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Knowledge and Attitude of AI Among Medical and Dental Students in Karachi: A Cross-Sectional Study

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Abstract

Background: Artificial Intelligence (AI) is rapidly transforming healthcare, with applications in diagnosis, treatment, prognosis, and drug discovery. Preparing medical professionals for an AI-driven future requires evaluating students' baseline knowledge and perceptions regarding AI. This study aimed to assess medical and dental students' awareness, attitudes, and preferred modes of incorporating AI into their education, while also exploring concerns about AI replacing future career roles.

Materials and Methods: A questionnaire-based cross-sectional survey was conducted from August to November 2023 after approval from the Institutional Review Board of JSMU. A modified version of a Canadian study questionnaire was distributed via social media to medical and dental students over 18 years of age. Using convenience sampling, 324 complete responses were obtained. Data were analyzed in SPSS version 20 using descriptive statistics and Chi-square or Fisher's exact tests to explore associations between demographic variables (gender, program, year of study) and AI-related knowledge, with a p-value ≤ 0.05 considered statistically significant.

Results: Most respondents (74.38%) reported social media as their primary AI information source. While 79.9% considered themselves somewhat familiar with AI, only 22.53% identified its correct definition. Knowledge varied significantly by academic program and year of study ($p \leq 0.05$), but not gender. Over half (56.17%) agreed AI basics should be taught, with 48.15% favoring curricular integration. The perceived benefits included early accurate diagnosis, improved access, and automation of routine tasks. However, 47.7% of MBBS and 41.33% of BDS students feared AI might replace their careers.

Conclusion: Students showed limited knowledge of AI despite recognizing its benefits in diagnosis, accessibility, and automation. Many feared career replacements, yet most supported learning AI basics through curricular integration. Targeted educational strategies are needed to enhance AI literacy and dispel misconceptions among future healthcare professionals.

Keywords: *Artificial intelligence; Knowledge; Attitude; Medical students; Dental student*

Introduction

Artificial Intelligence (AI) is "a field of research in which computers are applied to mimic human intelligence". [1] AI has changed the course of medicine and healthcare as we know of today . [2] AI through its exactitude, has the potential to decrease complexity and lessen the workload of healthcare providers. [2,3] In this regard, research has shown that AI can not only enhance diagnostic accuracy through analysis of patient records in a short timeframe [4] but also has the potential to predict clinical events with more accurate interpretation [3], provide prognosis [5], assist in drug discovery [6,7] improve treatment, and also reduce disease burden. [4]

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One of the major implementations of AI that is being extensively used in medicine is Deep Learning (DL). DL allows us to identify complex patterns and it analyzes data using multiple layers of artificial neural networks which are inspired by the biological neuronal structure. [8]

Areas of medicine relying largely on imaging data namely radiology [9,10] pathology [11] dermatology [12,13,14,15] and oncology [16] have already started using AI and generating its benefits. AI has continued to progress and is now developing past image processing and integrating itself into other fields, such as cardiology [17,18] and psychiatry [19], and thus will continue to amass a lot of use in different areas in the future.

As the interest in exploring the applications of AI in medicine increases, so do the efforts to incorporate it into education and research. Scientifically advanced countries are already promoting AI for further development by spending resources on it. Third-world countries, like Pakistan, are only just turning their sights towards the potential that AI brings to the field of medicine and education, even in the presence of government policies. [20]

Considering the importance of AI in the modern era, it becomes critical that even the undergraduates pur-

suing medicine be equipped with the fundamentals regarding it. Medical students play a significant role in shaping the future of medicine [21] and for them to be able to do so efficiently, it is vital to supply them with the latest trends in emerging tech. To make the students capable of participating and increasing their interest towards these areas, understanding their perception and baseline knowledge is of utmost importance. Several studies have shown that the insufficient exposure to and knowledge of AI has impacted medical students' career choices in addition to affecting their mental health. [2] In this regard, minimal literature is available in Pakistan, out of which one study does not focus solely on undergraduates [20] and the other, which does, is limited to the students of Peshawar .[22] None of them focus on the knowledge and attitude of the students of Karachi.

