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Artificial intelligence in Nigerian nursing education: Are future nurses prepared for the digital revolution in healthcare?

David B. Olawade [a,b,c,d,*], Aanuoluwapo Clement David-Olawade [e], Oluwayomi B. Rotifa [f], Ojima Z. Wada [g]

[a] Department of Allied and Public Health, School of Health, Sport and Bioscience, University of East London, London, United Kingdom
[b] Department of Research and Innovation, Medway NHS Foundation Trust, Gillingham ME7 5NY, United Kingdom
[c] Department of Public Health, York St John University, London, United Kingdom
[d] School of Health and Care Management, Arden University, Arden House, Middlemarch Park, Coventry, CV3 4FJ, United Kingdom
[e] Endoscopy Unit, Glenfield Hospital, University Hospitals of Leicester, NHS Trust, Leicester, United Kingdom
[f] Department of Radiology, Afe Babalola University MultiSystem Hospital, Ado-Ekiti, Ekiti State, Nigeria
[g] Division of Sustainable Development, College of Science and Engineering, Hamad Bin Khalifa University, Qatar Foundation, Doha, Qatar

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ABSTRACT

Aim/Objective: This study aims to assess the knowledge, exposure, and willingness of Nigerian nursing students to integrate artificial intelligence (AI) into healthcare, identifying gaps that may hinder its adoption.
Background: AI is revolutionizing healthcare through improved diagnostics, predictive analytics, and automated administrative processes. However, research on AI awareness and adoption among nursing students in low- and middle-income countries (LMICs), particularly in Nigeria, remains limited. Understanding the preparedness of future nurses for AI integration is crucial for optimizing healthcare delivery and education.
Design: A cross-sectional study design was employed to evaluate AI knowledge, exposure, and adoption readiness among nursing students in Nigeria.
Methods: The study involved 676 nursing students from five universities in Nigeria. A structured questionnaire was administered to assess sociodemographic characteristics, AI knowledge, exposure to AI facilities, and willingness to adopt AI technologies. Data were analyzed using descriptive and inferential statistics with Microsoft Excel and JASP 0.19. Associations were tested using ANOVA and Chi-square tests at a 95 % confidence interval ($p < 0.05$).
Results: Findings revealed that 98 % of students had low AI knowledge, with only 1.8 % demonstrating average knowledge and 0.15 % showing high knowledge. Despite this, 85.5 % were willing to take AI training, and 92.6 % believed AI could enhance healthcare workflow. However, concerns regarding inadequate infrastructure (43.5 %) and privacy issues (37.1 %) were prevalent. Significant associations were found between AI knowledge and location, self-perception, and willingness to train ($p < 0.001$).
Conclusions: The study highlights critical knowledge gaps in AI among Nigerian nursing students despite a high willingness for adoption. AI education should be integrated into nursing curricula, and infrastructure improvements are necessary to support AI implementation in healthcare. Addressing these gaps will better prepare nursing students for the evolving landscape of AI-driven healthcare.

1. Introduction

Artificial Intelligence (AI) is rapidly transforming various sectors, including healthcare, by enhancing diagnostic accuracy, streamlining administrative processes, and improving patient outcomes (Olawade et al., 2024a; Clement David-Olawade et al., 2025; Da'Costa et al., 2025). AI applications in healthcare include machine learning-based disease prediction, robotic-assisted surgeries, natural language processing in medical documentation, and AI-driven decision support systems that are revolutionizing clinical practice globally (Olawade et al.,

* Corresponding author at: Department of Allied and Public Health, School of Health, Sport and Bioscience, University of East London, London, United Kingdom.
E-mail addresses: d.olawade@uel.ac.uk (D.B. Olawade), aanuclement23@gmail.com (A. Clement David-Olawade), RotifaYhommie@gmail.com (O.B. Rotifa), ojimawada14@gmail.com (O.Z. Wada).

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2024b; Soladoye et al., 2025). As the healthcare industry embraces these technological advancements, nurses, as frontline healthcare providers, must be adequately prepared to integrate AI into their practice to ensure optimal patient care and safety (Buchanan et al., 2020; Rony et al., 2024). However, concerns about knowledge gaps, ethical considerations, and infrastructural limitations raise critical questions about the readiness of nursing students for AI adoption in healthcare settings (Rony et al., 2024).

The integration of AI in healthcare has been widely explored in developed countries, where structured AI curricula, training, and exposure are more prevalent among healthcare professionals (Issa et al., 2024; Naseer et al., 2025). These studies consistently demonstrate the positive impact of formal AI education on healthcare professionals' competency and confidence in utilizing AI technologies. However, research in low- and middle-income countries (LMICs), including Nigeria, remains limited, with little understanding of how nursing students perceive, engage with, and prepare for AI-driven healthcare systems (Ono et al., 2024; Rajah et al., 2024; Zuhair et al., 2024). Addressing this knowledge gap is critical, given the growing reliance on AI to improve healthcare delivery and mitigate workforce shortages in many LMICs.

In Nigeria, healthcare institutions are gradually adopting digital technologies, such as electronic medical records (EMRs) and telemedicine platforms, yet the adoption of more advanced AI applications remains limited (Babatope et al., 2024; Ono et al., 2024). This slow uptake is partly due to a lack of infrastructure, limited access to AI education, and concerns about data security and ethical implications (Eke and Adeyemi, 2024; Onyezere et al., 2024). Nigerian nursing students, as future healthcare professionals, must be equipped with the necessary AI knowledge and skills to navigate these emerging technological changes effectively and safely (Rajah et al., 2024). However, little is known about their current level of AI knowledge, their exposure to AI technologies in healthcare, and their willingness to integrate AI into their clinical practice.

Previous studies have also shown resistance and skepticism about its implementation (Mollura et al., 2020; Mousavi Baigi et al., 2023). This is particularly concerning in nursing education, where AI is rarely incorporated into training curricula despite its growing importance in modern healthcare delivery (Richardson et al., 2023; Salama et al., 2025). Without adequate education and exposure, nursing students may struggle to adapt to AI-driven healthcare environments, limiting the potential benefits of AI adoption. Moreover, misconceptions and fears about AI replacing human jobs further complicate its acceptance among healthcare workers (Akinrinmade et al., 2023). Understanding how Nigerian nursing students perceive AI can inform policymakers and educators in designing interventions that enhance AI literacy and foster a positive attitude toward AI adoption in healthcare.

