Malaysian Medical Students' Attitudes and Readiness Toward AI (Artificial Intelligence): A Cross-Sectional Study

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Alvin Yong Zong Tung[1,2] and Ley Wen Dong[2]

[1]Faculty of Medical Sciences, Newcastle University Medicine Malaysia, Johor Bahru, Malaysia.
[2]Wrexham Maelor Hospital, Wrexham, UK.

ABSTRACT

OBJECTIVES: The Malaysian health ministry has started introducing artificial intelligence (AI) technology to aid local healthcare delivery. This study aims to survey Malaysian medical students' attitudes toward AI and evaluate their readiness to work with medical AI technology.

METHODS: An online questionnaire on Google Forms was distributed to all 31 medical schools in Malaysia. The questionnaire consists of 3 sections: the first part surveyed the participants' demographics, the second assessed the participants' attitudes toward AI, and the final part utilizes the Medical Artificial Intelligence Readiness Scale for Medical Students (MAIRS-MS) scale to evaluate their AI readiness.

RESULTS: Three hundred and one students from 17 universities in Malaysia responded to the questionnaire. 87.36% of students agreed that AI will play an essential role in healthcare; 32.55% of students were less likely to consider a career in radiology due to the advancement of AI. The majority of students (71%) felt that teaching in AI will benefit their careers, while 69.44% agreed that all students should receive teaching in AI. Around 44.5% of students felt that they will possess the knowledge required to work with AI upon graduation. On the MAIRS-MS scale, students had a mean score of 21 of 40 for the cognitive factor, 25 of 40 for the ability factor, 10 of 15 for the vision factor, and 11 of 15 for the ethics factor. Overall, Malaysian students had a mean total score of 67±14.8 out of 110.

CONCLUSION: Malaysian medical students have demonstrated awareness of AI and a willingness to learn more about it. More work needs to be done to improve students' AI readiness, particularly their knowledge and application of AI technology. Malaysian universities should start to work on incorporating AI teaching into their curricula.

KEYWORDS: artificial intelligence, medical students, education

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CORRESPONDING AUTHOR: Alvin Yong Zong Tung, Faculty of Medical Sciences, Newcastle University Medicine Malaysia, Jalan Sarjana 1, Educity, 79200 Iskandar Puteri, Johor Bahru, Malaysia. Email: alvin.tung@wales.nhs.uk

Introduction

Artificial intelligence (AI) can be comprehensively defined as a machine's capability to demonstrate intelligent human behavior. Machine learning and deep learning are 2 key subsets of AI which are vastly applied and utilized to improve patient care in various clinical fields. Mintz et al refer to the former as a computer's ability to learn from experience and modify its processing based on new data. Deep learning takes this one step further, having the ability to evaluate numerous datasets at a time, process them, and eventually produce an output.[1]

The utility of AI in medicine has experienced significant growth in recent years, supplemented by the increasing availability of healthcare data and significant investments by technological companies. AI has now permeated a wide range of medical disciplines, with systems developed to assist physicians in fields such as radiology,[2] pathology,[3] and precision oncology.[4]

Worldwide, many countries have started adopting AI to improve the efficiency of their healthcare system delivery. In Australia, machine learning has been leveraged to create a clinical decision support tool. This helps primary care physicians stratify and predict patients' risk of admission to the Emergency Department, consequently reducing unnecessary hospital admissions.[5] The Topol Review commissioned by the National Health Service (NHS) in the United Kingdom has already published its recommendations for enabling AI in the NHS. The recommendations include involving patients in designing and implementing AI services, educating healthcare professionals regarding all aspects of data and AI in healthcare, and collaborating with the global community of data scientists.[6]

In Malaysia, the health ministry has recently employed AI to develop the Hotspot Identification for Dynamic Engagement system to help identify potential hotspots for COVID-19 infections.[7] The government also partnered with Huawei to install an AI-assisted quantitative medical image analysis system in local hospitals, which will help healthcare providers screen thousands of computed tomography images for potential COVID-19 infection.[8]

Justification of study

Despite extensive investments by the Malaysian health ministry in improving local healthcare using AI, the attitudes of Malaysian

medical students toward AI are currently unknown. A recent study on 112 Malaysian physicians showed that most (78.3%) believe AI can speed up healthcare processes.[9] However, many are still apprehensive about the quality of AI technology, with only 46.1% of respondents agreeing that AI can deliver vast amounts of clinically relevant high-quality data in real-time.