In addition to this, medical students are bounded by limited knowledge due to scarce curricular and extracurricular resources. [21] As mentioned above, knowing their attitude and baseline knowledge would also provide a foundation to design the curriculum in accordance to the data. [2]

In this study, our aim is to assess medical and dental students' knowledge and attitudes about AI. This would help identify the gaps which, if addressed, would eventually enable the integration of AI for the improvement of the healthcare system, particularly in developing nations. Despite the fact that there is an abundance of information about AI which is accessible via the internet and other resources worldwide, it is hypothesized that medical students in Pakistan, notably those in Karachi, are not acquainted with it resulting in little interest in accessing it. Therefore, this study will provide the students a platform to express their ideas and enthusiasm for incorporating AI and its utilization into their curriculum as well.

Material and Methods

This cross-sectional survey was conducted from August 2023 to November 2023 among undergraduate medical and dental students at Jinnah Sindh Medical University (JSMU), Karachi. The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki and received approval from the Institutional Review Board (IRB) of Jinnah Sindh Medical University (Reference No: JSMU/IRB/2023/752, approved on June 24, 2023). All participants provided informed consent before participating in this study. Completion of the questionnaire after reading the study information was considered as consent to participate.

The study aimed to assess knowledge, familiarity, and attitudes regarding artificial intelligence (AI) in healthcare and to explore factors associated with knowledge levels. The questionnaire was adapted from a previously validated Canadian study by Teng et al. (2022), followed by content validation by a community medicine specialist with expertise in health education research. A pilot test was conducted with 20 students (excluded from final analysis) to ensure clarity, reliability, and cultural appropriateness of the tool for the Pakistani context. Based on pilot feedback, minor wording changes were made, and internal consistency of knowledge and attitude domains was assessed using Cronbach's alpha.

The final questionnaire consisted of three sections: (i) demographic information (age, gender, field of study, and year of study), (ii) self-reported familiarity with AI (measured on a 5-point Likert scale), and (iii) objective knowledge and attitude items regarding AI. Knowledge was assessed using multiple-choice items, with one point assigned per correct response. A total knowledge score was calculated, and "adequate knowledge" was defined as achieving ≥70% of the total score, in line with prior studies. Attitudes toward AI in medicine were measured using Likert-scale items covering domains such as curricular integration, perceived benefits, and concerns regarding career replacement.

The target population included undergraduate MBBS and BDS students of JSMU who were ≥18 years of age and who consented to participate. Students from other programs (e.g., nursing, pharmacy, or allied health) were excluded. Data was collected using an online survey distributed via social media platforms including WhatsApp, Facebook, and Instagram, employing a convenience sampling strategy. Completion of the questionnaire after reviewing the study information sheet was considered as informed consent. No personal identifiers were collected, and data were stored on a password-protected computer accessible only to the principal investigator. Ethical approval for the study was obtained from the Institutional Review Board of JSMU

The minimum required sample size was calculated using the OpenEpi sample size calculator for a single population proportion. At a 95% confidence level, 5% margin of error, and an expected prevalence of adequate AI knowledge of **48.2%** (based on Aboalshamat et al.'s study conducted among medical students in Saudi Arabia), the required sample size was estimated as **n = 384**. Considering potential non-response and incomplete data, we targeted a minimum of 324 complete responses. Ultimately, 324 valid responses were included in the final analysis. The dependent variable in this study was knowledge about AI, while independent variables included age, gender, field of study, and year of study. However, only 324 complete and valid responses were obtained, corresponding to an overall missing/non-response rate of approximately **15.6%**. Incomplete questionnaires (e.g., those with missing demographic or knowledge responses) were excluded from the final analysis. For cases where only a small number of attitude items were missing, pairwise deletion was applied, and available data were analyzed. Since the proportion of item-level missing data among included responses was <5% and appeared random, no imputation techniques.

The primary aim of the study was to evaluate the gap between self-reported familiarity and actual knowledge of AI among medical and dental students at JSMU.

