



MEDIKKA

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2025 EDITION
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INSIDE THIS EDITION:

- Factors Affecting Clinical Medical Education and Learning at the University of Nigeria Teaching Hospital, Enugu Nigeria
- Medical Education in the Era of Virtual Reality
- Addressing Burnout and Mental Health in Medical Students
- Challenges of Medical Education in Sub-Saharan Africa

THEME:

**MEDICAL EDUCATION IN THE ERA
OF VIRTUAL REALITY**



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The following categories of manuscripts are accepted for publication:

Research articles: Original research concerning any aspect (e.g. aetiopathogenesis, epidemiology, diagnosis, management and prevention) of disease. Animal research contributions of relevance to human health are also welcome.

Review articles including meta-analysis: Detailed systematic and critical evaluation of the literature on a specified clinical problem. Reviews should include information such as type of studies and the selection process.

Short communication and case reports: These may be unique case reports, clinical experiences and short reports of origin research.

All articles are subjected to peer-review by the MEDIKKA board of editorial consultants.

Manuscript requirements

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- Running title (not more than forty characters)
- Title of Article/Paper
- Name, Address, Qualifications and Departmental/Institutional Affiliation of the Author(s)
- References using Vancouver style
- Tables and illustrations
- Key words for indexing (three to six)

Original and research articles should contain an abstract of 150-200 words.

The Editor reserves the right to shorten and/or correct the articles received (in consultation with the Editorial consultants) without altering the subject matter of the articles.

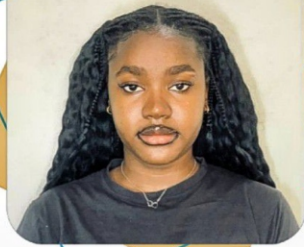
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NOTE

From the

EDITOR-IN-CHIEF



Medical education is the foundation of healthcare, shaping future professionals through rigorous training and continuous learning. As medicine evolves, so must our approach to education, incorporating new technologies and methodologies to enhance learning and patient care.

This edition of MEDIKKA explores the challenges and opportunities in medical education, particularly in resource-limited settings. With advancements like artificial intelligence and virtual reality becoming part of training, we must ask: "How do these shape the future? What barriers exist, and how can we overcome them?" Through this journal, we contribute to this discussion by presenting insights, reflections, and research from medical students and professionals.

As a publication of the University of Nigeria Medical Students Association (UNMSA), MEDIKKA has always been a platform for academic and intellectual contributions. Notably, in this edition, every article was authored by members of our association, showcasing the depth of talent and scholarship within UNMSA. This highlights our commitment to fostering student-led research and medical discourse.

We are deeply grateful to Dr. Francis Chukwuani for his mentorship, support, and role in the final review process of this edition. His dedication to student-led academic initiatives continues to inspire us.

A special appreciation also goes to our research supervisor Prof. Madu Anazoeze Jude for his invaluable assistance in the research we conducted. His expertise and guidance have significantly enriched our study, and we are truly grateful for his support in fostering research excellence.

We also extend our sincere gratitude to AmBliN for sponsoring our research. Their support has been instrumental in ensuring the success of our study, and we appreciate their commitment to advancing medical research.

I also want to acknowledge the editorial board members, whose tireless efforts in reviewing, editing, and curating this journal ensured its quality and relevance. Your dedication has been instrumental in making this edition possible.

We hope this edition sparks meaningful discussions, challenges perspectives, and inspires further inquiry into the evolving landscape of medical education.

Grace N. Kaluokoro
Editor-In-Chief
MEDIKKA Journal, 2025 Edition



NOTE *From the* PRESIDENT



Dear Esteemed Readers,

It is with great pleasure that I welcome you to this edition of **MEDIKKA**, a journal that continues to serve as a platform for insightful discussions and research. Each edition reflects the dedication and intellect of our medical community, and this one is no exception.

Medical education is constantly evolving, shaped by innovations and challenges. This edition captures a broad spectrum of topics—from the factors influencing our learning experiences to the integration of new technologies and the personal well-being of medical students. These discussions are not just academic but deeply relevant to our journey as future healthcare professionals.

I extend my sincere appreciation to the Editorial Board for their hard work and to every contributor whose research, reviews, and perspectives have made this edition possible. Your dedication to knowledge and progress is truly commendable.

To our readers, I hope this journal serves as a source of inspiration and learning. May it spark new ideas and encourage conversations that drive positive change in medical education and beyond.

UCHENNA O. NTO

The President,
University of Nigeria Medical Students' Association
(2024/2025)

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FACTORS AFFECTING CLINICAL MEDICAL EDUCATION AND LEARNING AT THE UNIVERSITY OF NIGERIA TEACHING HOSPITAL, ENUGU, NIGERIA.

Ovute Valentine Ifunanya¹, Ozioko Somtochukwu Chiemerie¹, Ozoemena Chimbuchi Emmanuel¹

¹Department of Community Medicine, Faculty of Clinical Sciences College of Medicine, University of Nigeria, Enugu Campus.

ABSTRACT

Background: Assessment of factors affecting clinical medical education and learning at the University of Nigeria Teaching Hospital Enugu.

Aim: The aim of this study was to assess the factors affecting clinical medical education and learning in University of Nigeria Teaching Hospital Enugu, Nigeria from the perspective of the clinical medical students.

Methods: A cross-sectional study was conducted with clinical medical students (400L,500L and 600L) of the University of Nigeria Teaching Hospital Enugu, five research objectives were formulated in carrying out the study. Data were collected using well-structured questionnaires and analyzed using statistical package for social sciences(SPSS) version 27.

Results: There were 393 respondents with a mean age 23-25. The majority (217 or 55.2%) of respondents had good attitude and commitment towards clinical postings and attendance to it, 56.7% (223) indicated that patients were not always cooperative, 51% (200) indicated that their monthly allowance are not enough and it has affected their clinical learning, 87.4% (343) also agreed that the lack of accommodation options within the hospital affect their clinical education and learning, 55.4% (218) of the respondents reported that there were not enough medical doctors to teach students during clinical rotations and smaller groups of students will be more effective for clinical learning.

Conclusion: This study found out good attitude and commitment among the student respondents towards clinical posting, but socio-economic factor, lack of adequate accommodation, low doctors to students ratio, and difficulty patients were noted to negatively affect students' clinical medical education and learning.

Keywords: Clinical education, factors, learning, doctors, students, affecting

INTRODUCTION

Clinical medical education is a pivotal component in the training of future healthcare professionals. It bridges the gap between theoretical knowledge acquired in the classroom and the practical skills

needed in a clinical setting. Effective clinical education ensures that medical students are not only knowledgeable but also capable of providing high-quality patient care upon graduation.

The University of Nigeria Teaching Hospital (UNTH) Enugu, as a leading medical training institution, plays a significant role in shaping the competencies of medical students in Nigeria. However, like many medical schools worldwide, UNTH Enugu faces various challenges and influencing factors that impact the quality of clinical education.

Investigation of factors related to the academic performance of medical students becomes a topic of growing interest in the higher educational circle. Many recent studies were carried out to explore factors affecting medical students' academic performance.¹ Research report showed that students' performance is affected by many factors. Among these factors, facility-related factors such as classroom facilities and environment, internet access, overcrowding, dormitory environment, availability of library, and reference books are identified.²

Clinical education is a cornerstone in the training of healthcare professionals, ensuring they possess the skills and knowledge necessary to provide quality patient care. Clinical medical education, in particular, provides the student with the opportunity to translate theoretical knowledge into a variety of psychomotor skills needed to care for the patient.³ Clinical teaching does not limit to teaching alone, rather it actually deals with the process wherein students are supported in their learning process while interacting with real patients during clinical settings. The purpose of the current review was to explore the factors that impact clinical teaching and then propose the potential recommendations to overcome them.⁴

Medical students experience a variety of learning activities in the environs of the medical college, which are usually complex and unique⁵ its most important determinant is the curriculum⁶. Students' perceptions of their educational environment have a significant impact on their behavior, academic progress and achievements⁷. Understanding students' perceptions of their educational environment is also useful for improving the quality of learning.⁸

There is a critical need for further research to assess the factors affecting clinical medical education and learning in Nigerian institutions more particularly at the University of Nigeria Teaching Hospital Enugu.

Hence, this study aims to assess these factors affecting effective clinical education from the perspective of clinical medical students of University of Nigeria Teaching Hospital, Enugu Nigeria, so as to bring them to bare and propose potential recommendations to overcome them.

METHODOLOGY

Study Area And Design

This study was conducted in the University of Nigeria Teaching Hospital Ituku Ozalla, Enugu State. This is a cross-sectional study to assess factors affecting clinical medical education and learning amongst clinical medical students at the University of Nigeria Teaching Hospital Enugu, Nigeria.

Study Population

The study population consists of clinical medical students enrolled in the College of Medicine, University of Nigeria. This includes students in the classes of 2026 and 2025 (400 Level A and B), 2024(500 Level) and 2023(600 level) of the faculty of medical sciences, University of Nigeria. The clinical medical students who at the time of study and data collection were critically ill or were on temporal suspension by the academic authority were excluded from the study.

Sample Size Determination

The sample size was calculated and determined using the Cochran's formula. The minimum sample size used was to be 420.

Sampling Technique

Simple random sampling was used in selecting our respondents. Proportional allocation of samples was done to ascertain the number of students was recruited from each academic level of study using the class list as a frame, and within each class random selection was done to pick our respondents until the sample size was reached.

Data Collection Instruments

A self-administered, structured questionnaire was

used to collect data from clinical medical and dental students (400 to 600 level) of the University of Nigeria, Old UNTH and Ituku-Ozalla campuses. The questions were asked to reflect the various objectives of the study.

Data Collection

Data collection was done by members of the research group. Informed consent was sought and obtained before the data collection.

Data Analysis

Data analysis was done using the software Statistical Product and Service Solutions (Version 27). The socio-demographic characteristics of the participants were summarized using descriptive statistics, such as mean and corresponding percentages. Quantitative data was presented using tables and bar charts to provide a visual representation of the findings. Measures such as mean, frequency, percentage, proportion, and standard deviation were used to describe the quantitative data. To assess the significance of data comparisons, the Chi-square test was employed, which is a statistical test used to determine if there is a significant association between categorical variables. By employing these methods, the study aimed to collect and analyze data effectively, ensuring proper representation of participants' characteristics and providing statistically meaningful insights into the relationship between variables of interest.

Ethical Consideration

Ethical clearance was obtained from the Health Research and Ethics Review Committee at the University of Nigeria Teaching Hospital (UNTH). The study was conducted in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its subsequent amendments. Students who agreed to participate in the research provided informed consent. They were assured of the confidentiality of the data they provide for the study. It was made clear to the respondents that they have every right to refuse to participate in the study to ensure their voluntary participation.

RESULTS

We had a response rate of 93.57% as 420 questionnaires were distributed, 393 were returned and properly filled.

	FREQUENCY	PERCENTAGE (%)
GENDER:		
Male	195	49.6
Female	198	50.4

AGE:		
20 – 22	116	29.5
23 – 25	237	60.3
26 – 29	32	8.1
30 and above	8	2.0
MARTIAL STATUS		
Single	373	94.9
Married	17	4.3
Divorced	3	0.8
ETHNICITY		
Igbo	361	93.4
Yoruba	5	1.3
Hausa	3	0.8
Essan	1	0.3
Urhobo	3	0.8
Ibibio	5	1.3
Igala	2	0.5
Ogoni	1	0.3
Nga	1	0.3
Ukwani	1	0.3
Annang	1	0.3
Ebira	1	0.3
Ijaw	2	0.5
RELIGION		
Christianity	384	97.7
Islam	6	1.5
Others	3	0.8
ACADEMIC LEVEL		
400	93	23.7
500	155	39.4
600	145	36.9

The age of the participants ranged between 18 – 42, with a mean age of 23.57 ± 2.22 , median age of 23 years and majority between the age of 23-25(60.3%). Majority of the participants were females (50.4%), single (94.9%). Majority of them identified as Christians (97.7%). Participants were drawn from different levels, with most from 500 level (39.4%). Majority of the participants were of the Igbo tribe (93.4%).

SECTION B: TO ASSESS STUDENT'S ATTITUDE AND COMMITMENT AND ITS EFFECT ON THEIR CLINICAL EDUCATION AND LEARNING

Table 2: Student's attitude and commitment

	FREQUENCY	PERCENTAGE (%)
1. Attendance to clinical postings is key to obtaining clinical knowledge and skills		
- Strongly disagree	16	4.1
- Disagree	13	3.3
- Neither agree nor disagree	18	4.6

- Agree	139	35.5
- Strongly agree	205	52.4
<hr/>		
2. I enjoy attending clinical postings		
- Strongly disagree	13	3.3
- Disagree	41	10.5
- Neither agree nor disagree	88	22.5
- Agree	204	52.2
- Strongly agree	45	11.5
<hr/>		
3. How often do you miss clinical postings in a month?		
- Once	128	32.9
- Twice	137	35.2
- Thrice	68	17.5
- More	56	14.4
<hr/>		
4. I'll go for clinical postings even if attendance was not mandatory?		
- Strongly disagree	25	6.4
- Disagree	71	18.2
- Neither agree nor disagree	69	17.6
- Agree	181	46.3
- Strongly agree	45	11.5
<hr/>		
5. I participate actively and ask questions on concepts I do not understand?		
- Always	72	18.4
- Often	128	32.7
- Sometimes	176	45.0
- Never	15	3.8

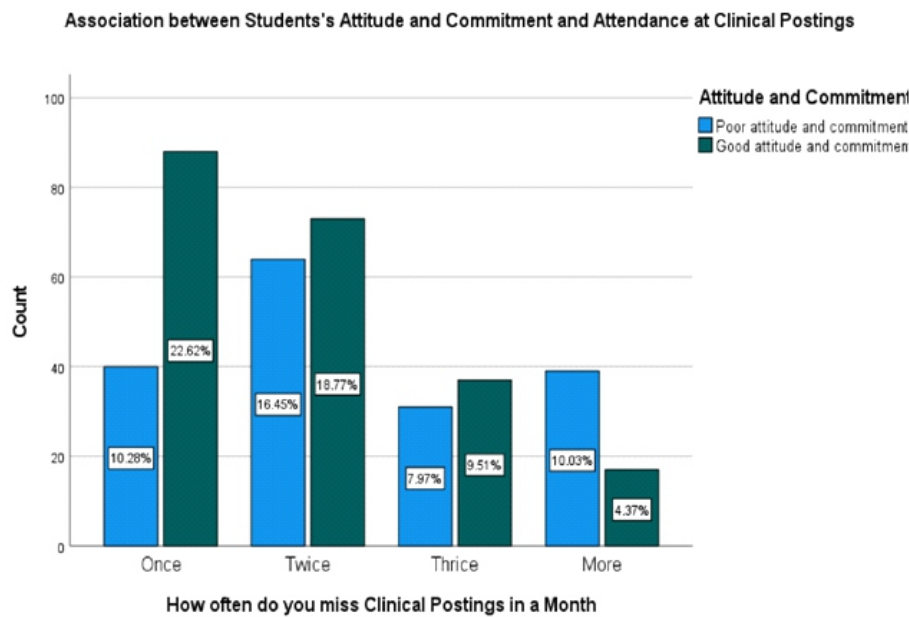
The overall attitude and commitment of students was calculated using 3 questions. A scoring system was used to determine their attitude and commitment, the more positive responses were given a score of 5 and 4, 'I don't know' a score 3 and the more negative answers were assigned 2 and 1. The scores ranged from 4 – 15, those who scored from 12 and above were taken to have good attitude and commitment and below 12, poor attitude and commitment. Majority of the students (55.2%) have good attitude and commitment on their clinical education and learning.

Table 3: Students' Attitude and Commitment to their Clinical Education

	FREQUENCY	PERCENTAGE (%)
Poor attitude and committment	175	44.8
Good attitude and committment	216	55.2

**significant p-value (<0.05)

Table 4: Association between Students' Attitude and Commitment on Clinical Education and Attending Clinical Postings (Monthly)



Variables	Attitude and Cooperations		Chi-square	P-value
	Poor (%)	Good (%)		
How much do you miss clinical postings?			23.706	<0.001*
- Once	40 (31.3)	88(68.8)		
- Twice	64 (46.7)	73 (53.3)		
- Thrice	31 (45.6)	37 (54.4)		
- More	39 (69.6)	17 (30.4)		

The Chi square test shows there is a statistically significant association between students' attitude and commitment on clinical education and attending clinical postings (p<0.05).

FIGURE 2: A simple bar chart showing the association between students' attitude and commitment on clinical education and attending clinical postings.

SECTION C: ASSESSMENT OF THE EFFECTS OF PATIENTS ATTITUDE AND EXTENT OF COOPERATION ON CLINICAL EDUCATION AND LEARNING

Table 5: Patient's attitude

	FREQUENCY	PERCENTAGE (%)
1. Patients are always cooperative with me?		
- Yes	167	43.3
- No	219	56.7
2. Have you ever experienced any form of harassment or abuse from patients?		
- Yes	69	18.0
- No	314	82.0
3. Have you ever resorted to tipping patients off for the sole purpose of getting them to cooperate?		
- Yes	191	49.5
- No	195	50.5

4.Does this affect your clinical learning?		
- Yes	198	53.8
- No	170	46.2

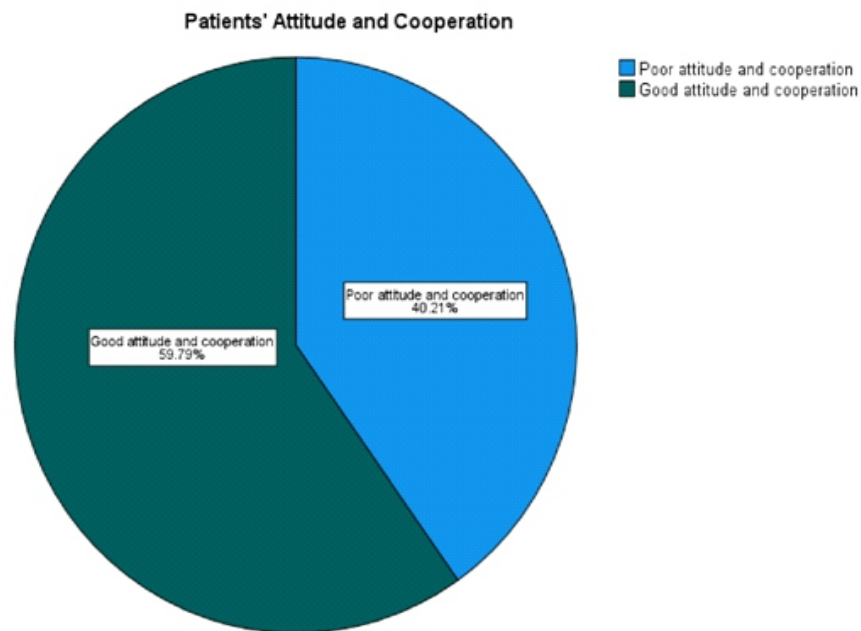
The patients' attitude and cooperation were calculated using 3 questions. A scoring system was used to determine their attitude and cooperation, the positive answer was given a score of 1 and the negative answer a score of 0. The scores ranged from 0 – 3, those who scored from 2 and above were taken to have good attitude and cooperation and below 2, poor attitude and cooperation. Majority of the patients (59.8%) have good attitude and cooperation on students' clinical education and learning.

Table 6: Patients' Attitude and Cooperation

	FREQUENCY	PERCENTAGE (%)
Poor attitude and committment	175	44.8
Good attitude and committment	216	55.2

FIGURE 3:a simple pie chart showing patients' attitude and cooperation.

Table 7: Association between Patients' Attitude and Cooperation and Clinical Education and Learning



Variables	Attitude and Cooperations		Chi-square	P-value
	Poor (%)	Good (%)		
Does this affect your clinical learning?			81.818	<0.001*
Yes	122 (61.9)	75 (38.1)		
No	26 (15.4)	143 (84.6)		

Significant p-value (<0.05)

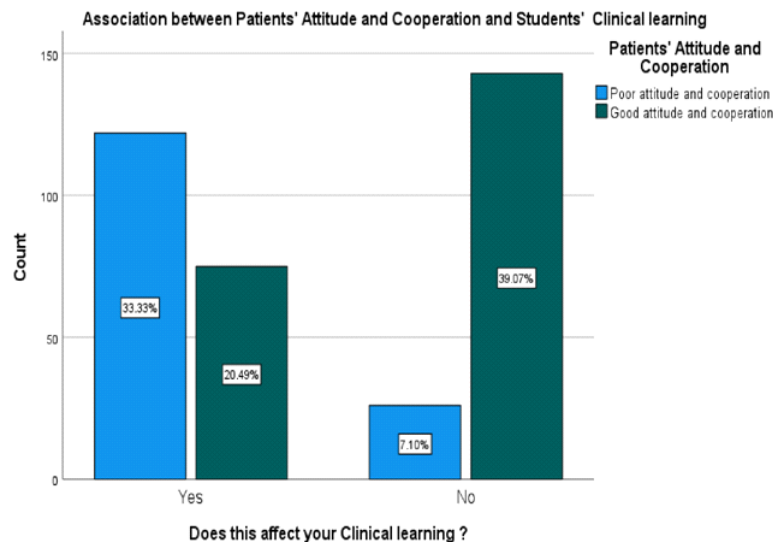
The Chi square test shows there is a statistically significant association between patients'attitude and cooperation and students' clinical education (p<0.05).

FIGURE 4: A simple bar chart showing the association between patients' attitude and cooperation and students' clinical education.

SECTION D: TO MEASURE THE EFFECTS SOCIOECONOMIC FACTOR ON CLINICAL EDUCATION AND LEARNING

Table 8: Effect of socioeconomic conditions

	FREQUENCY	PERCENTAGE (%)
1. How much do you receive monthly as allowance in naira (monthly)?		
- Less than 5,000	13	3.4
- 5,000 – 10,000	6	1.5
- 10,000 – 20,000	31	8.0
- 20,000 – 50,000	162	41.8
- Above 50,000	176	45.4
2. Is the stated amount sufficient for the stated period?		
- Yes	126	32.6
- No	260	67.4
3. Im still able to forward adequate meals?		
- Yes	268	68.9
- No	121	31.3
4. I have missed postings/lectures because I didn't have enough money for transportation		
- Yes	150	38.7
- No	238	61.3
5. I do not have all the necessary clinical equipment because I don't have enough money for transportation?		
- Yes	171	44.2
- No	216	55.8
6. I have missed clinical postings/lectures because I was too hungry to attend		
- Yes	88	22.6
- No	302	77.4
7. Has this in any way affected my clinical learning experience?		
- Yes	196	51.0
- No	188	49.0



The socioeconomic condition of students was calculated using 5 questions. A scoring system was used to determine their socioeconomic conditions, the positive answer was given a score of 1 and the negative answer a score of 0. The scores ranged from 0 – 5, those who scored from 3 and above were taken to have good socioeconomic conditions and below 3, poor socioeconomic conditions. Majority of the students (59.7%) have good socioeconomic conditions.