With the introduction of several AI systems into the Malaysian healthcare system, evaluating medical students' AI readiness is vital to determine if future doctors are ready to work with AI technology. Karaca et al[10] define AI readiness as "a healthcare provider's preparedness state in knowledge, skills, and attitude to utilise healthcare-AI applications during delivering prevention, diagnosis, treatment, and rehabilitation services in amalgam with own professional knowledge." The rapid development of AI technology in healthcare will mean that medical schools will have to adapt quickly to equip the next generation of doctors with the skills required to embrace AI in their future work.[11] As of now, however, the Malaysian Medical Council Standards for Undergraduate Medical Education do not mandate any teaching of AI in Malaysian medical schools.[12]

Research aims and questions

The 2 main aims of this study were (1) to survey Malaysian medical students regarding their attitudes toward AI in healthcare in this study and (2) to evaluate medical AI readiness among Malaysian medical students. Hopefully, the results will further inform future decisions regarding the implementation of medical AI locally and curriculum design for medical schools.

The main research questions were:

- What are Malaysian medical students' attitudes toward AI?
- What are Malaysian medical students' AI readiness scores based on the Medical Artificial Intelligence Readiness Scale for Medical Students (MAIRS-MS) scale?[10]

Methods

Study design

A cross-sectional qualitative study method was used to explore Malaysian medical students' attitudes and readiness toward AI. Malaysian medical students were invited to complete an anonymous online questionnaire created using Google Forms. Consent of the participants was obtained by ticking an agreement check box on Google Forms. In addition, a participant information sheet was attached to the form to provide participants with more information regarding the study. Eligibility criteria required participants to be currently enrolled in a Malaysian medical school and are in years 1 to 5 of their study. Students who were taking time out of their undergraduate program were excluded.

The questionnaire used for this study is subdivided into 3 main sections. The first part of the questionnaire was designed to assess the participant's demographics, including gender, year of study, and name of university. For the second section, 11 questions adapted from the questionnaire previously developed by Sit et al[13] were used to evaluate Malaysian medical students' attitudes toward AI. For these questions, participants were asked to respond using a 5-point Likert scale ranging from "strongly agree" to "strongly disagree."

The final section used the MAIRS-MS scale developed by Karaca et al[10] to assess medical AI readiness among Malaysian medical students. The MAIRS-MS scale is a validated and reliable (Cronbach's alpha = 0.87) tool for evaluating the perceived readiness levels of medical students on AI technologies and applications. The MAIRS-MS questionnaire consists of 22 items with a 5-point Likert scale and scores students on 4 domains of AI readiness: cognition, ability, vision, and ethics. The cognition domain measures the student's knowledge of the terminology and logic of AI as well as data science. Ability measures the student's readiness in choosing the appropriate AI application, using the application appropriately and their ability to explain the application to patients. Vision measures the student's ability to explain the limitations, strengths, and weaknesses of AI in medicine and to predict future opportunities and threats. Lastly, the ethics domain evaluates the student's ability to adhere to legal and ethical regulations when using AI technologies.

Each item on the MAIRS-MS is scored between 1 (minimum) to 5 (maximum) points. "Strongly disagree" is given a score of 1, "disagree" is given a score of 2, "neutral" is given a score of 3, "agree" is given a score of 4, and finally "strongly agree" is given a score of 5. The final mean score of all respondents in each domain is calculated to evaluate their AI readiness.

Data collection

The questionnaire was distributed to all 31 medical schools in Malaysia via email and social media to be circulated among their faculty. Data collection was performed over 3 months between August to October 2021. As data for the number of medical students in each university was not publicly available, a target sample size for this study was not defined.

Data analysis

Analysis and visualization of the data were performed using the SPSS software (version 26) and Microsoft Excel. Simple percentages were used to describe the medical students' attitudes and readiness toward AI.

