

ORIGINAL ARTICLE 

Knowledge, attitude, and practice of artificial intelligence (AI) among medical students: A cross-sectional study from Ipoh, Perak

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ABSTRACT

Introduction:

Artificial intelligence (AI), replicates human intelligence, is increasingly gaining attention in higher education to address traditional educational challenges. AI offers vast potential for implementation in pathology, cardiology, radiology, and dermatology. Its potential to revolutionise the current medical practices in these areas is significant. This study aims to explore the knowledge, attitude, and practice (KAP) of AI among medical students at Quest International University in Malaysia.

Methods:

A cross-sectional descriptive study was conducted at the Faculty of Medicine, Quest International University (QIU) from January 2024 to March 2024. A structured questionnaire was distributed among the medical students of QIU, where 53 students responded to the questionnaire and participated in this research.

Results:

All students had an idea about AI, but only 54.7% were aware of the subtype classification of AI. Regarding the AI application in medical fields, radiology, and Pathology, the vast majority were unaware 73.6%, 71.7%, and 73.6% respectively. Indians have significantly good knowledge compared to other ethnicities [$Chi(df) = 12.95 (4)$, $P value = 0.005$]. The majority of the students agreed upon the essentiality 48(90.6%), inclusion of AI in the medical curriculum and specialist training 44(83%), early diagnosis and disease assessment 40(75.5%), AI essentiality in radiology 36(67.9%), Pathology 38(71.7%).

Conclusion:

There is a need for training in AI which will improve the knowledge of AI and influence their attitudes towards using it in medicine. Achieving widespread and flawless AI in medicine is challenging, but a collaborative effort between education institutions and government organisations may help improve the scenario.

Keywords

Artificial intelligence, education, medical students, pathology, radiology

Introduction

Artificial intelligence (AI) is a software system that endeavours to replicate human intelligence by utilising data sources autonomously to make decisions or aid humans in decision-making. [1, 2] AI is an umbrella term that encompasses machine learning, representation learning, deep learning, and natural language processing. It is a discipline within computer science that is capable of analysing vast quantities of data. However, its scope is not limited to computer science alone but rather includes other disciplines such as medicine, philosophy, psychology, linguistics, and statistics. [1]

In the ever-evolving landscape of higher education, the integration of AI has become increasingly prevalent. It represents a paradigm shift, offering innovative solutions to traditional educational challenges. From personalised learning platforms to AI-driven assessment tools, universities are leveraging these technologies to improve teaching methodologies and prepare students for a tech-driven future. Universities worldwide are under increasing pressure to equip students with the skills and knowledge required to navigate an AI-driven world. As AI technologies are embraced worldwide to enhance learning experiences, it is crucial to investigate the current knowledge, practice, and extent of AI utilisation among university students, which is imperative for educators, administrators, and policymakers seeking to optimise the benefits of these advancements.

In the field of medicine, AI has made significant contributions to the treatment of many diseases with reduced diagnostic errors and improved patient monitoring. [3, 4] As AI applications become more ubiquitous, understanding how university students perceive, engage with, and leverage AI is crucial for ensuring the relevance and effectiveness of educational programmes. Wealthy nations have offered significant financial assistance for AI development, particularly in medicine. Low-income countries need more substantial initiatives to use AI, and there is a shortage of research on the subject. According to the World Health Organisation (WHO), there will be a deficit of around 12.9 million healthcare professionals globally by 2035. [5]

AI has extensive opportunities for applications in pathology, cardiology, radiology, and dermatology and can entirely change the current practice of medicine in these fields. The crucial significance of AI in the field of pathology is well documented. [6] The system offers image-based diagnostic capabilities and enhances the pathologist's comprehension of microscopic slides by integrating electronic slides and computer-assisted diagnosis. The use of AI in pathology improves the ability of current experimental and laboratory tests to predict and prognosis. It also makes it easier to understand tissue histology and molecular data. [7] Machine learning and deep learning techniques have already been adopted in cardiology to detect individuals prone to rapid coronary plaque advancement and predict the likelihood of a heart attack and pulmonary hypertension. [8, 9] AI can increase the value of the non-analytical, human-focused

components of medicine. In an era of rapidly expanding medical knowledge, healthcare professionals face the challenge of analysing vast amounts of information and making informed medical judgements. AI will enhance physicians' diagnostic and problem-solving abilities while diminishing their need to comprehend digital data. [10] AI algorithms assist radiologists in identifying abnormal phenotypic traits in images, classifying them, generating hypotheses about the patient's underlying ailment, determining the appropriate operation, and interpreting the results. [11, 12] AI has similar potential in dermatology, specifically in its ability to provide strong and reliable diagnostic imaging and assessment for various benign and malignant skin conditions. Similarly, in ophthalmology, AI assists in the diagnosis and evaluation of multiple abnormalities related to the retina and other eye conditions. [13-16]