Table 4.9: Socioeconomic Conditions of Students

	FREQUENCY	PERCENTAGE (%)
Poor attitude and committment	153	40.3
Good attitude and committment	227	59.7

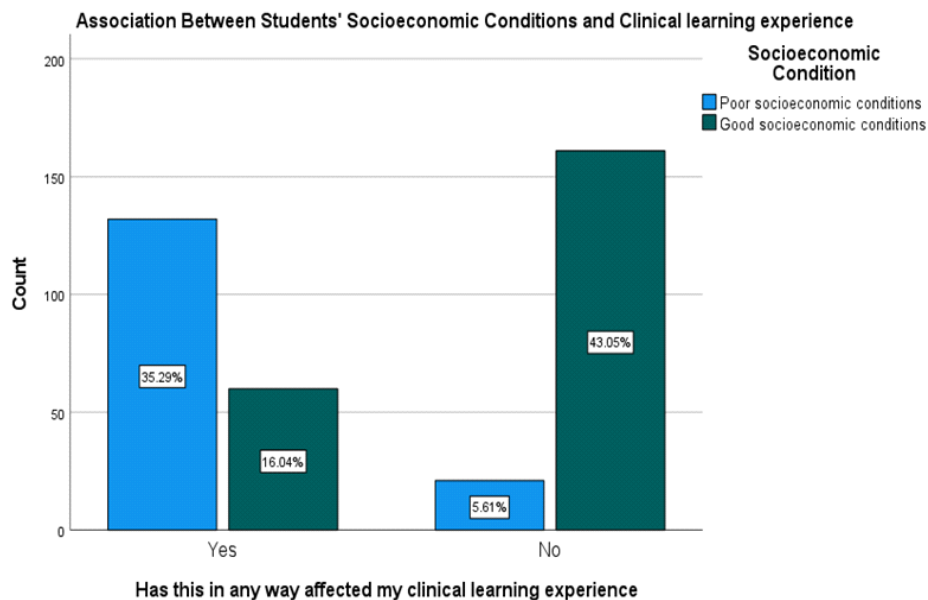
Table 4.10: Association between Students' Socioeconomic Conditions and Students' Clinical Education and Learning

VARIABLE	Attitude and Cooperations		Chi-square	P-value
	Poor (%)	Good (%)		
Does this affect your clinical learning?			126.511	<0.001*
Yes	132 (68.8)	60 (31.3)		
No	21 (11.5)	161 (88.5)		

**significant p-value (<0.05)

The Chi square test shows there is a statistically significant association between students' socioeconomic conditions and students' clinical education (p<0.05).

FIGURE 6: A simple bar chart showing the association between students' socioeconomic conditions and students' clinical education.



SECTION E: EFFECT OF ACCOMMDATION INADEQUACIES ON STUDENT'S CLINICAL EDUCATION AND LEARNING

Table 4.11: Effect of accommodation inadequacies

	FREQUENCY	PERCENTAGE (%)
1. Are you currently living in the hostel?		
- Yes	279	72.7
- No	105	27.3

2. If no, how has the lack of accommodation space affected your student's clinical education/learning?		
- Has not affected it	66	33.2
- Moderately affected it	98	49.2
- Severely affected it	35	17.6
<hr/>		
3. If yes, how would you rate the current accommodation facilities for medical education?		
- Poor	127	37.4
- Fair	153	45.0
- Good	47	13.8
- Very good	9	2.6
- Excellent	4	1.2
<hr/>		
4. How proximal is the hostel to the hospital?		
- Near	107	29.3
- Far	44	12.1
- Very far	214	58.6
<hr/>		
5. Is there an available school bus that transports you to the hospital?		
- Yes	193	51.9
- No	179	48.9
<hr/>		
6. Do you think you will learn better if the hostel is located within the hospital?		
- Yes	345	93.2
- No	25	6.8
<hr/>		
7. Have you ever considered skipping clinical postings because of the far location of the hospital?		
- Yes	291	77.8
- No	83	22.2

27.2% of respondents don't currently live in the hostel. Majority (49.2%) believe the lack of hostel has moderately affected them, 17.6% says it has severely affected them while 33.2% says it has not affected them. Majority of students (58.6%) said the hostel is very far from the hospital. There is an available school bus that transports students to the hospital according to 51.9% of respondents. Majority of students (93.2%) believe they will learn better if the hostel is located within the hospital and 77.8% of students have considered skipping postings because of the far location.

	Agree (%)	Strongly Agree (%)	Disagree (%)	Strongly Disagree (%)
I am satisfied with current accommodation facilities for clinical education	107 (28.1)	22 (5.8)	155 (40.7)	107 (28.1)
The far distance between the hospital and the hostel has greatly affected my clinical learning experience	141 (37.3)	163 (43.1)	56 (14.8)	141 (37.3)
The lack of accommodation options within the hospital has caused me stress or inconvenience during my clinical postings	158 (42.2)	169 (45.2)	30 (8.0)	17 (4.5)

1-Strongly Disagree (SD), 2-Disagree(D), 3-Agree(A), 4-Strongly Agree (SD)

Majority of students (80.4%) agree that the far distance between the hospital and hostel has greatly affected their clinical learning experience.

SECTION F: TO ASCERTAIN THE EFFECT OF STUDENT TO TEACHER RATIO ON STUDENTS' CLINICAL EDUCATION AND LEARNING

Table 4.12: Effect of student to teacher ratio

	FREQUENCY	PERCENTAGE (%)
1. Are there enough teachers (doctors) accessible to you during your clinical postings? - Yes - No	204 163	55.6 44.4
2. How often do you interact with your teachers (doctors) during clinical postings? - Frequently - Occasionally - Rarely	124 197 60	32.5 51.7 15.7
3. How many are you in your current posting group? - Below 10 - 10 - 20 - 21 - 30 - 31 - 40 - 41 - 50 - Above 50	36 188 48 41 10 50	9.7 50.4 12.9 11.0 2.7 13.4
4. Do you have an academic adviser? - Yes - No	182 190	48.9 51.1

Majority of students (55.6%) agree there are enough teachers (doctors) accessible to students during clinical postings. Majority of respondents (51.7%) occasionally interact with teachers (doctors) during postings. About half of the students (50.4%) are between 10 – 20 in their posting group. A good number of students (51.1%) do not have an academic adviser.

Almost all the students (98.7%) agree smaller groups with more individualized attention (doctors) during clinical postings would be preferable. 91.9% of respondents agree they would be more likely to participate in clinical postings if there were fewer students.

	Agree (%)	Strongly Agree (%)	Disagree (%)	Strongly Disagree (%)
There are no enough medical doctors to teach students during clinical rotations	151 (39.3)	62 (16.1)	151 (39.3)	20 (5.2)
Smaller group sizes with more individualized attention from teachers (doctors) during clinical postings would be preferable	110 (28.7)	268 (70.0)	4 (1.0)	1 (0.3)
I would be more likely to participate in clinical postings if there were fewer students	133 (34.9)	217 (57.0)	29 (7.6)	2 (0.5)

1-Strongly Disagree (SD), 2-Disagree(D), 3-Agree(A), 4-Strongly Agree (SD)

DISCUSSION

The respondent population for this research were undergraduate clinical students attending training at UNTH, Ituku-Ozalla. They comprise 50.4% (198) female and 49.6% (195) male students selected from the clinical class groups (400, 500, and 600 level), with an average age range of 23-25 years, 94.9% (373) single and the remaining 5.1% (20) married or divorced. The majority of them were of Igbo ethnicity and Christian religion.

This study found that the majority (more than 80%) of the respondents agreed that attendance at clinical postings is key to obtaining clinical knowledge and skills. Also, 63.7% (250) of the respondents reported that they enjoy attending clinical postings, and about 68.1% (268) of them only missed posting once or twice in a month with 57.8% (227) of them reporting that they would go for clinical postings even if the attendance was not mandatory and the majority of them would always, often or sometimes participate actively and ask questions on concepts they did not understand during postings. The overall attitude and commitment of students to attendance to clinical postings was measured at 55.2% (217) which represents a good attitude and commitment to clinical postings among the respondents, although the self-reporting feature of the questionnaire could affect the generalization and reliability of this data.

Also from the analysis, an association between the students' attitude and commitment to clinical education and attending clinical postings was established, with a statistically significant p-value of <0.001, stating that the attitude and commitment of the student to clinical posting will affect their attendance to same. There have not been enough empirical research around these objectives and therefore the findings can't be discussed alongside findings from other studies.

Also from this study, it was discovered from 56.7% (223) of the respondents that patients are not always cooperative with them. However, the majority of them had never experienced any form of harassment or abuse from patients (82%=322) and had never resorted to tipping the patients off for the sole purpose of getting them to cooperate (50.5%=198). It was reported by 53.8% (211) of the respondents that the patients' attitude affected their clinical learning. The majority of the patients were reported to be cooperative and show a good attitude towards the students on clinical posting. From the analysis, an association between the patients' attitude and cooperation to clinical education and attending clinical

postings was established, with a statistically significant p-value of <0.001, stating that the attitude and cooperation of patients to students on clinical posting will affect their attendance to same.

Contrary to this finding, a study done by Onotai L. et al, aimed to determine the overall attitude and perception of patients toward medical students' involvement in their hospital care revealed that there was a high acceptance rate for medical students' involvement in the care delivery among patients⁹. Also, in another study by Izadi P et al, it was found that the total score of patients' attitudes toward the presence of the students was above average. In addition, the total score of patients' feelings toward the presence of the students was also above average¹⁰. However, these findings do not address the direct objective of our research and cannot be used to compare the findings of our research.

The study found that the majority of the students received more than #50,000 as a monthly allowance. It was also noted that 87.2% (343) of the respondents did not receive less than #20,000 as a monthly allowance. Although the majority of them: (68.9%=271) could afford an adequate meal, (61.3%=241) had not missed lectures/postings because they didn't have enough money for transportation, (55.8%=219) had all the necessary clinical equipment, (77.4%=304) never missed lectures/postings because they were too hungry to attend, it was however noted that the majority (67.4%=265) of the respondents still reported that their monthly allowance was not sufficient for the month, and these factors had affected the clinical learning experience of the majority (51%=200). It was noted generally that 59.7% (235) of the respondents had good socioeconomic conditions. A statistically significant association between students' socioeconomic conditions and students' clinical education was established with a p-value <0.001, stating that students' socioeconomic condition has a significant impact on the student's clinical education.

In a study by Kencie Ely et al, it was found that medical students in the disadvantaged group (lower socioeconomic status) scored significantly lower in their exams than their counterparts with higher socioeconomic status¹¹. Contrarily, another study revealed that medical students who receive(s) less than ten thousand naira (≈US\$27) every month as upkeep allowance had better academic performance than students who received much more¹³. However, these studies centered on academic performance and not focused on attitude towards clinical education.

Also, from the findings of this study, 72.7% (286) of the students were living in the hostel, of which 82.4% (324) rated the accommodation poor and at most, fair. The majority (70.7% =278) of the respondents reported that the hostel was far from the hospital, although 51.9% (204) reported that there was school bus to transport students to the hospital. 93.2% (366) of the respondents submitted that they would learn better if their hostel was located within the hospital.

It was also noted that 77.8% (306) of the respondents had considered skipping clinical postings because they lived at a far location from the hospital. 66.2% (260) of the respondents were not satisfied with their current accommodation facilities, 80.4% (316) of the respondents agreed the far distance between the hospital and the hostel had greatly affected their clinical learning experiences, and 87.4% (343) also agreed that the lack of accommodation options within the hospital had caused them stress/inconvenience during their clinical postings. It is therefore concluded from these findings that accommodation inadequacies affect the respondents' clinical education and learning.

A study by Salmani et al that the number of students in each department (47.3%) and the attitude of staff and lack of facilities and equipment (47%) were reported as barriers to clinical education.¹⁵ In another descriptive, it was found that shortage of students' accommodation depleted students' performance in that it encouraged truancy and poor concentration of student in their academic work¹⁴. It is also noted that these findings do not address the direct objectives of our research. Although these findings are related to the objectives of our study, they were all carried out outside Nigeria, none has been done within the country.

The majority (55.6% =219) of the respondents in this study reported that there were enough teachers (Doctors) accessible to them during their clinical postings. Also, only 32.5% (128) of them reported that they often had frequent interactions with their teacher during clinical posting, the others occasionally (51.7% =203) or rarely (15.7% =62) interacted. The majority (60.1% =236) of the respondents reported being 20 and below in a group, but it was also noted that 16.1% (63) of the respondents were more than 40 in their posting group. 51.1% (201) of the respondents did not have an academic adviser. It was noted that 55.4% (218) of the respondents reported that there were not enough medical doctors to teach students during clinical rotations. 98.7% (388) of the respondents agreed that smaller group sizes with more individualized attention from teachers (doctors) during clinical postings would be preferable, and 91.9% (361) of the respondents agreed that they

would be more likely to participate in clinical postings if there were fewer students in the posting groups. These responses infer that the student to-teacher ratio affects the students' clinical education and learning.

In a cross-sectional study done by Ofei-Dodoo S et al, majority of their respondents had good clinical experiences which were attributed to interaction with the attending physician supportive residents¹⁵. However, those who had undesirable clinical experiences attributed it to not having enough patient exposure, the group size of clinical learners, and not having enough time with the attending physicians. In another cross-sectional descriptive study done by Gemuhay HM et al, the majority (60%) of nursing students reported that clinical placement did not provide them with adequate opportunity for effective clinical learning and they mentioned shortage of nurse tutors in clinical areas as the main reason for inadequate clinical learning¹⁶. Although these findings are related to what this project wants to achieve, it does not directly address the objectives of our study.

Study limitation

1. The participation of the respondents will be voluntary, and the questionnaire will be completed by the students who chose to fill it out. However, the data obtained from the students will be self-reported. This reliance on self-reported data could potentially compromise the accuracy of the study, as the researchers are unable to verify its validity.
2. Due to the busy schedules of the students, they may not be able to give the required attention and time to participate in the research, particularly considering their approaching examinations. This may affect the response rate and potentially introduce bias in the data collected. We were able to avert this by meeting them at their various hostels during the weekends, we also delayed data collection from the 400 level class till they were done with their third professional examination.

CONCLUSION

This study found out good attitude and commitment among the student-respondents towards clinical posting. This was portrayed by the majority of them enjoying clinical posting, not missing posting deliberately, participating actively and asking questions during posting. It was also found from this study that patients' cooperation was not a challenge among the majority of the respondents as the majority had never been harassed by a patient, and had not bribed a patient to be treated.

A significant association was found between patients' and students' attitudes to clinical education and students attending clinical.

It was also found from this study that the socioeconomic condition of students significantly affects students' clinical education. Still from this study, It is concluded that accommodation inadequacies affect the respondents' clinical education and learning as the majority of the respondents reported that they had considered skipping clinical postings because they lived at a far location from the hospital, far distance between the hospital and the hostel had greatly affected their clinical learning experiences, lack of accommodation options within the hospital had caused them stress/inconvenience during their clinical postings. Also, the majority of the respondents reported that there were not enough medical doctors to teach students during clinical rotations, smaller group sizes with more individualized attention from teachers (doctors) during clinical postings would be preferable and that they would be more likely to participate in clinical postings if there were fewer students in the posting groups.

This strengthened the fact that the student-to-teacher ratio affects the students' clinical education and learning.

The paucity of related publications limited the discussion of the findings of this study. There have not been enough studies addressing the direct objectives of this study and it made it difficult to compare the findings of this work to other researchers' findings. However, these findings will serve as a foundation/pioneer in this area of research.

RECOMMENDATIONS

From inferences drawn from working on this project and the findings made, we recommend that;

Efforts should be made to locate the students' hostels within or close to their training facilities in order to reduce the stress of them coming from a far place and other risks associated with it.

Their posting group population should be minimized in order to foster more interactions and participation of the students during clinical postings. Attention be given to the environment of training of health workers in the areas of where they live, student-to-patient interactions and vice versa, and bridging the wide gap in student-to-teacher population found in most training institutions.

REFERENCES

1. Ahmad A, Abulaban A, Al Shawwa L, Merdad A, Baghlaf S, Abu-shanab J, et al. Factors Potentially Influencing Academic Performance among Medical Students. *Advances in Medical Education and Practice* [Internet]. 2015 Jan;6:65
2. Hussain I, Suleman Q. Factors Contributing to Students' Unsatisfactory Academic Achievement in English at Secondary Level. *Journal of Culture, Society and Development* [Internet]. 2017 [cited 2024 Apr 9];35(0):22
3. Anbari Z, Ramezani M. The obstacles of clinical education and strategies for the improvement of quality of education at Arak University of Medical Sciences in 2008. | *Arak Medical University Journal* | EBSCOhost [Internet]. openurl.ebsco.com. 2010
4. Dornan T, Conn R, Monaghan H, Kearney G, Gillespie H, Bennett D. Experience Based Learning (ExBL): Clinical teaching for the twenty-first century. *Medical Teacher*. 2019 Aug 6;41(10):1098-105.
5. Nosair E, Mirghani Z, Mostafa RM. Measuring Students' Perceptions of Educational Environment in the PBL Program of Sharjah Medical College. *Journal of Medical Education and Curricular Development*. 2015 Jan;2:JMECD.S29926.
6. Kohli V, Dhaliwal U. Medical students' perception of the educational environment in a medical college in India: a cross-sectional study using the Dundee Ready Education Environment questionnaire. *Journal of Educational Evaluation for Health Professions* [Internet]. 2013 Jun 30;10:5.
7. Genn JM. AMEE Medical Education Guide No. 23 (Part 1): Curriculum, environment, climate, quality and change in medical education—a unifying perspective. *Medical teacher*. 2001 Jan 1;23(4):337-44..
8. Al-Natour S. Medical students' perceptions of their educational environment at a Saudi university. *Saudi Journal of Medicine and Medical Sciences*. 2019;7(3):163.
9. Onotai L.O Patient's perception and attitude towards medical students involvement in patients care at a Nigerian University Teaching Hospital [Internet]. *International Research Journals*; 2012 [cited 2024 May 5].

10. Izadi P, Pirasteh A, Shojaienejad A, Omid A. Patients attitude and feeling toward the presence of medical students in Shahid Mostafa Khomeini educational clinics. *Iranian Journal of Medical Education*. 2014;14(4):303-11.
11. Kencie E, Gemma L, Andersen S, Deepal P, Simanton E. Medical Students Socioeconomic Status and Academic Performance in Medical School. *ProQuest [Internet]*. 2023 [cited 2023 Aug 2]
12. Ekwochi U, Osuorah CD, Ohayi SA, Nevo AC, Ndu IK, Onah S. Determinants of academic performance in medical students: evidence from a medical school in south-east Nigeria. *Advances in Medical Education and Practice*. 2019 Aug;Volume 10:737-47.
13. Salmani F, Eghbali B, Garnjifard M. Barriers to quality of clinical education from the viewpoints of medical students of Birjand University of Medical Sciences in the academic year 2018-2019 [Internet]. 2020 [cited 2024 May 28].
14. Etomes SE, Lyonga fin student-teacher ratio and students' academic performance in public universities: the case of the university of buea, cameroon. *European Journal of Education Studies [Internet]*. 2020 Jun 9;7(6). Available from: <https://www.oapub.org/edu/index.php/ejes/article/view/3110/5747>
15. Ofei-Dodoo S, Goerl K, Moser S. Exploring the Impact of Group Size on Medical Students' Perception of Learning and Professional Development During Clinical Rotations. *Kansas journal of medicine [Internet]*. 2018;11(3):70-5. Available from: <https://www.ncbi.nlm.nih.gov/pmc/article/PMC6122880/>
16. Gemuhay HM, Kalolo A, Mirisho R, Chipwaza B, Nyangena E. Factors Affecting Performance in Clinical Practice among Preservice Diploma Nursing Students in Northern Tanzania. *Nursing Research and Practice [Internet]*. 2019 Mar 19; 3;2019(3453085). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6420979/>

PREVALENCE OF COMMON MENTAL DISORDERS (ANXIETY AND DEPRESSION) AND ASSOCIATED FACTORS AMONG MEDICAL STUDENTS IN UNEC

Tagbo Chidi Moses¹, Toneh Obruche Chiazoka¹, Ubani Royal Chisom¹, Uche Ifeanyi Valentine¹

Department of Community Medicine Faculty of Clinical Sciences College of Medicine, University of Nigeria, Enugu Campus

ABSTRACT

Background: Mental health issues, including anxiety and depression, are increasingly recognized among university students, particularly in demanding academic environments. This study explores the prevalence, manifestations, and associations of common mental disorders among medical students at the University of Nigeria, Enugu Campus.

Methods: A cross-sectional study was conducted with 360 undergraduate medical students using a descriptive survey. Data was analyzed with SPSS version 26, and a 99.0% response rate was achieved from the distributed questionnaires. Socio-demographic and psychosomatic factors were examined, and the prevalence of mental disorders was assessed.

Results: The mean age of participants was 21.96 years (SD=3.35), with the majority aged 21-25 and in their 5th year of study. Prevalence rates for common mental disorders included headaches (42.3%), poor sleep (31.5%), and nervousness (45.3%). Feeling unhappy was observed in 31.9% of students, with 15.0% reporting suicidal thoughts. Notably, 38.8% of students had scores indicating the presence of common mental disorders. Significant associations were found between financial distress and academic decline with the presence of mental disorders ($p < 0.05$), socio-demographic factors and number of hours of sleep

Conclusions: A significant proportion of medical students at the University of Nigeria experience common mental disorders, with academic and financial stressors being prominent contributors. These findings underscore the need for targeted mental health interventions and support systems to address the challenges faced by students in high-pressure academic settings

INTRODUCTION

Anxiety can be defined as apprehension, tension, or uneasiness that stems from the anticipation of danger, which may be internal or external [1]. Depression is a

common disorder involving a depressed mood or loss of pleasure or interest in activities for long periods of time [1,2]. The burden of anxiety globally is 3% in the general population [3] however it rises to about 30% among medical students. In Nigeria a similar scenario is seen with anxiety recorded among medical students from the various medical schools in different states [4]. Although, the prevalence decreases to below 15% in Enugu, anxiety remains a burden among medical students in Enugu [5-10].

This study aims to determine the prevalence of mental disorders and associated factors among medical students of the University of Nigeria. By examining the prevalence of anxiety and depression and its relationship with poor sleep, academic performance, and financial burden among medical students, this research will help to inform evidence-based interventions and policies aimed at promoting mental health and wellbeing among medical students.

METHODOLOGY

Study area and design

This study was carried out in University of Nigeria Enugu Campus and University of Nigeria Teaching Hospital Old site and University of Nigeria Teaching Hospital New site in Ituku/Ozalla Enugu State. The study was an analytical cross-sectional study which assessed the prevalence of anxiety and associated factors.

Study Population

This study was carried out among medical students from second to the final year of academic study who gave their consent after appropriate explanation of the study and liberty to withdraw from the study at any point. Students who were too sick to participate were excluded from the study.

Sample size determination

The sample size was calculated and determined using the Cochran's formula. The minimum sample size used was to be 361.

Ethical Consideration:

Ethical approval will be sought from the Ethical Committee University of Nigeria Teaching Hospital, Ituku-Ozalla.

An informed verbal consent will be sought from all participants prior to the administration of the survey instrument. The participants comfort and convenience were put into consideration.

Respondents were assured of the confidentiality of the information shared and revealing identity such as name was not required.

The information sought was obtained without bias and was strictly restricted to relevance to the study

Study instrument:

A well-constructed, written and self-administered questionnaire was used for this study.

Data Analysis

Data was analyzed using the Statistical Package for Social Sciences Software (SPSS 26.0 version, 2018). The results computed will be presented in percentages and figures. The responses were properly scrutinized to ensure invalid responses and missing information were not used for analysis.

RESULTS

We had a response rate of 99.9%, with 360 out of 362 distributed questionnaires completed and returned.

4.1 SOCIO-DEMOGRAPHICS OF RESPONDENTS**TABLE 1:SHOWING PARTICIPANTS SOCIO-DEMOGRAPHIC CHARACTERISITCS**

Variables		Frequency (N=360)	Percentage (%)
Age	16-20	107	29.7
	21-25	224	62.2
	26-30	28	7.8
	>30	1	0.3
	<i>Mean= 21.96 (SD=3.35)</i>		
Undergraduate level	2 nd year	60	16.5
	3 rd year	70	19.3
	4 th year	56	15.6
	5 th year	125	34.9
	6 th year	49	13.7
Gender	Male	214	59.4
	Female	146	40.6
Ethnicity	Igbo	316	87.8
	Yoruba	13	3.6
	Hausa	8	2.2
	Others	22	6.1
Marital status	Single	337	93.6
	Married	18	5.0
	Divorced	2	0.6
	Widowed	2	0.6
Religion	Christian	346	96.1
	Muslim	12	3.3
	Traditional religion	2	0.6
Monthly allowance	<10,000	56	16.1
	10,000 – 20,000	56	16.1
	20,000 – 40,000	94	27.1
	40,000 – 60,000	73	21.0
	>60,000	68	19.6

The socio-demographic characteristics of the 360 participants reveal a mean age of 21.96 years (SD=3.35), with the majority (62.2%) aged 21-25. Most students are in their 5th year (34.9%). The gender distribution is 59.4% male and 40.6% female. Ethnically, 87.8% are Igbo, followed by 3.6% Yoruba and 2.2% Hausa. The majority (93.6%) are single, with 96.1% identifying as Christian. Monthly allowances vary, with 27.1% receiving 20,000 – 40,000 Naira. This demographic snapshot highlights the predominance of Igbo ethnicity and Christianity among the students, with a significant proportion in the 21-25 age range and in their later years of study.