This study aims to address these critical gaps by systematically evaluating the current state of AI preparedness among Nigerian nursing students. Specifically, this research seeks to:

I. Assess the level of AI knowledge among Nigerian nursing students across multiple institutions
II. Evaluate their exposure to AI technologies in healthcare settings during their academic training
III. Examine their willingness and attitudes toward adopting AI in clinical practice
IV. Identify factors that influence AI knowledge, exposure, and adoption readiness
V. Provide evidence-based recommendations for integrating AI education into nursing curricula

These objectives are essential for understanding how to effectively prepare Nigerian nursing students for the digital transformation of healthcare and ensure they can leverage AI technologies to improve patient outcomes and healthcare delivery efficiency. This study employs a cross-sectional design involving nursing students from five purposefully selected universities in Nigeria. The findings will contribute to the growing body of research on AI adoption in healthcare education, particularly in LMICs, and provide evidence-based recommendations for integrating AI training into nursing programs. The results will inform curriculum development, policy formulation, and infrastructure planning to better prepare future nurses for AI-enhanced healthcare environments. Ultimately, equipping nursing students with AI competencies will ensure that they can effectively leverage technology to improve patient care, enhance workflow efficiency, and contribute to the broader digital transformation of healthcare in Nigeria.

2. Methodology

2.1. Study design and setting

This cross-sectional study assessed the knowledge, exposure, and willingness of nursing students to adopt AI in healthcare across five purposefully selected universities in Nigeria: Afe Babalola University Ado-Ekiti (ABUAD), Bowen University, Ekiti State University (EKSU), Ondo State University of Medical Sciences (UNIMED), and the University of Ibadan (UI). These universities were strategically chosen based on several criteria: the presence of well-established nursing departments, geographic distribution across southwestern Nigeria, availability of trained research assistants (RAs) within these institutions, and varying institutional characteristics (including both public and private universities) to ensure diverse perspectives.

2.2. Participants and sampling technique/size

The study employed a probability sampling method using simple random sampling to select participants. The target population comprised all registered nursing students across the five selected universities. The sample size for each university was determined proportionally to the total number of nursing students in each institution, aiming to reach at least 10 % of the student population per location to ensure representative data and highlight location-based differences. A 10 % addition was made to account for potential non-response. Eligibility criteria included: (1) being enrolled as a student in one of the selected universities, (2) being registered in a nursing program at any academic level, and (3) providing voluntary consent to participate. Students were selected through on-spot surveys using simple random sampling from available students in each class. Exclusion criteria included students who were on academic suspension or those who declined to participate after being informed about the study.

The final sample comprised 676 nursing students distributed as shown in Fig. 1.

2.3. Data collection instrument

A structured, self-administered questionnaire was specifically

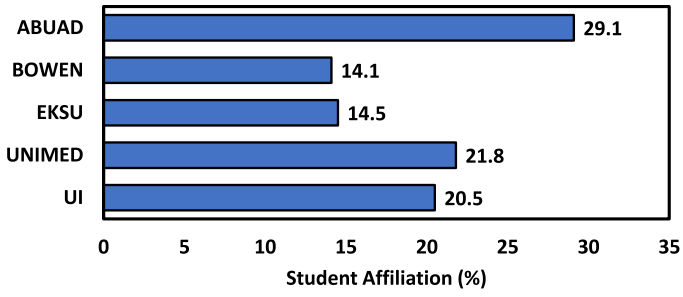

Fig. 1. Distribution of nursing students selected across the represented universities.

developed for this study after extensive literature review and consultation with subject matter experts. The questionnaire development process involved three phases: (1) initial item generation based on literature review and expert consultation, (2) content validation by a panel of five experts (including nursing educators, AI specialists, and healthcare administrators), and (3) pilot testing with 30 nursing students not included in the main study to assess clarity and comprehensibility.

The questionnaire was designed to assess AI awareness among nursing students. The final questionnaire consisted of four main sections:

- **(A) Sociodemographic Information (6 items)** - including academic year, degree program, program of study, age range, religion, and marital status
- **(B) Knowledge about AI Facilities in Healthcare (6 items)** - assessing self-rated knowledge, familiarity with AI applications (13 specific applications), knowledge of AI terminologies (13 specific terminologies), and three open-ended questions testing understanding of machine learning, supervised/unsupervised learning, and Internet of Things (IoT)
- **(C) Exposure to AI Integration/Facilities in the Workplace (1 item)** - evaluating practical experience with 13 specific AI technologies during clinical placements and academic training
- **(D) Willingness to Adopt New AI Technologies in Healthcare (8 items)** - measuring attitudes, concerns, and readiness using a 3-point scale (Yes/Undecided/No) for eight specific statements about AI adoption

Face and content validity of the instrument were established through review by a panel of local healthcare specialists, nursing educators, and AI professionals. The questionnaire demonstrated good internal consistency with Cronbach's alpha values of 0.82 for the knowledge section and 0.79 for the willingness section. The knowledge scoring system combined responses from multiple-choice questions about AI applications and terminologies, with additional points awarded for correct responses to open-ended questions. Total knowledge scores were then recoded into three levels: low (0−16), average (17−24), and high (25−34) based on tertile distribution of scores and expert consensus on clinically meaningful cut-off points.

Specific examples from the questionnaire include:

- Knowledge section: "Which of these AI-driven facilities in the healthcare setting do you know about? (Multiple selection from 13 options including Electronic record keeping, Diagnostic differentials, Robot-assisted procedures, etc.)"
- Open-ended questions: "What do you understand by machine learning?" and "What do you understand by Internet of Things (IoT)?"
- Willingness section: "I am willing to take a training course to learn about the application of AI in healthcare settings" (Yes/Undecided/No response options)

2.4. Data collection process

Data collection was conducted between June and December 2024 across all five participating universities. Trained research assistants, who were postgraduate students or junior faculty members at each institution, administered the questionnaires. Prior to data collection, a two-day training workshop was conducted for all research assistants to ensure standardized data collection procedures. The questionnaires were distributed during scheduled class sessions after obtaining permission from course instructors. Participants were provided with clear instructions emphasizing the confidentiality of their responses and their right to withdraw at any time. Contact information for the principal investigator was provided for any questions or concerns. Participants were given adequate time to complete the questionnaire, with an average completion time of 25–30 min due to the inclusion of open-ended questions.

2.5. Data management and analysis

Data were managed and analyzed using Microsoft Excel and JASP 0.19. The choice of JASP was made due to its user-friendly interface, comprehensive statistical capabilities, and suitability for educational research settings, particularly in resource-limited environments where expensive statistical software may not be readily available. Descriptive statistics, including frequencies, proportions, means, and standard deviations, were used to summarize the data, presented in charts and tables. Open-ended responses about machine learning, supervised/unsupervised learning, and IoT were scored by two independent reviewers using predefined criteria, with disagreements resolved through discussion. These scores were incorporated into the overall knowledge assessment. Data were checked for completeness and accuracy before analysis, with missing data handled using listwise deletion for cases with more than 10 % missing responses.