The specific objectives were:

1. To determine the association between year of study and AI knowledge levels.
2. To assess student attitudes toward incorporating AI education into the medical curriculum.
3. To explore the prevalence of concerns regarding AI potentially replacing future careers.
4. To identify student preferences for curricular versus extracurricular approaches to AI education.

Statistical analysis was performed using SPSS version 20. Descriptive statistics were used to summarize demographic characteristics, self-reported familiarity, knowledge scores, and attitudes. For the primary aim (comparing self-reported familiarity with actual knowledge), McNemar's test was applied to paired proportions, and agreement was further assessed using Cohen's kappa. Associations for secondary objectives were examined using Chi-square tests or Fisher's exact tests for categorical comparisons. Attitudinal outcomes (Likert items) were summarized as frequencies and proportions. A p-value <0.05 was considered statistically significant.

Results

Demographic Details:

From the distributed questionnaires, 324 responses were received that fit the inclusion criteria for the research. These responses were then analyzed to obtain the results. Of the 324 undergraduates, 174 were from the MBBS program and 150 were from the BDS program at Jinnah Sindh Medical University. The majority of the responses (273, or 84.3%) were from female students, while the remaining 51 (15.7%) were from male students.

Age was divided into three categories, namely, 18–20 years, 21–23 years, and 24-26 years. The age group ranging from 21 to 23 years old provided the largest number of responses, accounting for 206 (63.78%) responses. The second highest number of responses were from the age group of 18- to 20-year-olds, with 104 (32.20%) responses. The fewest were obtained from 24 to 26-year-olds, with only 13 (4.02%) responses. (Table 1)

Table.1 Respondent Demographics.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	50	15.4
	Female	274	84.6
Age (years)	18–20	105	32.4
	21–23	206	63.6
	24–26	13	4.0
Program	MBBS	174	53.7
	BDS	150	46.3
Year of Study	1st year	53	16.4
	2nd year	67	20.7
	3rd year	68	21.0
	4th year	91	28.1
	5th year	45	13.9

Knowledge about AI:

The majority of students (74.38%) reported social media as their primary source of information about AI, while some obtained information from other online sources (19.4%). Only 15 (4.6%) students reported having no prior knowledge of AI.

The students were asked about their familiarity with the concept of AI, and a large majority (259, or 79.9%) reported being somewhat familiar with it. 47 (14.5%) students reported being very familiar with AI, while only 18 (5.6%) said they were not familiar with it at all. When asked to choose a definition of AI, 114 (35.18%) and 103 (31.78%) students selected partially accurate definitions, such as "the ability of a digital program to perform tasks associated with human intellect" and "the simulation of human intelligence in machines that are programmed to act like humans," respectively. The most accurate definition, "software that can learn from experience, adjust to new inputs, and make decisions," was only chosen by a little less than a quarter of the students (73, or 22.53%). A few students (36, or 10.49%) chose completely inaccurate options. (Figure 1) Chi-square analysis revealed significant associations between AI knowledge and both program of study ($\chi^2 = 15.23$, $p = 0.004$) and year of study ($\chi^2 = 18.67$, $p = 0.001$). (Table 2a). Gender showed no significant association with AI knowledge ($\chi^2 = 2.14$, $p = 0.143$). (Table 2b)

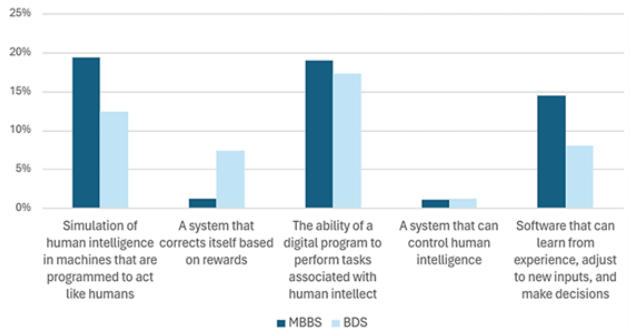

Figure 1. Perceptions of artificial intelligence among medical (MBBS) and dental (BDS) students at JSMU. The figure illustrates responses to the question, *"What do you think describes artificial intelligence best among the following options?"* with comparisons shown between MBBS and BDS programs.

