ISSN: 2581 – 3633
PubMed - National Library of Medicine - ID: 101745081

International Journal of Medical Science and Advanced Clinical Research (IJMACR)

Available Online at:www.ijmacr.com

Volume – 7, Issue – 4, July - 2024, Page No. : 97 – 106

Assessing the knowledge, attitude and perception of undergraduate medical students towards artificial intelligence in healthcare and its incorporation in medical education – A cross sectional study

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How to citation this article: Dr. Vanathy Karunamoorthy, Dr. Gayathri Rajendran, Dr. Jayapriya Dhayalan, "Assessing the knowledge, attitude and perception of undergraduate medical students towards artificial intelligence in healthcare and its incorporation in medical education – A cross sectional study", IJMACR- July- 2024, Volume – 7, Issue - 4, P. No. 97 – 106.

Type of Publication: Original Research Article

Conflicts of Interest: Nil

Abstract

Background: Artificial intelligence (AI) is booming tremendously in every area of our lives. And medical field is no exception. Its implications include accurate diagnosis, disease surveillance, predictive analytics & risk assessment, formulating personalized prescriptions, dose optimization, therapeutic drug monitoring, virtual healthcare assistance, mental health support, designing intelligent tutoring system for students in medical education etc. Hence it becomes essential for the medical students to be aware of the basics of AI by incorporating it into medical education. It would help them to be confident and equipped with in handling AI tools in their future. This study aims at increasing the awareness of medical students about the necessity of learning AI through a questionnaire based on their knowledge, attitude and perception towards AI.

Aims and objectives: To assess the knowledge, attitude and perception of undergraduate medical students of a private medical college in Chennai towards AI and incorporating AI in medical education.

Materials and methods: This cross-sectional pre-validated questionnaire based study was conducted among 369 undergraduate medical students of Bhaarath medical college and hospital, Chennai. The questionnaire was administered to the students through

Google forms to those who consented for the study and asked to fill up. The responses were collected, entered in Microsoft excel sheet 2010 and analysed in percentages.

Results: Of the 369 participants, 78.1% are aware of the terms artificial intelligence, machine learning, deep learning cumulatively. Majority had knowledge on the fields in which AI can be used. 37.8% believed that AI wouldn't be able to provide empathetic care to patients. 91.4% reported that AI would have an important role in healthcare. 67.9% of students are less confident at present on using AI tools at the end of their medical course. 54.8% had reported that AI would replace their role in future. Yet 83% of students are willing to learn AI in medical education. 78% students said that it has to be incorporated in medical school.

Conclusion: The study emphasizes the current knowledge, attitude and perception of undergraduate medical students towards AI and the necessity to incorporate it in medical curriculum so that today's students who are tomorrow's practitioners would be able to handle AI tools efficiently in healthcare.

Keywords: Artificial Intelligence, Medical Education, Medical Students, Machine Learning, Deep Learning.

Introduction

Artificial intelligence (AI) has become the current buzzword, capturing the attention of industries, medical sector, researchers and the general public alike. This surge in interest is fueled by the rapid advancements in machine learning, robotics etc, which have transformed AI from a futuristic concept into a tangible force driving innovation.[1] Companies across various sectors including healthcare are leveraging AI to streamline operations, enhance customer experiences, and gain competitive advantages.[2] Moreover, AI's potential to solve complex problems, from healthcare diagnostics to climate change modelling, has sparked widespread excitement and investment.[3]As discussions around AI's ethical implications and societal impact intensify, it is clear that AI is not just a technological trend but a profound shift reshaping our world.[4]

Artificial intelligence (AI) is revolutionizing healthcare, offering transformative potential in diagnostics, treatment, and patient care.[5]AI-powered systems can analyze vast amounts of medical data quickly and accurately, aiding in early disease detection and personalized treatment plans.[6]For example, machine learning algorithms can identify patterns in medical images, often detecting conditions such as cancers or neurological disorders with higher precision than traditional methods.[7]AI is also enhancing patient care through predictive analytics, which can forecast patient outcomes and optimize hospital resource management.[8] Additionally, AI-driven virtual assistants are improving patient engagement and adherence to treatment protocols by providing real-time health monitoring and support.[9],[10]

Artificial Intelligence (AI) is also evolving in medical education by enhancing learning, diagnosis, and treatment processes. AI-driven tools, such as virtual simulations and intelligent tutoring systems, would provide personalized learning experiences, enabling students to grasp complex medical concepts through interactive and adaptive modules.[11] These technologies facilitate the visualization of anatomical structures and physiological processes, making abstract concepts more appreciable.[12],[13] Moreover, AI-powered platforms would offer continuous assessment and feedback, allowing educators to monitor student progress and address learning gaps promptly.[14]This would enhance the efficiency and effectiveness of medical education but

also prepare future healthcare professionals to handle AI in clinical practice, ultimately improving patient outcomes.

