

Research Article

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

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Abstract

Background: Artificial intelligence has recently grown in popularity and revolutionized several sectors, including healthcare and medical education. AI technology has 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 assess the future of artificial intelligence in the Pakistan's healthcare system and to assess 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.

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Introduction

Around the world, numerous organizations are using artificial intelligence as a virtual tool. Training AI models in developed countries poses a risk to its use in 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 COVID-19 pandemic, with applications including early detection of disease and reach diagnosis, evaluation of minor defects in medical imaging, providing perso-

nalized 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 use these patterns to analyze correlations and trends and predict future events.⁴ Developed countries have set aside significant resources for research on AI and its execution in the healthcare system. They are utilizing AI algorithms to help radiologists discover anomalous phenotypic traits in images, categorize them, generate predictions about the patient's underlying ailment, kind of procedure, and interpret the outcomes. The use of AI in pathology increases the diagnostic qualities of pre-



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existing experiments and procedures of laboratory testing, Furthermore the evaluation of histologic slides of tissues and genomic data.⁵ Despite government objectives to promote AI, developing countries such as Pakistan continue to lag in the field of education, research, and applications of Artificial Intelligence especially in the healthcare system. There are still many obstacles in the way of implementing AI in the healthcare industry in Pakistan, even with the presidential initiative. These obstacles include financial instability, a shortage of competent healthcare professionals to build diagnostic standards that form the basis for algorithms, insufficient information on general public opinion and consequences associated with the use of AI, fear of replacement of physicians, social stigmas, privacy and medicolegal consequences.⁶

While the world is working tirelessly to increase the use of advanced Artificial Intelligence technologies in the healthcare system, we should not overlook the drawbacks of AI in healthcare, which include issues related to data gathering, algorithm development, ethics, society, clinical deployment, and — above all—biased and discriminating algorithms. Inadequate design or using erroneous or unbalanced data in algorithms might result in biased software and technical artifacts.⁷ Thus, AI just perpetuates the racial, gender, and age prejudices that already exist in our 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 seeks to ascertain their degree of acquaintance with the current status of artificial intelligence in healthcare and look into potential barriers to its use. In nations like Pakistan, where many medical professionals and students are still ignorant about artificial intelligence's (AI) potential, this research attempts to bridge the gap between AI's present underutilization and its promise in healthcare. Although developed countries have produced a large portion of the current research on AI in healthcare, less attention has been paid to its use in the developing ones like Pakistan. In order to better prepare future healthcare professionals, educational reform is necessary, as the hypothesis indicates that Pakistani medical students might not fully understand the implications of AI in medical practice. To promote a better understanding of how AI can enhance patient care in Pakistan and other comparable contexts, the study aims to increase awareness and offer guidance on the potential applications of AI.

Methodology

This study was a cross-sectional survey among the medical students. A sample size of 302 was needed to attain an absolute accuracy of $\pm 5\%$ at a 95% confidence level, based on an estimated proportion of basic AI knowledge among medical

students of 27.3%.⁶ The sample population was chosen through Consecutive non-probability sampling. 302 medical students were chosen for the study after taking formal informed consent for participation in the study while Doctors and students of disciplines other than MBBS were excluded.

Informed consent was taken from 302 medical students. For collection of Data, a preformed questionnaire was distributed through google forms that was designed to contain both open-ended and closed-ended questions regarding demographic and background information, knowledge and perception of artificial intelligence, use of Artificial Intelligence in individual patient care, health system, population health, impact of Artificial Intelligence in medical profession, Artificial Intelligence ethics and AI and medical education⁽²⁾. Throughout the data collection process the privacy and confidentiality of the students was protected.

Data were entered and analyzed using SPSS software version 23.0. For categorical variables frequencies and percentages were calculated. For quantitative variables mean and standard deviations were calculated. To compare categorical variables chi-square test was applied. Ap value ≤ 0.05 would be considered significant.

Results

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

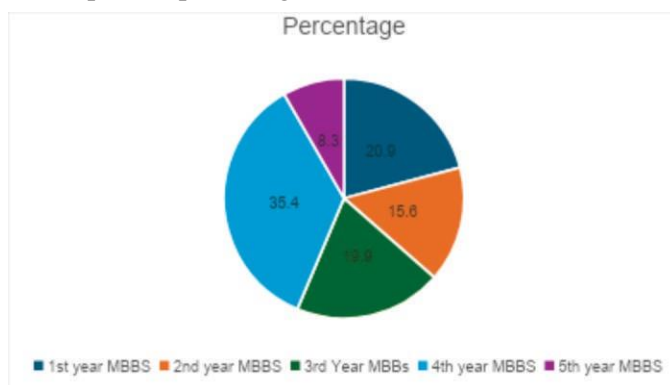


Figure 1: Pie chart illustration showing percentage distribution of students of each class Participated in survey.

