

## Original Research Article

# Medical students' perception of the use of artificial intelligence in medical education

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## ABSTRACT

**Background:** Artificial Intelligence (AI) refers to technology that can efficiently perform tasks that typically require human intelligence, such as decision-making, teaching, object detection, and solving complex problems. As a veritable tool in medical education, this study was conducted to assess medical students' awareness, perception and usage of AI in learning.

**Methodology:** This study was conducted at the Department of Paediatrics, University of Port Harcourt Teaching Hospital (UPTH). The subjects were one hundred and thirty-nine 5th-year medical students who had completed 3 months of Paediatrics and Obstetrics/Gynaecology clinical rotations. Data was collected using a semi-structured, open-ended questionnaire. Data were analysed using IBM SPSS Statistics version 26. Statistical significance was set at  $p < 0.05$ .

**Results:** 64 (46%) of the respondents are aware of AI. 57 (44%) of respondents applied AI during their clinical training. The most commonly used AI tool is Chatbots. 57(100%). The major limitations to AI use were unreliable internet connectivity (62%) and the high cost of AI hardware and software (53%). Most respondents (68%) expressed ethical concerns about the use of AI. There was a statistically significant relationship between awareness of AI and the use of AI in learning ( $p=0.0001$ )

**Conclusion:** This study demonstrates average awareness of AI's use and benefits among medical students. The major limitations to using AI were unlimited internet connectivity and the cost of AI tools. To maximize the benefits of AI in medical education in developing countries, medical schools need to increase their awareness and infrastructural capacity.

**Keywords:** Artificial intelligence, Medical education, Medical students' perception.

## INTRODUCTION

Artificial intelligence (AI) has been described as the science of using computers, technology, and robots to model intelligent human behaviours and roles with minimal human instructions and interventions.<sup>1</sup> In the medical and health sector, the benefits of using AI are tremendously promising. This is especially true as AI has demonstrated the potential to be a valuable tool in

diagnostics and clinical decision-making due to its proficiency in integrating vast volumes of clinical data and enhancing patient care.<sup>2</sup> In clinical practice, for instance, analogue monitors and warning systems have long been replaced with AI systems, which now detect early signs of clinical deterioration, promptly identify early signs of sepsis, alerting health care professionals; similarly, the role of AI in drug discovery and therapeutics is also gaining grounds in the pharmaceutical industry.<sup>3-5</sup>

The application of Artificial intelligence in education (AIED), more so in medical education, has gained attention in contemporary times due to the impressive ability of technology to carry out tasks requiring human intelligence at satisfactory levels and beyond, including efficient computer-assisted teaching. In terms of learning, AI can contribute broadly to medical education by direct instruction, support teaching, and empowering the learner using various subthemes as classified by Narayanan S et al.<sup>6</sup>

These subthemes include Chatbots, Intelligent tutoring systems, Virtual patients, gamification and adaptive learning systems.<sup>6</sup> The famous AI Chatbots like ChatGPT have been employed worldwide in the enhancement of interactive learning and skill acquisition in diverse educational settings, including in developing countries in sub-Saharan Africa.<sup>7-9</sup> Similarly, in clinical practice, AI systems are now being used to create dynamically generated clinical vignettes and algorithms that can aid easy access to various beneficial clinical scenarios in quick time.<sup>6</sup>

Furthermore, the advent of other AI chatbots such as FoondaMate-a tool particularly popular in southern Africa and recently Meta AI, is now revolutionising learning as students can ask their AI-enabled study tools on social media applications like WhatsApp, Messenger, Instagram chats and receive conversational replies that help them with their schoolwork.<sup>10,11</sup> Other applications of AI systems such as virtual patient stimulators, conversational agents, virtual humans, augmented realities, and also learning machines have been applied in medical education to improve such clinical skills as taking accurate and relevant medical histories, performing physical examinations, developing practical communication skills, professionalism, and overall competence in clinical skills.<sup>6</sup>

In the aspect of clinical reasoning, modern AI technologies are now of immense benefit in diverse ways, including the generation of decision trees that aid in the navigation of complex decision-making processes, algorithm-based diagnosis, graph-based models and efficient systems of which, when leveraged on, will enhance clinical reasoning, apt decision making, reduce clinical errors and possibly improve patients' outcomes.<sup>6,12,13</sup> However, an important factor limiting the integration of AI in education and clinical practice is the concern with the regulation of AI and ethical issues. Many educational institutions struggle to effectively integrate AI into their teaching practices and learning protocols due to certain ethical considerations and potential implications on the overall effects of AI.<sup>14,15</sup>

