Research Article

Artificial Intelligence and the Future of Healthcare in Pakistan and Challenges in Medical Students - A Cross-Sectional Study

Aleena Sameen[1], Ahmad Ali[2], Aleena Shafique[3], Ahmed Ali[4], Aleena Arshad[5], Naila Bajwa.[6]

[6]Rahbar Medical College, Lahore, [1-5]King Edward Medical University, Lahore/ Mayo Hospital, Lahore.

Abstract

Background: Artificial Intelligence (AI) has recently grown in popularity and revolutionized several sectors, including healthcare and medical education. AI technology have shown promise as a means of enhancing clinical results and the medical field functionality. Still, Pakistan's healthcare sector faces several hurdles in using Artificial Intelligence.

Objectives: This study aimed to access the future of artificial intelligence in the Pakistan's healthcare system and to access challenges in medical students.

Methods: This cross-sectional study addressed 302 medical students from notable medical institutions across Pakistan. A designed online questionnaire that evaluated the participant's knowledge with the application of AI in the healthcare system of Pakistan and challenges faced by them served as the data collection method. Data was analyzed using SPSS software, version 23.0.

Results: Among the 302 respondents, most of the respondents had never attended any session providing AI knowledge during their course. 74.8% of the students agreed that AI can perform better and replace human beings in analyzing patient information to reach diagnosis. Only 29.1% of the participants agreed that the medical education they are currently receiving is adequately preparing them for working alongside AI tools in the future.

Conclusion: According to this survey, most of the medical students thought that AI can diagnose patients more accurately than humans, but existing medical education does not adequately equip students to work with AI tools in the future.

Keywords: Artificial Intelligence, healthcare, challenges, medical students, Pakistan.

Corresponding Author: Naila Bajwa **Email:** bajwanaila31@gmail.com

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Introduction

Around the world, numerous organizations are using Artificial Intelligence (AI) as a virtual tool. Training of AI models in developed countries poses a risk to its use by underdeveloped countries like Pakistan regarding the diseases and health problems more common in underdeveloped countries in comparison to developed ones, like Tuberculosis, Poliomyelitis etc.[1] AI has emerged as a significant tool in the wake of the COVID-19 pandemic, with applications including early detection of disease and diagnosis, evaluation of defects in medical imaging, providing personalized treatment plans, research and development of drugs, predictive analysis, and risk management.[1,2] Because AI can replicate human cognitive capabilities, it has revolutionized industries, improved productivity, and created new opportunities.[3]

AI offers a wide range of healthcare applications, including enhancing precision in diagnosis, projecting clinical results, and providing optimized treatment recommendations. Massive amounts of pre-designated training data are used by AI systems, which then analyze correlations and trends to predict future events.[4] Developed countries have set aside significant resources for research on AI and its execution in healthcare systems. They are utilizing AI algorithms to help radiologists discover anomalous phenotypic traits in images, categorize them, generate predictions about the patient's underlying ailment, type of procedure, and interpret outcomes. The use of AI in pathology increases the diagnostic qualities of pre-existing experiments and procedures of laboratory testing, including evaluation of histologic slides of tissues and genomic data.[5]

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Despite government objectives to promote AI, developing countries such as Pakistan continue to lag in education, research, and applications of Artificial Intelligence, especially in the healthcare system. There are still many obstacles in implementing AI in healthcare in Pakistan, even with presidential initiatives. These obstacles include financial instability, shortage of competent healthcare professionals to build diagnostic standards that form the basis for algorithms, insufficient information on public opinion and consequences associated with AI use, fear of replacement of physicians, social stigmas, privacy concerns, and medicolegal consequences.[6]

While the world is working to increase the use of advanced Artificial Intelligence technologies in healthcare, the drawbacks of AI should not be overlooked. These include issues related to data gathering, algorithm development, ethics, society, clinical deployment, and biased and discriminating algorithms. Inadequate design or use of erroneous or unbalanced data might result in biased software and technical artifacts.[7] Thus, AI perpetuates racial, gender, and age prejudices already present in society, widening the wealth divide.[8]

The study's goal is to determine the level of awareness and perception regarding artificial intelligence among medical students of Pakistan. It aims to assess their acquaintance with the current status of artificial intelligence in healthcare and identify potential barriers to its use. In countries like Pakistan, where many medical professionals and students remain unaware of artificial intelligence's potential, this research attempts to bridge the gap between AI's underutilization and its promise in healthcare. Although developed countries have produced a large portion of research on AI in healthcare, less attention has been paid to its use in developing countries like Pakistan. Educational reform is necessary, as the hypothesis indicates that Pakistani medical students might not fully understand the implications of AI in medical practice. The study aims to increase awareness and offer guidance on potential applications of AI to improve patient care in Pakistan.