Attitude about AI:

Using Likert Scale, attitude of AI was assessed by giving general statements. Over half of the students (182, or 56.17%) completely agreed that healthcare students need to learn the basics of AI, while 45 (13.88%) completely disagreed with this notion. The remaining 97 students were neutral on this statement. When asked about the statement "AI has the potential to revolutionize healthcare and improve patient out-

Table 2a. Perceptions of Artificial Intelligence by Year of Study (n = 324)

What do you think describes Artificial Intelligence best among following?						
Year of Study	Simulation of human intelligence in machines that are programmed to act like humans	A system that corrects itself based on rewards	The ability of a digital program to perform tasks associated with human intellect	A system that can control human intelligence	Software that can learn from experience, adjust to new inputs, and make decisions	Total
1st Year (n=53)	16	8	20	1	8	53
2ndYear (n=67)	17	11	20	4	15	67
3rd Year (n=68)	17	6	32	0	13	68
4th Year (n=91)	37	2	28	1	23	91
5th Year (n=45)	16	1	14	0	14	45
Total (n=324)	103	28	114	6	73	324

Table 2b. Perceptions of Artificial Intelligence by Gender (n = 324)

What do you think describes Artificial Intelligence best among following?						
Gender	Simulation of human intelligence in machines that are programmed to act like humans	A system that corrects itself based on rewards	The ability of a digital program to perform tasks associated with human intellect	A system that can control human intelligence	Software that can learn from experience, adjust to new inputs, and make decisions	Total
Male (n=50)	21	4	11	0	14	50
Female(n=274)	82	24	103	6	59	274
Total	103	28	114	6	73	324

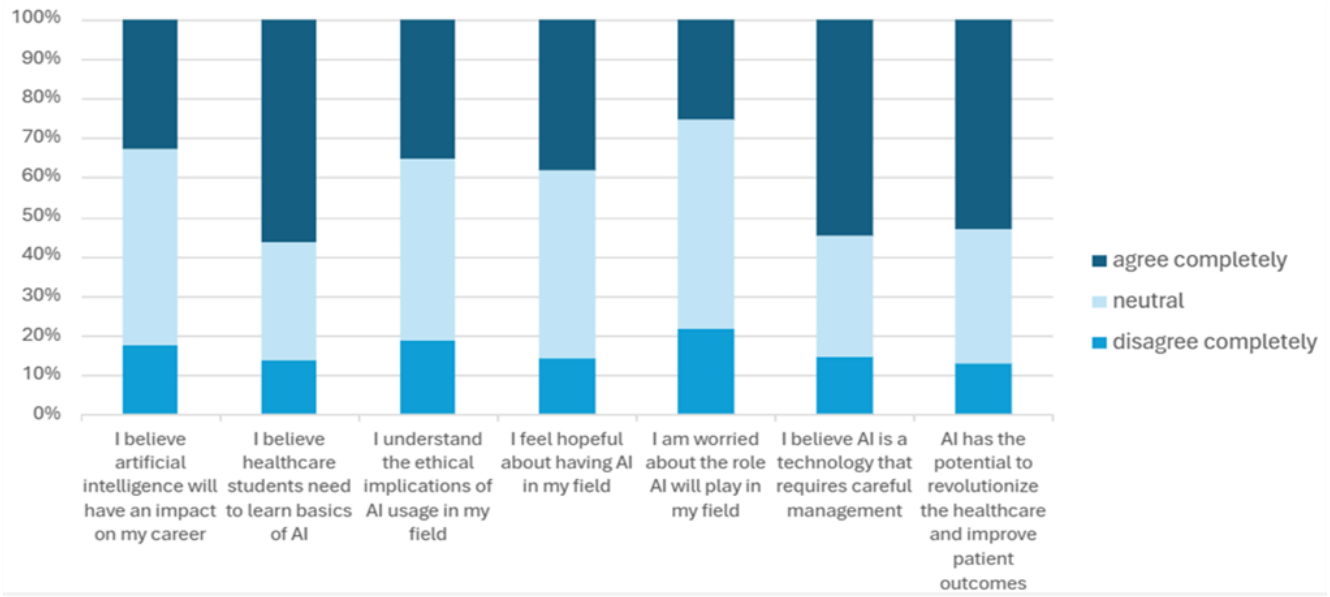

Figure 2. Attitudes of medical and dental students at JSMU toward artificial intelligence (n = 324). The figure illustrates levels of agreement, neutrality, and disagreement with statements regarding AI's impact, ethical implications, and potential role in healthcare and medical education.