Results

Demographics

A total of 301 medical students enrolled in the first to fifth year in Malaysia from 17 universities responded to the questionnaire (Table 1). Among the respondents, 181 (60.14%) were female and 120 (39.86%) male. Each year of study from years 1 to 5 was well and evenly represented.

Malaysian medical students' attitudes toward AI

The majority of respondents (87%) were in agreement that AI would play an essential role in healthcare, while only a small number of students (4.7%) disagreed with the statement (Table 2). Most students were neutral (38.2%) when asked whether they were less likely to consider a career in radiology given the advancement of AI. However, a significant portion (32.6%) agreed that they were less likely to choose radiology as a career, while 29.2% disagreed. Interestingly, just over half of the respondents (59.8%) felt that AI would replace some medical specialities during their lifetime.

Table 1. Demographic details of respondents.

Demographic details	Number (n) (%)
Gender	
Male	120 (39.86)
Female	181 (60.14)
Universities	
Newcastle University Medicine Malaysia (NUMed)	169 (56.14)
AIMST University	16 (5.31)
MAHSA University	20 (6.64)
Taylor's University	8 (2.65)
Universiti Kuala Lumpur Royal College Medicine of Perak (UniKL)	6 (1.99)
Widad University College	5 (1.66)
Manipal University College Malaysia (MMMC)	16 (5.31)
Monash University	11 (3.65)
Quest International University Perak	16 (5.31)
Universiti Sains Malaysia (USM)	1 (0.33)
Universiti Putra Malaysia (UPM)	1 (0.33)
Universiti Islam Antarabangsa Sultan Abdul Halim Mua'dzam Shah Kulliyyah (UniSHAMS)	7 (2.32)
Universiti Sains Islam Malaysia (USIM)	15 (4.98)
Universiti Kebangsaan Malaysia (UKM)	7 (2.32)
Royal College of Surgeons in Ireland and University College Dublin Malaysia Campus (RCSI & UCD)	1 (0.33)
International Islamic University Malaysia Kulliyyah of Medicine (IIUM)	1 (0.33)
International Medical University (IMU)	3 (0.99)
Year of study	
Year 1	59 (19.60)
Year 2	52 (17.27)
Year 3	76 (25.24)
Year 4	52 (17.27)
Year 5	62 (20.59)

In terms of their understanding of AI, only 31% of respondents claimed to have a grasp of the basic computational principles of AI, while just under half of those surveyed (44.2%) disagreed with the statement. On the other hand, a considerable portion of respondents (42.2%) were comfortable with the nomenclature related to AI. Encouragingly, two-thirds of students (67.4%) reported understanding the limitations of AI, with only 16.6% of students responding negatively to this statement.

Regarding questions on the teaching of AI in medical schools, the majority of respondents (71%) agreed that teaching in AI would be beneficial for their careers. Additionally, most participants (69.4%) agreed that all medical students should receive teaching in AI. However, less than half the students (44%) felt confident in using basic healthcare AI tools at the end of their medical degrees. When asked whether they felt that they would have a better understanding of the methods used to assess AI performance at the end of medical school, only 37.7% of respondents agreed with the statement. Over a quarter of those who responded (26.9%) had a neutral stance while a third (35.2%) disagreed with the statement. Overall, just under half of those surveyed (44.5%) felt they would possess the knowledge required to work with AI in clinical practice upon graduation. In contrast, approximately 35% of respondents were pessimistic that they would acquire the expertise to work with AI after medical school.

Malaysian medical students' AI readiness

Figures 1 to 4 reveal the results of Malaysian medical students' self-rated AI readiness based on the 4 domains of the MAIRS-MS scale: cognitive, ability, vision, and ethics. From the charts, we can see that the respondents rated their readiness levels in the cognitive and ability domain as lower, while rating their readiness in the vision and ethics factor higher. This is reflected in their mean MAIRS-MS score for each domain, as summarized in Table 3.

As previously stated, each item on the MAIRS-MS is scored between 1 to 5 points, with "strongly agree" given a score of 5 and "strongly disagree" given a score of 1. The respondents in this study had a mean score of 21 ± 5.8 points out of a possible total of 40 points for the cognition factor (Table 3). This is the domain in which the respondents performed the worst. For the ability factor, the respondents had a mean score of 25 ± 6.8 out of a total of 40. The mean score for the vision factor was 10 ± 2.6, from a total of 15. The ethics factor is where Malaysian medical students rated their highest scores with a mean of 11 ± 2.7 out of 15. Overall, medical students in Malaysia had a mean MAIRS-MS score of 67 ± 14.8 out of 110.