Methods

This cross-sectional survey was conducted among medical students. A sample size of 302 was required to attain an absolute accuracy of ±5% at a 95% confidence level, based on an estimated proportion of basic AI knowledge of 27.3%.[6] The sample population was chosen through consecutive non-probability sampling. A total of 302 medical students were included after obtaining informed consent, while doctors and students of disciplines other than MBBS were excluded.

Data were collected using a preformed questionnaire[2] distributed through Google Forms, containing open-ended and closed-ended questions on demographics, knowledge and perception of artificial intelligence, use of AI in patient care, health systems, population health, impact on the medical profession, AI ethics, and AI in medical education. Privacy and confidentiality were maintained throughout the data collection process.

Data were analyzed using SPSS version 23.0. Frequencies and percentages were calculated for categorical variables, while means and standard deviations were calculated for quantitative variables. Chi-square test was applied to compare categorical variables, and a p-value ≤ 0.05 was considered significant.

Results

Overall, 302 medical students from first year to final year MBBS completed our online questionnaire. Participation was highest among fourth year students (35.4%) and lowest among final year students (8.3%). The pie chart illustrates the percentage distribution.

Our questionnaire consisted of three sections. The first section included questions regarding demographic information and background knowledge of AI. Of the 302 respondents, 53.6% (n=162) were females and 45.7% (n=138) were males.

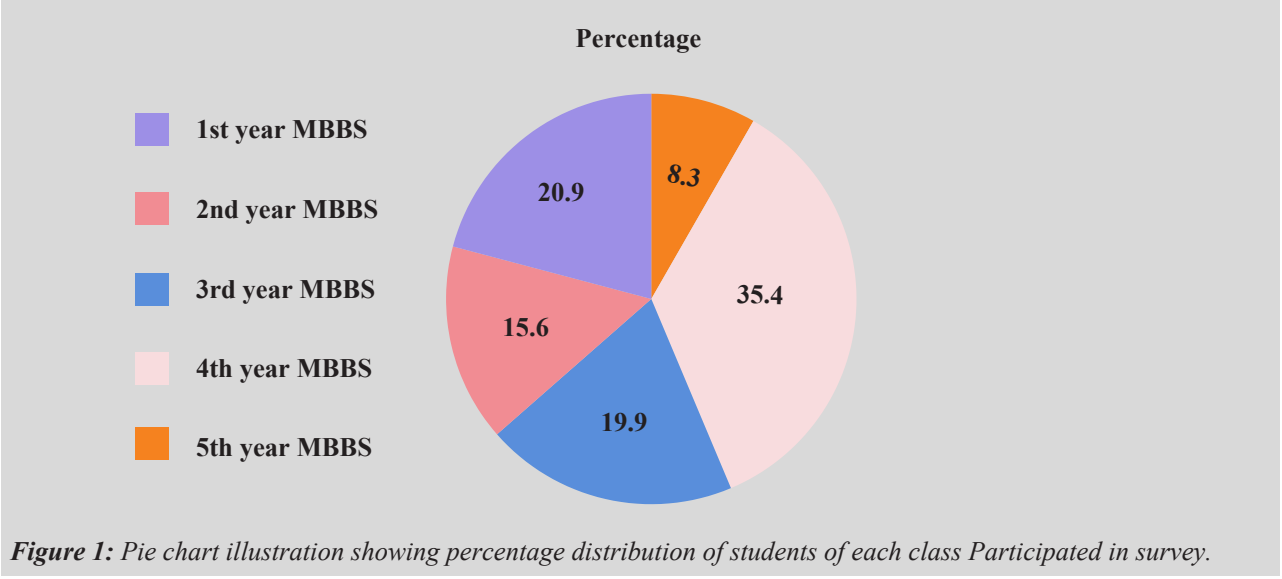

Figure 1: *Pie chart illustration showing percentage distribution of students of each class Participated in survey.*

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In descriptive statistics, frequencies and percentages were calculated for variables, while inferential analysis was conducted using the chi-square test. Regarding knowledge of AI, chi-square was significant for "Deep learning meaning" (p value = 0.015). A total of 46.4% (n=140) had a basic understanding of the term, while 53.6% did not. Variables including AI meaning, machine learning meaning, neural network meaning, and algorithm meaning were non-significant (p values > 0.05) (Table 2).

Table 1: *Demographic details of the participants (N=302)*

Parameters	Frequency n (%)
Gender	
Female	163(53.9)
Male	139(46.1)
Academic Background in computer science	
Yes	60(19.9)
No	242(80.1)
Lectures on AI	
Yes	131(43.4)
No	171(56.6)
Training in AI	
Yes	14(4.6)
No	288(95.4)

In individual patient care (perception of AI), chi-square was most significant for "Analyzing patient information" (p value 0.000). About 74.8% (n=226) agreed that AI could perform better or replace humans in analyzing patient information for diagnosis, while 25.2% disagreed.