Inferential statistics were conducted at a 95 % confidence interval ($p < 0.05$). One-way ANOVA was used to assess the association between mean knowledge scores and sociodemographic characteristics, as well as willingness to adopt AI technologies. Effect sizes were calculated using eta-squared (η^2) to determine the practical significance of significant findings. In cases of unequal variances (significant Levene's test), Welch's ANOVA was used, and Games-Howell post hoc tests replaced Tukey's post hoc tests. Chi-square tests were used to identify associations between exposure to AI facilities and the students' schools of study. Cramer's V was used to measure the effect size for significant associations. Confidence intervals (95 % CI) were calculated for all proportions and mean differences to provide additional context for the findings.

2.6. Ethical considerations

Ethical approval was obtained from BOWEN University Teaching Hospital Research Ethics Committee with the approval number "BUTH/REC-1134". Written informed consent was obtained from all participants prior to their participation, with clear assurance that their information would be kept strictly confidential and no identifiable information would be recorded. Participants were explicitly informed of their right to withdraw from the study at any point without any repercussions, ensuring they understood the study purpose, procedures, potential risks and benefits. Confidentiality was maintained throughout the study through the use of unique identifier codes instead of personal names, and secure data storage procedures. No undue compensation was provided to the participants to avoid coercion, though light refreshments were offered during data collection sessions.

3. Results

Table 1 provides the respondents' sociodemographic characteristics. All the nursing students were female (100 %), reflecting the current demographic composition of nursing programs in the participating Nigerian universities, where nursing remains a predominantly female profession due to cultural and historical factors. The majority were in their third (30.3 %) and fourth year (35.2 %). In addition, most of the students (96 %) were studying to earn their BSc in Nursing degree, with Christianity being the most prevalent religion (91 %). Almost all the students were single (99 %), which is consistent with the typical age profile of undergraduate nursing students, and the majority were between 21 and 25 years of age (57 %).

3.1. Knowledge about AI Facilities in healthcare

Table 2 shows a descriptive table of how students responded to some of the knowledge-based questions. The students displayed very poor

Table 1
Respondents' sociodemographic characteristics.

Variable	Frequency	Proportion (%)
Academic year	N = 676	
1	32	4.7
2	79	11.7
3	205	30.3
4	238	35.2
5	118	17.5
6	4	0.6
Degree in view		
Higher National Diploma (HND)	6	0.9
BSc.	649	96.0
MSc	10	1.5
PhD	8	1.2
Others	3	0.4
Age range		
< 16 years	5	0.7
> 16–20 years	208	30.8
21–25 years	384	56.8
26–30 years	76	11.2
> 30 years	3	0.4
Religion		
Christianity	616	91.1
Islam	58	8.6
Traditionalist	1	0.15
Atheist	1	0.15
Marital Status		
Single	669	99.0
Married	7	1.0

Table 2
Knowledge of specific applications of AI in healthcare and associated terminologies.

Variable	Yes	No
Electronic record keeping	468 (69.2 %)	208 (30.8 %)
Diagnostic differentials	155 (22.9 %)	521 (77.1 %)
Robot-assisted procedures	209 (31.0 %)	466 (69.0 %)
Disease detection from scans	351 (51.9 %)	325 (48.1 %)
Predictive analytics for patient outcomes	119 (29.4 %)	477 (70.6 %)
Personalized treatment plans	137 (20.3 %)	539 (79.7 %)
Drug interaction analysis	115 (17.0 %)	561 (83.0 %)
Virtual health assistants	187 (27.7 %)	489 (72.3 %)
Telemedicine platforms	171 (25.3 %)	505 (74.7 %)
Medical research assistance	171 (25.3 %)	505 (74.7 %)
AI in managing patient follow-up and adherence	70 (10.4 %)	606 (89.6 %)
Automated administrative tasks	96 (14.2 %)	580 (85.8 %)
AI in monitoring and managing chronic diseases	81 (12.0 %)	595 (88.0 %)
Correct definition of terms		
Machine learning	81 (12.0 %)	595 (88.0 %)
Supervised & Unsupervised learning	40 (5.9 %)	636 (94.1 %)
Internet of Things (IoT)	68 (10.1 %)	608 (89.9 %)

knowledge of AI in healthcare. For example, only less than10 % were familiar with the terms deep learning, natural language processing, and convoluted neural network (Fig. 2). The knowledge scores ranged from 0 to 27, with a mean knowledge score of 5.9 ± 4.0. The knowledge ranking reflected the dire state of AI in healthcare knowledge among tertiary institutions in Nigeria, with 98.0 % (663 respondents) having low knowledge, 1.8 % (12 respondents) having average knowledge, and 0.15 % (1 respondent) having high knowledge. When considering locations, as seen in Fig. 3, students from Bowen had the highest average knowledge score, while ABUAD students had the lowest.

The highest mean average was obtained among students under 16 years (8.2 ± 5.0) and over 30 years (8.7 ± 3.2), with age ranges in-between having average scores ranging from 5.6 ± 3.9–6.5 ± 3.9. Moreover, the students' self-perception of their AI knowledge was inaccurate ($p = 0.006$), emphasising the need for specific indicator questions. While the students who reported having no knowledge had the lowest mean knowledge score (4.7 ± 3.6), those who reported having average knowledge had the highest score (6.3 ± 4.2), followed by those who reported having low knowledge (5.4 ± 3.6), and with the students who reported having high knowledge with lower scores (5.2 ± 3.7). This comparison is clearly seen in Fig. 4, wherein only 29 % reported having low knowledge via self-assessment, while the questionnaire assessment revealed that 98 % had poor knowledge.

3.2. Willingness to adopt AI technology into healthcare

Table 3 highlights the respondents' willingness to adopt AI technologies in healthcare. The majority were willing to take a training course (86 %) and were confident about adapting well if technologies were implemented (90 %). However, some of the major concerns highlighted were insufficient infrastructure to maintain AI facilities if implemented (44 %) and ethical and privacy issues (37 %). Other concerns raised by over a tenth of the respondents were concerns about AI replacing humans leading to increased unemployment and a fundamental lack of trust in AI being reliable enough to effectively address healthcare needs.