Discussion

AI will undoubtedly play an essential role in healthcare in the future. This is reflected in Malaysian medical students'

Table 2. Malaysian medical students' attitudes toward AI.

Variable	Number (%)				
	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Q1. AI will play an important role in healthcare	97 (32.22)	166 (55.14)	24 (7.97)	5 (1.66)	9 (2.99)
Q2. I am LESS likely to consider a career in radiology, given the advancement of AI	20 (6.64)	78 (25.91)	115 (38.21)	71 (23.59)	17 (5.65)
Q3. Some specialties will be replaced by AI during my lifetime	38 (12.62)	142 (47.18)	47 (15.61)	53 (17.61)	21 (6.98)
Q4. I understand the basic computational principles of AI	8 (2.66)	85 (28.24)	75 (24.92)	103 (34.22)	30 (9.97)
Q5. I am comfortable with the nomenclature related to AI	13 (4.32)	114 (37.87)	96 (31.89)	63 (20.93)	15 (4.98)
Q6. I understand the limitations of AI	31 (10.30)	172 (57.14)	48 (15.95)	44 (14.62)	6 (1.99)
Q7. Teaching in AI will be beneficial for my career	48 (15.95)	166 (55.15)	65 (21.59)	19 (6.31)	3 (1.00)
Q8. All medical students should receive teaching in AI	75 (24.92)	134 (44.52)	58 (19.27)	29 (9.63)	5 (1.66)
Q9. At the end of my medical degree, I will be confident in using basic healthcare AI tools if required	30 (9.97)	102 (33.89)	67 (22.26)	72 (23.92)	30 (9.97)
Q10. At the end of my medical degree, I will have a better understanding of the methods used to assess healthcare AI algorithm performance	18 (5.98)	96 (31.89)	81 (26.91)	75 (24.92)	31 (10.30)
Q11. Overall, at the end of my medical degree, I feel I will possess the knowledge needed to work with AI in routine clinical practice	19 (6.31)	115 (38.21)	63 (20.93)	77 (25.58)	27 (8.97)

Abbreviation: AI, artificial intelligence.