Significant values were also observed for interpretation of diagnostic imaging, personalized treatment plans, and monitoring patient compliance (p values 0.008, 0.007, and 0.012 respectively). Most respondents agreed AI could outperform humans in these areas, except for preventative health recommendations, which was non-significant (p value = 0.747) (Table 3).

Considering the impact of AI on the medical profession, chi-square was non-significant for all variables, including number of jobs available, job reduction, and choice of specialty (p values > 0.05). However, 65.6% (n=198) believed AI would reduce job availability, and the majority agreed some specialties would be affected more than others.

In view of AI ethics, chi-square was non-significant for all variables, including ethical challenges, health equity, and Pakistan's healthcare system (p values > 0.05). Most students agreed AI would raise new ethical challenges (86.8%, n=262) and health equity concerns (79.8%, n=241). Only 20.5% (n=62) believed Pakistan's healthcare system is currently prepared for AI-related issues.

Lastly, findings related to AI and medical education showed significant values for working alongside AI tools

and training on AI competencies (p values 0.026, 0.003). Only 29.1% (n=88) felt current medical education prepares them to work with AI, while 86.8% (n=262) supported inclusion of AI courses. Chi-square was non-significant for compulsory training for every medical trainee (p value > 0.05) (Table 3).

Table 2: *Knowledge of AI*

Parameters	Response	Frequency n (%)	Chi-square value	p value
Understands Artificial intelligence meaning:	Yes	286(94.7)	7.954	0.093
	No	16(5.3)		
Understands Machine learning meaning:	Yes	193(63.9)	6.837	0.145
	No	109(36.1)		
Understands Neural network meaning:	Yes	105(34.8)	5.482	0.241
	No	197(65.2)		
Understands Deep learning meaning:	Yes	140(46.4)	12.355	0.015
	No	162(53.6)		
Understands Algorithm meaning:	Yes	132(43.7)	2.015	0.733
	No	170(56.3)		

Table 3: *Perception of AI*

Parameters	Response	Frequency n (%)	Chi-square value	p value
Preventative health recommendations by AI:	Yes	257(85.1)	1.939	0.747
	No	45(14.9)		
Analyze patient information:	Yes	226(74.8)	23.249	0
	No	76(25.2)		
Interpret diagnostic imaging:	Yes	256(84.8)	13.784	0.008
	No	46(15.2)		
Personalized treatment plans:	Yes	186(61.6)	14.2	0.007
	No	116(38.4)		

Monitor patient compliance:	Yes	209(69.2)	12.937	0.012
	No	93(30.8)		
Reduction of number of jobs available to me:	Yes	198(65.6)	1.57	0.814
	No	104(34.4)		
Reduction in jobs:	Yes	223(73.8)	0.236	0.994
	No	79(26.2)		
Choice of specialty:	Yes	100(33.1)	7.282	0.122
	No	202(66.9)		
Working alongside AI tools:	Yes	88(29.1)	11.089	0.026
	No	214(70.9)		
Training on AI competencies:	Yes	262(86.8)	15.951	0.003
	No	40(13.2)		
Training compulsory for every medical trainee:	Yes	252(83.4)	1.623	0.805
	No	50(16.6)		
Raise New ethical challenges:	Yes	262(86.8)	7.095	0.131
	No	40(13.2)		
Raise New challenges around health equity:	Yes	241(79.8)	2.484	0.647
	No	61(20.2)		
Pakistan healthcare system cope with the challenges:	Yes	62(20.5)	9.458	0.051
	No	240(79.5)		

Discussion

Artificial intelligence has transformed medical procedures globally and is utilized as a virtual tool in various regions of the world because of its incorporation into healthcare. Pakistani researchers and healthcare professionals are paying close attention to artificial intelligence, which could lead to considerable improvements in the provision of healthcare.[9]

The study was conducted among 302 students studying MBBS from various medical colleges with highest number of respondents (35.4%) from 4th year MBBS and lowest number of respondents (8.3%) from Final year

MBBS. 20.9% students from 1st year MBBS, 15.6% students were from second year MBBS, 19.9% from third year MBBS. All the participants were students of MBBS only.