In developing countries, trainers' and students' knowledge and application of the aforementioned AI subthemes appear to be evolving. However, in some regions, it could be more rudimentary, especially among lecturers and medical instructors, due to a lack of teachers conversant with AI and the expensive cost of AI software, among other factors.<sup>16</sup> This study aimed to identify undergraduate

medical students' perceptions and usage of AI, its impact on medical education, and the challenges of using AI in education for medical students in Port Harcourt, Nigeria.

## METHODS

### *Study type*

This is a descriptive cross-sectional study.

### *Study place*

The study was done at University of Port Harcourt Teaching Hospital, Nigeria.

### *Study duration*

The study was conducted between May 2024 and July 2024.

### *Sample size*

A total of one hundred and thirty-nine medical students from the 5th year class of the University of Port Harcourt answered the questionnaire; of the one hundred and forty-one consecutively (141) sampled medical students, which comprised the entire sampling frame of the class, two questionnaires were invalid due to incomplete data set, making a response rate of 98.5%.

### *Inclusion criteria*

All 5th-year medical students who had completed didactic lectures and 3 months of clinical rotation in Paediatrics & Child Health and Obstetrics & Gynaecology at the University of Port Harcourt/University of Port Harcourt Teaching Hospital were included in the study. Participants had all received compulsory courses in the use of the English language and computer appreciation and application during the foundation years.

### *Exclusion criteria*

Students on elective postings from other institutions and participants who did not consent to the study were excluded.

### *Ethical approval*

Ethical approval was obtained from the University of Port Harcourt Teaching Hospital Research and Ethics Committee. Written informed consent was confirmed with individual participants at the beginning of the survey.

This work used a self-administered semi-structured questionnaire. After obtaining informed consent, it was administered to the participants at the conclusion of their clinical rotations in Paediatrics and Obstetrics and Gynaecology.

The questions were constructed and phrased to be easily understood. The questionnaire had a consistent layout comprising five (V) sections, including demographics (i), awareness and understanding of the concept of AI in medical education (ii), perceived benefits and drawbacks of AI (iii), assessment of learning experiences with AI (iv), Limitations of AI use (v). Dichotomous questioning was used to determine whether participants were aware of AI and utilised it during their clinical rotations. The II, III, and IV sections of the survey contained multiple 5-point Likert questions graded from 1-5 (1= strongly disagree to 5=strongly agree) whereby participants rated their agreement towards a presented statement related to their awareness/understanding of AI, perceptions & attitudes towards AI, and their learning experiences. Section V contained semi-structured questions on the limitations of AI.

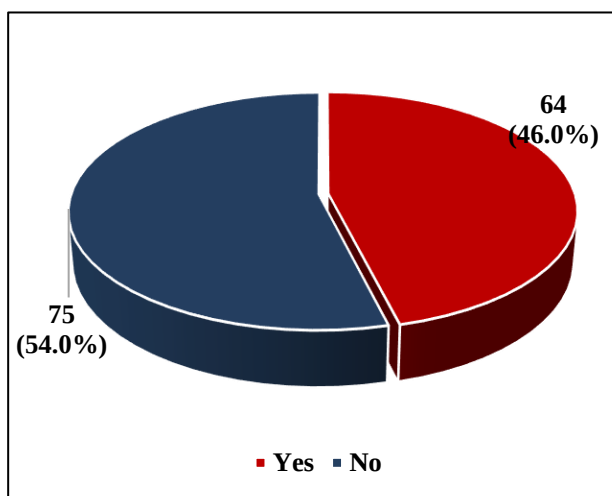
### Statistical analysis

Statistical analysis was performed using the IBM SPSS program version 26. The analysis included finding frequency, percentages, pie charts, tabulations, Likert relationships, and Chi-square. Simple descriptive statistics were presented in percentages. Comparisons were made to find relationships between the awareness/application of AI and learning experiences, as well as the relationship between sociodemographic factors and the awareness/application of AI. A p value equal to or less than 0.05 ( $p \leq 0.05$ ) was considered significant.