Table 2: Prevalence of common mental disorders (Anxiety and Depression) disorders among Medical students in University of Nigeria

Variables		Frequency (N=360)	Percentage (%)
Headaches	YES	150	42.3
	NO	204	57.5
Poor appetite	YES	59	16.6
	NO	296	83.1
Sleeps badly	YES	111	31.5
	NO	241	68.5
Easily frightened	YES	89	24.9
	NO	268	75.1
Shaky hands	YES	62	17.5
	NO	293	82.5
Feels nervous, tense or worried	YES	163	45.3
	NO	193	54.2
Poor digestion	YES	56	15.7
	NO	299	83.8
Have trouble thinking clearly	YES	69	19.3
	NO	288	80.7
Feels unhappy	YES	115	31.9
	NO	239	67.1
Religion	YES	45	12.6
	NO	313	87.4
Cries more than usual	YES	108	30.5
	NO	246	69.5
Difficulty in enjoying daily activities	YES	116	32.4
	NO	242	67.4
Difficulty in making decision	YES	97	27.4
	NO	256	72.3
Poor daily activities	YES	59	16.8
	NO	293	83.2
Inability to carry out a is useful part of my life	YES	154	43.8
	NO	198	56.3
lost interest in things	YES	33	9.3
	NO	320	90.7
Feeling of worthlessness	YES	53	15.0
	NO	300	85.0
Having suicidal thought	YES	124	34.8
	NO	232	65.2
Feels tired all the time	YES	84	23.5
	NO	270	75.6
Uncomfortable feeling in the stomach	YES	151	42.2
	NO	206	57.5

Among 360 medical students at the University of Nigeria, common mental disorders are prevalent. Headaches affect 42.3%, poor appetite 16.6%, and poor sleep 31.5%. Anxiety symptoms include nervousness in 45.3%, easily frightened in 24.9%, and shaky hands in 17.5%. Depression symptoms include feeling unhappy (31.9%), crying more than usual (12.6%), and feeling worthless (9.3%). Additionally, 15% have suicidal thoughts. Daily activities are impacted, with 30.5% finding it difficult to enjoy them and 34.8% feeling tired all the time. These figures highlight significant mental health challenges among the student population.

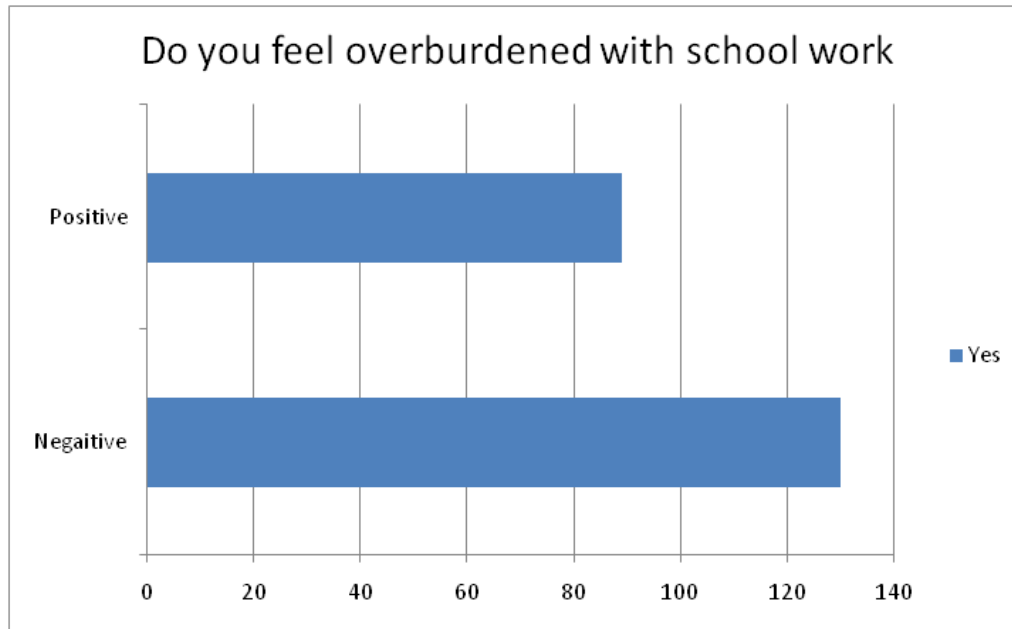


Figure 1: Showing undergraduates who feel overburden with school work

This figure indicates that among students who feel overburdened with school work, 130 do not have a mental health disorder, while 89 do. This suggests that a substantial number of students experiencing a high academic burden are also dealing with mental health issues, highlighting the potential impact of academic stress on

Table 3: To determine the manifestations of common mental disorders among Medical students in University of Nigeria

Variables		Frequency (%)	Percentage
Common mental disorder	Present (with score of ≥ 6)	124	38.8%
	Absent (with score of <6)	196	61.2%

The table presents the prevalence of common mental disorders among medical students at the University of Nigeria. Of the 360 students surveyed, 124 (38.8%) had scores indicating the presence of common mental disorders (≥ 6), while 196 (61.2%) had scores indicating the absence of such disorders (<6). This suggests that a significant portion of the student population, over one-third, experiences common mental disorders.

Table 4: The socio-demographic factors associated with common mental disorders among Medical students in University of Nigeria.

Variables		Common mental disorder present	Common mental disorder Absent	Chi square (p-value)
Age	16-20	44	54	5.696 (0.127)
	21-25	60	120	

	26-30 >30	12 0	12 1	
Undergraduate level	2 nd year 3 rd year 4 th year 5 th year 6 th year	21 26 20 36 19	29 34 28 81 24	4.598 (0.331)
Gender	Male Female	68 54	125 72	2.496 (0.287)
Ethnicity	Igbo Yoruba Hausa Others	111 1 2 7	171 9 6 12	5.756 (0.218)
Marital status	Single Married Divorced Widowed	114 8 0 0	186 7 1 2	3.931 (0.415)
Religion	Christian Muslim Traditional religion	113 7 1	194 3 1	4.656 (0.097)
Monthly allowance	<10,000 10,000 – 20,000 20,000 – 40,000 40,000 – 60,000 >60,000	18 17 30 23 29	32 33 54 41 32	3.085 (0.544)

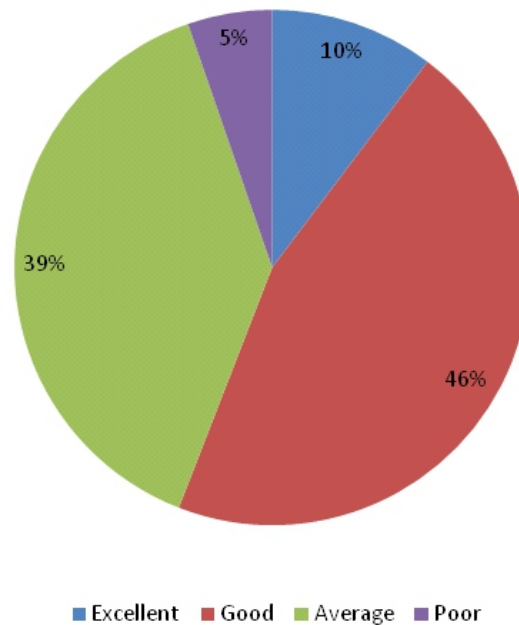
The table presents socio-demographic factors associated with common mental disorders among medical students at the University of Nigeria. No significant associations were found between age, undergraduate level, gender, ethnicity, marital status, religion, and monthly allowance with the presence of common mental disorders, as indicated by p-values greater than 0.05 for all variables. The highest prevalence was observed in the 21-25 age group, 5th-year students, males, Igbos, singles, Christians, and those with a monthly allowance of 20,000-40,000 Naira. However, the lack of statistical significance suggests these factors do not strongly correlate with mental disorders in this sample.

Table 5: Psychosomatic factors associated with common mental disorders among Medical students in University of Nigeria

Variables		Common mental disorder present	Common mental disorder Absent	Chi square (p-value)
Number of hours of sleep	<4hours	22	29	4.010 (0.260)
	4-6 hours	57	101	
	6-8 hours	35	62	
	8hrs	8	5	

The table shows the association between the number of hours of sleep and the presence of common mental disorders among medical students at the University of Nigeria. The highest prevalence of mental disorders was observed among students sleeping less than 4 hours (22) and 4-6 hours (57). However, the chi-square test indicates no significant association between sleep duration and the presence of mental disorders ($p = 0.260$). This suggests that the number of hours of sleep does not significantly impact the occurrence of common mental disorders among students.

How would you rate your academic performance



Majority of respondents, 45.6%, rate their academic performance as "Good," followed by 38.8% who rate it as "Average." A smaller proportion, 10.3%, considers their performance "Excellent," while 5.3% rate it as "Poor." This indicates that most students perceive their academic performance positively, with a significant portion feeling it is at least good or average.

Table 6: Association between common mental disorders and those experiencing other associated factors performance among medical students in university

Variables		Common mental disorder present	Common mental disorder Absent	Chi square (p- value)
Have you ever been treated for mental disorder	Yes	9	6	3.017 (0.082)
Have you ever used any psychoactive substance	Yes	67	82	8.289 (0.040)*
How often do you use psychoactive substance	Daily	5	3	13.879 (0.08)
	Weekly	6	4	
	Occasionally	34	29	
	Rarely	31	52	
	Never	46	103	

Family History of mental disorder	Yes	13	5	8.557 (0.003)*
Do you consider your relationship strained? If they are no longer alive, did you consider your relationship	Yes	20	8	13.732 (0.000)*

The table examines the association between common mental disorders and various mental health-related variables among medical students in the University of Nigeria. Students previously treated for mental disorders showed a higher prevalence of common mental disorders ($p=0.082$, not significant).

Psychoactive substance use was significantly associated with common mental disorders ($p=0.040$). Frequency of substance use varied but was not statistically analyzed for significance. A family history of mental disorders significantly correlated with common mental disorders ($p=0.003$). Strained relationships were also significantly associated with common mental disorders ($p=0.000$).

These findings indicate that psychoactive substance use, family history, and relationship strain are significant factors linked to mental disorders among this population.

DISCUSSION

The emotional well-being of medical students has been a concern since as early as 1956, as it can significantly impact their overall performance and lead to a cascade of consequences at both personal and professional levels. Numerous studies have highlighted considerable distress among medical students, although some have reported minimal or no evidence of stress.

In our study, 38.8% of students experienced anxiety and depression, indicating a high prevalence and is a little above the range of 29.2% to 38.7% in the global prevalence [3] but however similar to a study on mental health status of medical students in Calabar which showed that 39.2% had a poor mental health status. It is a higher than the results of comorbid anxiety and depression of 21.20%, with depression and anxiety at 51.30% and 30.1% independently, in a study in Ethiopia [11-13].

A study in ESUT showed a prevalence of anxiety of 63% which is a higher prevalence than the results in our study [5]. This higher value might be due to that study focusing only on anxiety whereas our study focuses on comorbid anxiety and depression. The self-administered and anonymous nature of the SRQ20 questionnaire prevented further follow-up on

students with common mental disorders.

The study also showed higher anxiety and depression prevalence among 5th year mental disorders possibly due to the stress of facing a clinical oriented professional MBBS exam (4th MBBS exam) which is different from the higher prevalence in preclinical students medical in a study in the University of Benin [11]. Also, our study showed a higher prevalence of anxiety and depression levels in males.

To better understand the variables affecting medical students' stress levels, we included socioeconomic factors in our questionnaire and found a relationship between financial distress, also sleep quality and academic performance where associated with common mental disorders. This is similar to the study on the evaluation of anxiety and depressive symptoms among University of Abuja medical students showing factors independently associated with co-morbid anxiety and depression were being a student receiving less than one dollar equivalent per day as allowance and being a student from the Igbo ethnic group and factors associated with psychiatric morbidity included being a student of a private institution, average academic performance, below average academic performance, and having a father or a mother with highest level of formal education below first degree and respectively [13].

Policy Implications

- Increased Funding:** Allocate resources for mental health services, research, and awareness campaigns.
- Improved Access:** Enhance access to evidence-based treatments, including psychotherapy and medication.
- Reduced Stigma:** Implement initiatives to reduce stigma and promote mental health literacy.
- Integrated Care:** Integrate mental health services into primary care and community settings.
- Workforce Development:** Train healthcare professionals to address mental health needs.

6. **Research Prioritization:** Fund research to better understand anxiety and depression, and develop effective interventions.
7. **Policy Reforms:** Address social determinants of mental health, such as education, employment, and housing.
8. **Monitoring and Evaluation:** Establish systems to track progress and evaluate policy effectiveness. By studying anxiety and depression, we can inform policy decisions, improve mental health outcomes, and reduce the significant social and economic burden associated with these conditions.

STUDY LIMITATIONS

The study's generalizability is limited as the sample was drawn from a single medical school, preventing cause-effect associations between psychological variables and depression. Another limitation is cost and distance between the three campuses as well as time constraint.

Other limitations include the lack of baseline mental health data at medical school entrance and the absence of population-based data for comparison. A mixed method study may have provided more insights.

The self-administered and anonymous nature of the SRQ20 questionnaire prevented further follow-up on students with common mental disorders.

Anxiety and depression have significant costs for individuals and society, including medical school dropout, suicide, relationship deterioration, marital problems, and impaired work ability.

CONCLUSION

A notable percentage of medical students at the University of Nigeria face mental health challenges. Academic stress and financial distress are strongly associated with these mental health issues. No significant correlation was found between socio-demographic factors and mental disorders, suggesting that mental health issues might be more influenced by psychosocial stressors rather than demographic characteristics.

RECOMMENDATIONS

Enhanced Mental Health Support Services: Establish or expand counseling and mental health services on campus to provide students with access to professional support. Regular workshops on stress management and mental well-being should be implemented.

Academic Support and Counseling: Develop academic support programs to help students manage their workload more effectively. Consider providing academic counseling and tutoring to alleviate stress and improve

performance.

Financial Assistance Programs: Introduce or enhance financial aid and support programs to address financial distress among students. This could include scholarships, emergency funds, or budgeting workshops.

Stress Management Initiatives: Implement stress management and resilience training as part of the curriculum or as extracurricular activities. Offer resources such as mindfulness and relaxation techniques.

Regular Mental Health Screenings: Conduct regular mental health screenings and assessments to identify students at risk and provide early intervention. Incorporate mental health education into the academic curriculum to increase awareness and reduce stigma.

Peer Support Networks: Encourage the formation of peer support groups and networks where students can share experiences and provide mutual support. Train student leaders in mental health first aid to foster a supportive community.

Sleep and Lifestyle Education: Provide education on the importance of adequate sleep and healthy lifestyle practices. Offer workshops or resources on maintaining a balanced lifestyle to support overall well-being.

Collaborative Research and Evaluation: Continuously evaluate the effectiveness of mental health interventions and support systems. Encourage ongoing research into the mental health needs of medical students and other high-pressure academic environments.

Implementing these recommendations can help address the mental health challenges faced by medical students and improve their overall well-being and academic performance.

REFERENCES

1. World health organization (WHO) [Internet]. Who.int. [cited 2024 Apr 15]. Available from: <https://www.who.int/>
2. Paho/who [Internet]. Paho.org. [cited 2024 Apr 15]. Available from: <https://www.paho.org/en>
3. Longino A. International journal of environmental research and public health. Wilderness Environ Med [Internet]. 2015 [cited 2024 Apr 15];26(1):99. Available from: <https://www.mdpi.com/journal/ijerph>
4. Esan O, Esan A, Folasire A, Oluwajulugbe P. Mental health and wellbeing of medical students in Nigeria: a systematic review. Int Rev Psychiatry [Internet]. 2019;31(7-8):661-72. Available from: <http://dx.doi.org/10.1080/09540261.2019.1677220>

5. Chinawa TAT, Chinawa JM, Aniwada E, Amadi O, Ndukuba AC, Uwaezuoke SN, editors. Spectrum of Anxiety Disorders Among Medical Students in a Nigerian Medical School: A Cross-Sectional Study With Standardized Screening
6. Abdulghani et al. *Med Teach*, 2012. Sleep disorder among medical students: relationship to their academic performance
7. Symptoms of anxiety and depression among medical students: study of prevalence and associated factors Bartira Oliveira Sacramento, Tassiana Lima dos Anjos, Ana Gabriela Lopes Barbosa, Camila Fagundes Tavares. Juarez Pereira Dias *Revista Brasileira de Educação Médica*. 45(01).
8. Carmen M, Lee M, Juarez G, Rae L, Robert M, Rodriguez JA, et al. PTSD, and stressors in medical students during the initial peak of the COVID-19 pandemic
9. Priyanka Shah, 1 Alisha Sapkota, 1 and Anjeel Chhetri. Anxiety and Stress among First-year Medical Students in a Tertiary Care Hospital: A Descriptive Cross-sectional Study
10. Banu H, Al-Fageer R, Al-Suwaidi R, editors. Cognitive emotions: Depression and anxiety in medical students and staff Author links open overlay panel Isra Ahmed.
11. Prevalence and predictors of depression and anxiety among medical students in Addis Ababa. Getinet Ayano *International journal of mental health systems*. 2019;13.
12. ORCID [Internet]. Orcid.org. [cited 2024 Apr 15]. Available from: <https://orcid.org/0000-0002-3896-226X>
13. Umar M, Suraj S, Umar B, Gajida A. Prevalence and factors associated with depression among medical students in Nigeria. *Niger Postgrad Med J* [Internet]. 2021;28(3):198. Available from: http://dx.doi.org/10.4103/npmj.npmj_414_21

FACTORS AFFECTING THE DECISION OF UNIVERSITY OF NIGERIA MEDICAL STUDENTS TO PRACTICE IN NIGERIA

Eloka Vitalis Ndubuisi¹, Elueche, Joshua Chibuzor¹, Emenike Clinton Ugwunna¹, Ene Ebubechukwu Leo¹

Department of Community Medicine, Faculty of Clinical Sciences College of Medicine, University of Nigeria Enugu Campus

ABSTRACT

Aim: This study aimed to investigate the factors influencing the career intentions of clinical medical students at the University of Nigeria, with a particular focus on their likelihood to practice medicine in Nigeria after graduation. The research sought to understand the attitudes, perceived challenges, and aspirations of future medical professionals in the context of Nigeria's healthcare system.

Method: A descriptive cross-sectional study was conducted among 307 fourth, fifth, and final year medical students at the University of Nigeria Teaching Hospital. Data was collected using a structured questionnaire that explored various aspects of students' career intentions, perceptions of the Nigerian healthcare system, and factors influencing their decision to practice in Nigeria or abroad. The study employed a combination of stratified and simple random sampling techniques.

Results: The study revealed that 26.4% of students were unsure about their future plans, while 21.5% expressed an inclination to remain in Nigeria, and 19.5% indicated they were unlikely to stay. Financial instability emerged as a primary concern, with 28.9% identifying it as the main factor influencing their decision. Other significant factors included the quality of healthcare infrastructure, availability of professional development opportunities, and political stability. A substantial majority (79.1%) felt that the government provided inadequate support for the medical profession in Nigeria. The study also uncovered significant dissatisfaction (57.5%) with the current medical training system. Interestingly, 94.7% of students who had participated in international medical programs reported that these experiences positively influenced their perception of overseas opportunities. However, contrary to previous studies, more students in this cohort preferred staying in Nigeria, possibly due to increased costs of emigration and recent improvements in local residency placements.

Conclusion: The findings highlight the complex interplay of factors influencing medical students' career decisions in Nigeria. While there are positive

indications of a preference to stay, significant challenges remain in the areas of healthcare infrastructure, professional development, and government support. The study underscores the need for comprehensive strategies to enhance medical education, improve healthcare facilities, provide financial incentives, and create a supportive policy environment.

INTRODUCTION

1.1 BACKGROUND

The quantity and distribution of workforce in the health workforce plays a significant role in the welfare of a nation. A direct link has been shown between the number of healthcare workers in a country and its ability to achieve positive health outcomes¹.

Physician migration from developing countries, including Nigeria and other countries in sub-Saharan Africa to more developed countries, seems to be on the increase in recent years and has become a major cause for concern². The emigration of medical doctors from developing countries to more developed countries is very common and is termed "physician brain-drain" and nicknamed "japa".

This has been associated with personal benefits to the physicians involved, such as higher education and income, but with resultant negative consequences on the health systems of the physicians' home countries³. It has posed serious challenges to the human resources for health in Nigeria. Resident doctors undergoing specialist training in the country's many tertiary hospitals have constituted significant proportion of physicians who had left or have intention to leave Nigeria for other nations of the world. This is also obtainable among the graduate medical doctors (house officers) doing their mandatory 1-year internship in the tertiary hospitals across the nation⁴.

In 2018, data from the World Health Organization showed that the ratio of physicians to the general population in Nigeria was 4 to 10,000⁵. In the face of an increasing disease burden globally and nationally, there is a need to develop strategies for reinforcing the Nigerian healthcare system.

The decisions that medical students make regarding their career paths have a direct effect on the future medical workforce of a country.

Their choice of specialty determines the specialty distribution of the country's medical workforce and its ability to deliver specialized healthcare services⁶. Medical school students are exposed to different areas of the profession and usually develop a preference for certain specialties during this time⁷.

The massive exodus of physicians from Nigeria has stalled the growth in physician population relative to the growth in the country's population⁸. According to the World Health Organization (WHO) Global Health Workforce of medical doctors, the number of physicians and physician per 10 000 population in Nigeria as of 2018 were 74 543 and 3.8, respectively⁹. These numbers are over-estimations as they include all doctors licensed to practice, including retired ones and those who might have emigrated to other countries. In 2021, the Nigeria Medical Association (NMA) lamented that less than half of the over 80 000 doctors registered with the Medical and Dental Council of Nigeria (MDCN) were practicing in the country, giving the country's doctor-to-population ratio of 1 to between 4 000 and 5 000, against the WHO recommended 1 doctor to 600 people. Early in 2022, the Medical and Dental Consultants Association of Nigeria (MDCAN) bemoaned that over 100 medical consultants left from 17 Nigerian tertiary health institutions in the preceding two years. Few months after, the body conducted a survey among her members which showed that over 500 medical and dental consultants had left Nigeria for developed countries over the preceding 2 years and nine out of every 10 consultants with less than 5 years of experience plan to leave the country for greener pasture¹⁰.

In order to have a clear understanding of the migration trend among physicians, a survey among medical students is important. Medical students are the future medical practitioners, and their emigration intention may give a projection of the medical brain drain trend and may give an indication of the medical work force in a country in the near future. This study aims to identify the factors influencing the decision of medical students to practice medicine in Nigeria after medical school.

METHODOLOGY

Study area and design

The study was carried out in Enugu state. The study site was the University of Nigeria Teaching Hospital (UNTH) Enugu. A descriptive cross-sectional study was employed for this study.

Study population

This study was conducted among fourth, fifth and final year medical students of University of Nigeria Teaching Hospital. Medical students who did not consent to the study were excluded.

Sample size estimation

The sample size for this study was determined using the Cochran's formula and a minimum of 330 participants was required for this study.

Sampling technique

The sampling technique employed in this study was the multistage sampling method. Initially, the clinical classes were stratified into three groups: fourth-year, fifth-year, and final-year medical students.

Once the strata were defined, a simple random sampling method was used within each stratum to select participants for the study.