Our questionnaire consisted of three sections. First section consisted of questions regarding demographic information and background knowledge of the participants regarding Artificial Intelligence (AI). Out of the 302 students who filled the questionnaire, 53.6% (n=162) were females and 45.7% (n=138) were males.

Among our respondents, majority did not have any academic background in computer science (80.1% n=242). About 43.4% of the students had attended talks or lectures on artificial intelligence, still leaving a majority of the population with no knowledge regarding it. 95.4% of participants lacked training in AI related programs. (Table 1)

Table 1: Participants' demographic & Background Info.

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 descriptive statistics, we gave frequencies and percentages of our variables and in inferential analysis, we applied chi-square test.

In knowledge of AI, chi-square was significant for "Deep learning meaning" (p value 0.015). 46.4% of students (n=140) had a basic understanding of the term while 53.6% did not. The variables AI meaning, machine learning meaning, neural network meaning, and algorithm meaning had non-significant values. (p values > 0.05). (Table 2)

Table 2: Participants' AI-Knowledge assessment

Parameters	Res- ponse	Fre- quency 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)		

In individual patient care (perception of AI) Chi square was most significant for "Analyzing patient information" (p value 0.000). 74.8% (n=226) of the students agreed that

AI can perform better or replace human beings in analyzing patient information to reach diagnosis while 25.2% disagreed.

Values for "Interpretation of diagnostic imaging, personalized treatment plans and monitoring of patient compliance" were also significant (p value 0.008, 0.007, 0.012). About 84.8% (n=256) of the respondents agreed that AI can interpret diagnostic imaging better than humans. 61.6% (n=186) agreed on AI's ability to formulate personalized treatment plans for the patients and prescribe medications more efficiently. Moreover, 69.2% (n=209) of the students agreed that AI can monitor patient compliance to medications better than humans while 30.8% disagreed. On the other hand, chi square was non-significant for "preventative health recommendations by AI" (p value 0.747) (Table 3).

Table 3: Participants' perception of AI in Healthcare

Parameters	Res- ponse	Fre- quency 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)		

Considering impact of AI on medical profession, Chi square was non-significant for all of the variables i.e. number of jobs available to the students, reduction of the number of jobs and choice of specialty (p values > 0.05). 65.6% ($n=198$) of the medical students agreed to the question regarding reduction in the number of jobs available to them while 34.4% ($n=104$) disagreed. Similarly, majority of the students agreed that AI will reduce number of certain medical specialties jobs more than the others.

In view of AI ethics, Chi square was non-significant for all the variables i.e. new ethical challenges, new challenges around health equity and Pakistan healthcare system. (p values > 0.05). 86.8% ($n=262$) of the respondents agreed that AI in medicine will raise new ethical challenges and 79.8% ($n=241$) agreed that new challenges will be raised around health equity. Only 20.5% ($n=62$) of the medical students agreed that the Pakistani healthcare system is presently designed to handle issues related to artificial intelligence in medicine while 79.5% ($n=240$) disagreed.

Lastly, the data obtained in light of AI and medical education showed Two significant values i.e. working alongside AI tools, training on AI competencies (p values 0.026, 0.003). Only 29.1% ($n=88$) of the participants agreed that the medical education they are currently receiving is suitably getting them ready to collaborate with AI tools in the future while 70.9% disagreed. In addition, 86.8% ($n=262$) of the students agreed that courses in AI skills should be part of medical education. While, chi square was non-significant for “compulsory training for every medical trainee” (p value > 0.05) (Table3).

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 back-

ground 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 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, 65.2% did not know what neural network mean and 53.6% did not know what deep learning mean. Majority of the participants (56.3) did not know 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 AI-knowledge, 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 AI 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 nearly one-third 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 A separate study conducted at University of the Netherlands revealed that AI will improve medical professional's performance.¹⁵

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.¹⁶ The development of AI can create a divide between those who have access to and those who do not; raising serious social issues.¹⁷

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.¹⁸

Our study yielded valuable insights into the perspective of future of AI in healthcare system of Pakistan and its challenges and opportunities. However, limitations may include respondents providing false information, medical students having very limited knowledge of AI, only a small number of students are being studied not the broader population 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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Author's Contributions:

Aleena Sameen: Analysis and interpretation of Data, Final approval

Ahmad Ali: Data Collection, Critical revision for important intellectual points, Final Approval

Aleena Shafique: Acquisition of Data, Data collection

Ahmed Ali: Conception and Design, Drafting of article, Critical revision for important points

Aleena Arshad: Data collection, Drafting of article, Critical revision for important points

Naila Bajwa: Analysis and interpretation of Data, Final Approval

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