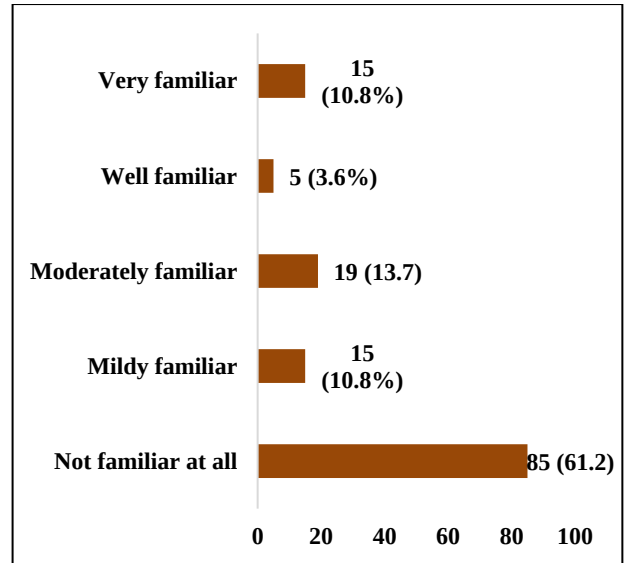
## RESULTS

Table I shows the sex distribution of the study participants. The participants were aged between 23 and 30, comprising 81 males (58.3%) and 58 females (41.7%).

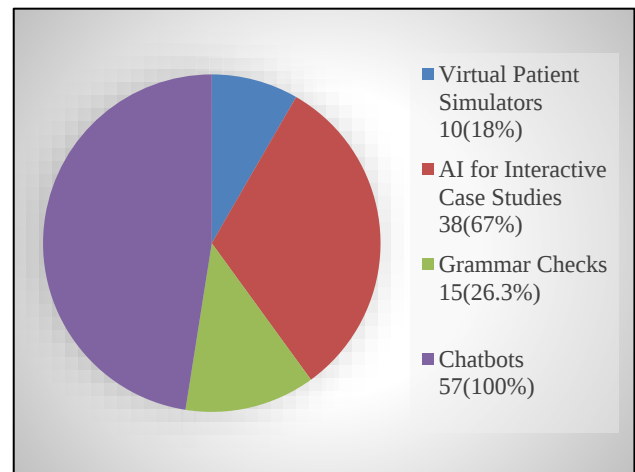
Of the 139 participants, 64 (46.0) were aware of Artificial Intelligence in the context of medical education, while 75 (54.0%) had no prior knowledge of AI and did not apply AI during their clinical rotations.



**Figure 1: Awareness of AI in medical education.**



**Figure 2: Familiarity of study participants with AI tools in medical education.**



**Figure 3: Frequency distribution of AI Tools (Subthemes) used by study participants. n=57.**

Only 15 (10.8%) of the study participants were very familiar with AI. A higher proportion of participants, 85 (61.2%), were completely unfamiliar with the use of AI tools for learning and its application in medical education.

Table II shows the perceived benefits of AI. Most participants, 88 (63.3%), think AI can improve the learning experience. However, this did not translate to their perceived benefits in terms of knowledge retention, better clinical decision making and increased efficiency, as 54.7%, 59% and 64%, respectively, did not see these as potential benefits of the use of AI.

Table III shows challenges and concerns regarding using AI in medical education. Respondents' major challenges were ethical concerns (68.3%) and a lack of human interaction (50.4%).

Table IV shows the impact of AI on the learning experience. A low proportion of respondents (41%) used AI as a learning tool during their clinical rotation. The majority of these rated their learning experience as Average (45%).

Regarding the application of AI in clinical acumen, clinical skills, and knowledge, 52.5% responded that AI

was of no benefit, while 18% admitted that AI was very effective in that regard.

Table V. shows the limitations of the use of AI in medical education. The major limitations were unreliable internet connectivity (61.9%), high cost of AI soft and hard wares (59.7%), and limited access to computers / mobile devices (53.2%).