Although several studies have been conducted in different parts of the world, studies are deficient in Malaysia. This study aimed to explore the knowledge, attitude, and practice (KAP) of AI among medical students at Quest International University in Perak State.

Methods

Study period, study design, and participants

This cross-sectional descriptive study was conducted at the Faculty of Medicine, Quest International University (QIU) from January 2024 to March 2024. A structured questionnaire adopted from a previous study by Swed S *et al*, 2022 was distributed among the medical students of QIU, where 53 students responded to the questionnaire and participated in this research. [17]

Inclusion and exclusion criteria

All students included in this research were from the different years of pre-clinical and clinical (year 1-5 MBBS students), aged between 18-30 years, were well-versed in English, and willing to participate. Individuals who refused to take part, weren't given consent, belonged to other faculties, and MBBS students who have completed and are awaiting graduation were excluded.

Collection of data and questionnaire

The recruitment of study participants was based on voluntary participation, and a convenient sample technique was adopted. The sample size was determined using a prior study conducted by Swed S *et al*. [17] Data was collected by the Google form distributed via email through the university email network.

Independent variables

Age, gender, ethnicity, nationality, and years of study were considered independent variables.

Dependent variables

Knowledge, attitude, and practice about AI-related questions were set as dependent variables.

Data management and statistical analysis

Statistical Package for Social Sciences (SPSS, version 26) was used for the statistical analysis. The Mann-Whitney U test, and Fisher exact test were performed. p-value < 0.05 was considered statistically significant.

Ethical committee approval

Approval for ethics was obtained from the Joint Research Ethical Committee (JREC) before the study commenced. To maintain the confidentiality of participants, all unique identifiers, such as names, addresses, email addresses, and phone numbers, were not collected. The informed consent form was distributed to the participants to maintain voluntary participation in responding to this study. Participants had the opportunity to inquire about any questions and were given the autonomy to engage, refuse, or quit their involvement at any given point.

Results

Table 1: Descriptive statistics of demographic profile (n =53)

Variable	n	(%)
Age		
18-20 years	20	(37.7)
21-23 years	30	(56.6)
>24 years	3	(5.7)
Gender		
Male	14	(26.4)
Female	38	(71.7)
Prefer not to say	1	(1.9)
Ethnicity		
Malay	1	(1.9)
Chinese	2	(3.8)
Indian	29	(54.7)
Others	21	(39.6)
Years of study		
1st year	24	(45.3)
2nd year	19	(35.8)
3rd year	6	(11.3)
4th year	2	(3.8)
5th year	2	(3.8)

Table 1 describes the demographic profile. The majority of the students (56.6%) were in the 21-23 age group. Females were more than 38 (71.7%) compared to males. Indians were more than 29 (54.7%), followed by others. The respondents were mostly from the preclinical years, 45.3% from 1st year and 35.8% from 2nd year.

Table 2 demonstrates the responses of the students' knowledge about AI. The response of item 1 indicated that all the respondents aware of existence of AI.

Table 2: Response of knowledge regarding AI (n=53)

No.	Question	Yes		No	
		n	(%)	n	(%)
Q1	Do you know what is AI?	53	(100.0)	0	(0.0)
Q2	Do you know about machine learning and deep learning (subtypes of AD)?	29	(54.7)	24	(45.3)
Q3	Do you know of any AI application in the medical field?	14	(26.4)	39	(73.6)
Q4	Have you ever been taught about AI in medical school?	24	(45.3)	29	(54.7)
Q5	Do you know about the application of AI in radiology?	15	(28.3)	38	(71.7)
Q6	Do you know about the application of AI in the pathology field?	14	(26.4)	39	(73.6)
Q7	Does your curriculum include AI?	8	(15.1)	45	(84.9)

However, only 54.7% were aware of machine. The responses also indicated that the vast majority of the students were unaware application and integration of AI in medical curriculum (item 3 to item 7).