Examining the respondents' willingness to learn about AI applications in healthcare (Table 4), inferential statistics revealed that their willingness was significantly dependent on their baseline knowledge scores ($p = 0.005$), with those unwilling having the lowest average scores (4.3 ± 3.0), followed by the undecided respondents (4.9 ± 3.1), and the willing respondents (6.1 ± 4.1). Surprisingly, respondents who did not agree AI integration into Nigerian healthcare would improve work process efficiency had the highest mean knowledge score (7.2 ± 4.5). This is probably because they doubt the preparedness based on infrastructure, maintenance, and availability/training of technical personnel. This was affirmed by the significantly higher ($p < 0.001$) average knowledge (6.8 ± 4.4) among respondents who doubted the availability of infrastructure to maintain AI facilities if integrated into healthcare. Moreover, the respondents who had privacy/ethical concerns and called for limiting the integration of AI due to distrust in its application were those with significantly higher ($p < 0.001$) average knowledge scores (6.8 ± 4.5 and 7.4 ± 4.6 respectively), indicating the importance of knowledge acquisition in fully understanding the potential risks involved. Finally, even though not statistically significant ($p = 0.105$), an increment in knowledge could also be expected to result in increased concern about the replacement of human jobs with AI and a corresponding increase in unemployment. This was reflected in the knowledge score distribution.

3.3. Exposure to AI integration/facilities in the hospital

As seen in Table 5, exposure to AI integration at the moment is quite low. The most prominent instance is with electronic record keeping (59.5 %), diagnostic differentials (16.7 %), predictive analytics (11.1 %), and virtual health assistants (10.7 %). Results from inferential statistics (Table 6) show that exposure was primarily location-specific. In ABUAD, all the students had gained exposure to electronic record-keeping, which was significantly higher than all other institutions ($p < 0.001$). More advanced applications like robot-assisted surgeries showed no significant differences across locations ($p = 0.542$), as most of the students had not been exposed to this.

4. Discussion

4.1. Principal findings

This study provides valuable insights into the knowledge, exposure, and willingness of Nigerian nursing students to adopt artificial intelligence (AI) in healthcare. The findings highlight significant gaps in AI awareness and preparedness, despite a strong willingness to integrate AI technologies into clinical practice. The most striking finding is the dramatic disconnect between students' self-perceived AI knowledge and their actual competency, with 98 % demonstrating objectively low

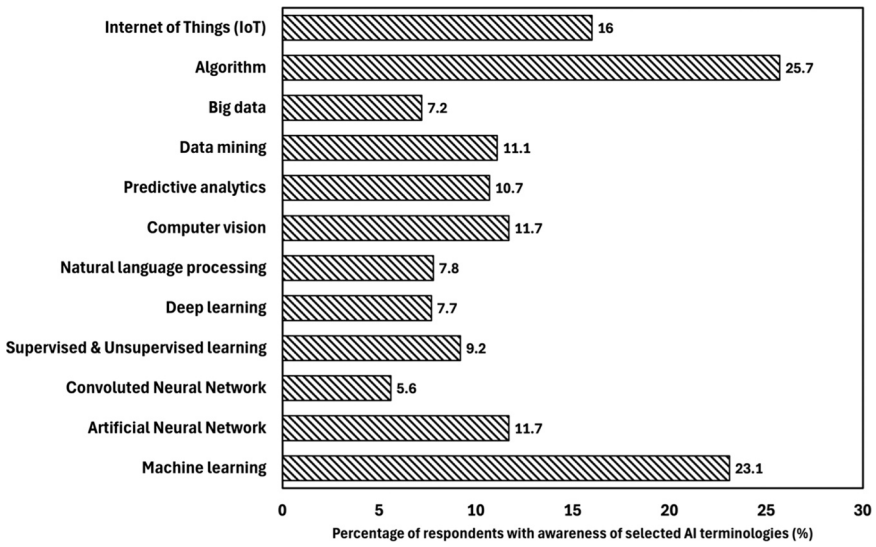

Fig. 2. Familiarity of students with common AI terminologies.

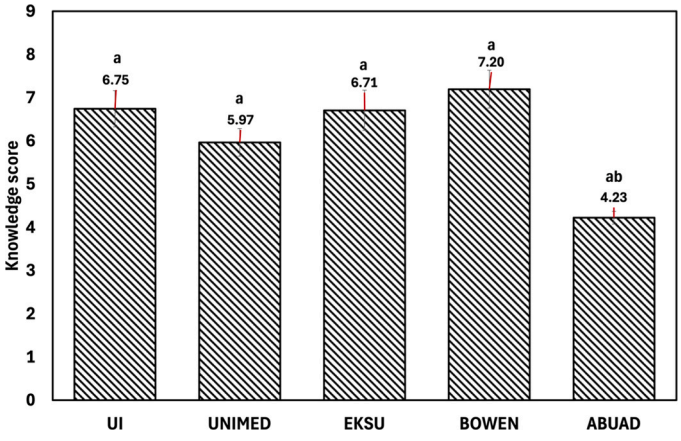

Fig. 3. Knowledge scores of students based on their school of study.

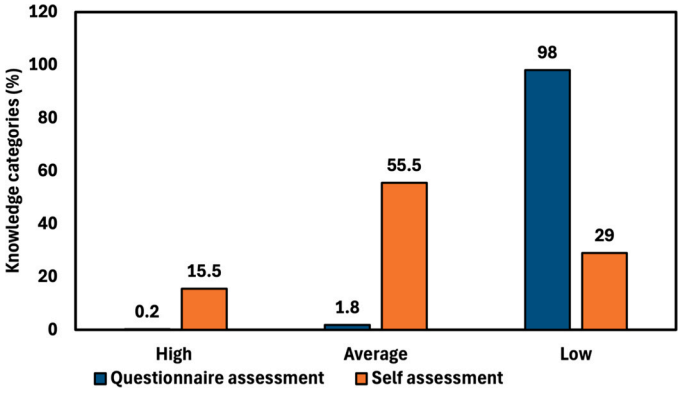

Fig. 4. Self-reported knowledge levels of students.

knowledge levels while only 29 % self-reported having low knowledge.

4.2. Comparison with prior studies

These results align with existing literature on AI adoption in healthcare education, which emphasizes the need for structured AI training in nursing curricula (Richardson et al., 2023; Naseer et al., 2025). The study revealed alarmingly low levels of AI knowledge among nursing students, with 98 % scoring within the low-knowledge category. This finding mirrors similar studies conducted in other LMICs, where healthcare professionals exhibit limited familiarity with AI-driven applications (Numviyumukiza et al., 2024; Nyarko, 2024). The low knowledge levels observed in this study may be attributed to the absence of AI-related coursework in nursing programs, a problem previously documented in studies evaluating AI adoption in medical and nursing education (Issa et al., 2024; Ehmke et al., 2025; Wei et al., 2025).