The current scenario in India is that the students who choose medical stream lack knowledge on technology involving computers as mathematics and computer science are not their main stream subjects.[15] Hence it becomes mandatory to assess the knowledge, attitude and perceptions of medical students towards incorporating artificial intelligence into medical education.

Aims and Objectives

Aim: The aim of the study is to increase awareness on the importance of learning AI among the undergraduate medical students.

Objective: The objective of the study is to assess the knowledge, attitude and perception of undergraduate medical students towards AI in healthcare and its incorporation in medical education.

Materials and Methods

Type of study: Questionnaire based Cross sectional study.

Study centre: Bhaarath medical college and hospital, Chennai.

Study Duration: 4 months(September 2023 to December 2023)

Study Participants: Undergraduate medical students from four professional years.

Permission: The study was conducted by following the ethical principles mentioned in declaration of Helsinki. Before commencing the study, the institutional ethics committee (Bhaarath medical college and hospital – BIEC – 060 -23) permission was obtained. Informed consent was obtained from the study participants.

Confidentiality: The e-mail IDs of participants were not collected and the confidentiality was strictly maintained.

Sample size: The sample size was calculated from a previous study [16] in which (213 (60.5%)) understood the basic principles of AI. Based on that a minimum sample size of 368 was needed to include the study with the assumption of 5% precision and 95% of confidence interval. It was calculated using the formula,

$n = Z^2_{1-\alpha/2}\, p\,(1-p) / d^2$

Where,

p: Expected proportion

d: Absolute precision

1-α/2: Desired confidence level.

There are 150 medical students in each professional year. Hence, there are 150 × 4 = 600 students in 4 professional years. By stratified random sampling method, the number of students to be included from each year was: 368/4 = 92. But, due to lack of responses from students, equal numbers of students could not be included from each year. Total number of responses received was 369 and it included 102 from first year, 122 from second year, 78 from third year, and 67 from Final year.

Inclusion Criteria

Students who had given informed consent and who had submitted complete responses were included in the study.

Exclusion Criteria

Students who had submitted incomplete responses were excluded from the study.

The structured and validated published questionnaire was sent to the students through Google Forms[17]. The questionnaire had four subdivisions that evaluated the students' knowledge and perception towards AI on medical education. The first subdivision had questions

on demographic details including age, year of study, computer literacy level. The second subdivision evaluated the knowledge and attitude about artificial intelligence. The third section of the questionnaire assessed the student's perceptions towards artificial intelligence. The fourth section included questions on knowledge about impact of artificial intelligence on medical education and willingness to use it. All the questionnaires were assessed based on the responses given by the students in terms of 4-point Likert scale as strongly agree, agree, disagree, strongly disagree. The analysis of the data collected was done with an Excel sheet and using descriptive statistical measures such as mean and percentages.

Results

Table 1shows questions on demographic details and on basic knowledge on computer technology. Out of the total 369 students who consented and submitted complete responses, 215 were males and 154 were female students. The computer literacy levels shows that 102 were just literate, 155 were competent and only 27 students were proficient. The question on usage of computer technology shows that 79 students always used, 267 used sometimes and 23 never used computer technology for learning. About 390 students have not completed any course on Artificial intelligence /Machine learning/Deep Learning. Only 29 students have completed either of the courses mentioned. 243 students have not attended or viewed any talks or lectures on Artificial intelligence and only 126 students have responded yes to that question. For the question on having attended any other training in computer programming/coding, 319 students said no and only 50 students have answered yes.

