
Familiar with AI	3.84	4.00	4	1.045
Currently learning about AI in the medical curriculum	2.34	2.00	1	1.146
AI should be mandatory for medical education (ME)	3.70	4.00	4	1.002
Confident to understand and utilise AI	3.41	3.50	4	1.045
AI will have a positive impact on the learning experience	3.85	4.00	4	0.919
Integration of AI in ME will be effective	3.97	4.00	4	0.864
AI facilitates the understanding and retention of medical concepts	3.90	4.00	4	0.867
AI improves patient outcomes	3.63	4.00	4	1.059
AI enhances the efficiency of healthcare delivery	3.83	4.00	4	0.882
AI helps in early disease detection	3.68	4.00	4	0.969
Excited about using AI tech as a future physician	3.73	4.00	4	1.067
Training on AI concepts during medical school is useful for future career	3.83	4.00	4	0.947
Concerned about the potential job displacement due to AI	3.48	4.00	4	1.136
Ethical dilemmas are challenges in the widespread adoption of AI	3.65	4.00	4	0.893
Confidence in the accuracy of AI tools recommendations	3.27	3.00	3	0.959
AI facilitates collaboration	3.43	3.00	3	0.954
AI allows for personalised learning experiences	3.68	4.00	4	0.825
There is sufficient support and training for the integration of AI	2.93	3.00	3	1.145
AI-generated feedback is valuable and contributes to learning	3.43	3.00	4	0.933
The use of AI helps in managing study time	3.43	3.00	3	0.987
Collaboration between AI and traditional teaching methods is effective	3.53	4.00	4	0.974
AI will have a significant impact on future medical practice	3.71	4.00	4	0.904

Figure 1: (A) AI topics of interest (B) AI challenges (C) AI expectations.
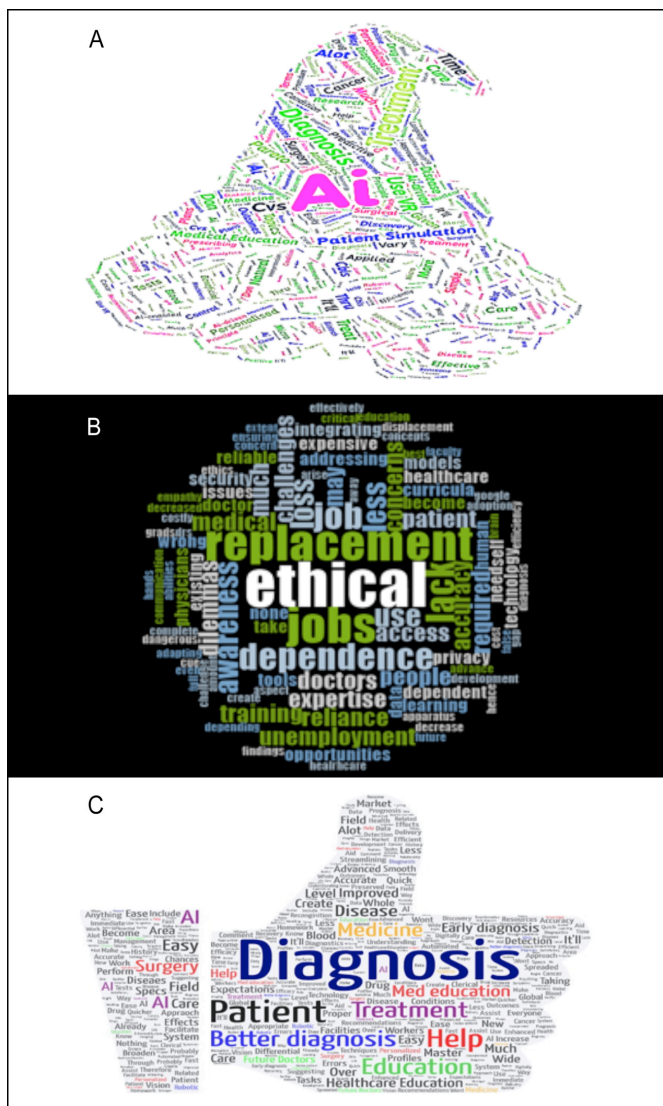
As shown in Table II, the majority of the participants expressed positive views on AI. They believed that AI improves and facilitates medical concepts 108 (71%), patient outcomes 86 (57%), healthcare delivery 106 (70%), early disease detection 93 (61%), collaboration among peers 74 (49%), and personalised learning experiences 96 (63%). A significant number of participants 79 (52%) thought that combining AI with conventional teaching is beneficial in medical education. However, many participants showed concerns about the potential job displacement for healthcare providers due to AI 78 (51%) and ethical dilemmas as a challenge in the future 86 (56%). The students expressed positive attitudes and confidence in their ability to understand AI 76 (50%), use it as a future physician 95 (63%), and accuracy of its tools 60 (40%) in medical education. The majority of the respondents agreed that AI will be effective in medical education 114 (75%), and AI-related skills should be mandatory in the academic curriculum 90 (59%). They agreed that AI will have a significant positive impact on learning experience 111 (72%) and future careers 105 (67%). The overall responses included SA (5%), D (9%), Neutral (39%), A (36%), and SA (15%).