A notable discrepancy was found between self-reported knowledge and actual knowledge scores. This overestimation of digital competency among healthcare students has been consistently reported in similar contexts (Machleid et al., 2020; Martzoukou et al., 2024). Addressing this gap through structured AI education may enhance students' ability to critically evaluate AI applications in clinical settings.

Table 3
Willingness to adopt new AI technologies in healthcare.

Question	Yes	Undecided	No
I am willing to take a training course to learn about the application of AI in healthcare settings	578 (85.5 %)	86 (12.7 %)	12 (1.8 %)
I believe integrating AI in current healthcare processes will make workflow more efficient	624 (92.3 %)	37 (5.5 %)	15 (2.2 %)
I am confident AI integration will help improve health outcomes of patients and increase the productivity of health professionals	551 (81.5 %)	96 (14.2 %)	29 (4.3 %)
I am confident I will be able to adapt and learn how to use emerging AI technologies if introduced	605 (89.5 %)	64 (9.5 %)	7 (1.0 %)
I doubt we have the infrastructure to maintain such facilities if introduced	294 (43.5 %)	167 (24.7 %)	215 (31.8 %)
I feel AI should not be trusted, so its integration should be limited	112 (16.6 %)	194 (28.7 %)	370 (54.7 %)
I have concerns over privacy and ethical issues	251 (37.1 %)	283 (41.9 %)	142 (21.0 %)
I do not support AI integration as it is designed to take over human jobs and increase unemployment	81 (12.0 %)	167 (24.7 %)	428 (63.3 %)

4.3. AI Exposure and infrastructure challenges

Despite the growing integration of AI in global healthcare settings,

Table 4
Association between knowledge of students and their sociodemographic characteristics and willingness to adopt AI in healthcare.

Variables	Knowledge scores	Sum of squares	df	Mean square	*F*	*p* value
Location	Between groups	871.3	4.0	217.8	23.1	< 0.001*
	Within groups	10112.7	260.0	38.9		
Year of study	Between groups	20.0	5.0	4.0	0.3	0.942
	Within groups	10964.0	670.0	16.4		
Age of students	Between groups	91.0	4.0	23.0	1.4	0.227
	Within groups	10892.1	671.0	16.2		
Marital status	Between groups	14.9	1	14.9	0.9	0.339
	Within groups	10969.2	674.0	16.3		
Self-perception of AI knowledge	Between groups	201.1	3	67.0	4.3	0.006*
	Within groups	10782.9	121.4	88.8		
Willingness to take AI training course	Between groups	104.8	2	70.4	6.5	0.005*
	Within groups	10843.2	28.7	378.1		
Believe AI integration will make workflow more efficient	Between groups	28.4	2.0	14.2	0.9	0.419
	Within groups	10943.8	671.0	16.3		
Doubt availability of infrastructure to maintain AI facilities	Between groups	477.5	2.0	238.8	14.9	< 0.001*
	Within groups	10506.5	418.8	25.1		
Confidence in being able to adapt after AI integration	Between groups	18.7	2.0	9.3	0.6	0.563
	Within groups	10965.3	673.0	16.3		
Distrust with AI	Between groups	361.7	2.0	180.9	9.4	< 0.001*
	Within groups	10621.6	265.0	40.1		
Concerns over privacy and ethical issues	Between groups	438.4	2.0	219.2	13.6	< 0.001*
	Within groups	10545.7	363.5	29.0		
Concerns over security of human jobs	Between groups	86.4	2.0	43.2	2.3	0.105
	Within groups	10897.7	195.7	55.7		

Table 5
Exposure to AI Integration/Facilities in the hospital.

Variable	Yes	No
Electronic record keeping	402 (59.5 %)	274 (40.5 %)
Diagnostic differentials	113 (16.7 %)	563 (83.3 %)
Robot-assisted procedures	23 (3.4 %)	653 (96.6 %)
Disease detection from scans	362 (53.6 %)	314 (46.4 %)
Predictive analytics for patient outcomes	75 (11.1 %)	601 (88.9 %)
Personalized treatment plans	53 (7.8 %)	623 (92.2 %)
Drug interaction analysis	37 (5.5 %)	639 (94.5 %)
Virtual health assistants	72 (10.7 %)	604 (89.3 %)
Telemedicine platforms	63 (9.3 %)	613 (90.7 %)
Medical research assistance	67 (9.9 %)	609 (90.1 %)
AI in managing patient follow-up and adherence	10 (1.5 %)	666 (98.5 %)
Automated administrative tasks	49 (7.2 %)	627 (92.8 %)
AI in monitoring and managing chronic diseases	17 (2.5 %)	659 (97.5 %)

exposure to AI-driven healthcare tools among the study population was relatively low. Electronic record-keeping was the most commonly encountered AI application (59.5 %), followed by disease detection from scans (53.6 %). Advanced applications such as robot-assisted procedures (3.4 %) and predictive analytics (11.1 %) were significantly underutilized. This aligns with prior studies indicating that AI exposure among healthcare students is largely limited to administrative applications, with little interaction with clinical decision-support tools (Turchioe et al., 2024; Vera, 2024).

The study also identified significant location-based disparities in AI exposure, with ABUAD students reporting the highest exposure rates. This disparity reflects the broader digital divide in Nigerian healthcare education, where institutional resources and technological infrastructure vary significantly between universities. This may be due to variations in institutional resources and infrastructure, as some private universities in Nigeria have invested more heavily in digital transformation efforts compared to public institutions (Olawade et al., 2020; Olanrewaju and Afolabi, 2022). The absence of exposure to AI-driven personalized treatment plans and drug interaction analysis tools suggests a broader limitation in AI implementation across healthcare institutions in Nigeria, reinforcing the findings of previous reports on digital health adoption barriers in sub-Saharan Africa (Ono et al., 2024).

4.4. Willingness and attitudes toward AI adoption

Despite their limited knowledge and exposure, nursing students expressed a high willingness to adopt AI technologies. The majority (85.5 %) were willing to take AI training courses, and 92.6 % believed AI integration would improve workflow efficiency. This positive attitude is consistent with findings from previous studies conducted in LMICs, where healthcare students recognize the potential benefits of AI despite a lack of formal training (Mousavi Baigi et al., 2023; Habib et al., 2024). However, significant concerns were raised regarding AI infrastructure, privacy, and job security.

Paradoxically, students with higher AI knowledge scores expressed greater skepticism about AI implementation, particularly regarding infrastructure adequacy and ethical concerns. This suggests that increased AI literacy leads to more nuanced understanding of implementation challenges rather than uncritical acceptance. The skepticism toward AI reliability, raised by 16.6 % of students, is consistent with global concerns about AI's trustworthiness in healthcare (Mollura et al., 2020; Mousavi Baigi et al., 2023). Additionally, concerns regarding AI replacing human jobs align with existing studies that highlight the fear of automation-driven unemployment in healthcare (Akinrinmade et al., 2023).