Study tool and data collection

A pretested structured questionnaire was used to collect data from the students. Data was collected via the questionnaires which were distributed at the various hostels and lodges as explained in the study site. An online questionnaire was also generated and used for the purpose of this study. There was a pretesting of the questionnaires on 5% of the sample size in another population that was not selected for the study. Their responses were not added to this study.

Data analysis

The Data was analyzed electronically using International Business Machines Corporation Statistical Product and Service Solutions (IBM SPSS) software version 26.0. The results obtained were presented using tables, bar charts, and pie charts accordingly. Summary statistics such as mean, frequency, and proportion were used to represent qualitative and quantitative data.

Ethical considerations

Ethical clearance was obtained from the ethics committee of the University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu state. Participation was voluntary and based on written informed consent. Confidentiality and anonymity of the respondents was ensured.

RESULTS**INTRODUCTION**

Three hundred and seven (307) participants were recruited in the study.

TABLE 1: SOCIO-DEMOGRAPHIC DATA

VARIABLES	FREQUENCY (N=307)	PERCENTAGE (%)	MEAN±SD
AGE			23.67 ± 2.510
<19	0	0	
19-24	189	68.5	
25-30	82	29.7	
31-35	5	1.8	
>35	0	0	
GENDER			
Male	211	68.7	
Female	96	31.3	
TRIBE			
Igbo	279	90.9	
Hausa	6	2.0	
Yoruba	5	1.6	
Others	17	5.5	
MARITAL STATUS			
Married	14	4.6	
Single	292	95.1	
Divorced	1	0.3	
RELIGION			
Christianity	291	94.8	
Islam	6	2.0	
African traditional religion	2	0.7	

The table above shows the baseline socio-demographic details of the participants. Most were aged 19-24 years (68.5%), males (68.7%), of the Igbo tribe (90.9%), single (95.1%) and Christians (94.8%).

LIKELIHOOD OF PRACTICING IN NIGERIA AFTER COMPLETION OF EDUCATION

FIGURE 1: LIKELIHOOD OF PRACTICING IN NIGERIA AFTER COMPLETION OF EDUCATION

This figure illustrates the likelihood of respondents practicing in Nigeria after completion of their education. Most of our respondents are still unsure (26.4%)

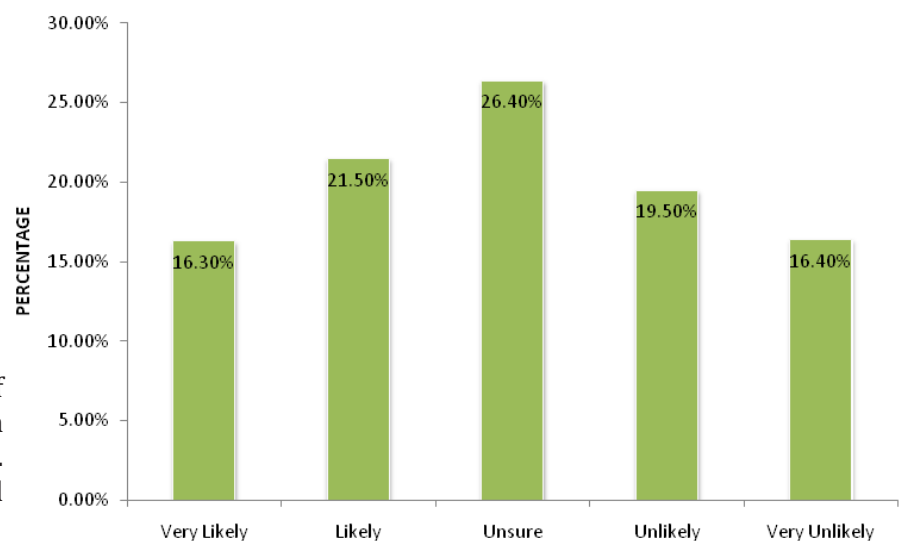


TABLE 2: FACTORS AFFECTING MEDICAL STUDENTS PRACTISING IN NIGERIA

QUESTION	FREQUENCY	PERCENTAGE
What are the primary factors influencing your decision to pursue a medical career in Nigeria? (Select all that apply)		
Prestige/status	68	12.4
Financial stability	159	28.9
Passion for medicine	105	19.1
Family expectations	43	7.8
Opportunities for specialization	90	16.4
Desire to serve the community	73	13.2
Other reasons	12	
How important are the following factors in your decision to practice medicine in Nigeria?		
Quality of health care infrastructure		
Very unimportant	30	2.2
Unimportant	30	10.6
Neutral	44	10.6
Important	72	15.5
Very important	107	25.4
Availability of professional development opportunities		
Very unimportant	25	37.8
Unimportant	24	8.9
Neutral	44	8.5
Important	89	15.7
Very important	99	31.7
Potential earnings/salary		
Very unimportant	35	35.2
Unimportant	21	12.4
Neutral	37	7.4
Important	55	13.1
Very important	135	19.4
Work-life balance		
Very unimportant	27	47.
Unimportant	17	9.4
Neutral	59	5.9
Important	96	20.6
Very important	87	33.6
Political stability/security		
Very unimportant	35	30.4
Unimportant	28	12.4
Neutral	50	9.9
Important	67	17.7
Very important	102	23.8
Cultural and social factors		
Very unimportant	32	36.2
Unimportant	44	11.3

Neutral	88	15.5
Important	75	31.0
Very important	45	26.4
Opportunities for research and innovation		
Very unimportant	37	15.8
Unimportant	26	12.1
Neutral	70	8.5
Important	75	22.8
Very important	74	24.4
What factors are most important to you when considering your future medical career? (Select all that apply)		
Salary and financial incentives	245	80.3
Work-life balance	230	75.4
Career advancement opportunities	234	76.7
Opportunities for personal and professional growth	227	74.4
Prestige and reputation of the institution	130	42.6
Impact on patient care and public health	209	68.5
Other reasons	0	0
How much influence do government policies have on your decision to pursue international practice opportunities?		
Strongly Influential	144	47.2
Moderately Influential	72	23.6
Neutral	60	19.7
Slightly Influential	14	4.6
Not Influential at all	15	4.9

Findings from the above table shows that the primary factor influencing the students decision to pursue a medical career in Nigeria was majorly financial instability (28.9%). Majority of our respondents agreed that quality of healthcare infrastructure (37.8%), availability of professional development opportunities (35.2%), potential earnings/salary (47.7%) and political stability/security(36.2%) are important factors in their decision to practice medicine in Nigeria.

TABLE 3: CULTURAL AND SOCIETAL FACTORS

QUESTION	FREQUENCY	PERCENTAGE
To what extent do cultural factors (e.g., language, customs, and traditions) influence your willingness to consider practising medicine in a foreign country?		
Strongly influential	50	16.3
Moderately influential	92	30.0
Neutral	90	29.3
Slightly influential	54	17.6
Not influential at all	21	6.8

Have you participated in any international medical programs? (e.g., volunteer work, medical missions, elective rotations) during your medical education?		
Yes	76	24.8
No	231	75.2
If yes, how did your experiences influence your perception of international practice opportunities?		p
Positively	72	94.7
Negatively	0	0
Neutral	4	5.3

This table shows that most of our respondents have not participated in any international medical training program (75.2%) and majority of those who have participated in an international medical training program agreed that their experiences positively influenced their perception of international practice opportunities (94.7%)

TABLE 4: EFFECT OF GOVERNMENT POLICIES ON THE ATTITUDE OF MEDICAL STUDENT PRACTISING IN NIGERIA

QUESTION	FREQUENCY	PERCENTAGE
How do you feel about the level of support provided to medical practitioners by the government in Nigeria?		
Very supportive	4	1.3
Supportive	16	5.3
Neutral	43	14.2
Not very supportive	139	46.0
Not supportive at all	100	33.1
Do you believe the current incentives provided by the government are sufficient to retain medical practitioners in the country?		
Yes	10	3.3
No	273	90.4
Unsure	19	6.3
How important do you think factors such as salary, working conditions, career advancement opportunities, and access to resources are in retaining medical practitioners in Nigeria?		
Very important	231	75.2
Important	37	12.1
Neutral	24	7.8
Not very important	5	1.6
Not important at all	5	1.6
Do you think addressing issues such as security, political stability, and social amenities would impact your decision to practice medicine in Nigeria?		
Yes	238	79.1
No	28	9.3
Unsure	35	11.6
What role do you think international partnerships and collaborations could play in improving healthcare delivery and retaining medical practitioners in Nigeria?		

Very significant role	112	36.5
Significant role	120	29.1
Neutral	46	15
Minor role	19	6.2
No role at all	5	1.6
<hr/>		
What role do you think professional associations or medical societies should play in retaining medical practitioners in Nigeria?	232	44.4
Advocating for better working conditions	172	32.9
Providing support and resources for practitioners	113	21.6
Lobbying the government for policy changes	6	1.1
Other reasons		

This table shows that most of our respondents feel that the government in Nigeria to medical practitioners in Nigeria (46%). Most of them do not believe that the current incentives provided by the government are sufficient to retain medical practitioners in the country (90.4%) and think that factors such as salary, working conditions, career advancement opportunities, and access to resources are very important in retaining medical practitioners in Nigeria (75.2%).

Most of our respondents think that addressing issues such as security, political stability, and social amenities would impact their decision to practice medicine in Nigeria (79.1%).

PERCEPTION OF OVERALL HEALTHCARE SYSTEM IN NIGERIA

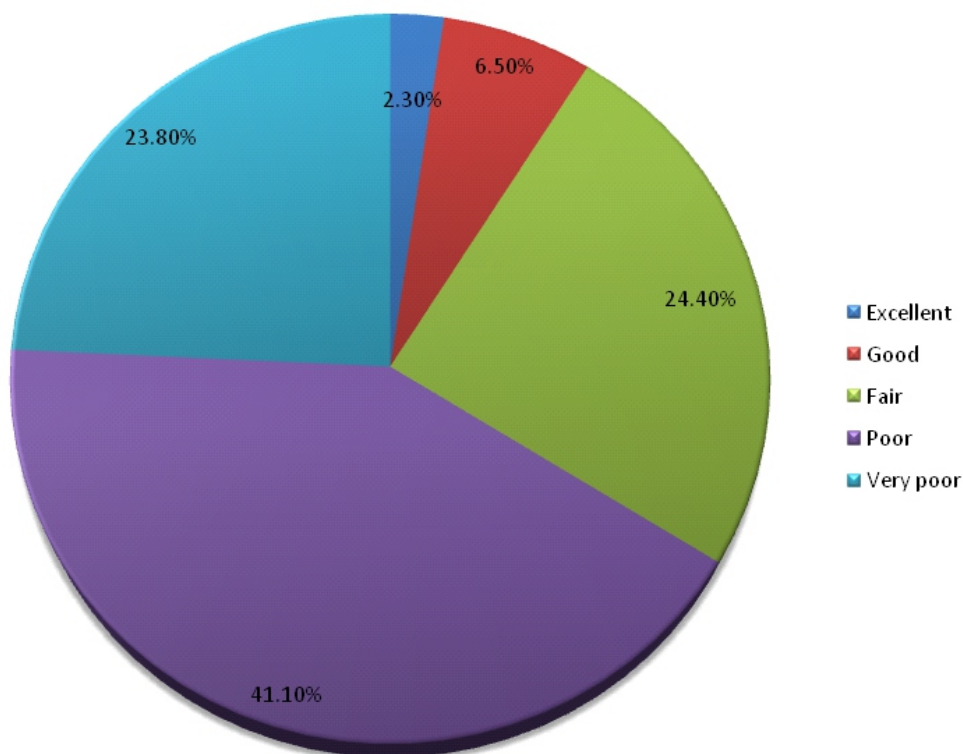


FIGURE 2: PERCEPTION OF OVERALL HEALTHCARE SYSTEM IN NIGERIA

This figure shows the perception of our respondents when considering the overall healthcare system in Nigeria. Most of the respondents perceive that the overall healthcare system in Nigeria is poor (41.1%).

TABLE 5: ROLE OF MENTORSHIP AND GUIDANCE

QUESTION	FREQUENCY	PERCENTAGE
Have you received mentorship or guidance from experienced medical professionals regarding your career path in Nigeria?		
Yes	143	47.4
No	159	52.6
How effective do you think mentorship programs or professional development opportunities would be in retaining medical practitioners?		
Very effective	78	25.9
Effective	123	40.9
Neutral	70	23.3
Not very effective	25	8.3
Not effective at all	5	1.7
How satisfied are you with the current medical education and training system in Nigeria?		
Very satisfied	12	3.9
Satisfied	21	6.9
Neutral	97	31.7
Dissatisfied	124	40.5
Very dissatisfied	52	17.0
In your opinion, what improvements could be made to the medical education and training system to better prepare medical practitioners for practice in Nigeria?		
More practical training opportunities	24	78.5
Curriculum reform	172	56
Better-equipped facilities	247	80.5
Enhanced faculty development programs	70	22.8
Other	19	6.2
How important is the availability of specialized training and professional development opportunities in your decision to practice medicine in Nigeria?		
Very important	151	49.7
Important	82	27
Neutral	57	18.8
Not very important	8	2.6
Not important at all	6	2

This table shows that most of our respondents have not received mentorship or guidance from experienced medical professionals regarding your career path in Nigeria (52.6%), think mentorship programs or professional development opportunities is effective in retaining medical practitioners (40.9%) and are dissatisfied with the current medical education and training system in Nigeria (40.5%).

Most of our respondents believe that better equipped facilities could improve the medical education and training system and better prepare medical practitioners for practice in Nigeria (80.5%). Also, most of respondents believe that the availability of specialized training and professional development opportunities is very important in their decision to practice medicine in Nigeria (49.7%).

TABLE 6: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS AND LIKELIHOOD TO PRACTICE MEDICINE IN NIGERIA

Variable	Very likely (%)	Likely (%)	Unsure (%)	Unlikely (%)	Very likely (%)	X ² test	P value
Age in year						7.533	0.480
19-24	26(13.8)	42(22.2)	56(29.6)	37(18)	28(14.8)		
25-30	17(20.7)	18(22)	16(19.5)	15(18.3)	16(19.5)		
31-35	1(20)	1(20)	1(20)	0(0)	2(40)		
Gender						4.558	0.336
Male	35(16.6)	52(24.6)	52(24.6)	40(19)	32(15.2)		
Female	15(15.6)	14(14.6)	29(30.2)	20(20.8)	18(18.8)		
Tribe						72.077	0.034*
Igbo	42(15.1)	59(21.1)	80(28.7)	53(19)	45(16.1)		
Hausa	4(66.7)	0(0)	0(0)	1(16.7)	1(16.7)		
Yoruba	3(60)	1(20)	0(0)	0(0)	1(20)		
Others	1(5.9)	6(35.3)	1(5.9)	6(35.3)	3(17.6)		
Marital status						10.524	0.230
Married	5(35.7)	0(0)	3(21.4)	3(21.4)	3(21.4)		
Single	45(15.4)	65(22.3)	78(26.7)	57(19.5)	47(16.1)		
Divorced	0(0)	1(100)	0(0)	0(0)	0(0)		
Religion						15.963	0.043*
Christianity	45(15.5)	65(22.3)	78(26.8)	59(20.3)	44(15.1)		
Islam	4(66.6)	0(0)	1(16.7)	0(0)	1(16.7)		
African traditional religion	0(0)	0(0)	0(0)	1(50)	1(50)		
Others	0(0)	0(0)	0(0)	0(0)	0(0)		

*p is significant

This table represents the outcome of association between socio-demographic factors and the likelihood to practice medicine in Nigeria. It shows that there is a significant association between tribe and religion and the likelihood to practice medicine in Nigeria. A higher proportion of Igbos was unsure of if they would practice in Nigeria (0.034) and a higher proportion of respondents who were Muslims were very likely to practice in Nigeria (0.043). No other significant associations were found.

TABLE 7: ASSOCIATION BETWEEN PERCEIVED CHALLENGES AND BARRIERS AND LIKELIHOOD TO PRACTICE MEDICINE IN NIGERIA

Perceived challenges and barriers	Very likely (%)	Likely (%)	Unsure (%)	Unlikely (%)	Very likely (%)	X ² test	
Poor	6	9	11	7	6	5.315	0.723
Moderate	37	52	66	49	41		
Good	5	4	1	3	3		

*= significant p-value

This table represents the outcome of association between perceived challenges and barriers and likelihood to practice medicine in Nigeria. No significant associations were found. (0.043). No other significant associations were found.

The table above shows the baseline socio-demographic details of the participants. Most were aged 21-25 years (72.5%), a slight majority of the participants were females (52.9%) and majority of them were in the department of medicine and surgery (83.0). Most of them resided in the hostel (66.6%). The level of study of participants was fairly evenly distributed among the 300, 400, 500 and 600 levels. Majority were Christians (98.5%), of Igbo ethnicity (90.1%) and single (98.3%).

DISCUSSION

The findings from this study revealed that the rate of emigration is higher among the Igbo ethnic group compared to the Yoruba and Hausa. Our results contradict the study done by Yakubu et al. (2023), who reported that health workers in the Southeast geopolitical zone have the lowest emigration rate¹¹. There are plausible reasons why the south has higher emigration intention rates than the north. It may be that, in totality, the north is more protective and preserving of its culture than the south, hence the idea of "japa" is taken more seriously in the south than in the north. . Northerners may perceive that some of their cultural practices (such as polygyny, adolescent marriage, etc.) may not be allowed in the West, and that may explain why they have lower emigration intention than those in the south¹². We also found no significant influence of gender on emigration intention. This supports the findings of Adeniyi et al. (2022) and testifies to the fact that women are currently migrating as much as men¹³.

There was a significant degree of uncertainty among students about their future plans. While a notable portion remained undecided (26.4%), 21.5% expressed an inclination to remain in Nigeria to

advance their medical careers. In contrast, 19.5% indicated that they were unlikely to continue their careers in Nigeria, preferring to explore opportunities abroad. Overall, the data showed that more students preferred staying in Nigeria than leaving. Interestingly, these findings contrast sharply with those reported by Badru et al. in Sokoto, where a much higher percentage (80.1%) of students indicated an intention to emigrate and work abroad¹⁴. This disparity may be attributed to several factors. One reason may be the high cost of processing travel documents, examination fees, and other expenses related to practicing medicine abroad, which have been exacerbated by the significant depreciation of the naira¹⁵. This depreciation has made the cost of these expenses prohibitively high for many students, potentially discouraging emigration plans. Additionally, the anticipated increase in the minimum wage by the federal government might make staying in Nigeria more financially appealing for medical graduates, although the impact may be limited by the naira's depreciation. The high costs of emigration likely provide a more compelling explanation for the observed difference in student preferences between the studies. Furthermore, changes in the residency placement process in Nigeria could also influence students' decisions. If residency placements have become more accessible or equitable, students may feel more optimistic about their prospects in the local healthcare system. This optimism can play a crucial role in their decision to remain in the country, as the opportunity to gain specialized training and experience is a significant factor in career planning.

Our analysis showed that financial instability is a significant concern for medical students considering their future careers, with 28.9% identifying it as the primary factor influencing their decision to practice medicine in Nigeria. This highlights the economic challenges faced by healthcare professionals in the country. Respondents also highlighted the quality of healthcare infrastructure, availability of professional development opportunities, and political stability as critical factors influencing their career decisions.

These findings are similar to those from a study conducted at the University of Ibadan in 2006¹⁶, indicating that little progress has been made in addressing these issues, and these challenges persist in Nigeria's healthcare sector. A significant majority of students, amounting to 79.1%, expressed the view that the government falls short in providing adequate support for the medical profession in Nigeria. Key issues such as poor working conditions, limited career advancement opportunities, inadequate salaries, and lack of access to resources are significant factors contributing to this sentiment. The lack of government interest is among the primary push factors driving students to seek opportunities abroad.

Most of our respondents have not participated in any international medical training programs. However, of those who have participated, 94.7% reported that their experiences positively influenced their perception of international practice opportunities. This suggests a significant correlation between participation in international medical training programs and a positive outlook on international practice opportunities.

Those who have experienced such programs are more inclined to consider working abroad, likely due to exposure to better resources, training facilities, and professional environments compared to what is available locally. This trend indicates that international training experiences may contribute to the desire among medical professionals to seek opportunities outside Nigeria.

This study also reveals that a considerable majority (57.5%) of students are dissatisfied with the current training system in Nigerian medical schools.

Additionally, nearly half (49.7%) believe that the lack of specialized training opportunities for professional growth is a significant factor driving emigration among medical professionals. The recent increase in residency positions in Nigeria may encourage individuals to pursue their medical careers domestically, offering valuable and cheaper avenues for professional advancement. Despite these improvements, the insufficient medical resources in Nigeria, compared to more developed nations, continue to be a deterrent¹⁴. This lack of resources contributes to the uncertainty that 26.4% of students feel about their decision to practice in Nigeria.

CONCLUSION

This study has provided valuable insights into the factors influencing the career intentions of clinical medical students at the University of Nigeria. The

findings revealed a significant degree of uncertainty and dissatisfaction among students, with notable concerns regarding the quality of medical training, insufficient healthcare infrastructure, and financial instability. In contrast to several other studies, a significant number of students expressed a desire to stay and advance their careers in Nigeria. The reasons behind this trend warrant further research to better understand the factors that influence this decision.

RECOMMENDATIONS

In light of this study, we recommend the following actions for the Nigerian government. These measures are intended to foster a more supportive environment for doctors and healthcare workers, addressing the pressing challenge of brain drain while ensuring the continued development of the nation's healthcare system. The proposed recommendations include:

1. Financial Support and Incentives:

Increasing the salaries of Nigerian healthcare professionals and adding performance-based bonuses, housing allowances, and transportation subsidies will significantly help in reducing brain drain. Additionally, enhancing pension plans and offering better retirement packages will ensure long-term financial security. Professional associations such as the Nigeria Medical Association can help advocate for these.

2. Improvement of the Working Environment:

Ensuring a sufficient number of healthcare workers will help reduce workload and prevent burnout, while establishing strong mental health support and counseling services could be crucial in making healthcare workers feel more comfortable, thereby reducing their desire to migrate.

3. Improved Training and Professional

Development opportunities: By offering advanced training and specialization opportunities within Nigeria, the desire for doctors to seek further education abroad is significantly reduced. This not only helps retain skilled professionals within the country but also plays a crucial role in lowering the overall emigration rate of healthcare workers.

4. Increased Budget Allocation to Healthcare:

We agree with Oseigban's (2021) study on the link between migration and the government's role in addressing brain drain¹⁷. The underfunding of Nigerian health institutions, due to insufficient budget allocation, is a major issue. We recommend that the health budget be increased to meet the WHO's standard of 15% of the total economic budget¹⁸.

5. Good governance

The government's effective allocation of funds, the assurance of life and job security, and the management of corruption are critical in determining whether skilled professionals and valuable citizens choose to stay in the country or not. Good governance is therefore essential for the growth and stability of Nigeria's healthcare system.

By implementing these measures, Nigeria can create a more attractive and sustainable healthcare system that not only retains its medical talent but also offers quality healthcare to its population.