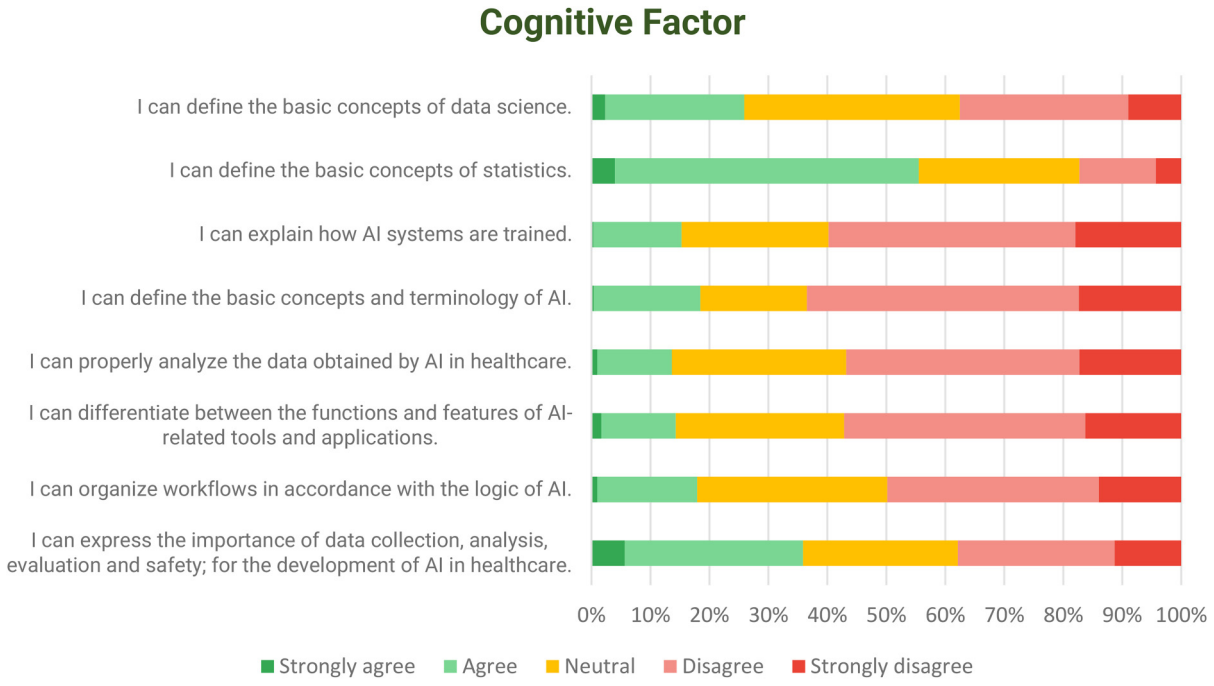

Figure 1. Malaysian medical students' readiness in the cognitive domain.

attitudes toward it, with 87.36% of respondents agreeing with the statement "AI will play an important role in healthcare". Similarly, Sit et al[13] reported that 88% of students agreed with this statement in the United Kingdom. These are encouraging signs that current medical students are aware of AI's growing presence in the healthcare industry. However, it is important to acknowledge that the use of AI is not without its challenges. Some concerns regarding AI in healthcare