4.5. Implications for curriculum development and policy

The findings from this study have significant implications for nursing education policy and curriculum development in Nigeria. The critical knowledge gaps identified necessitate immediate integration of AI literacy components into nursing curricula. This should include foundational AI concepts, ethical considerations, hands-on experience with AI tools, and critical evaluation skills. Educational institutions should prioritize partnerships with technology companies and healthcare organizations to provide students with practical AI exposure during clinical placements. Furthermore, the infrastructure disparities across institutions highlight the need for coordinated investment in digital health technologies across Nigerian universities. Policy interventions should focus on establishing minimum technology standards for nursing education programs and providing financial support for institutions lacking adequate AI-related infrastructure.

Inferential statistics provided further insights into the factors influencing AI knowledge, exposure, and willingness to adopt AI among

Table 6
Association between location and exposure to AI integration in healthcare.

Variables	UI	UNIMED	EKSU	BOWEN	ABUAD	X^2	p-value and Cramer V
Electronic record keeping							
Yes	79 (19.7 %)	53 (13.2 %)	40 (10 %)	30 (7.5 %)	200 (49.8 %)	209.587	< 0.001*
No	62 (22.6 %)	97 (35.4 %)	60 (20.1 %)	55 (20.1 %)	0 (0.0 %)		0.557
Diagnostic differentials							
Yes	13 (11.5 %)	22 (19.5 %)	26 (23.0 %)	10 (8.9 %)	42 (37.2 %)	16.468	0.002*
No	128 (22.7 %)	128 (22.7 %)	74 (13.1 %)	75 (13.3 %)	158 (28.1 %)		0.156
Robot-assisted procedures							
Yes	7 (30.4 %)	6 (26.1 %)	4 (17.4 %)	1 (4.3 %)	5 (21.7 %)	3.096	0.542
No	134 (20.5 %)	144 (22.1 %)	96 (14.7 %)	84 (12.9 %)	195 (29.9 %)		0.068
Disease detection from scans							
Yes	51 (14.1 %)	47 (13.0 %)	42 (11.6 %)	43 (11.9 %)	179 (49.4 %)	156.466	< 0.001
No	90 (28.7 %)	103 (32.8 %)	58 (18.5 %)	42 (13.4 %)	21 (6.7 %)		0.481
Predictive analytics for patient outcomes							
Yes	4 (5.3 %)	8 (10.7 %)	8 (10.7 %)	7 (9.3 %)	48 (64.0 %)	50.241	< 0.001
No	137 (22.8 %)	142 (23.6 %)	92 (15.3 %)	78 (13.0 %)	152 (25.3 %)		0.273
Personalized treatment plans							
Yes	3 (5.7 %)	2 (3.8 %)	10 (18.9 %)	14 (26.4 %)	24 (45.3 %)	29.355	< 0.001
No	138 (22.2 %)	148 (23.8 %)	90 (14.4 %)	71 (11.4 %)	176 (28.3 %)		0.208
Drug interaction analysis							
Yes	2 (5.4 %)	8 (21.6 %)	9 (24.3 %)	16 (43.2 %)	2 (5.4 %)	43.907	< 0.001
No	139 (21.8 %)	142 (22.2 %)	91 (14.2 %)	69 (10.8 %)	198 (31.0 %)		0.255
Telemedicine platforms							
Yes	25 (39.7 %)	10 (15.8 %)	14 (22.2 %)	10 (15.8 %)	4 (6.3 %)	28.925	< 0.001
No	116 (18.9 %)	140 (22.8 %)	86 (14.0 %)	75 (12.2 %)	196 (32.0 %)		0.207
AI in managing patient follow-up and adherence							
Yes	2 (20.0 %)	1 (10.0 %)	4 (40.0 %)	1 (10.0 %)	2.0 (20.0 %)	5.412	0.248
No	139 (20.9 %)	149 (22.4 %)	96 (14.4 %)	84 (12.6 %)	198 (29.7 %)		0.089
Automated administrative tasks							
Yes	18 (36.7 %)	2 (4.1 %)	17 (34.7 %)	9 (18.4 %)	3 (6.1 %)	39.576	< 0.001
No	123 (19.6 %)	148 (23.6 %)	83 (13.2 %)	76 (12.1 %)	197 (31.4 %)		0.242

nursing students. The analysis revealed that location had a statistically significant impact on knowledge scores ($p < 0.001$), with students from Bowen University achieving the highest scores. This suggests that institutional differences in AI-related training and exposure could influence students' knowledge levels, indicating the need for standardized AI education across all nursing programs (Pucchio et al., 2022). Additionally, students' self-perception of AI knowledge was significantly associated with their actual knowledge scores ($p = 0.006$), indicating the need for objective assessments rather than self-reported competence. Willingness to take AI training courses was also significantly associated with knowledge scores ($p = 0.005$), supporting the idea that greater knowledge leads to a higher interest in AI learning. Concerns about infrastructure availability ($p < 0.001$), privacy and ethical concerns ($p < 0.001$), and trust in AI ($p < 0.001$) were also significantly associated with knowledge levels, suggesting that students with a better understanding of AI were more aware of its potential challenges and risks. These findings emphasize the importance of structured AI education to improve both knowledge and critical engagement with AI technologies in healthcare.

5. Limitations of the study

This study has several limitations that should be considered when interpreting the findings. First, the study relied on a cross-sectional design, which captures data at a single point in time. This limits the ability to establish causal relationships between AI knowledge, exposure, and willingness to adopt AI in healthcare. Future longitudinal studies could provide deeper insights into changes in AI awareness and adoption over time, particularly as AI technologies become more prevalent in Nigerian healthcare settings.

Second, while the questionnaire was originally designed to assess AI awareness among various healthcare disciplines, this study focused specifically on nursing students from five universities in Nigeria, which may not fully represent the perspectives of nursing students across the country. While efforts were made to include universities with diverse backgrounds, the findings may not be generalizable to institutions with significantly different curricula, infrastructure, or levels of digital health integration. Additionally, the study's focus on southwestern Nigeria may limit the generalizability of findings to other geographic regions with different socioeconomic and technological contexts.

Third, the study relied primarily on self-reported data to assess willingness to adopt AI, which may be subject to social desirability bias. Participants may have overestimated their willingness to engage with AI technologies due to perceived expectations or pressure to appear technologically progressive. Future studies could incorporate objective measures, such as behavioral assessments or experimental interventions, to validate self-reported responses.