REFERENCES

- World Health Organization. Monitoring the Building Blocks of Health Systems: A Handbook of Indicators And Their Measurement Strategies. Geneva: WHO Document Production Services; 2010. p. 24-36
- Abdallah FW, Chan VW, Brull R. Transversus abdominis plane block: a systemic review. *Reg Anesth Pain Med* 2012; 37(3):193 – 209
- Ijumide HB, Wilfred IU. Brain drain and African development: Any possible gain from the drain? *Afr J Bus Manage*. 2012;6:2421-8
- Mullan F. The metrics of the physician brain drain. *N Engl J Med*. 2005;353(17):1810-8.
- The World Bank. Physicians Per 1000 People – United Kingdom, Nigeria | Data; 2021. Available from: <https://data.worldbank.org/indicator/SH.MED.PHYS.ZS?locations=NG>. [Last accessed on 2021 Aug 21
- Seleq S, Jo E, Poole P, Wilkinson T, Hyland F, Rudland J, et al. The employment gap: The relationship between medical student career choices and the future needs of the New Zealand medical workforce. *N Z Med J* 2019;132:529.
- Khader Y, Al Zoubi D, Amarin Z, Alkafagei A, Khasawneh M, Burgan S, et al. Factors affecting medical students in formulating their specialty preferences in Jordan. *BMC Med Educ* 2008;8:32.
- Worldometer. Nigeria population (2021). <https://www.worldometers.info/world-population/nigeria-population/>. Accessed 4 Oct 2021.
- World Health Organization. Health workforce: medical doctors. <https://www.who.int/data/gho/data/themes/topics/indicator-groups/indicator-group-details/GHO/medical-doctors>. Accessed 4 Oct 2021.
- Mullan F. The metrics of the physician brain drain. *New England journal of medicine*. 2005 Oct 27;353(17):1810-8
- Yakubu, K., Shanthosh, J., Adebayo, K. O., Peiris, D., and Joshi, R. 2023. Scope of health worker migration governance and its impact on emigration intentions among skilled health workers in Nigeria. *PLOS Global Public Health*, 3(1): e0000717.
- Lanati, M., and Venturini, A. 2021. Cultural change and the migration choice. *Review of World Economics*, 157(4): 799-852.
- Wadinga B, Ahmed A. Relationship Between Currency Devaluation and Economic Growth in Nigeria: An Empirical Evidence.
- Adeniyi MA, Efuntoye O, Popoola G, Adebayo O, Ekundayo O, Ibiyo M, Igbokwe MC, Ogunsuji O, Fagbule F, Egwu O, Kanmodi K. Profile and determinants of intention to migrate by early career doctors in Nigeria: A report from CHARTING study. *The International Journal of Health Planning and Management*. 2022 May;37(3):1512-25.
- Badru OA, Alabi TA, Okerinde SS, Kabir MA, Abdulrazaq A, Adeagbo OA, Badru FA. Investigating the emigration intention of health care workers: A cross-sectional study. *Nursing open*. 2024 May;11(5):e217.0
- Omigbodun OO, Odukogbe AT, Omigbodun AO, Yusuf OB, Bella TT, Olayemi O. Stressors and psychological symptoms in students of medicine and allied health professions in Nigeria. *Social psychiatry and psychiatric epidemiology*. 2006 May;41:415-21.
- WHO. Achieving the health related MDGs. It takes a workforce! Retrieved from: https://www.who.int/hrh/workforce_mdgs/en/ (2017).

EXPLORING MEDICAL STUDENTS' USE OF ARTIFICIAL INTELLIGENCE (AI) ASSISTANTS: KNOWLEDGE, ATTITUDES, AND MOTIVATIONS.

Grace N. Kaluokoro, Somtochukwu Iliemenam-Ejike, Joshua D. Josiah, Paul Ugwu
Godswill Chidubem, Emmanuel Johnson

ABSTRACT

Background: Artificial intelligence (AI) assistants are increasingly integrated into medical education, providing support for learning, research, and clinical reasoning. However, their adoption among medical students and the factors influencing their use remain underexplored. This study examines the knowledge, attitudes, and motivations behind AI assistant usage among medical students.

Methods: A cross-sectional descriptive study was conducted among 397 clinical medical students at the University of Nigeria Teaching Hospital, Ituku-Ozalla. Data were collected using a structured, self-administered questionnaire and analyzed with SPSS 21. Descriptive statistics summarized responses, while chi-square tests assessed associations between socio-demographic characteristics, knowledge, and attitudes toward AI assistants.

Results: A high level of familiarity with AI assistants was observed (98%), with ChatGPT being the most widely used (82.6%). Daily interaction with AI assistants was reported by 49% of respondents, with social media (42.8%) being the primary source of awareness. Most students perceived AI assistants as beneficial in medical education (51.7%) and efficiency-enhancing (42.3%). However, concerns about over-reliance on AI (39.2%), ethical issues (39.2%), and accuracy (40.8%) were notable. No significant associations were found between socio-demographic factors and knowledge or attitudes toward AI assistants.

Discussion: The study highlights the widespread acceptance of AI assistants among medical students, emphasizing their role in improving learning efficiency and access to information. However, concerns about accuracy, ethics, and critical thinking necessitate structured AI integration into medical education. Clear guidelines and AI literacy programs are recommended to ensure responsible and effective use of AI tools in medical training.

INTRODUCTION

Artificial intelligence (AI) is technology that enables computers and machines to simulate human

learning, comprehension, problem solving, decision making, creativity and autonomy^{1,2}. Artificial intelligence (AI) is a general term that implies the use of a computer to model intelligent behavior with minimal human intervention. AI is generally accepted as having started with the invention of robots².

It has undoubtedly become an integral part of the modern society. Its application has sufficed in (but not limited to) the following areas, viz., medicine, finance, social media, agriculture, education, fraud prevention, navigation, transportation^{3,4}. In medicine, AI can assist healthcare providers in diagnosing ailments, clinical reasoning, data analysis, and making informed clinical decisions^{5,6}. Today, AI-based products extend beyond imaging and pathology-based diagnostic modalities to include various medical fields such as rheumatology, neurology, endocrinology, ophthalmology, orthopedics and surgery^{7,8,9,10,11}.

AI Assistant also called AI Virtual Assistant, is a software powered by artificial intelligence (AI) that responds to inquiries in human-like languages in text or voice format⁷. It leverages natural language processing (NLP) to process, understand and generate responses to the system users in a conversational manner⁷. AI assistants could be chatbots, conversational agents or even AI virtual assistants which perform a variety of tasks across multiple devices and platforms.

Common virtual assistant technologies include: Siri, Cortana, Google assistant, Amazon's Alexa, Mycroft, ChatGPT etc^{12,13,14}.

The indispensability of AI assistants in medical education has become more evident in recent times since its advent. Hence, this study aims to explore the knowledge and attitude of medical students towards the use of artificial intelligence assistants and to identify the purpose for which medical students engage in AI assistants^{15,16}.

METHODOLOGY

Study area

The study was conducted in the University of Nigeria Teaching Hospital (UNTH) Ituku Ozalla.

Study design

This study was a cross-sectional descriptive study among clinical medical students of University of Nigeria Teaching Hospital, Ituku-Ozalla.

Study population

The study involved undergraduate medical students across all medical classes of the University of Nigeria Enugu Campus. This includes 2nd, 3rd, 4th, 5th and 6th year medical students. Medical students in the above levels who do not consent to the study or were too ill to participate in the study were excluded.

Sample size determination

The sample size for the quantitative study was calculated using the Cochran's formula. The final sample size to be used was 397 participants.

Sampling technique

In this study, a stratified random sampling technique was employed to ensure proportional representation of medical students across the different academic years.

Study instruments

A self-administered questionnaire developed for the purpose of this study was used. The items in the questionnaire were categorized into 6 including; socio-demographics data, knowledge and awareness of AI assistants, attitude towards AI assistants, challenges to the use of AI assistants, perceived benefits to the use of AI assistants, purpose and reasons for use of AI assistants.

Ethical considerations

Ethical approval was gotten from the Health Research

and Ethics Clearance Committee, University of Nigeria Teaching Hospital, Ituku-Ozalla, Enugu State. Informed consent was obtained from each participant prior to the recruitment of the study. Participation in this study was completely voluntary with verbal consent obtained from all participants, and an informed written consent form duly signed as it was attached to the questionnaire. Strict confidentiality of information provided as well as anonymity was assured. Participants were subject to any form of physical or psychological harm as a result of this research and were assured of their rights to withdraw from the study at any stage if desired.

Data collection methods

Data was collected from participants by the researchers after the questionnaire was pretested among 20 randomly selected clinical medical students of the University of Nigeria Teaching Hospital to ensure that there were no ambiguous questions.

Data analysis

The data collected was analyzed using the Statistical Package for Social Sciences (SPSS) 21. The study employed descriptive statistics, such as means and percentages, to summarize the socio-demographic characteristics of the participants. Quantitative data were presented using tables and bar charts for clear visualization. Descriptive measures including mean, frequency, percentage, proportion, and standard deviation were used to characterize the data. The Chi-squared test was utilized to assess the significance of data comparisons, indicating significant associations between categorical variables.

RESULTS

We had a 96.25% response rate as 385 of 400 questionnaires were filled and returned

TABLE 1: SOCIO-DEMOGRAPHIC CHARACTERISTICS (385)

Variable	Frequency (N=385)	Percentage (%)	Mean (SD)
Age			21.78 (2.468)
18-20	126	32.7	
21-23	180	46.8	
24-26	60	15.6	
>27	19	4.9	
Gender			
Male	204	53.0	
Female	181	47.0	
Ethnicity			
Igbo	351	91.2	
Yoruba	2	0.5	

Hausa	1	0.3	
Others	31	8.0	
Year of Study			
2 nd Year	93	24.0	
3 rd Year	100	26.0	
4 th Year	58	15.0	
5 th Year	50	13.0	
6 th Year	84	21.0	
Department			
Medicine	371	96.4	
Dentistry	14	3.6	
Marital status			
Single	376	97.7	
Married	8	2.0	
Separated	1	0.3	
Divorced	0	0	
Widowed	0	0	
Religion			
Christianity	378	98.2	
Islam	2	0.5	
African Traditional Religion	1	0.3	
Others	4	1.0	
In-School Place of Residence			
Hostel	237	61.6	
Off-Campus	148	38.4	

The table shows the baseline socio-demographic characteristics of our respondents. Most of our respondents were between the age range of 21-23 (46.8%), Male (53%), Igbo (91.2%), 3rd Year (26%). Majority were single (97.7%), Christians (98.2%), department of Medicine & Surgery (96.4%) and reside in the hostel (61.6%).

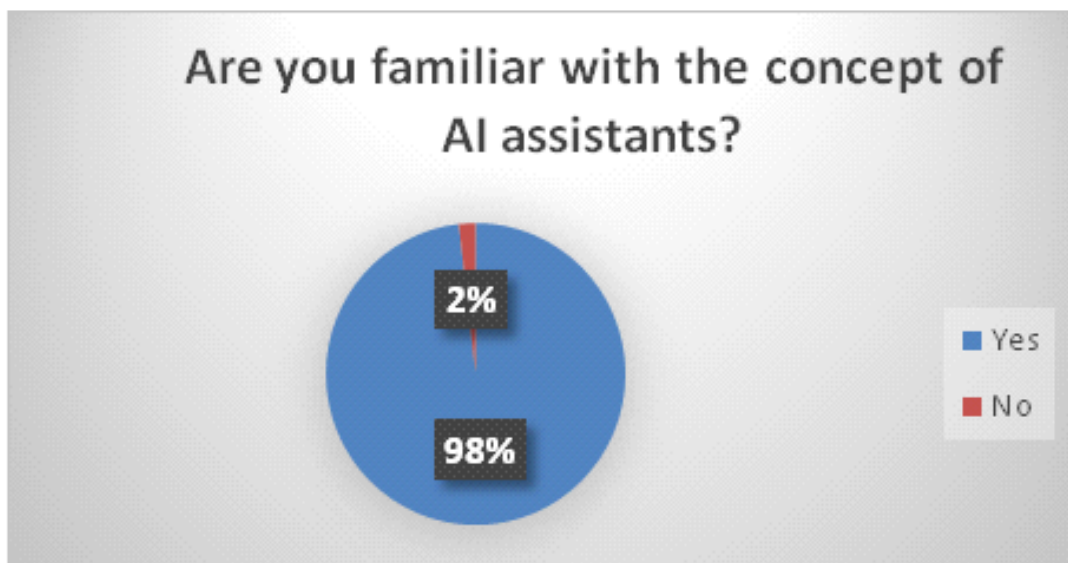
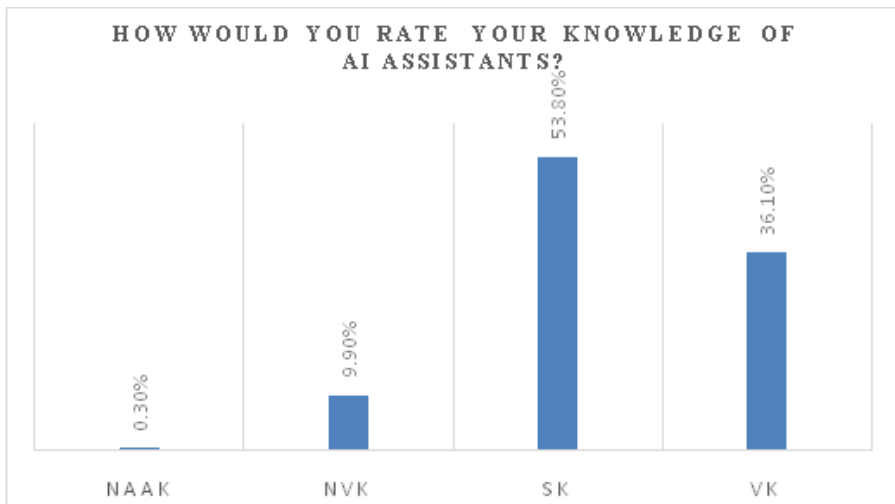


FIGURE 1: Are you familiar with the concept of AI assistants?

This figure shows that 98% of our respondents are familiar with the concept of AI assistants.



VK- Very Knowledgeable
 SK- Somewhat Knowledgeable
 NVK- Not Very Knowledgeable
 NAAK- Not at all knowledgeable

FIGURE 2: How would you rate your knowledge of AI assistants?

This figure shows that majority of our respondents (53.8%) are somewhat knowledgeable of AI assistants.

TABLE 2: KNOWLEDGE AND AWARENESS OF AI ASSISTANTS

Variable	Frequency (N=385)	Percentage (%)	Mean (SD)
How often do you interact with AI assistants?			
Daily	189	49.0	
Weekly	108	28.0	
Monthly	20	5.1	
Rarely	65	16.9	
Never	3	8.0	
Which AI assistants are you familiar with?			
ChatGPT	318	82.6	
Google Assistant	200	51.9	
Siri	93	24.2	
Alexa	35	9.1	
Meta AI	259	67.3	
Snapchat AI	95	24.7	
Others	24	6.2	
How did you learn about AI assistants?			
Social media	263	42.8	
Friends/peers	184	30	
Academic sources	90	14.6	
News/media	62	10	
Other	16	2.6	

The table shows that most of our respondents interact daily with AI assistants (49.1%), are familiar with ChatGPT (82.6%) and learnt about AI assistants through social media (42.7%)

TABLE 3: ATTITUDES AND PERCEPTION TOWARDS AI ASSISTANTS

Question	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
AI assistants are beneficial in medical education	199 (51.7)	154 (40)	29 (7.5)	2 (0.5)	1 (0.3)
I am comfortable using AI assistants for academic or medical purposes	147 (38.2)	157 (40.8)	69 (17.9)	8 (2.1)	4 (1)
AI assistants can improve medical students' efficiency	150 (39)	163 (42.3)	55 (14.2)	16 (4.2)	1 (0.3)
AI can assist in learning complex	168 (43.6)	163 (42.3)	38 (9.9)	12 (3.1)	4 (1)
AI will reduce the need for critical thinking in medical practice	72 (18.7)	134 (34.8)	86 (22.3)	66 (17.2)	27 (7)
AI might compromise patient privacy and confidentiality	56 (14.5)	93 (24.2)	117 (30.4)	85 (22.1)	34 (8.8)

This table shows that majority of our respondents agree that AI assistants are beneficial in medical education (51.7%), are comfortable using AI assistants for academic or medical purposes (40.8%), agree that AI assistants can improve medical students' efficiency (42.3%), can assist in learning complex medical concepts (43.6%) and will reduce the need for critical thinking in medical practice (34.8%).

TABLE 4: CHALLENGES TO THE USE OF AI ASSISTANTS

	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
Lack of access to reliable AI tools	6 (1.6)	181 (47)	74 (19.2)	31 (8.1)	6 (1.6)
Ethical concerns	62 (16.1)	151 (39.2)	101 (26.2)	60 (15.6)	11 (2.9)
Over-reliance on technology	100 (26)	151 (39.2)	79 (20.5)	40 (10.4)	15 (3.9)
Inaccuracy of AI-generated information	147 (38.2)	157 (40.8)	54 (14)	22 (5.7)	5 (1.3)

This table shows that majority of our respondents agree that the challenge to using AI assistants is lack of access to reliable AI tools (47%), ethical concerns (39.2%), over-reliance on technology (39.2%) and accuracy of AI-generated information (40.8%).

TABLE 5: PERCEIVED BENEFITS OF AI ASSISTANTS IN MEDICAL EDUCATION

Question	Strongly agree (%)	Agree (%)	Neutral (%)	Disagree (%)	Strongly disagree (%)
Improved access to information	177 (46)	183 (47.5)	23 (6)	2 (0.5)	0 (0)
Enhanced learning support	150 (39)	200 (51.9)	32 (8.3)	3 (0.8)	0 (0)
Time efficiency	169 (43.9)	185 (48.1)	28 (7.3)	3 (0.8)	0 (0)
Improved understanding of complex topics	173 (44.9)	167 (43.4)	34 (8.8)	5 (1.3)	6 (1.6)

This table shows that majority of our respondents agree that the following are the perceived benefits of AI assistant in medical education; improved access to information (47.5%), enhanced learning support (51.9%), time efficiency (48.1%) and improved understanding of complex topics (44.9%).

TABLE 6A: PURPOSES AND REASONS FOR THE USE OF AI ASSISTANTS

Question	Yes (%)	No (%)
For which purposes do you use AI assistants?	319(82.9)	66 (17.1)
General Knowledge queries	276(71.7)	109(28.3)
Medical information and research	180(46.8)	205(53.2)
Academic writing support	185(48.1)	200(51.9)
Practice and study aids	148(38.4)	237(61.6)
Personal productivity	14 (3.5)	371(96.4)
Which of the following AI assistant have you found helpful?		
ChatGPT	296(76.9)	89 (23.1)
Google Assistant	162(42.1)	223(57.9)
Siri	54 (14)	331 (86)
Alexa	10 (2.6)	375(97.4)
Meta AI	205(53.2)	108(46.8)
Snapchat AI	59 (15.3)	326(84.7)
Others	17 (4.4)	368(95.6)
In which of the following areas have you found AI assistants helpful?		
Study aids	298(77.4)	87 (22.6)
Clinical knowledge enhancement	187(48.6)	198(51.4)
Academic writing and assignment	193(50.1)	192(49.9)
Time management and organization	122(31.7)	263(68.3)
What is your primary motivation for using AI assistants in medical education?		
To enhance learning and understanding	281(73.0)	104 (27)
To save time	199(51.7)	183(48.3)
To access quick answers to complex questions	228(59.2)	157(40.8)
For practice and exam preparation	144(37.4)	241(62.6)
Others	4 (1)	381 (99)
Would you recommend AI assistants to your peers?	370(96.1)	15 (3.9)

This table shows that majority of our respondents use AI assistants for the purpose of general knowledge queries (82.9%), found ChatGPT helpful (76.9%), found AI assistants helpful as study aids (77.4%), have enhancing learning and understanding as the primary motivation for using AI assistants in medical education (73%) and will recommend AI assistants to your peers (96.1%).

TABLE 6B: PURPOSES AND REASONS FOR THE USE OF AI ASSISTANTS

Question	Frequency	Percentage (%)
Do you believe the use of AI in medical education should be promoted?		
Yes	253	65.7
Neutral	113	29.4
No	19	4.9

This table shows that majority of our respondents believe the use of AI in medical should be promoted (65.7%)

TABLE 7: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND KNOWLEDGE OF AI ASSISTANTS

Variable	Poor Attitude (%)	Moderate Attitude (%)	Good Attitude (%)	X ² test	P value
Age in years				11.281	0.080
18-20	26 (20.6)	78 (61.9)	22 (17.5)		
21-23	41 (22.8)	99 (55)	40 (22.2)		
24-26	9 (15)	43 (71.7)	8 (13.3)		
>27	3 (15.8)	16 (84.2)	0 (0)		
Gender				4.946	0.084
Male	37 (18.1)	122 (59.8)	45 (22.1)		
Female	42 (23.2)	114 (63)	25 (13.8)		
Ethnicity				7.569	0.271
Igbo	76 (21.7)	209 (59.5)	66 (18.8)		
Yoruba	0 (0)	1 (50)	1 (50)		
Hausa	0 (0)	1 (100)	0 (0)		
Others	3 (9.7)	25 (80.6)	3 (9.7)		
Year of Study				6.164	0.629
2 nd Year	20 (21.5)	56 (60.2)	17 (18.3)		
3 rd Year	28 (28)	56 (56)	16 (16)		
4 th Year	10 (17.2)	38 (65.6)	10 (17.2)		
5 th Year	7 (14)	33 (66)	10 (20)		
6 th Year	14 (16.7)	53 (63.1)	17 (20.2)		
Department				0.131	0.937
Medicine	76 (20.5)	228 (61.5)	67 (18.1)		
Dentistry	3 (21.4)	8 (57.2)	3 (21.4)		
Marital Status				0.861	0.930
Single	77 (20.5)	230 (61.2)	69 (18.3)		

Married	2 (25)	5 (62.5)	1 (12.5)		
Separated	0 (0)	1 (100)	0 (0)		
Divorced	0 (0)	0 (0)	0 (0)		
Widowed	0 (0)	0 (0)	0 (0)		
Religion				9.339	0.155
Christianity	79 (20.9)	233 (61.6)	66 (17.5)		
Islam	0 (0)	1 (100)	1 (0)		
ATR	0 (0)	0 (0)	0 (0)		
Others	0 (0)	2 (50)	2 (50)		
In-School Place of Res.				3.162	0.206
Hostel	42 (17.7)	152 (64.1)	43 (18.2)		
Off-Campus	37 (25)	84 (56.8)	27 (18.2)		

This table shows that there is no significant association between age, gender, ethnicity, year of study, department, marital Status, religion, in-school place of residence and attitude towards AI assistants.

TABLE 7: ASSOCIATION BETWEEN SOCIO-DEMOGRAPHIC CHARACTERISTICS AND ATTITUDE TOWARDS AI ASSISTANTS

Variable	Poor Attitude (%)	Moderate Attitude (%)	Good Attitude (%)	X ² test	P value
Age in years				6.701	0.349
18-20	2 (1.6)	45 (35.7)	79 (62.7)		
21-23	0 (0)	74 (41.1)	106 (58.9)		
24-26	2 (3.3)	22 (36.7)	36 (60)		
>27	0 (0)	6 (31.6)	13 (68.4)		
Gender				1.707	0.426
Male	3 (1.5)	73 (35.8)	128 (62.7)		
Female	1 (0.6)	74 (40.8)	106 (58.6)		
Ethnicity				3.338	0.765
Igbo	3 (0.9)	137 (40)	211 (60.1)		
Yoruba	0 (0)	1 (50)	1 (50)		
Hausa	0 (0)	0 (0)	1 (100)		
Others	1 (3.2)	9 (30)	21 (67.8)		
Year of Study				3.527	0.897
2 nd Year	1 (1.1)	31 (33.3)	61 (65.6)		
3 rd Year	1 (1)	42 (42)	57 (57)		
4 th Year	1 (1.7)	25 (43.1)	32 (55.2)		
5 th Year	0 (0)	20 (40)	30 (60)		
6 th Year	1 (1.2)	29 (34.5)	54 (64.3)		

Department				0.266	0.876
Medicine	4 (1.1)	141 (38)	226 (60.9)		
Dentistry	0 (0)	6 (42.9)	8 (57.1)		
MaritalStatus				4.051	0.399
Single	4 (1.1)	145 (38.6)	227 (60.4)		
Married	0 (0)	1 (12.5)	7 (87.5)		
Separated	0 (0)	1 (100)	0 (0)		
Divorced	0 (0)	0 (0)	0 (0)		
Widowed	0 (0)	0 (0)	0 (0)		
Religion				4.242	0.644
Christianity	4 (1.1)	144 (38.1)	230 (60.8)		
Islam	0 (0)	0 (0)	2 (100)		
ATR	0 (0)	0 (0)	1 (100)		
Others	0 (0)	3 (75)	1 (25)		
In-School Place of Res.				1.838	0.399
Hostel	3 (1.3)	96 (40.5)	138 (58.2)		
Off-Campus	1 (0.7)	51 (34.5)	96 (64.8)		

This table shows that there is no significant association between age, gender, ethnicity, year of study, department, marital Status, religion, in-school place of residence and attitude towards AI assistants.