**Table 1: Sociodemographic summary of study participants.**

| Variables            | Frequency | %     |
|----------------------|-----------|-------|
| <b>Sex</b>           |           |       |
| Male                 | 81        | 58.3  |
| Females              | 58        | 41.7  |
| <b>Year of study</b> |           |       |
| Level 500            | 139       | 100.0 |

**Table 2: Medical students' perception of the benefits of AI in medical education.**

| Variables                                            | Frequency | %    |
|------------------------------------------------------|-----------|------|
| <b>Percieved benefits of AI in medical education</b> |           |      |
| <b>Improved learning experience</b>                  |           |      |
| Yes                                                  | 88        | 63.3 |
| No                                                   | 51        | 36.7 |
| <b>Enhanced knowledge retention</b>                  |           |      |
| Yes                                                  | 63        | 45.3 |
| No                                                   | 76        | 54.7 |
| <b>Better clinical decision-making</b>               |           |      |
| Yes                                                  | 57        | 41.0 |
| No                                                   | 82        | 59.0 |
| <b>Increased efficiency</b>                          |           |      |
| Yes                                                  | 50        | 36.0 |
| No                                                   | 89        | 64.0 |
| <b>Others</b>                                        |           |      |
| Yes                                                  | 2         | 1.4  |
| No                                                   | 137       | 98.6 |

**Table 3: Challenges of AI use among medical students.**

| Variables                                 | Frequency | %    |
|-------------------------------------------|-----------|------|
| <b>Technical difficulties</b>             |           |      |
| Yes                                       | 47        | 33.8 |
| No                                        | 92        | 66.2 |
| <b>Lack of human interaction</b>          |           |      |
| Yes                                       | 70        | 50.4 |
| No                                        | 69        | 49.6 |
| <b>Ethical concerns</b>                   |           |      |
| Yes                                       | 95        | 68.3 |
| No                                        | 44        | 31.7 |
| <b>Overreliance on technology</b>         |           |      |
| Yes                                       | 61        | 43.9 |
| No                                        | 78        | 56.1 |
| <b>Antiquate the roles of the Teacher</b> |           |      |
| Yes                                       | 5         | 3.6  |
| No                                        | 134       | 96.4 |

**Table 4: Impacts of AI on learning experience and effectiveness.**

| Variables                                                     | Frequency | %    |
|---------------------------------------------------------------|-----------|------|
| <b>Have you used AI for learning purposes</b>                 |           |      |
| Yes                                                           | 57        | 41.0 |
| No                                                            | 82        | 59.0 |
| <b>Impact of AI on learning experience (n=57)</b>             |           |      |
| Not at all                                                    | 4         | 7.0  |
| Slightly                                                      | 10        | 17.5 |
| Average                                                       | 26        | 45.6 |
| Good                                                          | 9         | 15.8 |
| Significantly                                                 | 8         | 14.0 |
| <b>Impact of AI on clinical knowledge, acumen, and skills</b> |           |      |
| Not at all                                                    | 73        | 52.5 |
| Minutely                                                      | 8         | 5.8  |
| Mildly                                                        | 21        | 15.1 |
| Moderately effective                                          | 12        | 8.6  |
| Very effective                                                | 25        | 18.0 |

**Table 5: Limitations to the use of AI in paediatric education.**

| Variables                                                          | Frequency | %    |
|--------------------------------------------------------------------|-----------|------|
| <b>Limited access to computers or mobile devices</b>               |           |      |
| Yes                                                                | 74        | 53.2 |
| No                                                                 | 65        | 46.8 |
| <b>Unreliable internet connectivity</b>                            |           |      |
| Yes                                                                | 86        | 61.9 |
| No                                                                 | 53        | 38.1 |
| <b>High cost of AI software or hardware</b>                        |           |      |
| Yes                                                                | 83        | 59.7 |
| No                                                                 | 56        | 40.3 |
| <b>Limited availability of AI-trained healthcare professionals</b> |           |      |
| Yes                                                                | 56        | 40.3 |
| No                                                                 | 83        | 59.7 |
| <b>Concerns about data privacy and security</b>                    |           |      |
| Yes                                                                | 40        | 28.8 |
| No                                                                 | 99        | 71.2 |

**Table 6: Relationship between sociodemographic factors and level of awareness of AI in medical education.**

| Variables | Awareness  |           | Total      | Statistics     | P value |
|-----------|------------|-----------|------------|----------------|---------|
|           | Yes, n (%) | No, n (%) |            |                |         |
| Sex       |            |           |            |                |         |
| Male      | 42 (51.9)  | 39 (48.1) | 81 (100.0) | $\chi^2=2.636$ | 0.104   |
| Female    | 22 (37.9)  | 36 (62.1) | 58 (100.0) |                |         |