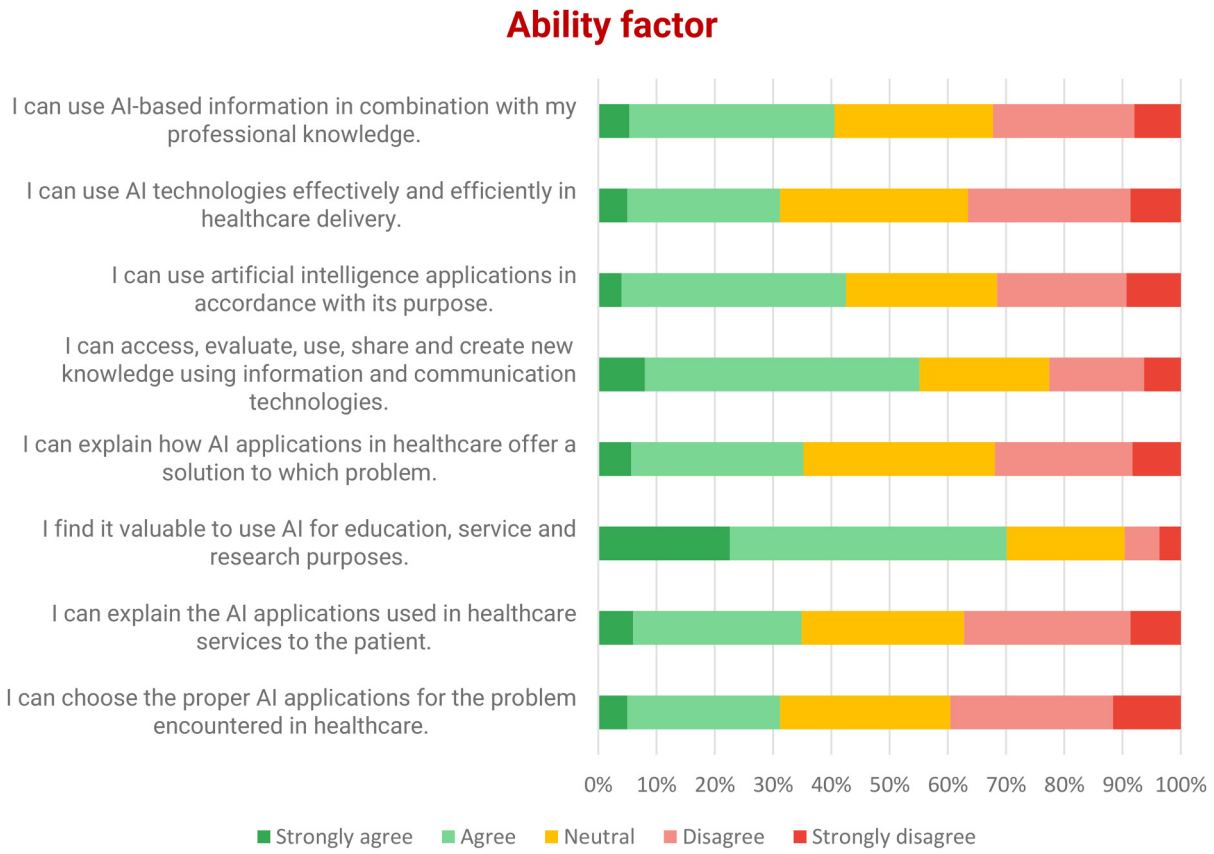

Figure 2. Malaysian medical students' readiness in the ability domain.

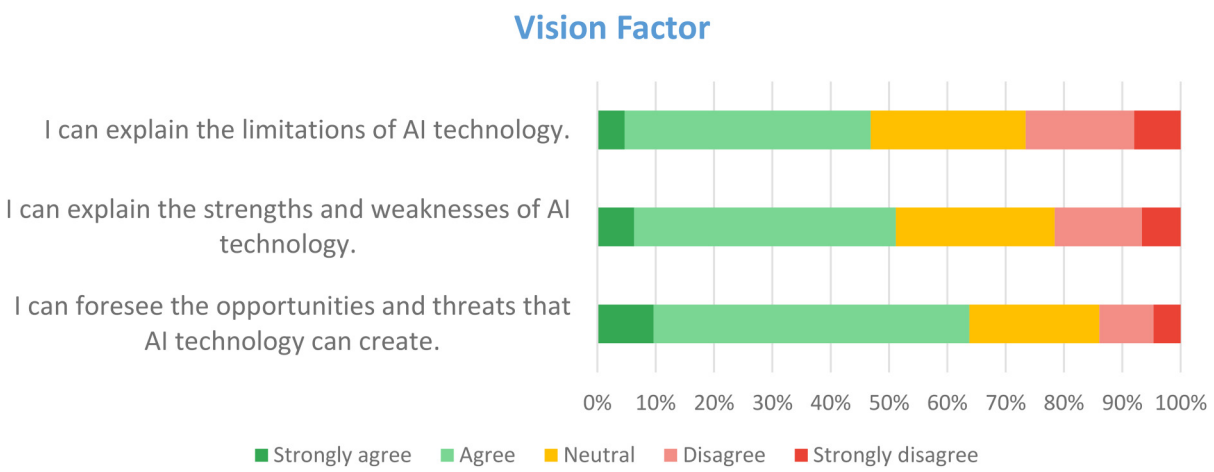

Figure 3. Malaysian medical students' readiness in the vision domain.

include data bias, ethical use of personal data, safety, and efficacy.[14] Currently, the implementation of AI in clinical practice remains limited due to the current hurdles in integrating it into existing healthcare systems.[15,16] Some of the challenges of incorporating AI systems include high cost, lack of knowledge, and lack of trust among stakeholders.[17]

Our study revealed that 32.55% of Malaysian students were less likely to consider a career in radiology given the advancement of AI, which is slightly lower than the figure reported in Sit et al[13] study of UK medical students (49.2%). In a study of Canadian medical students by Gong et al,[18] one-sixth of students were discouraged from applying to radiology due to developments in AI. A similar study of German medical students in 2018 showed that one-third of students were fearful of the development of AI in healthcare.[19] At a single institution in the United States, researchers found that 23% of students would not consider radiology due to fears that AI would make it obsolete.[20] These findings highlight the potentially