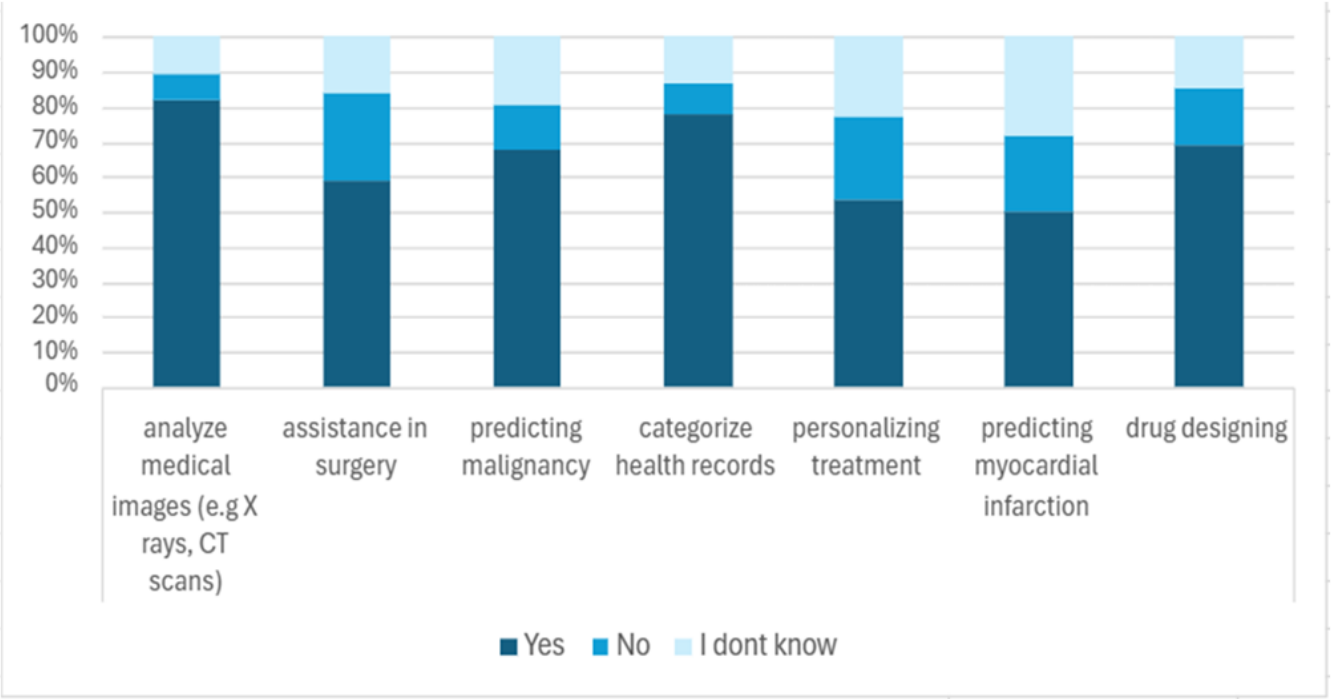

Figure 3. Perceptions of medical and dental students at JSMU regarding the potential role of artificial intelligence in medical practice (n = 324). The figure illustrates responses about whether AI can assist in various applications, including medical imaging, surgery, diagnosis, record management, treatment personalization, and drug designing.

comes," 172 (53.09%) students completely agreed, while only 42 (12.9%) disagreed, making this the least disagreed upon statement. The most neutral opinion was on the statement "I am worried about the role AI will play in my field," with 172 (53.09%) students choosing to be neutral. (Figure 2)