**Table 7: Relationship between awareness of AI and learning experiences.**

| Variables                                  | Awareness  |           | Total      | Statistics      | P value |
|--------------------------------------------|------------|-----------|------------|-----------------|---------|
|                                            | Yes, n (%) | No, n (%) |            |                 |         |
| Have you used AI in medical education      |            |           |            |                 |         |
| Yes                                        | 39 (68.4)  | 18 (31.6) | 57 (100.0) | $\chi^2=19.476$ | 0.0001* |
| No                                         | 25 (30.5)  | 57 (69.5) | 82 (100.0) |                 |         |
| Impact of AI on learning experience (n=57) |            |           |            |                 |         |
| Not at all                                 | 1 (25.0)   | 3 (75.0)  | 4 (100.0)  | $\chi^2=6.740$  | 0.150   |
| Slightly                                   | 9 (90.0)   | 1 (10.0)  | 10 (100.0) |                 |         |

Continued.

| Variables                                          | Awareness | Total     | Statistics | P value |
|----------------------------------------------------|-----------|-----------|------------|---------|
| Average                                            | 16 (61.5) | 10 (38.5) | 26 (100.0) |         |
| Good                                               | 7 (77.8)  | 2 (22.2)  | 9 (100.0)  |         |
| Significantly                                      | 6 (75.0)  | 2 (25.0)  | 8 (100.0)  |         |
| <b>AI on clinical acumen, knowledge and skills</b> |           |           |            |         |
| Not at all                                         | 33 (45.2) | 40 (54.8) | 73 (100.0) | 2.155   |
| Minutely                                           | 4 (50.0)  | 4 (50.0)  | 8 (100.0)  | 0.707   |
| Mildly                                             | 11 (52.4) | 10 (47.6) | 21 (100.0) |         |
| Moderately effective                               | 7 (58.3)  | 5 (41.7)  | 12 (100.0) |         |
| Very effective                                     | 9 (36.0)  | 16 (64.0) | 25 (100.0) |         |

\*p value  $\leq 0.05$  is statistically significant

## DISCUSSION

This study showed a relatively low level of awareness of artificial intelligence (AI) systems among the study participants. Less than half, 64 (46.0%) of the respondents are aware of AI in the context of medical education, and of these, only 57 (41%) used an AI tool for learning during their clinical rotations. AI is a relatively new technology, and like other technological advancements, there appears to be a lag in the awareness and adoption of these in developing countries and resource-limited regions.<sup>17,18</sup>

At present, the application of AIs at all levels of healthcare service delivery in sub-Saharan Africa is rudimentary and weakly regulated, compounded with several limitations that impede the implementation of digital health in low- to middle-income countries.<sup>19</sup> In sum, these may have contributed to the findings of this study. Similar to our findings, Mohammad et al, reported a low level of awareness of AIED among medical students (21%) in Pakistan.<sup>20</sup> In contrast, Oluwadiya et al reported an average level of AIED awareness among medical students and educators in Nigeria.<sup>16</sup> This stresses the need to bridge the gap between medical students and medical educators and this technology.

There was no significant difference between gender and the awareness of AIED in this study. This finding is in tandem with reports from a survey among a cohort of Nigerian medical students, but at variance with findings among Palestinian medical students' cohorts where male participants had better knowledge and awareness of AIED.<sup>16,21</sup>

Although cultural differences and gender inequality may have played a role in the past as regards female medical education amidst other social inequities in developing countries, recent studies have consistently demonstrated a balance in the perception and uptake of technology among both sexes in Nigerian medical institutions- a welcome development in the regional pursuits of attainment of SDG.<sup>16,22</sup>

The study participants' most commonly used AI subthemes were the conversational AI tools; Chatbots, and AI for Interactive case studies. These AI tools are particularly handy and do not require high-tech gadgets

other than mobile hand-held devices such as mobile phones and computers or stable internet connectivity. Chatbots, such as ChatGPT, FoondaMate and Meta AI, are the most popular among the general population in sub-Saharan Africa and are increasingly used as conversational AI that supports learning in diverse educational faculties.<sup>9,23</sup> Perhaps the incorporation of these tools in commonly used social media applications in smart hand-held devices makes for their popularity as AI tools.