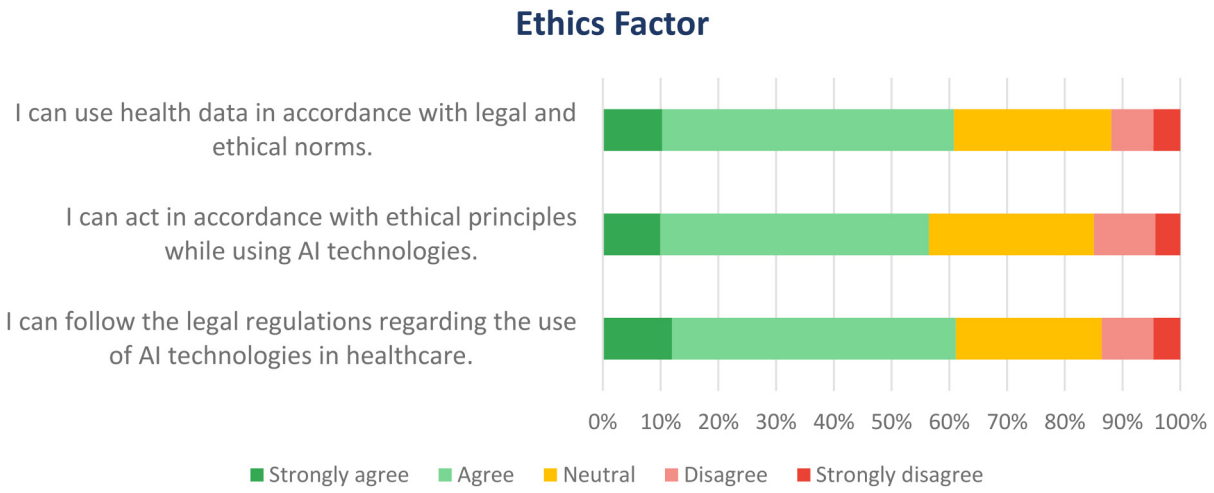

Figure 4. Malaysian medical students' readiness in the ethics domain.

Table 3. Mean MAIRS-MS scores of respondents.

Factor	Mean MAIRS-MS score (possible total score)
Cognitive	21 ± 5.8 (40)
Ability	25 ± 6.8 (40)
Vision	10 ± 2.6 (15)
Ethics	11 ± 2.7 (15)
Overall	**67 ± 14.8 (110)**

Abbreviation: MAIRS-MS, Medical Artificial Intelligence Readiness Scale for Medical Students.

significant impact of AI on future medical workforce recruitment, which may lead to workforce shortages in certain specialties, although the extent of this impact may vary across countries.

In light of these challenges, Sit et al[13] demonstrated that students who were trained in AI were less likely to rule out radiology as a career. Similarly, Pinto dos Santos et al[19] identified that students who understand AI were less afraid of working with it. An international survey of radiologists also found that those with advanced AI knowledge were much less fearful of AI technology.[21] Given these findings, it is probable that educating medical students in AI technology can help alleviate their fears of AI displacing their jobs. Several key ideas that are likely to address these negative perceptions include: (1) AI in healthcare is likely to augment, not replace doctors and (2) the use of AI still requires professional oversight as it cannot ethically be held responsible.[22] Furthermore, the results of this study have demonstrated that Malaysian medical students yearn to receive teaching in AI. Around 70% of respondents believe that teaching in AI will benefit their careers and that all students should receive teaching in this aspect. This sentiment is echoed by UK medical students, where an overwhelming 88% of students believe that learning AI will benefit their future careers.

In stark contrast to the United Kingdom cohort, however, more than 44% of Malaysian medical students felt that they will possess the knowledge required to work with AI upon graduation, compared to only 11.3% of UK medical students. Additionally, Gong et al[18] found that despite respondents in their study having an overall high confidence level in their AI understanding, they performed poorly when answering 5 true/false AI knowledge questions. Similarly, a study in Saudi Arabia showed that although 50% of respondents felt that they had a good understanding of AI, when assessed on their AI knowledge, they only averaged 1 question correct out of 5.[23] This is suggestive that there is a discrepancy between student's confidence in their AI knowledge and their actual understanding. Therefore, we suggest that a formal assessment of Malaysian medical students' actual knowledge of AI be undertaken so that a comparison with their attitudes can be made.

The results of this study are also consistent with students of other healthcare disciplines. A large-scale study on dental students found that 85.7% agreed that healthcare will be revolutionized by AI.[24] This sentiment is also echoed by students in medical physics around the world, where the majority also agreed that AI would play a fundamental role in their future practices.[25] Interestingly, contrary to our findings, most dental students disagreed that AI would replace physicians in the future (52.6%) compared to only 24.6% of medical students.