The top three benefits of AI selected by students were early and accurate diagnosis (61.54%), improved accessibility to healthcare (49.85%), and automation of routine tasks (46.46%). Additionally, students were asked about the use of AI in medical practice, and the top three selections were assisting in analyzing medical records (81.79%), categorizing health records

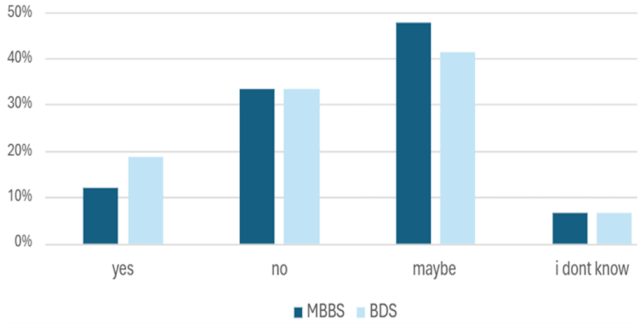

Fig 4. Do you think AI will replace your career in the future?

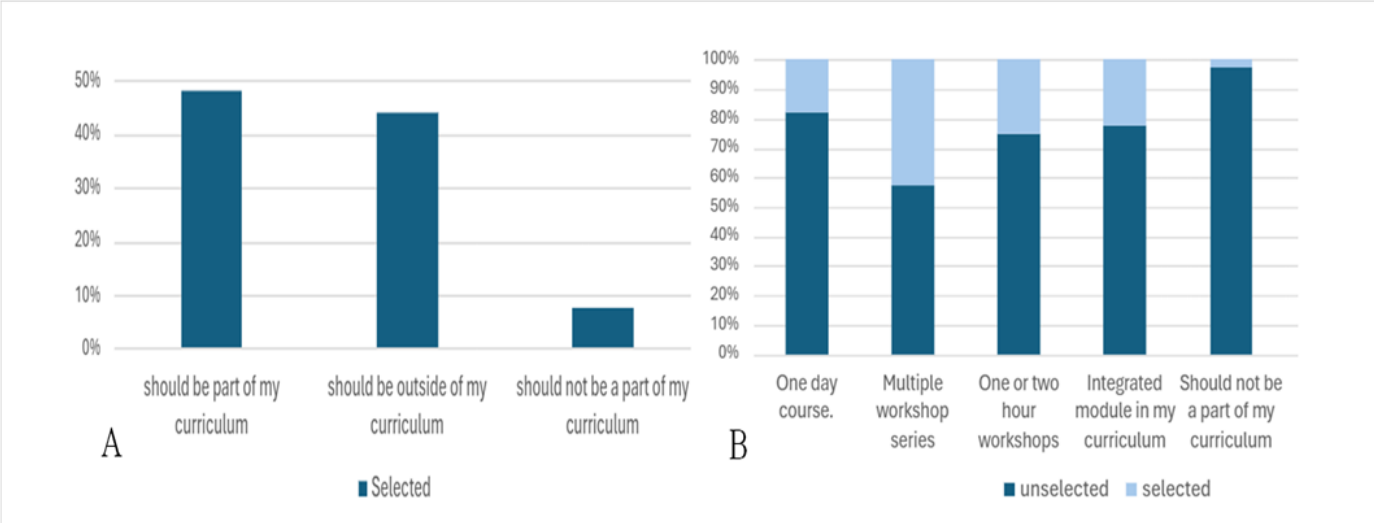

Figure 5. (A) Student opinions on whether AI basics should be included in the formal curriculum or considered extracurricular. (B) Preferred learning formats for AI basics, including short courses, workshops, or integration into the curriculum.