Hence, there is room for more exposure to the versatility of AI, especially as it can benefit medical training and education across faculties and students. Oluwadiya reported that grammar checks were the most commonly used AI tool in Nigerian medical schools; this was in contrast with our findings; perhaps the variation may be due to their inclusion of medical educators in their study population as these subsets of respondents more actively use such tools in the course of academic writing compared to medical students.<sup>16</sup> The use of robotics and other clinical AI subthemes such as virtual reality, gamification, and other software are still evolving; these appear to be largely unsubstantiated in medical educational spheres and are now being advocated for inclusion in the undergraduate and postgraduate educational levels.<sup>24</sup>

In terms of learning experiences, most participants admitted to the improved learning experience with the use of AI; this is similar to findings from a Jordanian survey where the majority of the medical students (71.4%) believed that AI would benefit learning and improve learning outcomes.<sup>25</sup>

However, in our study, despite the high proportion of respondents admitting to perceived improved learning experiences with AI, they did not think it could translate to benefits in terms of knowledge retention, better clinical decision making and increased efficiency. This may be explained by the relatively low awareness of AI, the limited spectrum of AI tools used, the type of AI tool available and the lack of implementation of AI applications in day-to-day clinical practice in the course of training in a resource-limited region. In the aspect of the application of AI in clinical skills, and knowledge and acumen, only 18% admitted that AI was very effective. (Table IV).

This furthermore depicts various degrees of limitations in the application of AI systems and sub-par utilisation of AI resources. Therefore, advocating for in-depth knowledge of this transformative technology among medical students and robust infrastructural improvements in developing countries is imperative. For instance, the application of AI subthemes beyond the Chatbots, like the Virtual patient models, which can simulate patients' symptoms and respond to students' clinical interventions, may holistically improve learning outcomes and expand learning satisfaction among students in developing countries, as seen in other climes.<sup>26</sup> Furthermore, evidence suggests that virtual reality improves health professionals' postintervention knowledge and skills outcomes compared with traditional education or other types of digital education, such as online or offline digital education. Hence, concerted efforts have to be employed to bring home these advancements to improve learning dynamics and enable better learning satisfaction among medical students in this region.

One of the major concerns raised by respondents was ethical considerations, which is in keeping with findings from a study among academic staff and students in a Saudi Arabian medical school.<sup>1</sup> The use of AI generates several ethical concerns, especially regarding academic integrity, plagiarism, privacy and confidentiality issues. Similarly, at the forefront of healthcare service delivery, it is equally a delicate subject matter because the application of AI poses questions ranging from the privacy of patient data and clinical information to the risk of breach of confidentiality. Also, biases in the formation of AI algorithms could amount to inequalities with the potential to breach principles of distributive justice and maleficence.

Additionally, the lack of transparency in AI decision-making processes may pose challenges for users to come to terms with how conclusions and inferences are drawn. Similarly, the potential devaluation of human judgment as AI becomes more integrated into educational frameworks is a substantial risk that remains a subject of discussion. Several measures, including prioritising confidentiality, obtaining informed consent, and providing better knowledge and awareness of the use of AI in medical education, have been proposed by some workers to curb several ethical challenges related to the application of AI in medical education.<sup>27</sup>

One of the major limitations to AI use in this study is the unreliability of internet connectivity; this finding is not unexpected as 78% of the sub-Saharan African population is not connected to the internet, including 60% of the adult population.<sup>28</sup> Stable internet connections in tertiary institutions of learning and hospitals come at a cost and appear luxurious.

This limits the use of various technologies, including AI, as exemplified in this study. Other limitations include the high financial cost of procuring AI soft and hard wares and limited access to mobile computers and devices. The

economic impact of using AI poses a major limitation in the sub-Saharan region, where scarce resources are primarily channelled towards providing basic life needs. The participant sample represents only a subset of the medical students undertaking clinical rotations. As a result, the findings may only be partially representative of the perceptions of the broader group of medical students in the pre-clinical and basic sciences.

## CONCLUSION

This study demonstrates sub-optimal awareness of the usage and benefits of AI in education among medical students, limiting the use of AI subthemes to mostly conversational AI available on smart devices. The major limitations to the use of AI were unreliable internet connectivity and the cost of AI tools. Ethical concerns about the application of AI in medical education remain a major factor, and concerted efforts should be made to ensure the appropriate application of AI in both clinical practice and learning to avoid breaches of ethical principles. There is a need for advocacy, awareness and enormous infrastructural upscaling in medical schools to maximise the benefits of AI in medical training and patient care in developing countries.

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