Fourth, all participants in this study were female, reflecting the current demographic composition of nursing programs in the participating universities. While this accurately represents the nursing student population in these institutions, it limits the generalizability of findings to male nursing students and may not capture potential gender-based differences in AI attitudes and adoption.

Additionally, the study primarily focused on knowledge and exposure to AI in healthcare without assessing practical AI competencies. Future research should evaluate hands-on AI skills among nursing students, including their ability to use AI tools, interpret AI-generated results, and integrate AI recommendations into clinical decision-making processes.

Finally, the cross-sectional nature of this study means that findings represent a snapshot of current conditions and may not reflect the rapidly evolving landscape of AI in healthcare education. As AI technologies and educational approaches continue to develop, regular follow-up studies will be necessary to track changes in knowledge, exposure, and attitudes over time.

Despite these limitations, this study provides valuable insights into the current state of AI knowledge, exposure, and willingness to adopt AI among nursing students in Nigeria, highlighting the need for targeted AI education and infrastructure improvements.

6. Conclusion

This study provides crucial insights into the knowledge, exposure, and willingness of nursing students in Nigeria to adopt artificial intelligence (AI) in healthcare. The findings reveal a significant gap in AI awareness, with the vast majority of students demonstrating low levels of knowledge about AI applications in clinical practice. However, the high level of willingness to learn (85.5 %) presents a valuable opportunity for educational intervention and curriculum enhancement. Despite this, there is a strong willingness among students to learn about and integrate AI into healthcare, underscoring the need for structured AI education within nursing curricula.

The study's most important contribution lies in demonstrating that knowledge gaps in AI education are not insurmountable barriers to adoption, provided that appropriate educational interventions and infrastructure improvements are implemented. The results also highlight disparities in AI exposure across institutions, with students in certain universities having greater interaction with AI-related technologies than others. This suggests that infrastructural differences and access to digital health resources play a role in shaping students' experiences with AI. Furthermore, the study identifies key concerns regarding AI adoption, including ethical considerations, privacy issues, and fears about job displacement, which need to be addressed through targeted education and policy reforms.

Given the increasing role of AI in global healthcare, it is imperative to equip future nurses with the necessary knowledge and skills to navigate AI-driven healthcare environments effectively. Integrating AI literacy into nursing education, enhancing institutional AI infrastructure, and fostering interdisciplinary collaboration between healthcare professionals and AI specialists are critical steps toward bridging the knowledge gap. Future research should explore the effectiveness of AI training programs for nursing students, assess how increased AI exposure influences attitudes and competencies over time, and investigate the long-term impact of AI education on nursing practice quality and patient outcomes. By addressing these gaps, nursing education in Nigeria can better prepare students for the evolving technological landscape of healthcare, ensuring that AI integration enhances, rather than disrupts, the nursing profession.

CRediT authorship contribution statement

David B. Olawade: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Supervision, Formal analysis, Data curation, Conceptualization. **Aanuoluwapo Clement David-Olawade**: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis. **Oluwayomi B. Rotifa**: Writing – review & editing, Validation, Methodology, Investigation. **Ojima Z. Wada**: Writing – review & editing, Writing – original draft, Methodology, Software, Formal analysis, Validation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Akinrinmade, A.O., Adebile, T.M., Ezuma-Ebong, C., Bolaji, K., Ajufo, A., Adigun, A.O., Mohammad, M., Dike, J.C., Okobi, O.E., 2023. Artificial intelligence in healthcare: perception and reality. Cureus 15 (9). https://doi.org/10.7759/cureus.44839.

Babatope, A.E., Adewumi, I.P., Ajisafe, D.O., Adepoju, K.O., Babatope, A.R., 2024. Assessing the factors militating against the effective implementation of electronic health records (EHR) in Nigeria. Sci. Rep. 14 (1), 31398. https://doi.org/10.1038/s41598-024-82736-8.

Buchanan, C., Howitt, M.L., Wilson, R., Booth, R.G., Risling, T., Bamford, M., 2020. Predicted influences of artificial intelligence on the domains of nursing: scoping review. JMIR Nurs. 3 (1), e23939. https://doi.org/10.2196/23939.

Clement David-Olawade, A., Olawade, D.B., Vanderbloemen, L., Rotifa, O.B., Fidelis, S. C., Egbon, E., Akpan, A.O., Adeleke, S., Ghose, A., Boussios, S., 2025. AI-Driven advances in low-dose imaging and enhancement-A review. Diagnostics 15 (6), 689. https://doi.org/10.3390/diagnostics15060689.

Da'Costa, A., Teke, J., Origbo, J.E., Osonuga, A., Egbon, E., Olawade, D.B., 2025. AI-driven triage in emergency departments: a review of benefits, challenges, and future directions. Int. J. Med. Inform., 105838 https://doi.org/10.1016/j.ijmedinf.2025.105838.

Ehmke, S.D., Bridges, J., Patel, S.E., 2025. Self-perceived knowledge, skills, and attitude of nursing faculty on generative artificial intelligence in nursing education: a descriptive, cross-sectional study. Teach. Learn. Nurs. https://doi.org/10.1016/j.teln.2024.12.008.

Eke, C., Adeyemi, M.O., 2024. Leveraging artificial intelligence for enhancement of public relations strategies in Nigerian economic recovery in 21st century. LWATI A J. Contemp. Res. 21 (3), 2–21.

Habib, M.M., Hoodbhoy, Z., Siddiqui, M.R., 2024. Knowledge, attitudes, and perceptions of healthcare students and professionals on the use of artificial intelligence in healthcare in Pakistan. PLOS Digit. Health 3 (5), e0000443. https://doi.org/10.1371/journal.pdig.0000443.

Issa, W.B., Shorbagi, A., Al-Sharman, A., Rababa, M., Al-Majeed, K., Radwan, H., Refaat Ahmed, F., Al-Yateem, N., Mottershead, R., Abdelrahim, D.N., Hijazi, H., 2024. Shaping the future: perspectives on the integration of artificial intelligence in health profession education: a multi-country survey. BMC Med. Educ. 24 (1), 1166. https://doi.org/10.1186/s12909-024-06119-8.

Machleid, F., Kaczmarczyk, R., Johann, D., Balčiūnas, J., Atienza-Carbonell, B., von Maltzahn, F., Mosch, L., 2020. Perceptions of digital health education among european medical students: mixed methods survey. J. Med. Internet Res. 22 (8), e19827. https://doi.org/10.2196/19827.

Martzoukou, K., Luders, E.S., Mair, J., Kostagiolas, P., Johnson, N., Work, F., Fulton, C., 2024. A cross-sectional study of discipline-based self-perceived digital literacy competencies of nursing students. J. Adv. Nurs. 80 (2), 656–672. https://doi.org/10.1111/jan.15844.