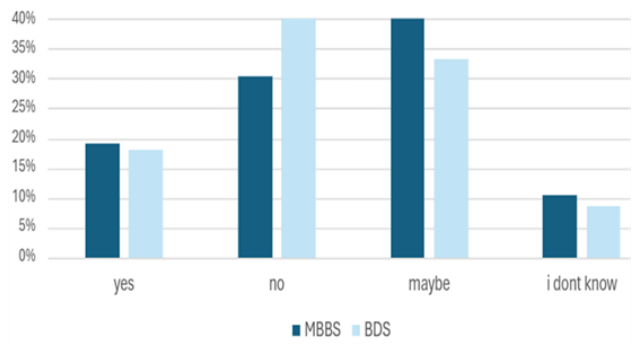

Fig 6. Do you think AI is being applied to medicine in Pakistan?

(77.78%), and drug designing (68.83%), which align with the benefits chosen by students. (Figure 3)

Students' Opinions on the Future of AI:

When asked about the potential vulnerability of AI in replacing their career, a majority of MBBS students (47.7%) and BDS students (41.33%) believed that AI might replace their career in the future. 33.33% of students from both programs denied this possibility, while 12.7% of MBBS students and 18.6% of BDS students agreed that AI will replace their career in the future. A minority of students (6.66%) remained unsure. (Figure 4)

When asked about the integration of AI into the curriculum, the majority (156, or 48.15%) were in favor of including AI in their curriculum, while 143 (44.14%) believed it should be extracurricular knowledge and 25 (7.716%) did not want AI to be a part of their curriculum. (Figure 5a, Figure 5b) About 120 (37%) students were unsure if Pakistan was utilizing AI in medicine, while 114 (35.2%) firmly denied its use and 59 (18.2%) believed it was being used. (Figure 6) When asked about the potential reasons for why Pakistan is not utilizing this technology, the majority of students (191, or 58.95%) agreed that a lack of awareness is the biggest obstacle. Other reasons that students agreed upon were a lack of proper training and, most importantly, a lack of financial resources.

Discussion

There is an underutilization of AI in many fields, but most importantly, in the medical field. The enormous patient load creates an increasing need to overhaul the system to make space for something more time-saving and practical. It becomes critical that the future of this field; the medical students are equipped with knowledge of tools that are rapidly revolutionizing medicine. Thus, this study was particularly conducted among medical and dental students to assess knowledge of the fundamental aspects of AI and its applications for a smoother transition into a more efficient healthcare structure.

With regards to the knowledge about AI, out of a total of 324 students, more than half of the students had a very basic understanding of the concept of AI, roughly the same statistics as found in a similar study conducted in Peshawar. [22]However, only a quarter of the students displayed a solid concept of AI, reflecting from their responses of what they thought described the best about AI. A previous study assessing self-perceived knowledge about AI too revealed this consistent gap. Where it was observed that over two-thirds of the population had just the basic concept of AI whereas only a little more than one-third understood the deeper aspects of AI. Furthermore, on comparing the statistically significant positive correlation of our assessment between year of study and the knowledge of AI with the above study, we found quite the contrary. Their study observed the level of qualification and the knowledge of AI to be independent of each other. [20]Additionally, their study showed statistically significant correlation between knowledge of AI and gender whereas in our study it was found to be statistically insignificant.

The major source of knowledge acquisition about AI in our population was social media, a finding consistent with previous similar studies conducted in the US and Germany. [23,24] Only 10% of our population was affirmative to have received formal education on this topic. Though social media could serve as a medium for basic knowledge, it does not provide practical neither ethical implication of AI and its use in medicine that can only be met with a robust formal teaching regime.

In our study, over half the students showed a positive attitude towards learning about AI. When asked about the applications of AI in medicine, the top three choices by students were (i) assist in analyzing medical images, (ii) categorizing health records and (iii) drug designing, though other studies report little regarding knowledge of applications. It is consistent with the findings of another study in Lahore, Pakistan, which reported radiology and pathology as most perceived medical fields to be impacted by AI. [20] More than half of the students believed that AI would help most with an earlier and accurate diagnosis, an observation similar to the findings in another study conducted in Pakistan. When asked about the benefit of AI being incorporated into medicine half the population supported the idea of it improving accessibility to general heath, which is contradictory to a study in Islamabad in which the majority has a belief that it is not compliant to be applied to every patient. Secondly, a little less than half of the population accepted the time-saving effect of AI in terms of automation of routine tasks. The option that was found least favored by our population was the benefit of AI to the field of genetics. Overall, there is a general consensus of AI improving the pre-existing field of medicine.