Table 3: Association between demographic factors and the knowledge (n = 53)

Variable	Poor	Good	chi	(df)	P value
Age					
	n (%)	n (%)			
18-20 years	11 (55.0)	9 (45.0)	4.075	(2)	0.100
21-23 years	23 (76.7)	7 (23.3)			
>24 years	1 (33.3)	2 (66.7)			
Gender					
	n (%)	n (%)			
Male	10 (71.4)	4 (28.6)	2.127	(2)	0.345
Female	25 (65.8)	13 (34.2)			
Prefer not to say	0 (0.0)	1 (1.0)			
Ethnicity					
	n (%)	n (%)			
Malay	0 (0.0)	1 (1.0)	12.952	(3)	0.005
Chinese	0 (0.0)	2 (1.0)			
Indian	16 (55.2)	13 (44.8)			
Others	19 (90.5)	2 (9.5)			
Years of study					
	n (%)	n (%)			
1st year	16 (66.7)	8 (33.3)	2.624	(4)	0.623
2nd year	11 (57.9)	8 (42.1)			
3rd year	4 (66.7)	2 (33.3)			
4th year	2 (1.0)	0 (0.0)			
5th year	2 (1.0)	0 (0.0)			

Table 3 demonstrates an association between demographic factors and knowledge. Students aged between 18-20 years have good knowledge on AI, 9 (45%) compared with the senior students. There is a significant association observed between ethnicities and knowledge about AI [*Chi(df) = 12.95 (4), P value = 0.005*]. There is no significant association of AI knowledge with other variables tested in this study.

Table 4: Response of attitude questionnaire (n=53)

No.	Question	Disagree		Agree	
		n	(%)	n	(%)
Q1	Do you believe AI is essential in the medical field?	5	(9.4)	48	(90.6)
Q2	Do you think AI should be included in medical school curriculum and specialist training?	9	(17.0)	44	(83.0)
Q3	Do you think that AI aids practitioners in early diagnosis and assessment of the severity of disease?	13	(24.5)	40	(75.5)
Q4	Do you believe that AI will replace physicians in the future?	37	(69.8)	16	(30.2)
Q5	Do you believe AI is very essential in the field of radiology?	17	(32.1)	36	(67.9)
Q6	Do you believe AI is essential in the field of Pathology?	15	(28.3)	38	(71.7)
Q7	Do you think the introduction of AI is essential in the situations like COVID-19 pandemic?	18	(34.0)	35	(66.0)
Q8	Do you believe AI would be a burden for practitioners?	35	(66.0)	18	(34.0)
Q9	Should a budget be allocated for the usage of AI in future pandemic situations?	21	(39.6)	32	(60.4)
Q10	Do you believe AI would increase the percentage of errors in diagnosis?	27	(50.9)	26	(49.1)

Table 4 expedites all questions associated with attitude towards AI. The majority of the students agreed upon the essentiality 48 (90.6%), inclusion of AI in the medical school curriculum and specialist training 44(83%), early diagnosis and disease assessment 40 (75.5%), AI essentiality in radiology 36 (67.9%), Pathology 38 (71.7%). The introduction of AI in COVID-19 was supported by 32 (60.4%), and budget allocation in future for the same pandemic situations was agreed by 32 (60.4%) students.

Table 5: Association between demographic factors and attitude toward AI (n=53)

Variable	Poor	Good	chi	(df)	P value
Age	n (%)	n (%)			
18-20 years	5 (25.0)	15 (75.0)	0.41	(2)	0.815 [×]
21-23 years	10 (33.3)	20 (66.7)			
>24 years	1 (33.3)	2 (66.7)			
Gender					
Male	4 (28.6)	10 (71.4)	0.485	(2)	0.785 [×]
Female	12 (31.6)	26 (68.4)			
Prefer not to say	0 (0.0)	1 (100.0)			
Ethnicity					
Malay	1 (100.0)	0 (0.0)	3.837	(3)	0.280 [×]
Chinese	0 (0.0)	2 (100.0)			
Indian	10 (34.5)	19 (65.5)			
Others	5 (23.8)	16 (76.2)			
Years of study					
1st year	8 (33.3)	16 (66.7)	6.383	(4)	0.172 [×]
2nd year	4 (21.1)	15 (78.9)			
3rd year	1 (16.7)	5 (83.3)			
4th year	2 (100.0)	0 (0.0)			
5th year	1 (50.0)	1 (50.0)			

[×]p>0.05

Table 5 describes the association between demographic factors and attitude towards AI. There is no significant association attitude toward AI between the variables tested in this study.