TABLE 8: ASSOCIATION BETWEEN KNOWLEDGE AND ATTITUDE TOWARDS AI ASSISTANTS

Variable	Poor Attitude (%)	Moderate Attitude (%)	Good Attitude (%)	X ² test	P value
Poor knowledge	1 (1.2)	33 (41.8)	45 (57)	2.742	0 . 6 0 2
Moderate knowledge	2 (0.9)	93 (39.4)	141 (59.7)		
Good knowledge	1 (1.4)	21 (30)	48 (68.6)		

This table shows that there is no significant association between knowledge and attitude towards to AI assistants

DISCUSSION

The findings of this study indicate a high level of familiarity with AI assistants among medical students, with 98% of respondents reporting awareness. This aligns with previous studies that have documented increasing AI awareness among medical students and physicians, reflecting the growing integration of AI in medical education and practice¹⁷⁻²¹. ChatGPT was the most recognized AI tool (82.6%), which is consistent with findings from two similar studies that identified ChatGPT as the most widely used AI assistant in academic and professional settings^{22,24}. Additionally, nearly half of the respondents (49%) reported daily

interactions with AI assistants, and social media (42.8%) was the primary source of AI awareness. This is comparable to a prior research that highlights the role of digital platforms in disseminating AI-related knowledge²⁴.

Regarding attitudes towards AI assistants, most of the respondents perceived them as beneficial in medical education (51.7%), enhancing efficiency (42.3%), and aiding in the learning of complex concepts (43.6%). These positive perceptions align with studies facilitating knowledge acquisition and academic performance among medical students²³⁻²⁶.

However, concerns about over-reliance on AI (39.2%) and potential threats to patient privacy (30.4%) were notable. Ethical concerns surrounding AI use in medicine have been well-documented in previous research, reinforcing the need for clear guidelines on responsible AI adoption^{23,24}. Furthermore, 34.8% of respondents believed that AI might reduce the need for critical thinking, suggesting a cautious approach to its integration in medical education. Similar concerns have been raised in other studies, emphasizing the importance of fostering AI literacy while maintaining strong clinical reasoning skills²⁴.

The major challenge identified in this study included limited access to reliable AI tools (47%), ethical concerns (39.2%), and the inaccuracy of AI-generated information (40.8%). These findings are in line with studies that have highlighted the risks of biased and misleading AI-generated content²³. However, unlike some previous research that identified unreliable internet connectivity as the primary limitation to AI adoption²⁴, our study found that tool reliability and ethical concerns were more pressing issues, this suggests that as AI becomes more integrated into medical education, students are shifting their concerns from accessibility to the quality and reliability of AI-generated information.

In terms of perceived benefits, the study reaffirmed AI assistants' positive impact on medical education, with respondents agreeing that AI assistants improves access to information (47.5%), enhances learning support (51.9%), and increases time efficiency (48.1%). These results are consistent with prior studies that have emphasized AI's role in streamlining learning and clinical decision-making^{24,25}. The findings highlight the transformative potential of AI assistants in resource-limited settings, where access to comprehensive medical literature and expert guidance is often constrained.

Interestingly, no significant associations were found between demographic characteristics and knowledge or attitudes toward AI assistants. This contrasts with a previous study that reported a significant link between awareness of AI and its use in academic learning²⁴. The lack of a clear association in our study suggests that AI familiarity is widespread across different student demographics, with usage patterns likely influenced more by personal preferences and learning styles than by socio-demographic factors.

Most respondents agreed that AI assistants are beneficial in medical education (51.7%), enhance

efficiency (42.3%), and assist in learning complex concepts (43.6%). However, concerns about over-reliance on AI assistants (39.2%) and potential compromises in patient privacy (30.4%) indicate that while AI assistants are perceived as useful, ethical considerations remain. Similar concerns were also reported in similar studies.²³⁻²⁶ The perception that AI assistants might reduce the need for critical thinking (34.8%) also suggests a cautious approach to its use in medical education.

The most significant challenges identified included lack of access to reliable AI tools (47%), ethical concerns (39.2%), and the inaccuracy of AI-generated information (40.8%). Similar concerns were also reported in other studies²³. However, this is different from a few other studies which reported unreliable connectivity as a major challenge to the use of AI assistants²⁴. These barriers highlight the need for improved AI integration strategies, emphasizing accuracy, accessibility, and ethical guidelines.

AI assistants were seen as improving access to information (47.5%), enhancing learning support (51.9%), and boosting time efficiency (48.1%). These findings underscore the transformative potential of AI in medical education, particularly in resource-limited settings where access to up-to-date information is crucial.

No significant associations were found between demographic characteristics and attitudes toward AI assistants. Similarly, no significant association was observed between knowledge levels and attitudes. This suggests that AI familiarity and usage are widespread across different student groups, and perceptions of AI are not significantly influenced by demographic differences. However, this is different from other studies which reported a significant association between awareness of AI and the use of AI assistants in learning²⁴.

CONCLUSION

The study highlights the widespread familiarity and use of AI assistants among medical students, with ChatGPT being the most commonly used tool. While AI is widely perceived as beneficial in enhancing learning efficiency, concerns regarding its accuracy, ethical implications, and potential impact on critical thinking remain.

The findings emphasize the need for structured AI integration in medical education, ensuring that AI tools complement rather than replace essential cognitive and ethical reasoning skills.

RECOMMENDATIONS

To maximize the benefits of AI assistants in medical education while addressing the identified challenges, institutions should incorporate AI literacy programs into their curricula. This will enable students to critically evaluate AI-generated information and use these tools effectively. Additionally, there is a need for clear regulatory guidelines at both institutional and national levels to ensure ethical AI usage, particularly in fields like medicine where accuracy and confidentiality are crucial.

Furthermore, AI assistants should be positioned as supplementary learning aids rather than replacements for human decision-making and critical thinking skills. This can be achieved by encouraging students to verify AI-generated information against standard medical sources. By addressing these areas, AI assistants can be effectively integrated into medical education, enhancing learning while mitigating potential risks.

REFERENCES

1. INVESTOPEDIA [Internet]. Investopedia. 2019. Available from: <https://www.investopedia.com>
2. Hamet P, Tremblay J. Artificial intelligence in medicine. *Metabolism*. 2017 Apr;69S:S36-S40. Doi: 10.1016/j.metabol.2017.01.011. Epub 2017 Jan 11. PMID: 28126242.
3. Agnieszka Jadwiga Wójcik-Czerniawska. The Role of Artificial Intelligence in Modern Finance and Sustainable Marketing. *Advances in marketing, customer relationship management, and e-services book series*. 2023 Jun 26;355-71.
4. NCAIR [Internet]. Nitda.gov.ng. 2024. Available from: <https://ncair.nitda.gov.ng>
5. Khosravi M, Zare Z, Mojtabaieian SM, Izadi R. Artificial Intelligence and Decision-Making in Healthcare: A Thematic Analysis of a Systematic Review of Reviews. *Health Serv Res Manag Epidemiol*. 2024 Mar 5;11:23333928241234863. Doi: 10.1177/23333928241234863. PMID: 38449840; PMCID: PMC10916499.
6. Alowais, S.A., Alghamdi, S.S., Alsuhebany, N. et al. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ* 23, 689 (2023). <https://doi.org/10.1186/s12909-023-04698-z>
7. MahdiZarei, HamidEftekhariMamaghani, Abbasi A, Hosseini MS. Application of artificial intelligence in medical education: A review of benefits, challenges, and solutions. *MedicinaClínicaPráctica*. 2024 Apr 1;7(2):100422-2.
8. Stafie CS, Sufaru IG, Ghiciuc CM, Stafie II, Sufaru EC, Solomon SM, Hancianu M. Exploring the Intersection of Artificial Intelligence and Clinical Healthcare: A Multidisciplinary Review. *Diagnostics (Basel)*. 2023 Jun 7;13(12):1995. Doi: 10.3390/diagnostics13121995. PMID: 37370890; PMCID: PMC10297646.
9. Adham El Sherbini, Glicksberg BS, ChayakritKrittanawong. Artificial intelligence in primary care. Elsevier eBooks. 2024 Jan 1;1-13.
10. Adham El Sherbini, Glicksberg BS, ChayakritKrittanawong. Artificial intelligence in general internal medicine. Elsevier eBooks. 2023 Sep 15;15-24.
11. Raghavan L, Cheng CY, Wong TY. Artificial intelligence in ophthalmology II: glaucoma. Elsevier eBooks. 2023 Sep 15;113-7.
12. Hoy MB. Alexa, Siri, Cortana, and More: An Introduction to Voice Assistants. *Med Ref Serv Q*. 2018 Jan-Mar;37(1):81-88. Doi: 10.1080/02763869.2018.1404391. PMID: 29327988.
13. Nobles AL, Leas EC, Caputi TL, Zhu SH, Strathdee SA, Ayers JW. Responses to addiction help-seeking from Alexa, Siri, Google Assistant, Cortana, and Bixby intelligent virtual assistants. *NPJ Digit Med*. 2020 Jan 29;3:11. Doi: 10.1038/s41746-019-0215-9. PMID: 32025572; PMCID: PMC6989668.
14. Yang S, Lee J, Sezgin E, Bridge J, Lin S. Clinical Advice by Voice Assistants on Postpartum Depression: Cross-Sectional Investigation Using Apple Siri, Amazon Alexa, Google Assistant, and Microsoft Cortana. *JMIR*

- 2021 Jan 11;9(1):e24045. Doi: 10.2196/24045. PMID: 33427680; PMCID: PMC7834933.
15. Chan KS, Zary N. Applications and Challenges of Implementing Artificial Intelligence in Medical Education: Integrative Review. *JMIR Med Educ.* 2019 Jun 15;5(1):e13930. Doi: 10.2196/13930. PMID: 31199295; PMCID: PMC6598417.
 16. Sun L, Yin C, Xu Q, Zhao W. Artificial intelligence for healthcare and medical education: a systematic review. *Am J Transl Res.* 2023 Jul 15;15(7):4820-4828. PMID: 37560249; PMCID: PMC10408516.
 17. Mohammad Muzaffar Mir, Mir G, Nadeem Tufail Raina, Mir S, Mir S, ElhadiMiskeen, et al. Application of Artificial Intelligence in Medical Education: Current Scenario and future Perspectives. *PubMed [Internet].* 2023 Jul 1;11(3):133–40. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10352669/>
 18. MahdiZarei, HamidEftekhariMamaghani, Abbasi A, Hosseini MS. Application of artificial intelligence in medical education: A review of benefits, challenges, and solutions. *MedicinaClínicaPráctica.* 2024 Apr 1;7(2):100422–2.
 19. Chan KS, Zary N. Applications and Challenges of Implementing Artificial Intelligence in Medical Education: Integrative Review. *JMIR Medical Education [Internet].* 2019 Jun 15 [cited 2019 Nov 13];5(1):e13930. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6598417/>
 20. Sapci AH, Sapci HA. Artificial Intelligence Education and Tools for Medical and Health Informatics Students: Systematic Review. *JMIR Medical Education.* 2020 Jun 30;6(1):e19285.
 21. Varma J, Fernando S, Boon Ping Ting, ShahrukhAamir, Rajesh Sivaprakasam. The Global Use of Artificial Intelligence in the Undergraduate Medical Curriculum: A Systematic Review. *Cureus.* 2023 May 30.21. Narayanan S, Ramakrishnan R, Durairaj E, Das A, Narayanan S, Ramakrishnan R, et al.
 22. Ankamah S, Gyesi K, Amponsah V. Awareness, knowledge, and attitude towards artificial intelligence: Perspective of medical students in Ghana. *Information Development.* 2024 Sep 17;
 23. Jackson P, GayathriPonathSukumaran, Babu C, M. Christa Tony, DeenStephano Jack, Reshma VR, et al. Artificial intelligence in medical education – perception among medical students. *BMC Medical Education.* 2024 Jul 27;24(1).
 24. Wobo KN, Nnamani IO, Alinnor EA, Gabriel-Job N, Paul N. Medical students' perception of the use of artificial intelligence in medical education. *International Journal of Research in Medical Sciences [Internet].* 2024 Dec 31 [cited 2025 Jan 28];13(1):82–9. Available from: https://www.msionline.org/index.php/ijrms/article/view/14539?utm_source=perplexity
 25. Hadithy ZAA, Lawati AA, Al-Zadjali R, Sinawi HA, Hadithy ZAA, Lawati AA, et al. Knowledge, Attitudes, and Perceptions of Artificial Intelligence in Healthcare Among Medical Students at Sultan Qaboos University. *Cureus [Internet].* 2023 Sep 8;15(9). Available from: <https://www.cureus.com/articles/181065-knowledge-attitudes-and-perceptions-of-artificial-intelligence-in-healthcare-among-medical-students-at-sultan-qaboos-university#>
 26. Moldt JA, Festl-Wietek T, MadanyMamlouk A, Nieselt K, Fuhl W, Herrmann-Werner A. Chatbots for future docs: exploring medical students' attitudes and knowledge towards artificial intelligence and medical chatbots. *Medical Education Online.* 2023 Feb 28;28(1).

Evolution of Medical Education: Historical Perspectives, Objectives, and Changing Processes.

Okike C. Christian

Faculty of Clinical Sciences College of Medicine, University of Nigeria Enugu Campus

1.0 INTRODUCTION

In response to scientific advancement and the increasing societal needs, medical education has evolved and continues to evolve. Throughout most of the twentieth century, the traditional medical educational system has led to the production of generations of clinically skilled and scientifically grounded physicians [1]. Notwithstanding, sporadic changes during the turn of the millennium have greatly contributed to a revolution in undergraduate medical education (UME) and graduate medical education (GME) [1,2,3]. This multifaceted change qualifies as an abrupt and disruptive innovation. It therefore requires continuous assessment of the enduring value of the medical educational system and sustainable medical practice in shaping the healthcare system worldwide [2, 4].

This review article will examine the historical development and perspectives of medical education. It also explores the purpose and objectives of medical education and its changing processes. This will help create feedback that can be imbibed in our academic curricula and in bridging obtainable gaps in modern healthcare, with the beneficiaries being burgeoning practitioners, developing physicians, and the general public, thus, ensuring better outcomes for academic medicine and clinical practice.

2.0 HISTORICAL PERSPECTIVES OF MEDICAL EDUCATION.

The teaching of medicine from the days of the early priest-physicians has had a highly personal characteristic through a close physician-pupil relationship, which despite varying in degrees as times have changed has remained persistent even till modern times [5]. This is reflected in what is termed "The evolution of Medical education". Medical education is simply defined as art with scientific principles. The uniqueness of medical education is in its dealing with human life and well-being. Medical education requires distinctive knowledge, skills, and behavior unlike other branches of science, technology, literature, and art [6].

Furthermore, research shows that it is difficult to ascertain the origin of medical education however, many authorities usually consider that it goes back

several thousand years to the era of Ancient Greece where the ancient precepts on the earliest statement on pupil-teacher relationship can be traced back to [5, 7]. This inference can be found in the commentaries written by a Charaka, who like Hippocrates was a great teacher in medicine [5]. It is also further exemplified in the Hippocratic oath. This apprenticeship system spread across Rome and Greece where medical practices began to emphasize a scientific approach thus giving way to the medieval times.

During the medieval times, the first school of medicine was founded by the representatives of the four cultural forces persisting during the era: a Greek, a Jew, a Latin, and an Arab [5,8]. This era gave way to the Renaissance which marked the renaissance of Italian medical schools especially those of Padua, Bologna, Ferrara, and Pisa. A good number of the practicing physicians of the fourteenth and fifteenth century England practiced in these medical schools.

The period of transition was soon after the Renaissance. It gave way to "new learning" in the Western world giving life to both science and medicine. The development of medical schools in the 18th and 19th Centuries saw the establishment of key medical institutions in Europe and the US [5,9]. It was also remarkably marked by the advances in anatomy, pathology, and morbid anatomy which significantly transformed the curriculum of medical schools [9, 10].

Furthermore, we also witnessed the transition from physician-student tutorship to formalized and structured medical education with well-organized curricula, as shown by the Flexner's report of 1910 [11]. This report transformed the nature and process of medical education via; standardization of medical education and learning, promoting emphasis on science, reduction in the number of schools, an increase in more rigorous training, and the increased role of government participation [11,12]. Ultimately, this marked a radical shift in how medicine was taught and embraced scientific knowledge and its advancement as the defining ethos of a modern physician and leading to the establishment of the biomedical model as the gold standard of medical training.

3.0 OBJECTIVES OF MEDICAL EDUCATION

3.1 Personal and Professional Development

Medical education exemplifies the qualities that are crucial for sustaining development in the field of medicine. The development of self-awareness of one's emotional limitations is very key to enabling practitioners and medical students to learn when to seek help. This involves practicing healthy coping mechanisms in response to stress, managing competitive demands among personal and professional responsibilities and applying flexibility and maturity when adjusting to change and difficult situations [12].

In addition, through professional development, medical professionals learn to demonstrate trustworthiness which plays a fundamental role in building strong relationships, ensuring that all parties—patients, families, and healthcare teams, feel at ease.

Also, to balance the increasing demands of health care, medical education through professional development enables medical professionals to develop administrative, leadership, organizational and time management skills which are essential for optimizing work-life balance [13]. Also, medical education enables health professionals learn that uncertainty is an inevitable part of clinical healthcare and thus, must rely on appropriate resources that can help guide decision-making and patient care effectively.

3.2 MULTIDISCIPLINARY COLLABORATION.

To deliver safe and effective patient centered care, inter-professional collaboration is key. It demonstrates the ability to work with different healthcare professionals to provide a climate of mutual respect, dignity, diversity, and trust [12, 14]. Medical education also provides the channel which helps to describe the roles of every member of the healthcare team. This helps to apply the team's diverse knowledge to address and ensure a holistic approach to the health needs of individuals and populations. Effective communication is crucial for multidisciplinary collaboration. Healthcare professionals are required to interact responsibly to foster seamless coordination of care for individual patients and entire populations.

3.3 PRACTICE-BASED LEARNING AND IMPROVEMENT

Practice-based learning and improvement as an objective in medical education helps medical professionals to investigate and evaluate patients' care. It further emphasizes the ability to appraise one's

medical practice to integrate scientific evidence into everyday decision-making. By identifying the strengths and limitations in one's knowledge, skills, and attitudes, healthcare professionals can set personal learning and improvement goals that help address this deficiency in their area of expertise [15].

Furthermore, practice based learning enables the systemic analysis of medical practice using quality improvement methods and further helps to implement changes with the purpose of improvement. Also, by continuously incorporating feedback and self-reflection into daily practice, healthcare providers can identify areas for improvement and implement changes to enhance patient outcomes.

Staying informed about recent developments, technologies, guidelines, and scientific advances is crucial and practice-based learning and improvement provides opportunities where healthcare providers can continuously seek out, appraise, and assimilate new research and evidence that is relevant to their patients' health problems [15].

3.4 PATIENT CARE

Through medical education, patient care that fosters compassion, appropriate and effective treatment of health problems, and health promotion is possible. It involves performing medical, diagnostic, and technical procedures that are essential to post-graduate training [16]. The process begins with gathering accurate and critical information through history taking, physical examination, lab data, and imaging to assess a patient's condition. Medical education offers clinical reasoning through which healthcare professionals develop a differential diagnosis to achieve a focused approach to treatment. Also, the use of evidence-based practices allows for accurate diagnoses and effective treatment plans through monitoring and interpreting necessary tests.

A key aspect of patient care involves carrying out management plans that are patient-centered, safe, effective, and value-based. These plans through counseling and education, empower patients to engage in preventive health care and take an active role in their care plans to involve patients and their families in the decision-making process. Additionally, patient care helps medical professionals initiate evaluation and management by recognizing a patient requiring urgent or emergent care early enough [16, 17].

Also, providing appropriate referrals of patients helps ensure continuity of care, particularly when patients transition between different providers or healthcare settings.

This includes specialist referrals, follow-ups, and steady monitoring of patient's progress, providing health care services to communities geared towards preventing health problems. Through these collaborative interventions, Medical objectives through patient care are extended to include prevention, education, and collaboration for better health outcomes.

3.5 INTERPERSONAL AND COMMUNICATION SKILLS.

Through interpersonal and communication skills, the exchange of information and collaboration with health professionals, patients and their families is effective. Medical professionals are trained to speak with empathy, compassion, and active listening, geared to a diverse range of socioeconomic and cultural backgrounds, fosters a positive and productive work environment which is very critical for high-quality care [18].

Teamwork is another key aspect of communication skills. Healthcare professionals are trained to effectively work with others as members or leaders of a healthcare team to ensure that everyone collaborates to achieve the best outcomes for patients.

Also, maintaining clear, accurate, and original records with attention to privacy is essential through proper medical education. It ensures patients' safety while adhering to legal and ethical standards. Furthermore, it teaches medical professionals how to handle difficult conversations, such as those about death, end-of-life care, breaking bad news, and disclosure of errors.

Through interpersonal communication, medical professionals understand the emotional dynamics between healthcare professionals, patients, and families, thus, fostering meaningful interactions [12,18, 19]. Additionally, medical education also helps healthcare providers identify and address barriers such as language differences, education levels, or intellectual challenges crucial to ensure that communication remains clear and effective, thus contributing to improved care and a supportive environment for all involved.

3.6 KNOWLEDGE FOR PRACTICE.

Medical education enables practitioners to demonstrate knowledge of evolving biomedical, clinical, epidemiological, and social-behavioral sciences and subsequently and apply that knowledge to patient care. Medical practitioners are trained to apply effective clinical reasoning to assess and respond to clinical situations by utilizing investigative and analytical approaches [12, 20]. This involves

applying established and emerging scientific principles that are crucial to healthcare and broader populations.

Physicians are trained to integrate principles of clinical sciences into clinical reasoning and other aspects of evidence-based healthcare. This involves the application of the principles of epidemiological sciences to identify health problems, risk factors, and treatment strategies while addressing healthcare disparities and focusing on disease prevention and health promotion for both patients and populations.

In addition to scientific and clinical knowledge, social-behavioral sciences play a crucial role in patient care. Healthcare providers must be able to assess how psychosocial and cultural factors influence health, disease, care-seeking behaviors, and adherence to treatment plans. Understanding and addressing barriers and attitudes toward care is essential for effective patient care [20].

4.0 CHANGING PROCESSES IN MEDICAL EDUCATION.

Medical education is constantly evolving to reflect advancements in science, shifts in healthcare delivery, and societal needs. As the focus of medical care shifts from acute to chronic disease management, curricula have adapted and schools have also broadened instructions on emerging public health issues with a more comprehensive understanding of patient care. Thus, the structure of medical training is changing as well, with a focus on early clinical exposure and integrated curricula that combine basic and clinical sciences. These processes are highlighted in the following preceding paragraphs.

4.1 SIMULATION AND VIRTUAL LEARNING

The rise of high-fidelity simulations and virtual reality has played a crucial role in revolutionizing medical simulations and training. In traditional training models, real patients were practiced by students, which led to mistakes that compromised patient safety. Simulations by providing immersive and hands-on learning environments without risks to real patients allow students to practice complex procedures in a safe and controlled setting [22].

Thus, this safe space fosters an environment where students can learn from their mistakes without causing any harm.

For example, simulation-based training (SBT) utilizing virtual reality systems allow medical students to conduct virtual surgeries or navigate complex anatomy with life-like precision.

These technologies enable students to build muscle memory, increase their confidence, and bridge the gap between theoretical knowledge and clinical application [22, 23]. More so, because simulations can be repeated as often as necessary, students are better prepared to gain early mastery before interacting with real-life situations.

4.2. E-LEARNING AND ONLINE RESOURCES

E-learning platforms and Massive Open Online Courses (MOOCs) have transformed the accessibility and flexibility of medical education. These platforms provide flexibility in learning by providing students from around the world with access to high-quality lectures, peer discussions, and assessments [24]. This allows students to study at their own pace and further helps to break down geographical limitations and time constraints.