At present, a cut-off point for the MAIRS-MS scale has yet to be established. Therefore, it will not be able to determine whether a test-taker has "adequate readiness" or not.[10] We propose revisiting the average scores of Malaysian medical students on the MAIRS-MS scale once a cut-off point has been established. To the best of our knowledge, this is the first study to use the MAIRS-MS scale, and therefore a comparison with the results of other studies is not available. However, the scores provide insights into the AI readiness of Malaysian

medical students. It is worth noting that respondents performed relatively poorly in the cognitive and ability factors compared to the vision and ethics factors. In particular, more students disagreed rather than agreed with the majority of statements in the cognitive domain of the MAIRS-MS scale. This is suggestive that medical students in Malaysia may not be adequately prepared to work with AI, particularly in terms of knowledge, understanding and application. Therefore, we propose that Malaysian medical schools particularly emphasize these 2 domains when designing curricula to educate students on AI technology in healthcare.

The results of this study have demonstrated that more work needs to be done to prepare medical students in Malaysia to work with AI, and medical schools are at the forefront of addressing this issue. We believe that universities in Malaysia should start incorporating AI teaching into their curriculum to ensure that their students are AI-ready upon graduation. Paranjape et al[26] recommend that AI training be introduced at all stages of medical education. Before starting medical school, mathematical concepts relevant to AI such as probability, calculus, and linear algebra should be introduced in pre-admission assessments such as BioMedical Admissions Test (BMAT) and University Clinical Aptitude Test (UCAT) here in Malaysia. During the preclinical phase of the course, students should be introduced to the fundamentals of AI, work with medical datasets, and be exposed to AI's ethical and legal aspects. This is followed by the introduction of AI-based clinical applications and the teaching of more advanced concepts during the clinical phase of the course. Unfortunately, the implementation of AI into medical education does come with its own set of challenges. Some of these include insufficient curricular hours to implement AI teaching, lack of qualified staff to teach AI and issues of confidentiality and privacy and learner's data.[27]

Limitations

As accurate up-to-date data for the number of medical students in Malaysia is not available, the sample size needed for this study was not determined. However, in 2020, there were approximately 3000 medical graduates in Malaysia. Assuming there were 15,000 medical students in Malaysia, a sample size of 375 is needed for a confidence level of 95% and a margin of error of 5%. This meant that our sample size of 301 was slightly underpowered, and therefore did not allow for quantitative analysis of results between gender and year of study. Additionally, 56% of the participants in our study were from the same university, and no response was received from 14 of the 31 universities. It is possible, therefore, that the results of this study may not be representative of the entire population of Malaysian medical students. It should be noted that this study aims to understand the attitudes and readiness of Malaysian medical students toward AI, rather than drawing a definitive conclusion.

Our study was also limited by the fact that it was restricted to self-reported data. This meant that our data were potentially biased by selective memory and exaggeration by participants. As mentioned above, previous studies have demonstrated that while students may report high confidence levels in AI understanding, this finding was not reflected when they were formally assessed for their AI knowledge. Therefore, formal assessment and verification of Malaysian medical students' AI readiness should be undertaken to confirm the findings of this study.

Conclusion

Malaysian medical students have demonstrated awareness about AI and showed a willingness to learn more about it, similar to the sentiments shared by students from the United Kingdom, Germany and the United States. In terms of readiness to work with AI, our study showed that there is room for improvement in all 4 domains, particularly the cognitive and ability domain, where Malaysian medical students rated the lowest scores on the MAIRS-MS scale. Therefore, we suggest that medical schools in Malaysia start incorporating AI teaching into their curriculum, not only to improve students' AI readiness but also to help students understand and embrace AI as a complementary tool in healthcare delivery.

Abbreviations

AI	artificial intelligence
MAIRS-MS	Medical Artificial Intelligence Readiness Scale for Medical Students
BMAT	BioMedical Admissions Test
UCAT	University Clinical Aptitude Test

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Ethics and consent

Ethical approval for this study was provided by the Newcastle University Ethics Committee (Ref: 13934/2020).

ORCID iD

Alvin Yong Zong Tung https://orcid.org/0000-0001-6783-0445

Supplemental Material

Supplemental material for this article is available online.

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