Table 1: Demographic details, basic knowledge on computer technology and AI

Characteristics	n=369 (%)
Gender	Male: 215 (58.4) Female: 154 (41.6)
Professional year	I Year: 102 (27.64) II Year: 122 (33.06) III Year: 78 (21.14) Final year: 67 (18.15)
Computer literacy level	Literate: 187 (50.6) Competent: 155 (42.0) Proficient: 27 (7.4)
Usage of computer technology for learning	Always: 79 (21.4) Sometimes: 267 (72.4) Never: 23 (6.2)
Have you completed any course where Artificial intelligence /Machine learning/Deep Learning were taught or discussed?	Yes: 29 (7.8) No: 340 (92.2)
Have you attended or viewed any talks or lectures on Artificial intelligence?	Yes:126 (34.2) No:243 (65.8)
Did you have any other training in computer programming/coding?	Yes: 50 (13.6) No: 319 (86.4)

Table 2 assessed the knowledge and attitude of students about AI. Majority of the students agreed that they understood what the term AI, ML, DL means, they also agreed that AI is essential in the field of medicine. Most of the students have known about the capability of AI like ability to use patient information to reach diagnosis, read and interpret diagnostic imaging, formulate personalized medication prescriptions, performing robotic surgeries, provide documentation of medical records, assisting hospitals in capacity planning and human resources, conducting population health surveillance and outbreak. But majority of students have disagreed on the ability of AI in providing empathetic care to the students and in providing psychiatric/personal counseling.

Table 2: Knowledge about artificial intelligence

Statement	Strongly agree	Agree	Disagree	Strongly disagree
I understand what the term ‘’Artificial intelligence”, "Machine learning", "Deep learning" means	59 (16)	229 (62.1)	73 (19.8)	8 (2.1)
AI is essential in the field of medicine	70 (18.9)	271 (73.3)	24 (6.6)	4 (1.2)
AI would be able to use patient information to reach diagnosis.	65 (17.7)	260 (70.4)	40 (10.7)	4 (1.2)
AI would be able to read and interpret diagnostic imaging.	57 (15.6)	272 (73.7)	32 (8.6)	8 (2.1)
AI would be able to formulate personalized medication prescriptions	38 (10.3)	231 (62.6)	88 (23.9)	12 (3.3)
AI has a role in performing robotic surgeries	56 (15.2)	255 (69.1)	46 (12.3)	12 (3.3)
AI will be able to provide empathetic care to patients.	17 (4.9)	122 (32.9)	157 (42.4)	73(19.8)
AI will be able to provide psychiatric/personal counseling.	15 (4.1)	125 (33.7)	167 (45.3)	62 (16.9)
AI will be capable of providing documentation such as updated medical records about patients	77 (21)	271 (73.3)	15 (4.1)	6 (1.6)
AI will assist hospitals in capacity planning and human resource	62 (16.9)	261 (70.8)	38 (10.3)	8 (2.1)
AI will be able to conduct population health surveillance and outbreak	49 (13.2)	249 (67.5)	57 (15.6)	14 (3.7)

Table 3 shows the responses on the perceptions of the students towards AI. It is evident that majority of students have agreed that AI will play an important role in healthcare, that it will replace some specialities in healthcare during their lifetime. It is also apparent that most of the students have not understood the basic principles of AI, not comfortable with AI terminologies, not understood the limitations of AI. It is also obvious that most of the students have disagreed for questions on confidence in using AI tools at the end of their medical degree, possess the knowledge needed to work with AI in routine clinical practice at the end of their medical degree, have better understanding of the methods used to assess healthcare AI performance at the end of their medical degree in the current scenario. The table also shows that greater number of students have agreed that AI teaching will benefit their career and that all medical students receive AI teaching.

Table 3: Attitude and perceptions towards artificial intelligence

Statement	Strongly agree	Agree	Disagree	Strongly disagree
AI will play important role in healthcare	67 (18.1)	270 (73.3)	24 (6.6)	8 (2.1)
AI will replace some specialties in healthcare during my lifetime	33 (9.1)	224 (60.5)	97 (26.3)	15 (4.1)
I understand basic principles of AI	38 (10.3)	93 (25.1)	219 (59.3)	19 (5.3)
I am comfortable with AI terminologies	26 (7)	117 (31.7)	200 (54.3)	26 (7)
I understand the limitations of AI	49 (13.2)	90 (24.3)	213 (58)	17 (4.5)
AI teaching will benefit my career	67 (18.1)	256 (69.5)	38 (10.3)	8 (2.1)
All medical students receive AI teaching	76 (20.6)	244 (66.3)	38 (10.3)	11 (2.9)
I will be confident using AI tools at the end of my medical degree	41 (11.1)	77 (21.0)	216 (58.4)	35 (9.5)
I will possess the knowledge needed to work with AI in routine clinical practice at the end of my medical degree	37 (9.9)	71 (19.3)	231 (62.6)	30 (8.2)
I will have better understanding of the methods used to assess healthcare AI performance at the end of my medical degree	41 (11.1)	70 (18.9)	223 (60.5)	35 (9.5)

Table 4 shows the perception of students on impact of AI on medical education and their willingness to use it. It is discernible that a large percentage of students have agreed that AI will have positive impact on medical education, incorporating AI in medical education would ease the learning process, medical training should include competencies on AI, using AI in medical education would prepare them for real clinical practice. Majority of the students have agreed that AI would replace their future role as a physician.