The COVID-19 pandemic fueled this trend, as many medical universities had to shift to online platforms to make medical education more accessible and convenient [25]. This caused traditional lectures and textbooks to be complemented and even replaced by interactive digital platforms, thus offering a more enhanced learning experience in a more dynamic and personalized way.

Today, the hybrid model of “blended learning”, which combines online resources with hands-on clinical practice has become a core part of medical education. Students can now access a pool of medical databases and video tutorials, and revisit lectures and course materials as needed, allowing students to deepen their knowledge beyond what is taught in the traditional classrooms.

4.3 TELEMEDICINE AND REMOTE LEARNING

The World Health Organization defines telemedicine as “the delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment, and prevention of disease and injuries, research and evaluation, and for the continuing education of health care providers, all in the interests of advancing the health of individuals and their communities” [26].

The rise of telemedicine has redefined both healthcare delivery and medical education. In light of the COVID-19 pandemic, telemedicine became a necessity for remote consultations and medical schools began to adapt by incorporating telemedicine training into their curricula [27]. This training includes diagnosing patients remotely, conducting vital consultations, and

maintaining effective doctor-patient communication through telecommunication tools, hence, fostering efficient healthcare delivery. Telemedicine education allows medical professionals to be prepared for a fast-evolving healthcare landscape where remote care is becoming the norm, especially in rural communities.

4.4 ADAPTIVE LEARNING AND ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is a branch of computer science that centers on developing algorithms and software that copy human thinking and decision-making. The rapid emergence of AI in today's world has emerged as an integral part of healthcare and medical education, and has been adopted by several medical institutions worldwide [28,29].

In medical institutions, AI is used as an intelligent and effective tool for facilitating the decision-making process. The sub-themes of the use of AI such as chatbots, intelligent tutoring systems (ITSs), virtual patients and adaptive learning systems can enhance students' knowledge, skill development, and understanding of complex medical concepts [28]. Thus, AI-integrated medical education paves new opportunities for advanced teaching and learning experiences with improved outcomes.

4.5 COMPETENCY-BASED EDUCATION

Competency-based medical education (CBME) is a model for medical training and assessment that focuses on achieving specific competencies required for the practice of medicine [30]. These competencies are defined based on the needs of patients, society, and the healthcare system and they do not follow the fixed, time-based curriculum. Student progress in medical school is demonstrated by the mastery of these crucial skills which include clinical reasoning, communication, procedural skills, and professional behavior. CBME better aligns with the objectives of producing highly skilled and competent healthcare professionals by focusing on competencies other than the time spent on training [30, 31].

4.6 CROSS-CULTURAL COMPETENCIES AND TRAINING

There is a growing emphasis on teaching students cross-cultural competencies as healthcare systems become increasingly multicultural. Medical education now trains students on how to work effectively with patients from different cultural backgrounds, understand different health beliefs, and also on managing cultural sensitivities [32]. This is important not only for patient care improvement but also for reducing health disparities and culture shocks in the global healthcare systems.

4.7 INTERDISCIPLINARY EDUCATION

The shift towards “interdisciplinary education” reflects the complexity of modern healthcare and a “silo” approach to healthcare cannot continue. Hence, collaboration among healthcare providers is crucial for positive outcomes. Coming together as a team will bring the individual strengths of each discipline to focus on patient care and complement the weaknesses of other healthcare providers [33]. Thus, many medical schools now integrate various basic sciences from the outset, creating a more holistic learning experience. This approach enables students to make connections between practical application and theoretical knowledge, helping them to see the correlation of multidisciplinary approaches to patient care.

5.0 CONCLUSION

In conclusion, the evolution of medical education illustrates the responses to advancements in healthcare and medical sciences. To meet the increasing demands of modern healthcare, Medical education has consistently evolved to better equip physicians for these changes, this is evident from its historical roots of apprenticeship-based learning to a more revised evidence-based curricula.

The integration of new technologies, such as simulation-based training, e-learning, and telemedicine, has substantially enhanced a learning experience that is better adapted to the disruption in the medical landscape. These changes emphasize the importance of continuous innovation in medical education to create a burgeoning generation of medical professionals who are flexible, adaptable, skilled, and prepared to address the turbulent tides of evolution in both local and global health landscapes.

By continuously adapting to new knowledge and healthcare needs, medical education shines a ray of light in shaping the future of healthcare that we all desire and subsequently, it ensures that medical students and physicians remain at the helm of clinical excellence and practice.

REFERENCES

1. Gregg A, Turner EL, Scarborough H. Medical education | Benefits, Challenges & Solutions [Internet]. Encyclopedia Britannica. 2024. Available from: <https://www.britannica.com/science/medical-education/Requirements-for-practice>
2. Europe PMC. Europe PMC [Internet]. Available from: <https://europepmc.org/article/med/26859376>
3. Samarasekera DD, Goh PS, Lee SS, Gwee MCE. The clarion call for a third wave in medical education to optimise healthcare in the twenty-first century. *Medical Teacher* [Internet]. 2018 Oct 3;40(10):982–5. Available from: <https://doi.org/10.1080/0142159x.2018.1500973>
4. Shelton PG, Corral I, Kyle B. Advancements in Undergraduate Medical Education: Meeting the challenges of an evolving world of education, healthcare, and technology. *Psychiatric Quarterly* [Internet]. 2016 Nov 5;88(2):225–34. Available from: <https://doi.org/10.1007/s1126-016-9471-x>
5. Fulton J. History of medical education. *British Medical Journal* [Internet]. 1953 Aug 29;457–61. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2029428/pdf/brmedj03405-0017.pdf>
6. Ronaghy H. A brief history of Medical Education. *Science Forecast Journal* [Internet]. 2018 Apr 30; Available from: <https://scienceforecastoa.com/Articles/JFM-V1-E1-1007.pdf>
7. Emmanouil P, Pavlos M, Avgerinos ED, Sofia A, Christos T. Evolution of medical education in ancient Greece. *Chinese Medical Journal* [Internet]. 2008 Nov 1;121(21):2202–6. Available from: https://www.researchgate.net/publication/23661014_Evolution_of_medical_education_in_ancient_Greece
8. Guemes L. Main characteristics of medieval medical education and its legacy in contemporary medical education. *Research Gate* [Internet]. 2022 Oct; Available from: https://www.researchgate.net/profile/Luciana-Acosta-Gueemes/publication/364335885_Main_characteristics_of_medieval_medical_education_and_its_legacy_in_contemporary_medical_education/links/634adae0ff870c55ce27e825/Main-characteristics-of-medieval-medical-education-and-its-legacy-in-contemporary-medical-education.pdf?origin=publication_detail&tp=eyJlb250ZXh0ljp7ImZpcnNOUGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uRG93bmxvYWQlLCJwcmV2aW91c1BhZ2UiOiJwdWJsaWNhdGlvbiJ9fQ

9. Richardson RG, Rhodes P, Thomson WAR, Guthrie DJ, Underwood EA. History of medicine | History & Facts [Internet]. Encyclopedia Britannica. 2024. Available from: <https://www.britannica.com/science/history-of-medicine/The-spread-of-new-learning>
10. McLean J. The Medical Renaissance | History of Western Civilization II [Internet]. Available from: <https://courses.lumenlearning.com/suny-hccc-worldhistory2/chapter/the-medical-renaissance/#:~:text=During%20the%20Renaissance%2C%20experimental%20investigation,anatomy%20and%20modernized%20medical%20research.>
11. Duffy T. The Flexner Report – 100 Years Later. *Yale Journal of Biology and Medicine* [Internet]. 2011 Sep;84(3):269–76. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3178858/>
12. Beck A. The Flexner report and the standardization of American medical education. *Journal of American Medical Association* [Internet]. 2004 Jun; Available from: https://www.researchgate.net/profile/Andrew-Beck/publication/8579952_STUDENTJAMA_The_Flexner_report_and_the_standardization_of_American_medical_education/links/02bfe5137d867065c4000000/STUDENTJAMA-The-Flexner-report-and-the-standardization-of-American-medical-education.pdf?origin=publication_detail&tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmVpY2F0aW9uLiwiGFnZSI6InB1YmVpY2F0aW9uRG93bmxvYWQlLCJwcmV2aW91c1BhZ2UiOiJwdWJsaWNhdGlvbiJ9fQ
13. Farahmand S, Malakan E. Exploring the effective elements on the personal and professional development among health-care providers: a qualitative study. *National Library of Medicine* [Internet]. 2022 Aug 25;11(256). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9621364/>
14. Tarberna M. The Multidisciplinary Team (MDT) Approach and Quality of Care. *Nigeria Library of Medicine* [Internet]. 2020 Apr;10(85). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7100151/>
15. Ogrinc G, West A, Eliassen MS, Liuw S, Schiffman J, Cochran N. Integrating Practice-Based Learning and Improvement into Medical Student Learning: Evaluating Complex Curricular Innovations. *Teaching and Learning in Medicine* [Internet]. 2007 Jun 19;19(3):221–9. Available from: <https://doi.org/10.1080/10401330701364593>
16. Tawada K. The importance of medical education on health care [Internet]. 2022. Available from: <https://www.globalscienceresearchjournals.org/articles/the-importance-of-medical-education-on-health-care-90882.html>
17. Wijnen-Meijer M. Focus on patients in medical education. *GMS Journal for Medical Education* [Internet]. 2021 Aug 15;38(5). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8256126/>
18. Gilligan C, Powell M, Lonsdale C. Interventions for improving medical students' interpersonal communication in medical consultations. *Cochrane Library* [Internet]. 2021 Feb 9; Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8094582/>
19. Choudhary A, Gupta V. Teaching communications skills to medical students: Introducing the fine art of medical practice. *International Journal of Applied and Basic Medical Research* [Internet]. 2015 Aug 15;S41–4. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4552065/>
20. Lauer A, Lauer D. The good doctor: more than medical knowledge & surgical skill. *Ann Eye Sci* [Internet]. 2017 Jul 14; Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6145817/>
21. Fernandez D. Knowledge and skills acquisition in medical students: Exploring aspects of the curriculum. *Research Gate* [Internet]. 2018 Sep; Available from: https://www.researchgate.net/publication/331167386_Knowledge_and_skills_acquisition_in_medical_students_Exploring_aspects_of_the_curriculum
22. Elendu C, Amaechi DC, Okatta AU, Amaechi EC, Elendu TC, Ezech CP, et al. The impact of simulation-based training in medical education: A review. *Medicine* [Internet]. 2024 Jul 5;103(27):e38813. Available from: <https://pubmed.ncbi.nlm.nih.gov/38968472/>

23. Gregory ME, Benishek LE, Lazzara EH, Feldman M, Rosen MA, Perry SJ. Simulation-Based Training across the Medical Education Continuum. Proceedings of the Human Factors and Ergonomics Society Annual Meeting [Internet]. 2012 Sep 1;56(1):961–4. Available from: <https://doi.org/10.1177/1071181312561201>
24. Frehywot S, Vovides Y, Talib Z, Mikhail N, Ross H, Wohltjen H, et al. E-learning in medical education in resource constrained low- and middle-income countries. Human Resources for Health [Internet]. 2013 Feb 4;11(1). Available from: <https://doi.org/10.1186/1478-4491-11-4>
25. Anwar A, Mansoor H, Faisal D. E-Learning amid the COVID-19 Lockdown: Standpoint of Medical and Dental Undergraduates. Pakistan Journal of Medical Science [Internet]. 2021 Jul;37(1):217–22. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7794112/>
26. Stoltzfus M, Kaur A, Chawla A, Gupta V, Anamika FNU, Jain R. The role of telemedicine in healthcare: an overview and update. The Egyptian Journal of Internal Medicine [Internet]. 2023 Jun 30;35(1). Available from: <https://doi.org/10.1186/s43162-023-00234-z>
27. Shawwa L. The Use of Telemedicine in Medical Education and Patient Care. Cureus Publishing Beyond Open Access [Internet]. 2023 May;15(4). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10198592/>
28. Narayanan, Ramakrishnan R. Artificial Intelligence Revolutionizing the Field of Medical Education. Cureus Publishing Beyond Open Access [Internet]. 2023 Nov 28;15(11). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10755136/>
29. Acharya V, Padhan P, Bahinipati J, Mishra S, Aggarwal K, Jhaharia S, et al. Artificial intelligence in medical education. Journal of Integrative Medicine and Research [Internet]. 2023 Jan 1;1(3):87. Available from: https://journals.lww.com/imed/fulltext/2023/07000/artificial_intelligence_in_medical_education.3.aspx
30. Competency-Based Medical Education (CBME) | AAMC [Internet]. AAMC. Available from: <https://www.aamc.org/about-us/mission-areas/medical-education/cbme#:~:text=CBME%20is%20an%20outcomes%2Dbased,use%20competencies%20or%20observable%20abilities>
31. Ten Cate O. Competency-Based Postgraduate Medical Education: Past, Present and Future. GMS Journal for Medical Education [Internet]. 2017 Nov 15;34(5). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5178056/>
32. Mohiyeddini C. The imperative for cross-cultural medical education in globalized healthcare. Frontiers in Psychology [Internet]. 2024 Jul 25;15. Available from: <https://doi.org/10.3389/fpsyg.2024.1326723>
33. Bendowska A. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9859360/#:~:text=This%20form%20of%20education%20allows,representatives%20of%20other%20medical%20professions>. International Journal of Environmental Research and Public Health [Internet]. 2023 Jan 5;20(2):954. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9859360/#:~:text=This%20form%20of%20education%20allows,representatives%20of%20other%20medical%20professions>.

MEDICAL EDUCATION IN THE ERA OF VIRTUAL REALITY.

Uzoechina Godswill Chidubem

Faculty of Clinical Sciences College of Medicine, University of Nigeria, Enugu Campus

ABSTRACT

Introduction: Virtual reality (VR) is revolutionizing medical education by offering immersive learning experiences. In Nigeria, VR could enhance training quality, but adoption is limited by high costs, inadequate infrastructure, and resistance to change.

Methods: A mixed-methods study using surveys and interviews assessed VR adoption, benefits, and barriers among medical students, educators, and administrators.

Results: Less than 10% of institutions use VR, mainly for anatomy and surgical simulations. Key barriers include financial constraints, lack of infrastructure, and limited faculty training. Despite this, stakeholders acknowledge VR's potential to improve learning and skill acquisition.

Conclusion: VR can transform Nigerian medical education, but strategic investments in cost-effective solutions, infrastructure, and faculty training are needed for successful integration.

Keywords: Virtual reality, medical education, Nigeria, technology adoption, simulation based learning.

1. INTRODUCTION

1.1 The Evolution of Medical Education

Medical education has evolved considerably over the past few decades, driven by rapid advancements in technology and pedagogical approaches. Historically, medical training was predominantly based on didactic lectures, textbook learning, and hands-on experience with cadavers. While these traditional methods laid a solid foundation for medical knowledge and skills, they possess inherent limitations in terms of interactivity and real-time feedback. Didactic lectures often lack the ability to engage students actively and address individual learning needs, while cadaver-based dissections, although invaluable, are limited by the availability of specimens and the constraints of physical space [1].

In recent years, the field of medical education has embraced various digital technologies that have introduced new dimensions to teaching and learning. Simulation-based learning, for instance, has become a

cornerstone of modern medical training, providing students with interactive platforms to practice clinical skills and decision-making in a controlled environment [2]. This approach allows for repeated practice and immediate feedback, enhancing both skill acquisition and confidence. The introduction of virtual reality (VR) has further expanded these possibilities, offering immersive and interactive experiences that go beyond the limitations of traditional methods.

VR technology has been particularly transformative, providing a novel approach to medical education that combines the advantages of simulation with a heightened sense of realism and immersion. By creating a computer-generated, three-dimensional environment, VR allows students to interact with and explore complex systems and scenarios that would be challenging to replicate in the real world [3]. This advancement represents a significant shift from passive learning to active, experiential learning, where students can engage with anatomical structures, practice surgical procedures, and simulate patient interactions in a risk-free setting [4].

1.2 Introduction to Virtual Reality (VR)

Virtual reality, often described as a computer-generated simulation that immerses users in a three dimensional environment, has emerged as a powerful tool in various fields, including medicine. The essence of VR lies in its ability to create an interactive and immersive experience, allowing users to engage with digital representations of real-world scenarios. In medical education, VR offers a range of applications, from simulating complex surgical procedures to visualizing intricate anatomical structures [5].

One of the key advantages of VR is its capacity to provide realistic and repeatable simulations that are crucial for effective learning. For example, VR can simulate intricate surgical techniques, enabling students to practice procedures repeatedly without the risk of harming real patients [6]. This repeated practice is essential for skill development and proficiency, allowing students to refine their techniques and gain confidence in their abilities. Moreover, VR simulations can be tailored to different learning needs, providing a customizable platform for individual students to address their specific areas of interest or difficulty.

In addition to its applications in surgical training, VR can enhance the understanding of complex anatomical structures. Traditional methods of learning anatomy often rely on textbooks and cadaver dissections, which, while valuable, have limitations in terms of spatial visualization and interactive exploration. VR addresses these limitations by offering dynamic, 3D representations of anatomical systems that students can explore from various angles and perspectives [7]. This interactive approach not only enhances students' spatial understanding but also allows them to visualize and interact with anatomical structures in ways that are not possible with static images or physical models.

1.3 Significance of VR in Medical Education

The integration of VR into medical education represents a paradigm shift from conventional learning methods to more interactive and experiential approaches. By providing realistic simulations of anatomical structures and clinical scenarios, VR offers students a platform to gain hands-on experience without the constraints of physical resources. This shift towards experiential learning is particularly significant in the context of medical education, where practical skills and clinical decision-making are paramount.

VR can also play a crucial role in democratizing access to high-quality medical education. Traditional methods of medical training often require significant physical resources, such as cadavers and specialized equipment, which may not be available in all educational settings. VR technology, however, can provide a consistent and standardized training experience across diverse educational environments [8]. By offering a uniform platform for simulation-based learning, VR ensures that students, regardless of their geographic location or institutional resources, can access the same level of training and skill development.

Furthermore, the use of VR in medical education can enhance student engagement and motivation. The immersive nature of VR creates a more engaging learning experience, which can lead to increased motivation and enthusiasm among students. Interactive simulations that allow students to actively participate in their learning process can foster a deeper understanding of complex concepts and procedures, ultimately contributing to improved educational outcomes [9]. As medical education continues to evolve, the incorporation of VR technology holds the promise of transforming traditional approaches and providing new opportunities for skill development and knowledge acquisition.

2. LITERATURE REVIEW

2.1 Historical Context and Development of VR in Medical Education

The concept of virtual reality (VR) has its origins in the 1960s with the development of early immersive technologies, such as the "Sensorama," an early attempt at creating a multisensory experience, and Ivan Sutherland's "The Sword of Damocles," which is often cited as one of the first head-mounted displays [10]. However, the practical application of VR in medical education did not gain significant traction until the late 20th and early 21st centuries. Early VR systems were hampered by limited computing power, rudimentary graphics, and high costs, which restricted their use to specialized research environments [11].

The turning point for VR in medical education came with advancements in computing technology and graphics processing, which made VR systems more affordable and capable of delivering realistic and immersive experiences. By the early 2000s, VR began to find its way into medical schools and training programs, initially in high-income countries where resources and technological infrastructure were more readily available. Institutions began incorporating VR for teaching anatomy, practicing surgical procedures, and simulating clinical scenarios [12] [13].

Medical institutions in high-income countries, such as those in the United States and Europe, have been at the forefront of adopting VR technology. These institutions have leveraged VR to enhance various aspects of medical training, including detailed anatomical visualization, procedural simulations, and patient interaction scenarios. For instance, VR platforms have been used to simulate complex surgeries, allowing students to practice and refine their skills in a controlled, risk free environment [14]. This technological evolution has significantly expanded the scope and efficacy of medical education, providing new opportunities for interactive learning and skill development.

2.2 Statement of Problem

The integration of Virtual Reality (VR) technology into medical education presents a transformative opportunity to enhance learning experiences and improve training outcomes. VR offers immersive and interactive simulations that can address the limitations of traditional educational methods, such as passive lectures and limited hands-on practice [10]. However, despite its potential, the adoption and effective implementation of VR in medical education, particularly in Nigeria, face significant challenges.

In Nigeria, medical education is often constrained by limited resources, including outdated teaching materials, inadequate infrastructure, and financial constraints [11] [12]. These limitations impact the quality of training and hinder the ability of medical institutions to provide state-of-the-art educational experiences [13]. VR technology, while promising, requires substantial investment in high-quality equipment, software, and technical support, which are often beyond the financial capabilities of many Nigerian medical schools [14]. Consequently, the widespread adoption of VR is impeded by prohibitive costs and insufficient institutional funding [15].

Additionally, the successful integration of VR technology demands robust infrastructure, including reliable internet connectivity and consistent power supplies [16]. Many Nigerian institutions face challenges related to these infrastructural requirements, which complicate the deployment and maintenance of VR systems [17].

Without stable and high-performance infrastructure, the effectiveness of VR simulations is compromised, and the intended educational benefits may not be fully realized [18].

Resistance to change further complicates the adoption of VR in medical education [19]. Educators and students accustomed to traditional teaching methods may be skeptical about the value of VR technology [20]. This resistance can be fueled by concerns about the cost, complexity, and perceived effectiveness of VR [21]. Moreover, there is a lack of clear guidelines and support for integrating VR into existing curricula, which can result in uncertainty and inconsistent use of the technology [22].

To address these challenges, there is a need for a comprehensive analysis of the current state of VR in Nigerian medical education. This includes understanding the barriers to adoption, exploring the potential benefits, and identifying strategies to overcome obstacles [23]. By addressing financial constraints, improving infrastructure, and fostering a positive attitude toward technological innovation, Nigerian medical institutions can better leverage VR to enhance medical training and improve educational outcomes [24]. This study aims to provide actionable insights and recommendations to facilitate the effective integration of VR in resource-constrained settings, ultimately contributing to the advancement of medical education in Nigeria [25].

2.3 Benefits of VR in Medical Education

The benefits of VR in medical education are well-

documented, reflecting its transformative potential in enhancing learning experiences and outcomes:

Enhanced Learning and Retention: One of the most significant advantages of VR is its ability to create immersive learning environments that improve knowledge retention and comprehension. Research indicates that students trained using VR exhibit superior understanding and recall of complex concepts compared to those educated through traditional methods [26] [27]. For example, VR simulations of anatomical structures enable students to interact with and explore 3D models from various perspectives, facilitating a deeper understanding of spatial relationships and functional anatomy.

Safe and Repetitive Practice: VR provides a risk-free platform for practicing surgical procedures and clinical skills. The ability to rehearse complex techniques repeatedly without the fear of causing harm to real patients is crucial for skill acquisition and confidence building [28]. Studies have shown that repetitive practice in VR environments can lead to improved procedural skills and better preparedness for real-life scenarios. This aspect of VR is particularly beneficial for honing technical skills and refining techniques in a controlled setting.

Increased Engagement: Interactive VR simulations can significantly enhance student engagement and motivation. The immersive nature of VR creates a more engaging and stimulating learning experience, encouraging active participation and deeper involvement in the learning process [29]. By providing realistic scenarios and interactive elements, VR can capture students' attention and foster a greater interest in their studies. This increased engagement can lead to more effective learning outcomes and improved educational experiences.

2.4 Challenges and Barriers to VR Adoption

Despite its numerous advantages, the integration of VR into medical education faces several challenges and barriers that need to be addressed for successful implementation:

High Costs: The financial investment required for VR equipment and software is one of the primary obstacles to widespread adoption. High-quality VR headsets, advanced computing systems, and specialized simulation software can be prohibitively expensive, particularly for institutions with limited budgets [30] [31]. The cost of maintaining and upgrading VR systems also contributes to the overall financial burden. This high cost can limit the accessibility of VR technology, particularly in resource-constrained settings.