Table 6 explains the responses to the questionnaire related to AI practice. Almost half of the participants used AI and reported that AI made tasks easy. The majority of the participants, 46 (86.8%), thought that the physician's role is important in the application and evaluation of AI in the medical field. Regarding the likelihood of working on AI in the future, 36 (67.9) showed interest.

Table 6: Response of practice questionnaire (n=53)

No.	Question	Yes		No	
		n	(%)	n	(%)
Q1	Have you ever applied AI technology in any field?	26	(49.1)	27	(50.9)
Q2	Which radiographic modalities have you used for AI applications? (if applicable)	14	(26.4)	39	(73.6)
Q3	For which pathological assessment you have used AI? (if applicable)	11	(20.8)	42	(79.2)
Q4	Was it easy for you to apply AI?	20	(37.7)	33	(62.3)
Q5	Did AI make your task easy?	27	(50.9)	26	(49.1)
Q6	Do you think the physician's role is important in the application and evaluation of AI in the medical field?	46	(86.8)	7	(13.2)
Q7	Would you like to work on AI in the future?	36	(67.9)	17	(32.1)

Table 7: Association between demographic factors and the practice of AI (n=53)

Variable	Poor	Good	chi	(df)	P value
Age	n (%)	n (%)			
18-20 years	7 (35.0)	13 (65.0)	1.098	(2)	0.578 [×]
21-23 years	12 (65.0)	18 (60.0)			
>24 years	2 (1.0)	1 (33.3)			
Gender					
Male	2 (14.3)	12 (85.7)	6.234	(2)	0.044 [*]
Female	18 (47.4)	20 (52.6)			
Prefer not to say	1 (1.0)	0 (0.0)			
Ethnicity					
Malay	0 (0.0)	1 (1.0)	2.098	(3)	0.552 [×]
Chinese	0 (0.0)	2 (1.0)			
Indian	12 (41.4)	17 (58.6)			
Others	9 (42.9)	12 (57.1)			
Years of study					
1st year	12 (50.0)	12 (50.0)	11.786	(4)	0.019 [*]
2nd year	3 (15.8)	16 (84.2)			
3rd year	2 (33.3)	4 (66.7)			
4th year	2 (1.0)	0 (0.0)			
5th year	2 (1.0)	0 (0.0)			

^{*}p<0.05, [×]p>0.05

Table 7 shows the association between demographic factors and AI practice. Male students had significantly better practice for the usage of AI when compared to female students [*Chi(df) = 6.23 (2), P value = 0.044*]. There is a

significant association between years of study and their practice towards AI [$Chi(df) = 11.78 (4), P\ value = 0.019$].

Discussion

Artificial intelligence (AI) is an area of computer science that specifically deals with the generation of computer programmes capable of doing actions that usually involve human intelligence. [18] The rapid advancement of Artificial Intelligence in healthcare has successfully addressed numerous challenges associated with the delivery of medical services. [19] The research focused on the KAP of the study participants.

We observed that all students are aware of AI. Overall, students' sentiments were positive, and they held optimistic expectations regarding the application of AI in the field of medicine. They perceived AI as a supportive instrument that may enhance doctors' information accessibility, aid physicians in making more precise clinical assessments, reduce medical errors, and enhance patients' healthcare accessibility.