Table 4: Perception on impact of artificial intelligence on medical education and willingness to use it

Question	Strongly agree	Agree	Disagree	Strongly disagree
Artificial Intelligence systems will have a positive impact on medical education	67 (18.1)	260 (70.4)	33 (9.1)	9 (2.5)
Incorporating Artificial Intelligence in medical education would ease the learning process	67 (18.1)	258 (70)	35 (9.5)	9 (2.5)
Medical training should include competencies on Artificial Intelligence	67 (18.1)	252 (68.3)	39 (10.7)	11 (2.9)
Using Artificial Intelligence in medical education will prepare me for real clinical practice	52 (14.0)	241 (65.4)	61 (16.5)	15 (4.1)
Artificial Intelligence will replace my future role as a physician	36 (9.9)	166 (44.9)	131 (35.4)	36 (9.9)

Discussion

369 students participated in the study. Of this 58.4% were male students and 41.6% were female students. The highest response of 33.06% was from II year and least response was from final year (18.15%). About 50.6% of students consider themselves literate, 42.0% as competent and 7.2% as proficient on computer literacy level. 92.2% of students have not completed any course where Artificial intelligence /Machine learning/Deep Learning were taught or discussed, 65.8% have not attended or viewed any talks or lectures on AI and 86.4% of students have not got any training in computer programming/coding. In a study by Hadithy at al on medical students of Muscat, 54.3% of respondents were female and 45.7% were male students. Also, 62.4% of students had no academic background in computer science, 80.5% of respondents had not attended any lectures or taken classes related to AI and or 83.3% had not done a course on programming and coding.[17]This data shows that the medical students have lack of adequate knowledge on computer technology.

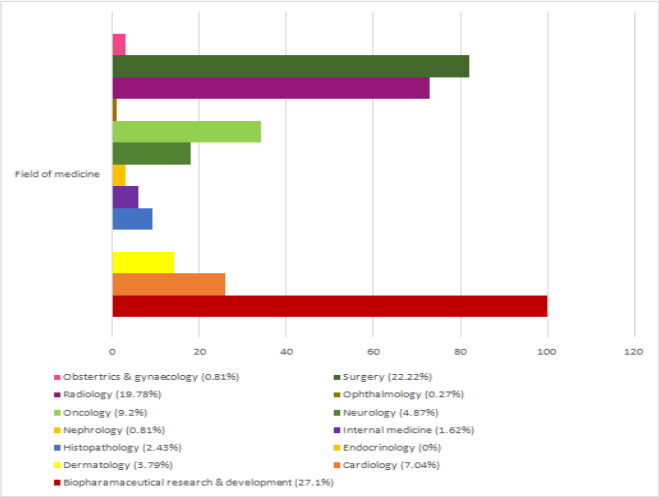
In this study, questions on knowledge about artificial intelligence showed that 78.1% of students understood what the term ‘’Artificial intelligence”, "Machine learning", "Deep learning" means. 92.2 % thought that AI is essential in the field of medicine. Majority of the students have known about the implications of AI in health care like usage of AI to reach diagnosis (17.7% strongly agree,70.4% Agree), usage in reading and interpreting diagnostic imaging(15.6% strongly agree,73.7% Agree), formulating personalized medication prescriptions (10.3% strongly agree,62.6% Agree), performing robotic surgeries (15.2% strongly agree,69.1% Agree), providing documentation such as updated medical records about patients (21% strongly agree,73.3% Agree), assisting hospitals in capacity planning and human resource (16.9% strongly agree,70.8% Agree), conducting population health surveillance and outbreak (13.2% strongly agree,67.5% Agree). In a study by Habib et al on healthcare professionals and medical students, a similar results were obtained showing that a majority of the participants

agreed on the capabilities of AI in healthcare systems as mentioned above.[18]

Further, a majority of students did not agree on the ability of AI in providing empathetic care to patients (42.4% Disagree,19.8% Strongly disagree), providing psychiatric/personal counselling (45.3% Disagree,16.9% Strongly disagree). Interestingly, it was similar to the study by Hadithy at al that majority of the students believed that AI will not provide emotional support to patients (69.2% extremely unlikely, 14.0% unlikely) and provide psychiatric counseling (60.6% extremely unlikely, 21.7% unlikely).[17]

On a question about perception of students on which field of medicine can AI be applied, 27.1% of the students reported biopharmaceutical research and development, 22.2% on field of surgery, 19.7% in the field of radiology (Fig.1). This is in contrast with a study by Allam et al which showed that the students believed radiology would be the most impacted field by AI (49.3%).[19]Also, in Doumat et al study, 89.7% believed surgery would be the field that would incorporate AI extensively.[20]

Fig.1: Perception of students on field of medicine in which AI can be applied.