Lack of understanding of how AI may be integrated into their fields or how to interpret AI-generated results may lead to fear or distrust of such applications among the medical students. With regards to this, when asked if AI could potentially risk the careers of medical and dental students replacing them, half the students across both programs think there is a possi-

bility of AI replacing their careers. Though a quarter are convinced of it occurring in the future with MBBS students being slightly higher in ratio than BDS ones. Whereas, Zaboor et al's study population displayed the notion that AI would not replace physicians but rather serve as a supplement to aid practitioners. Insights from a study conducted in Islamabad were of a similar opinion where half of the population disagreed that AI would replace their careers . [25] Overall, a little over one-third students believed that AI will impact their career in 10 years whereas the other third believed it will impact their career in 5 years. Additionally, when asked if AI was currently being used in healthcare facilities in their country, the students were unsure and some even disagreed that it was being utilized. The top three reasons according to the students as to why it was not being utilized are: lack of awareness, lack of proper training and lack of financial resources. These findings were more or less the same as observed by Zaboor et al, highlighting the more regional obstacles faced by a developing country. [20]

There is an equal divide between those in favor of AI being a part of the curriculum and those who are not. This is unlike what is reported in other national and international studies. Studies in Pakistan and USA [20,23] showed an overwhelming majority supporting the incorporation of AI into the school curriculum. If their respective programs were to introduce the basics of AI, the students chose the following to be the most important objectives to them: (i) identify ways AI can improve healthcare quality improvement, (ii) identify when technology is appropriate for a given clinical context, (iii) be able to communicate how the technology works in a way that others can understand, (iv) understand and interpret AI-generated results. The top choice for both programs geared towards using AI for improved healthcare quality shows that medical students are aware of the subpar quality of the health system in Pakistan and are enthusiastic about finding a new avenue to deliver better care. Because of the lack of resources, it is important to know when to apply AI to facilitate treatment and recovery.

Lastly, the limitations of our study should also be considered. It was conducted at a single university gaining insights from only two departments, without participation from students at any other universities. As mentioned in the results, 274 students were females and only 50 were males which indicates a gender bias, but only serves to reflect the unequal gender distribution seen in a majority of medical institutions. Distribution of the e-questionnaire predisposes to selection bias which could have affected our results. It could have led to misunderstanding of questions along with some recall bias which cannot be ignored. The usage of convenience sampling undermines the possibility of a generalized opinion across the population. Despite these limitations, we believe that our study provides certain valuable insights.

Most prominent of which is a less subjective view of the students' knowledge compared to other studies in the same region which relied on self-reported responses using dichotomous scales in assessing the knowledge of AI. [20] Moreover, our study also illustrates how students would prefer to have AI integrated as a learning tool either curricular or extracurricular, provided with the objectives most important for them to learn about. Consequently, we reckon that these findings are advantageous in providing further direction to education and health policymakers.

Conclusion

Although most students reported being somewhat familiar with AI, only a minority could correctly define it, highlighting substantial knowledge gaps. Students identified early diagnosis, improved accessibility, and automation of routine tasks as major benefits, while many also feared AI might replace their careers. Over half favored learning AI basics, with curricular integration preferred by most. These findings underscore the need to develop structured educational strategies—both curricular and extracurricular—that not only improve AI literacy but also address misconceptions about career replacement, ensuring future healthcare professionals can effectively adapt to an AI-enhanced system.

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Author Contributions

1. **Tooba Adil:** Concept, study design, and manuscript drafting.
2. **Eman Izhar:** Data collection and analysis.
3. **Bushra Shahid:** Data collection and literature review.
4. **Shanzah Imran:** Questionnaire development and data entry.
5. **Hania Khalid:** Data interpretation and result compilation.
6. **Mehreen Akram:** Proof reading, formatting, and final manuscript review.