Thematic analysis of the qualitative survey revealed several key themes. Nvivo analysis created word clouds/tag clouds where the size of the word correlates with the frequency of responses of the participants (large words mean more frequency) as shown in Figure 1.

Figure 1A shows positive anticipation and topics of interest for students. They expressed enthusiasm about AI's potential to enhance learning experiences, citing personalised learning modules, virtual patient simulations, AI-enabled diagnosis / medical imaging interpretation, personalised treatment plans / robotic surgery, and medicine discovery, and development as exciting prospects.

A recurring theme was its ethical implications in medical practice. Students voiced concerns over challenges such as ensuring access to reliable data for training AI models, privacy and security issues, AI integration into existing curricula, resources, and training, potential job replacement, lack of empathy and critical thinking, and dependence on AI technologies (Figure 1B).

Students emphasised that technology should be used to support human abilities, not take their place. Improved diagnostics and treatment outcomes, robotic surgeries, enhanced patient care through personalised medicine, efficient healthcare delivery, advancements in medicine discovery and development, better management of healthcare resources, personalised and tailored educational experiences, collaborative learning, and teaching through virtual realities are the future expectations from AI (Figure 1C).

DISCUSSION

This study aimed to explore medical students' understanding of AI integration in medical education and is the first of its kind in the local context. Similar studies have focused on practising physicians in this regard, despite the research void regarding undergraduate students' opinions on AI in medical education. It contributed to the current knowledge base by providing valuable insights into medical students' unique viewpoints on AI in their education, which complement and extend the existing literature on this topic.

These findings align with prior studies, which indicate that students generally hold positive attitudes towards incorporating AI into education.[14] They recognise its capacity to personalise learning and enhance access to information. Students in this study expressed good knowledge and favourable views of AI's potential benefits in healthcare, similar to a Canadian study where the majority of students (87.1%) exhibited high levels of AI understanding, with no significant knowledge disparities between different groups.[15] Similar findings were reported by dos Santos et al., which demonstrated 52% of students' AI familiarity and positive attitude.[16]

Similar to many global reports, challenges and concerns about using AI have emerged in this research as well including shifting away from human activities, ethical issues, loss of professional control, and lack of resources. These issues emphasise the significance of considering ethics related to data privacy, bias, and transparency in different situations, as healthcare professionals have repeatedly expressed their concerns in this regard.[17-19] In the present study, 51% of students thought that AI would take over the jobs of healthcare professionals, Jha et al.'s research also found that more than half of the respondents agreed that AI could reduce the number of jobs for doctors in the future.[20]

Similar to a study by Mir et al., the present study also highlighted the significance of structured AI training. They emphasised that students should be trained in AI-related areas such as skill development, ethical concerns, medical error reduction, data security and recording protocols, applications selection criteria, tools' reliability, virtual reality (VR) applications, surgical robots, and AI's role in diagnosis and treatment, to benefit from its revolutionary potential in the practice of medicine.[21]

Regarding AI's impact on future healthcare, the majority of students (57.3%) in the present study had optimistic views. This shows that positive perceptions about AI development, its integration into medical education, and predicted career gains are correlated, which is in line with studies by Teng et al.[22] Similar to this particular study, a study conducted by Ahmed et al. in 2022 reported that the majority of the medical students (70%) and doctors (81.8%), believed that AI would become a valuable tool in near-future, enhancing diagnoses rather than replacing human physicians.[23]

It is recommended that similar research should be conducted across different cultures and educational institutions to explore varied perceptions on AI and its future integration into medical education (comparative study); medical students should be monitored for AI's impact on their education and career path over time (longitudinal research); and the impact of AI should be evaluated on their development of critical thinking, communication, and ethical decision-making (skill impact).

The study may have faced certain limitations as it was confined to undergraduates and one institution. Moreover, it relied on self-reported online surveys, making it vulnerable to potential biases and non-response. However, despite its limitations, it provides useful and insightful information about students' understanding and knowledge of AI and its role in medical education. Therefore, it can be used to guide future healthcare and education policy decisions.

CONCLUSION

The participants revealed good knowledge and positive views towards AI integration into medical education. They believed that it improves medical concepts and learning experience and will have a positive impact on patient outcomes, healthcare delivery and future practices; while others perceived ethical dilemmas, job displacement, and resources as a challenge. For the benefit of future healthcare, research in this field must continue as medical education advances to have successful AI integration.

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Both authors approved the final version of the manuscript to be published.

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