Our students in the 18-20 years age group have relatively good knowledge when compared with other age groups. Indians have significantly better knowledge compared to other ethnicities, which may be due to more AI usage in their studies. Second-year students have relatively good knowledge compared to other students, which may be due to the fact that they are in the basic sciences, so they read content regarding AI applications in basic science subjects such as pathology. Recent breakthroughs showed potential progress in integrating AI into medical education among basic science medical students. The ability of artificial intelligence to analyse vast amounts of information and offer predictive analytics is transforming the way students comprehend intricate biological systems and disease causes. Technologies powered by AI can improve the efficiency of learning by providing personalised educational experiences and helping to understand complex scientific concepts. [20] Students in this study took an interest in AI usage as it helps students to participate in experiential learning actively, promoting the development of crucial cognitive abilities such as critical thinking and problem-solving skills that are necessary for their future medical practice. As AI progresses, it is anticipated that its involvement in medical education will grow, ultimately enhancing the training of healthcare workers to become more skilled and adaptable. AI's use of deep learning algorithms, data mining analysis, intelligent impact recognition, and medical informatics will be a real game changer. [21]

We found that most students agreed on the essentiality of the inclusion of AI in medical school curricula, specialist training, early diagnosis, and disease assessment. This may be because this study was conducted in the post-pandemic era of COVID-19 when students realised the importance of AI in medical education. A study by Swed S showed that 68.1% of the respondents acknowledged AI use in the COVID-19 pandemic situation. [17] These findings are

consistent with research from Pakistan (74.4%) and the UK (78%), where the importance of AI in medicine was well acknowledged by the students. [22, 23] The essentiality of AI in radiology and pathology was strongly agreed upon by the respondents 445(29.5) and 396 (26.3%), respectively. [17]

The incorporation of digital slides into the pathology workflow allows for the use of modern algorithms and computer-aided diagnostic tools, expanding the pathologist's perspective beyond what can be seen on a microscopic slide and enabling the utilisation and integration of knowledge that surpasses human capabilities. The field of digital pathology holds significant promise for advancements in artificial intelligence. [24]

Accurate diagnosis of many forms of malignancies heavily relies on the quantification of digital whole-slide images of biopsy samples. Enhanced AI systems can effectively carry out mitosis detection, accurately segment histologic components, including nuclei, tubules, and epithelium, quantify events and analyse and classify tissue, promising great potential. [25-27]

We found males had significantly better practice for the usage of AI, and 2nd year students practised AI significantly more than other students in different clinical and pre-clinical years. In general, the results indicate that the participants possess a moderately solid foundational understanding of artificial intelligence. In addition, they demonstrated a favourable impression and attitude towards the utilisation of artificial intelligence (AI) in radiology. They recognised its significance in the field of diagnosis and healthcare practice.

More than half of our students agreed or strongly agreed on the question of budget allocation for the usage of AI in future pandemic situations. Students realised the potential of AI's ability to generate sophisticated predictive models for diseases such as COVID-19. Models developed for the diagnosis of COVID-19 can also be used for the identification of similar disorders. Additionally, transfer learning techniques can be employed to decrease the amount of time required to train these models. [28]

Conclusion

Students are interested and have basic ideas about AI. There is a need for training in AI to increase the knowledge of undergraduate medical students in Malaysia and influence their attitudes towards using AI in medicine. Many participants reported being unaware of the subtype classification and not using AI in the related field, but they have a positive attitude towards AI utilisation in the medical profession. Achieving widespread and flawless AI in medicine is challenging, but a collaborative effort between education institutions and government organisations may help improve the scenario. Training on AI and its use in the medical field should be mandatory for medical undergraduates. However, ethical, governance, and

regulatory factors are crucial for its development and integration.

Limitations and future scope

Our research is done in a small group of students, so future studies are required with a large number of students as a nationwide study to get a more clear picture.

Abbreviations

Artificial intelligence (AI), Joint Research Ethics Committee (JREC) Statistical Package for Social Sciences (SPSS), Quest International University (QIU)

Relevance of the study

AI is gradually becoming an integral part of the healthcare system, offering innovations in diagnostics, treatment planning, personalised medicine, and patient management. Understanding the level of knowledge and attitudes towards AI among future healthcare professionals is crucial for successful AI integration. Insights from this research urge the development and integration of targeted educational programmes that address gaps in knowledge and skills. Educators and policymakers can identify areas for improvement in creating supportive environments for the integration of AI in healthcare settings. Such research is vital for bridging the gap between technological advancements and practical healthcare applications, ensuring an advanced way to serve patients.

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Authors' contribution

All authors made equal contributions to the study in terms of planning, data collecting, data analysis/interpretation, paper writing, manuscript revision, and final approval of the manuscript. All authors also agreed to be responsible for all parts of the work.

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Availability of data and materials

All data underlying the results is available as part of the article, and no additional source data is required.

Competing interests

None declared.

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