Regarding the demographic distribution, notably higher number of female students participated in the research than the male students with percentage of female students being 53.6% and male being 45.7%. As being medical students, majority of our respondents lacked information and background in computer science with 80.1% students having no academic background in computer science and 19.9% having knowledge of computer science. Among the respondents 43.4% students have attended lectures on AI while the remaining huge percentage (56.6%) of students never attended lectures. Overall, only 4.6% participants ever attended training about AI and its uses in healthcare leaving the rest (95.4%) students who never attended any training. A study conducted at Aga Khan Medical University, Karachi, Pakistan revealed that 68.8% medical students had a basic knowledge of AI.[2] While a study conducted at KIST Medical College, Nepal 91.7% students never attended any talks or lecture on AI.[10]

When considering the Knowledge of AI among medical students, majority (94.7%) of the respondents knew the meaning of AI while 5.3% did not know. Regarding machine learning meaning, a large percentage (63.9%) knew what it means while 36.1% didn't know. Contrary to this, majority (65.2%, 53.6%) did not know what neural network and deep learning respectively mean. Majority of the participants (56.3) did not the meaning of Algorithm. A study conducted among medical students in Saudi Arabia showed that 38% students have basic knowledge of AI.[11] A separate study conducted in Syria showed that 70% students have basic knowledge of AI, 34.7% having basic knowledge of machine learning and deep learning.[12] Being in medical field it is necessary for the medical students to have primary or fundamental knowledge of the recent advancements (AI in the present scenario).

While considering the perception of artificial intelligence in terms of individual patient care, majority of the participants (85.1%) agreed that AI provides patients with preventive health recommendations. Around 74.8% participants hold the opinion that AI can analyze patient information to reach diagnosis and prognosis. Meanwhile 84.8% anticipate that AI can create tailored treatment strategies for patients and customized medical prescriptions. Additionally, 61.6% and 69.2% respondents considered it to be a reliable application for the personalized treatment plans and for monitoring patient compliance respectively. A study conducted at German tertiary referral Hospital revealed that a significant majority supported the use of in medicine and healthcare, with 53.18% of the respondents rating it positively or very positively.[13]

Our research showed the negative impact of AI on medical profession in terms of the availability of jobs to the medical professionals as the work done by humans these days will be done by robots or the machines. According to our study, 65.6% think that AI will reduce the number of jobs available, 73.8% think that AI will affect the provision of jobs to the medical professionals than any other field as the work done by them will be done through AI. While a small percentage of students (33.1%) agreed that AI has already affected or will affect the choice of specialty among medical students despite the small advancements in the field of AI in Pakistan but mainly because of the provision of innovative tools, enhancing clinical decision making and the unique opportunity to be at the forefront of cutting-edge healthcare technologies. Contrary to this, a study conducted at Dartmouth revealed that AI will help physicians by handling routine tasks, allowing better doctor patient interaction. Though AI is unlikely to replace physicians in the near future but medical professionals must understand AI technology to improve their skills.[14]

Regarding AI ethics, our study revealed that majority of the respondents (86.8) think that the integration of AI in medicine will bring new ethical and social issues. While 79.8% agreed that AI will introduce new challenges related to health equity by potentially exacerbating existing disparities and creating new ones. Overall, quite a large percentage of students (79.5%) agreed that the Pakistani healthcare system is currently not prepared to address the challenges related to AI. According to a separate study, public discussion surrounding the ethics of AI is a relatively recent phenomenon but it has raised serious concerns among the masses.[15] The development of AI can create a divide between those who have access to and those who do not; raising serious social issues.[16]

While considering the relation between AI and medical education in Pakistan, 70.9% students agreed that the curriculum is not preparing them effectively to work with AI tools through a multifaceted approach. 86.8% students (a large majority) agreed that medical training should incorporate education on AI competencies to prepare healthcare professionals for the evolving landscape of healthcare. A huge percentage (83.4%) agreed that it is imperative that every medical trainee receives training in AI competencies. With the increased use of AI tools in healthcare professionals it is necessary for the medical practitioners to be up to date, well informed and well educated.[17]

Our study yielded valuable insights into the perspective of the future of AI in healthcare system of Pakistan and its challenges and opportunities. However, the limitations may include respondents providing false information, medical students having very limited knowledge of AI, only a small number of students are being studied and not the broader population is being studied, sample bias towards internet users only. Acknowledging these limitations is crucial for shaping effective research and implementation strategies in today's fast evolving technological landscape.

The study highlighted the importance of AI in the healthcare system of Pakistan, the challenges faced by medical professionals, the limitations of AI tools provision and the future opportunities it is holding for the medical field.

Conclusion

According to this survey, AI can diagnose patients more accurately than humans by performing tasks and analyzing patient data, but existing medical education does not adequately equip doctors to work with AI tools in the future. It would be easier for medical students to use AI in the future if training on AI competences was included in their medical education.

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Authors Contribution:
AS, AA: Involved in conceptualization of study and writing original draft.
AS, AA, AA: Involved in data curation, formal analysis and final review & editing.
NB: Involved in design of study and final review & editing.

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