Mollura, D.J., Culp, M.P., Pollack, E., Battino, G., Scheel, J.R., Mango, V.L., Elahi, A., Schweitzer, A., Dako, F., 2020. Artificial intelligence in low-and middle-income countries: innovating global health radiology. Radiology 297 (3), 513–520. https://doi.org/10.1148/radiol.2020201434.

Mousavi Baigi, S.F., Sarbaz, M., Ghaddaripouri, K., Ghaddaripouri, M., Mousavi, A.S., Kimiafar, K., 2023. Attitudes, knowledge, and skills towards artificial intelligence among healthcare students: a systematic review. Health Sci. Rep. 6 (3), e1138. https://doi.org/10.1002/hsr2.1138.

Naseer, M.A., Saeed, S., Afzal, A., Ali, S., Malik, M.G.R., 2025. Navigating the integration of artificial intelligence in the medical education curriculum: a mixed-methods study exploring the perspectives of medical students and faculty in Pakistan. BMC Med. Educ. 25 (1), 273. https://doi.org/10.1186/s12909-025-06487-6.

Numviyumukiza, E., Niyonsenga, J., Niyibizi, J.B., Jansen, S., 2024. Are Low and Middle-Income Country Universities "AI Resilient": Exploring the Use of ChatGPT among Medicine and Health Sciences Students in Rwanda. Preprint. https://doi.org/10.21203/rs.3.rs-4436431/v1.

Nyarko, A.J., 2024. Exploring Ghanaian tertiary students' perceptions towards AI as a First-Hand source of health information for diagnosis and Self-Medication. J. Health Inform. Afr. 11 (1), 64–76. https://doi.org/10.12856/JHIA-2024-v11-i1-940.

Olanrewaju, B.U., Afolabi, J.A., 2022. Digitising education in Nigeria: lessons from COVID-19. Int. J. Technol. Enhanc. Learn. 14 (4), 402–419. https://doi.org/10.1504/IJTEL.2022.126754.

Olawade, D.B., Olorunfemi, O.J., Wada, O.Z., Afolalu, T.D., Enahoro, M.A., 2020. Internet addiction among university students during COVID-19 lockdown: case study of institutions in Nigeria. J. Educ. Hum. Dev. 9 (4), 165–173. https://doi.org/10.15640/jehd.v9n4a18.

Olawade, D.B., Aderinto, N., Olatunji, G., Kokori, E., David-Olawade, A.C., Hadi, M., 2024a. Advancements and applications of artificial intelligence in cardiology: current trends and future prospects. J. Med. Surg. Public Health, 100109. https://doi.org/10.1016/j.glmedi.2024.100109.

Olawade, D.B., David-Olawade, A.C., Wada, O.Z., Asaolu, A.J., Adereni, T., Ling, J., 2024b. Artificial intelligence in healthcare delivery: prospects and pitfalls. J. Med. Surg. Public Health, 100108. https://doi.org/10.1016/j.glmedi.2024.100108.

Ono, G.N., Obi, E.C., Chiaghana, C., Ezegwu, D., 2024. Digital divide and access: addressing disparities in artificial intelligence (AI) health information for Nigerian rural communities. Soc. Sci. Res. 10 (3). https://doi.org/10.31586/ssr.2024.1003.

Onyezere, C.V., Oforleta, C.M., Onyezere, C.E., 2024. Artificial intelligence and sustainable development in Nigeria, West Africa (2015-2024). international. J. Public Adm. Dev. Stud. 1 (1), 1–16.

Pucchio, A., Rathagirishnan, R., Caton, N., Gariscsak, P.J., Del Papa, J., Nabhen, J.J., Vo, V., Lee, W., Moraes, F.Y., 2022. Exploration of exposure to artificial intelligence in undergraduate medical education: a Canadian cross-sectional mixed-methods study. BMC Med. Educ. 22 (1), 815. https://doi.org/10.1186/s12909-022-03907-4.

Rajah, A.S., Sardauna, Z.M., Ladan, M.A., 2024. Exploring the experience and perception of artificial intelligence utilization among students of department of nursing, bayero university kano. Real Nurs. J. 7 (3), 220–228. https://doi.org/10.34302/rinnj.07.03.220.

Richardson, E.L., Gordon, J., Ginnetti, R., Cochran, R., Conklin, S., Oetjen, R., Oetjen, D., 2023. Are nursing faculty future-ready? the effects of emerging technologies on nursing education. J. Nurs. Educ. 62 (12), 689–700. https://doi.org/10.3928/01484834-20231107-01.

Rony, M.K.K., Numan, S.M., Akter, K., Tushar, H., Debnath, M., tuj Johra, F., Akter, F., Mondal, S., Das, M., Uddin, M.J., Begum, J., 2024. Nurses' perspectives on privacy

and ethical concerns regarding artificial intelligence adoption in healthcare. Heliyon 10 (17). https://doi.org/10.1016/j.heliyon.2024.e36449.

Salama, N., Bsharat, R., Alwawi, A., Khlaif, Z.N., 2025. Knowledge, attitudes, and practices toward AI technology (ChatGPT) among nursing students at Palestinian universities. BMC Nurs. 24, 269. https://doi.org/10.1186/s12912-025-02638-9.

Soladoye, A.A., Olawade, D.B., Adeyanju, I.A., Akpa, O.M., Aderinto, N., Owolabi, M.O., 2025. Optimizing stroke prediction using gated recurrent unit and feature selection in Sub-Saharan Africa. Clin. Neurol. Neurosurg., 108761 https://doi.org/10.1016/j.clineuro.2025.108761.

Turchioe, M.R., Kisselev, S., Van Bulck, L., Bakken, S., 2024. Increasing generative artificial intelligence competency among students enrolled in doctoral nursing research coursework. Appl. Clin. Inform. 15 (05), 842–851. https://doi.org/10.1055/a-2359-0474.

Vera, F., 2024. Students' perceptions of the integration of artificial intelligence nursing education: a study at a private Chilean university. Transformar 5 (4), 58–73.

Wei, Q., Pan, S., Liu, X., Hong, M., Nong, C., Zhang, W., 2025. The integration of AI in nursing: addressing current applications, challenges, and future directions. Front. Med. 12, 1545420. https://doi.org/10.3389/fmed.2025.1545420.

Zuhair, V., Babar, A., Ali, R., Oduoye, M.O., Noor, Z., Chris, K., Okon, I.I., Rehman, L.U., 2024. Exploring the impact of artificial intelligence on global health and enhancing healthcare in developing nations, 21501319241245847 J. Prim. Care Community Health 15. https://doi.org/10.1177/21501319241245847.