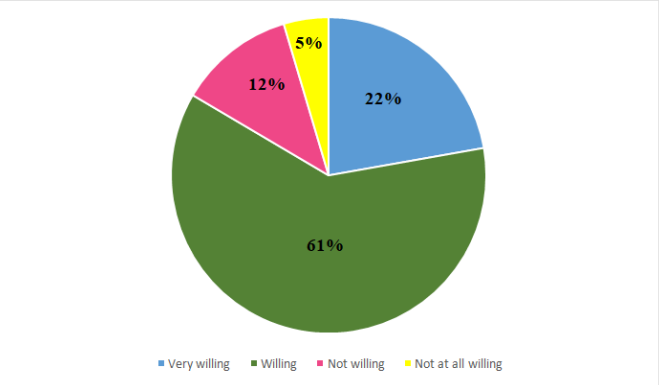


Assessment of attitude and perception towards AI shows that most of the students believed AI would play important role in healthcare (18.1% Strongly agree, 73.3% Agree) and it would replace some specialities in healthcare very soon (9.1% Strongly agree, 60.5% Agree). Saad at al obtained similar results in his study.[21]Majority of students reported that they do not understand the basic principles of AI (59.3% Disagree, 5.3%, Strongly disagree), not comfortable with AI terminologies (54.3% Disagree, 7.0%, Strongly disagree), not understand the limitations of AI (58.0% Disagree, 4.5%, Strongly disagree). Majority of students showed a positive attitude by agreeing that AI teaching would benefit their carrier (69.5% Agree, 18.1% strongly agree) and all medical students should receive AI training (66.3% Agree, 20.6% Strongly agree). This is in accordance with Jha et al study which showed that 42.2% of students agreed, 32.8% of students strongly agreed that healthcare students should learn the basics of AI and would be a highly required tool in their field (38% Agree, 31.5% Strongly agree).[22] Nevertheless, a large number of students reported negative attitude on the confidence of using AI tools (58.4% Disagree, 9.5%, Strongly disagree), possess the knowledge needed to work with AI in routine clinical practice (62.6% Disagree, 8.2%, Strongly disagree), better understanding of the methods used to assess healthcare AI performance at the end of their medical degree(60.5% Disagree, 9.5%, Strongly disagree). A similar results were arrived by Alwadani et al in his study.[23]

Students perception on impact of artificial intelligence on medical education shows that a greater percentage believed AI would have positive impact on medical education (18.1% Strongly agree, 70.4% Agree), Incorporating Artificial Intelligence in medical education would ease the learning process (18.1% Strongly agree,

70.0% Agree), Medical training should include competencies on Artificial Intelligence (18.1% Strongly agree, 68.3% Agree), Using Artificial Intelligence in medical education will prepare me for real clinical practice (14.0% Strongly agree, 65.4% Agree). They also reported that it will replace their future role as a physician (9.9% Strongly agree, 44.9% Agree). A similar results were reflected in the study by Al Saad et al.[24]The question on assessment of students' willingness to learn AI in medical education shows that 61% of students were willing, 22% were very willing (Figure 2). They also reported that training for AI should begin while they were in medical school (78%) and in residency (22%).

Figure 2; Willingness to learn AI in medical education



Conclusion

The study reflects an overall scenario on the knowledge, attitude, perception of undergraduate medical students of a medical college in Tamilnadu, India, towards artificial intelligence in healthcare and its incorporation in medical curriculum. On comparison with the available literature, the study shows a positive mindset of students on the emerging trend of AI in healthcare and the necessity of updating their skills to embrace newer technologies. Our study shows that students are aware of the importance of incorporating AI in medical curriculum and they possess a positive attitude in learning AI. This would definitely transform them to be more competent in handling AI tools in their future practice. To achieve this, the curriculum designers should take initiatives to incorporate AI teaching in medical curriculum to enable the students to be ready for the inevitable AI.

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