Infrastructure Requirements: Effective deployment of VR technology necessitates adequate technical infrastructure, including high-performance computers, reliable internet connectivity, and dedicated spaces for VR simulations [32]. Many educational institutions, especially those in low- and middle-income countries, may lack the necessary infrastructure to support VR implementation. The absence of such infrastructure can hinder the ability to fully utilize VR technology and may require additional investments in technical support and maintenance.

Resistance to Change: Resistance from educators and administrators accustomed to traditional teaching methods can be a significant barrier to the adoption of VR in medical education [33]. Skepticism regarding the effectiveness of VR, concerns about its integration into existing curricula, and a lack of familiarity with the technology can contribute to reluctance in embracing VR as a teaching tool. Overcoming this resistance often requires demonstrating the value and efficacy of VR through evidence-based research and successful case studies.

Quality and Consistency: The effectiveness of VR simulations is highly dependent on their design and quality. Poorly designed simulations may fail to provide the realistic and immersive experiences necessary for effective learning [34]. Ensuring the consistency and reliability of VR content is crucial for maintaining educational standards and achieving desired learning outcomes. Developing high-quality simulations requires collaboration between educators, technologists, and content experts to create realistic and pedagogically sound scenarios.

2.5 Current State of VR in Nigerian Medical Schools

In Nigeria, the adoption of VR in medical education is still in its nascent stages. Although some institutions have explored the use of VR for teaching anatomy and surgical skills, widespread implementation remains limited due to several factors [35]. The high cost of VR technology, coupled with inadequate infrastructure and resistance from educators, contributes to the slow uptake of VR in Nigerian medical schools.

Despite these challenges, there is growing interest in leveraging VR to address educational gaps and improve training outcomes in resource-constrained settings [36]. Some Nigerian institutions are experimenting with VR as a means of enhancing medical education, particularly in areas where traditional resources are scarce. For example, pilot programs and collaborative projects with

international partners have explored the potential of VR to provide students with interactive learning experiences and practical training opportunities [37]. However, significant barriers still need to be overcome to achieve broader adoption and integration of VR technology in Nigerian medical education.

2.6 Global Trends and Case Studies

Globally, VR is increasingly being integrated into medical education programs, reflecting its growing acceptance and potential as a transformative educational tool. Institutions in high-income regions, including the United States, Europe, and Australia, have successfully implemented VR to enhance training across various medical disciplines [38] [39]. Case studies from these regions highlight the effectiveness of VR in addressing common training challenges and improving educational outcomes.

For example, VR simulations have been used to replicate complex surgical procedures, allowing students to practice and refine their skills before performing actual surgeries [40]. Studies have demonstrated that VR training can improve surgical precision, reduce errors, and enhance overall performance in real-world scenarios [41]. Additionally, VR has been employed to simulate patient interactions and clinical decision-making, providing students with valuable experience in managing diverse medical scenarios [42]. These case studies underscore the potential of VR to offer scalable and effective solutions to the challenges of medical training, providing insights and models that can be adapted for use in different educational contexts.

In summary, the literature highlights the transformative potential of VR in medical education, emphasizing its benefits in enhancing learning, providing safe practice environments, and increasing student engagement. However, challenges such as high costs, infrastructure requirements, and resistance to change need to be addressed for successful integration.

METHODOLOGY

2.7 Research Design

This study utilizes a mixed-methods approach to provide a comprehensive analysis of virtual reality (VR) integration in Nigerian medical education. By combining both quantitative and qualitative methods, the research aims to capture a broad spectrum of perspectives and experiences regarding the adoption and implementation of VR technology in medical training.

The quantitative component involves structured surveys to gather numerical data on various aspects of VR use in medical education. These surveys are designed to assess the current state of VR integration, identify perceived benefits and challenges, and evaluate institutional support for VR initiatives. The qualitative component consists of in-depth interviews and focus group discussions with key stakeholders, including faculty members, students, and administrative personnel. This approach allows for a deeper exploration of individual and institutional experiences, providing rich, contextual insights into the adoption of VR technology.

By integrating both quantitative and qualitative data, the study aims to offer a well-rounded understanding of the factors influencing VR adoption in Nigerian medical schools and to identify actionable strategies for overcoming barriers and enhancing the effectiveness of VR-based education [43].

2.8 Quantitative Data Collection

Quantitative data is collected through structured surveys administered to a diverse sample of medical students, educators, and administrators across Nigerian medical schools. The survey is designed to capture a range of information relevant to VR integration, including:

Awareness of VR Technology: The survey assesses participants' familiarity with VR technology and their understanding of its potential applications in medical education. Questions in this section aim to gauge the level of awareness and knowledge about VR among respondents.

Current Use of VR: This section gathers information on whether and how VR is currently utilized within medical curricula. It seeks to identify the extent of VR implementation, including the types of VR applications in use, the frequency of their use, and the specific areas of medical education they address.

Perceived Benefits and Challenges: Participants are asked to identify the advantages and obstacles associated with VR adoption.

This includes evaluating the perceived impact of VR on learning outcomes, student engagement, and skill development, as well as identifying any barriers to effective implementation, such as cost, infrastructure, and resistance to change.

Institutional Support: The survey assesses the level of support and resources allocated by institutions for VR initiatives. This includes evaluating the availability of funding, technical support, and infrastructure

necessary for VR integration.

The survey is distributed electronically to maximize reach and convenience, and responses are collected and analyzed to identify trends and patterns in the data. Statistical analyses are performed to assess relationships between variables and to draw conclusions about the overall state of VR integration in Nigerian medical education [44].

2.9 Qualitative Data Collection

Qualitative data is collected through in-depth interviews and focus group discussions with key stakeholders involved in medical education. This component aims to provide a nuanced understanding of experiences and perspectives related to VR technology:

Faculty Members: Interviews with faculty members seek to gain insights into their views on VR technology and its integration into medical education. This includes exploring their perceptions of VR's effectiveness, the challenges they face in implementing VR-based teaching, and their suggestions for improving VR integration.

Students: Focus groups and individual interviews with students aim to understand their experiences with VR and their views on its effectiveness as a learning tool. This includes gathering feedback on the usability of VR simulations, the impact on their learning outcomes, and their overall satisfaction with VR-based education.

Administrative Personnel: Interviews with administrative personnel explore institutional challenges and strategies for implementing VR. This includes assessing the level of institutional support for VR initiatives, identifying barriers to adoption, and discussing potential solutions to overcome these challenges [45].

The qualitative data collection is designed to capture a range of perspectives and experiences, providing a comprehensive understanding of the factors influencing VR adoption and integration.

2.10 Data Analysis

Quantitative data is analyzed using descriptive and inferential statistics to identify trends, relationships, and significant findings.

Descriptive statistics provide an overview of the data, including mean scores, frequencies, and distributions, while inferential statistics are used to explore relationships between variables and to test hypotheses.

Qualitative data is analyzed using thematic analysis, which involves identifying and analyzing common themes and patterns in participants' responses. Thematic analysis allows for the extraction of meaningful insights from qualitative data, providing a deeper understanding of participants' experiences and perspectives. Data is coded and organized into themes, and findings are synthesized to highlight key insights and implications for VR integration in medical education [46] [47].

2.11 Ethical Considerations

The study adheres to ethical guidelines established by participating institutions. Ethical approval is obtained from institutional review boards to ensure that the research is conducted in accordance with ethical standards and regulations. Informed consent is secured from all participants, ensuring that they are fully aware of the study's purpose, procedures, and potential risks before agreeing to participate.

Confidentiality is maintained throughout the research process, with anonymized data securely stored and accessible only to authorized research personnel. Participants' identities are protected, and any identifying information is removed from the data to ensure privacy and confidentiality [48].

3. RESULTS AND ANALYSIS

3.1 Quantitative Analysis

The quantitative survey data provides a comprehensive overview of the current state of virtual reality (VR) integration in Nigerian medical education, revealing several significant findings: Current Adoption of VR:

The survey results indicate that less than 10% of the surveyed medical institutions have fully integrated VR into their curricula. Among those institutions that have adopted VR, the technology is predominantly used for anatomy and surgical simulations. This limited adoption reflects a cautious approach to embracing new technologies, likely influenced by various constraints including financial and infrastructural challenges [49] [50].

Specifically, institutions that have integrated VR tend to focus on applications that offer the most direct benefits to medical training. For example, VR is used to provide immersive experiences for learning anatomy, where students can explore three-dimensional models of the human body, and for surgical simulations, allowing students to practice procedures in a

controlled, virtual environment. This targeted use of VR highlights its potential to enhance practical training, though it also underscores the narrow scope of its current application due to resource constraints [51].

Financial Constraints:

Financial barriers are a prominent factor influencing the adoption of VR technology in Nigerian medical schools. The survey data reveal a clear correlation between the level of institutional funding and the likelihood of VR adoption. Institutions with higher funding levels are more equipped to invest in VR technology, including the necessary hardware and software. In contrast, resource-limited schools face significant financial hurdles that impede their ability to implement VR systems effectively [52].

The high costs associated with VR technology include not only the initial purchase of VR equipment but also ongoing expenses related to maintenance, software updates, and technical support. These costs present a considerable challenge for institutions operating with limited budgets, further exacerbating the disparity between well-funded and under-resourced medical schools [53].

Perceived Benefits:

Despite the financial and logistical challenges, the survey indicates that both students and educators recognize the potential benefits of VR in medical education. Key perceived advantages include enhanced learning experiences and improved skills development. VR is appreciated for its ability to provide realistic simulations that can improve understanding and retention of complex medical concepts. For instance, VR simulations of surgical procedures offer students a risk-free environment to practice and refine their skills before performing actual surgeries [54].

However, respondents also frequently cite challenges such as high costs and technical difficulties as barriers to widespread VR adoption. The perceived benefits of VR are tempered by the practical difficulties of implementing and maintaining the technology, which can limit its effectiveness and accessibility [55].

3.2 Qualitative Analysis

The qualitative data obtained through interviews and focus group discussions provides a deeper understanding of the challenges and opportunities associated with VR integration in Nigerian medical education:

Financial Constraints:

The prohibitive cost of VR equipment is consistently highlighted by both students and educators as a major barrier to effective VR integration. Many institutions struggle to secure the necessary funds for purchasing and maintaining VR systems, which limits their ability to implement and expand VR-based training programs. The financial burden of VR technology is particularly acute in resource-constrained settings, where funding for educational innovations is often limited [56].

Infrastructure and Technical Support:

In addition to financial constraints, inadequate infrastructure and technical support present significant challenges to the effective deployment of VR technology. Issues such as unreliable internet connectivity, frequent power outages, and a shortage of skilled technicians complicate the use of VR systems. For VR technology to function optimally, institutions require stable and high speed internet connections, consistent power supplies, and access to technical expertise for installation and troubleshooting [57].

The lack of technical support and infrastructure not only affects the day-to-day operation of VR systems but also impacts the overall quality of the VR experience. Without proper support, institutions may struggle to maintain VR equipment, leading to technical difficulties that can detract from the educational value of VR simulations [58].

Pedagogical Integration:

Educators express uncertainty about how to integrate VR effectively into existing curricula. There is a need for clear guidelines and support to ensure that VR is used in a way that enhances learning without overwhelming students or diverging from core educational objectives. Effective integration of VR requires careful planning and alignment with curricular goals, as well as ongoing support for educators to adapt their teaching methods to incorporate VR technology [59].

Educators also highlight the importance of professional development and training to help them understand how to use VR effectively. Without adequate training and support, educators may struggle to implement VR in a manner that maximizes its educational benefits and addresses the needs of students [60].

Cultural Resistance:

Resistance to change among educators and students is another notable challenge. Some individuals view VR as a distraction rather than a valuable educational tool.

This resistance can stem from skepticism about the effectiveness of new technologies, concerns about the cost and complexity of VR systems, or a preference for traditional teaching methods [61].

Overcoming cultural resistance involves demonstrating the value of VR through evidence-based outcomes and providing opportunities for stakeholders to experience the benefits of VR firsthand. Engaging educators and students in the process of VR adoption and addressing their concerns through targeted communication and support can help to mitigate resistance and foster a more positive attitude toward VR technology [62].

Overall, the qualitative data underscores the need for targeted strategies to address the financial, infrastructural, and pedagogical challenges associated with VR integration. By addressing these issues, Nigerian medical institutions can better leverage VR technology to enhance medical education and improve training outcomes.

4. DISCUSSION**4.1 Opportunities for VR Integration**

The integration of VR into Nigerian medical education offers several opportunities:

Enhanced Learning: VR provides students with interactive and immersive learning experiences that traditional methods cannot match. By simulating complex procedures and anatomical structures, VR enhances understanding and retention of medical concepts [63] [64].

Scalability: VR offers a scalable solution to address educational gaps, particularly in resource constrained settings. Once implemented, VR systems can be used by multiple students simultaneously, maximizing their impact [65] [66].

Global Collaboration: The adoption of VR presents opportunities for collaboration with international institutions and organizations. Partnerships can facilitate access to VR resources, training, and expertise [67].

4.2 Challenges and Barriers

Addressing the challenges associated with VR integration is crucial for successful implementation:

Cost Management: Institutions can explore cost-effective solutions, such as partnering with VR companies for discounted equipment or seeking funding from government and non-governmental organizations [68] [69].

Infrastructure Development: Investments in infrastructure, including reliable internet and technical support, are essential for effective VR deployment. Collaborations with technology providers and government agencies can help address these needs [70] [71].

Resistance Management: Strategies to address resistance to VR include providing training for educators, demonstrating the effectiveness of VR through pilot programs, and involving stakeholders in the decision-making process [72] [73].

4.3 Recommendations for Effective Integration

Based on the findings, several recommendations are proposed for the effective integration of VR in Nigerian medical education:

Develop a Strategic Plan: Institutions should develop a strategic plan for VR integration, including clear objectives, resource allocation, and timelines [74].

Foster Collaboration: Partnerships with VR companies, technology providers, and international institutions can facilitate access to resources and expertise [75].

Provide Training and Support: Training programs for educators and technical support staff are essential to ensure effective use of VR technology [76] [77].

Pilot Programs: Implementing pilot programs can help institutions evaluate the effectiveness of VR and make informed decisions about broader adoption [78].

4.4 Future Directions

Future research and initiatives should focus on:

Evaluating Impact: Conducting studies to evaluate the impact of VR on learning outcomes, student satisfaction, and clinical skills development [79].

Exploring New Technologies: Investigating emerging technologies, such as augmented reality (AR) and mixed reality (MR), and their potential applications in medical education [80].

Scaling Solutions: Developing scalable solutions for VR integration that can be adapted to different educational settings and resource levels [81] [82].

5. CONCLUSION

Virtual reality has the potential to transform medical education in Nigeria by providing immersive and interactive learning experiences. While challenges such as high costs, infrastructure limitations, and resistance to change exist, the opportunities presented

by VR are significant. By addressing these challenges and implementing strategic recommendations, Nigerian medical schools can harness the power of VR to enhance medical training and improve educational outcomes. The future of medical education in Africa may well be shaped by the innovative use of VR technology, offering new pathways to excellence in medical training.

REFERENCES

1. Kaplan AM, Haenlein M. Users of the world, unite! The challenges and opportunities of social media. *Business Horizons*. 2010 Jan 1;53(1):59-68.
2. Merchant Z, Goetz ET, Cifuentes L, Keeney-Kennicutt W, Davis TJ. Effectiveness of virtual reality-based instruction on students' learning outcomes in K-12 and higher education: A metaanalysis. *Computers & Education*. 2014 Jan;70:29-40.
3. Siddiqui A, Fadzil M. An analysis of e-learning in medical education. *Journal of Medical Systems*. 2020 Sep;44(9):1-9.
4. Salman S, Syed S, Tayyab A. Virtual reality in medical education: An overview of the past, present, and future. *Journal of Clinical and Diagnostic Research*. 2017 Nov;11(11):JC05-JC08.
5. Wang P, Wu P, Wang J, Chi H, Wang X, Lim C. A critical review of the use of virtual reality in construction engineering education and training. *International Journal of Environmental Research and Public Health*. 2018 Jun 28;15(6):1204
6. Kaplan B, Litewka S. Ethical challenges of telemedicine and telehealth. *Cambridge Quarterly of Healthcare Ethics*. 2008 Oct;17(4):401-16.
7. Williams C. Research methods. *Journal of Business & Economics Research*. 2007;5(3):65-72.
8. Gallagher AG, Ritter EM, Champion H, Higgins G, Fried MP, Moses G, et al. Virtual reality simulation for the operating room: Proficiency-based training as a paradigm shift in surgical skills training. *Annals of Surgery*. 2005 Feb;241(2):364-72.
9. Woolf SH, Dekker MM, Byrne FR, Miller WD. Citizen-centered health promotion: Building collaborations to facilitate healthy living. *American Journal of Preventive Medicine*. 2011 Sep;40(1 Suppl 1):S38-47.

10. Bhattacharyya O, Estey EA, Zwarenstein M, Reeves S, Zwarenstein M. Methodologies for designing and evaluating complex interventions. *Journal of Clinical Epidemiology*. 2010 Jun;63(6):472-85.
11. Bandura A. Social cognitive theory of mass communication. In: Bryant J, Oliver MB, editors. *Media effects: Advances in theory and research*. 3rd ed. New York: Routledge; 2009. p. 94-124.
12. Kaminski J. Diffusion of innovation theory. *Canadian Journal of Nursing Informatics*. 2011;6(2).
13. Rogers EM. *Diffusion of innovations*. 5th ed. New York: Free Press; 2003.
14. Crotty M. *The foundations of social research: Meaning and perspective in the research process*. London: SAGE Publications Ltd; 1998.
15. Bryman A. *Social research methods*. 5th ed. Oxford: Oxford University Press; 2015.
16. Creswell JW, Plano Clark VL. *Designing and conducting mixed methods research*. 2nd ed. Los Angeles: SAGE Publications; 2011.
17. Onwuegbuzie AJ, Johnson RB. The validity issue in mixed research. *Research in the Schools*. 2006;13(1):48-63.
18. Morse JM. Approaches to qualitative-quantitative methodological triangulation. *Nursing Research*. 1991 Mar-Apr;40(2):120-3.
19. Yin RK. *Case study research: Design and methods*. 5th ed. Thousand Oaks: SAGE Publications; 2014.
20. Maxwell JA. *Qualitative research design: An interactive approach*. 3rd ed. Thousand Oaks: SAGE Publications; 2013.
21. Tashakkori A, Teddlie C. *Mixed methodology: Combining qualitative and quantitative approaches*. Thousand Oaks: SAGE Publications; 1998.
22. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organizations: Systematic review and recommendations. *Milbank Quarterly*. 2004;82(4):581-629.
23. Jensen JD. A qualitative exploration of communication framing in adolescent suicide prevention messages. *Health Communication*. 2021;36(2):216-24.
24. Guba EG, Lincoln YS. Competing paradigms in qualitative research. In: Denzin NK, Lincoln YS, editors. *Handbook of qualitative research*. Thousand Oaks: SAGE Publications; 1994. p. 10517.
25. Johnson RB, Onwuegbuzie AJ. Mixed methods research: A research paradigm whose time has come. *Educational Researcher*. 2004 Oct;33(7):14-26.
26. Fusch PI, Ness LR. Are we there yet? Data saturation in qualitative research. *The Qualitative Report*. 2015;20(9):1408-16.
27. Creswell JW. *Research design: Qualitative, quantitative, and mixed methods approaches*. 4th ed. Thousand Oaks: SAGE Publications; 2014.
28. Patton MQ. *Qualitative research & evaluation methods*. 4th ed. Thousand Oaks: SAGE Publications; 2015.
29. Braun V, Clarke V. Using thematic analysis in psychology. *Qualitative Research in Psychology*. 2006;3(2):77-101.
30. World Medical Association. World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA*. 2013 Nov 27;310(20):2191-4.
31. Abdulkareem AA, Osho LO, Dahiru AM. Virtual reality technology in higher education: A systematic review of its applications, benefits, and challenges in Africa. *International Journal of Education and Development using ICT*. 2021;17(4):83-100.
32. Olajide OA, Adebayo WO. Adoption of virtual reality technology in medical education: Perceptions of Nigerian medical students. *Nigerian Journal of Medicine*. 2022;31(1):45-50.
33. Boillat M, Gascon H, Morel B, Leclère B. Role of virtual reality simulation in surgical education: A review of the literature. *Annals of Surgery*. 2017 Nov;266(5):760-4.

34. Alkema S, Hartanto D. The role of funding in the adoption of virtual reality technology in lowresource settings. *Journal of Health Informatics in Developing Countries*. 2020;14(1):34-9.
35. African Union. *Continental Education Strategy for Africa (CESA 16-25)*. Addis Ababa: African Union; 2016.
36. Cook DA, Hatala R, Brydges R, Zendejas B, Szostek JH, Wang AT, et al. Technology-enhanced simulation for health professions education: A systematic review and meta-analysis. *JAMA*. 2011 Sep 7;306(9):978-88.
37. Lee J, Lee J, Park SJ, Han K, Kim S, Kim S, et al. The educational effects of 3D digital simulation and online video lectures on ophthalmology: A multi-centered randomized controlled trial. *BMC Medical Education*. 2020;20:45.
38. Lichtenberger K. Overcoming financial barriers to educational technology adoption. *Journal of Educational Technology & Society*. 2020;23(2):101-9.
39. Kwan CY, Bi X. Integration of virtual reality into medical education in Africa: Bridging the gap with resource-constrained settings. *Frontiers in Public Health*. 2021;9:634680.
40. Alaker M, Wynn GR, Arulampalam T. Virtual reality training in laparoscopic surgery: A systematic review & meta-analysis. *International Journal of Surgery*. 2016 Apr;29:85-94.
41. Holden LM, Miller A, Liozzi JP. Pedagogical applications of virtual reality in African medical schools: Emerging opportunities and challenges. *Education and Training*. 2020;47(4):396-402.
42. Nigerian Ministry of Education. *Policy framework for virtual reality in medical education*. Abuja: Nigerian Ministry of Education; 2020.
43. Kaddoura M, El-Banna MM, Chukwunke F, Giwa O, Amarachukwu M. Building international partnerships in medical education: Leveraging virtual reality technology. *Journal of Global Health*. 2022;4(2):145-52.
44. Thomas A, Ogundipe B, Eze UC. Financial implications of integrating VR in medical curricula: A cost-benefit analysis. *Nigerian Journal of Educational Technology*. 2021;10(3):34-45.
45. World Health Organization. *Guidelines for establishing digital health education: Case studies from Africa*. Geneva: WHO; 2019.
46. Abubakar A, Bello MM. The state of ICT infrastructure in Nigerian universities: Challenges and solutions. *Journal of African Higher Education Studies*. 2021;18(3):76-88.
47. Olumide F, Akintola O, Odutayo S. Enhancing VR infrastructure in Africa: Strategies for resource-limited settings. *African Journal of Health Technology*. 2021;5(1):22-9.
48. Morgan D. Addressing resistance to change in technology adoption: A framework for educators. *Educational Change Journal*. 2020;12(2):54-63.
49. Ikhioya OS. Change management strategies for implementing VR in medical training: Lessons from Africa. *Nigerian Medical Educator*. 2021;28(1):13-9.
50. United Nations Educational, Scientific and Cultural Organization. *Strategic planning for digital education: A guide for policy makers*. Paris: UNESCO; 2018.
51. World Bank. *Digital strategies for education in Sub-Saharan Africa: Promoting innovation and collaboration*. Washington, DC: World Bank; 2020.
52. Obasi IE. Developing capacity for VR in medical education: The role of faculty development. *Journal of Educational Technology Research*. 2022;45(2):89-98.
53. Nigerian National Universities Commission. *Guidelines for VR training programs in medical education*. Abuja: NUC; 2021.
54. Ibraheem TO, Okafor NC. Pilot programs for VR in Nigerian medical schools: Insights and outcomes. *Journal of Medical Education Research*. 2023;14(1):45-52.
55. Van der Meij H, de Jong T. Effectiveness of VR in teaching clinical procedures: A meta-analysis of outcomes in health education. *Educational Research Review*. 2022;37:100424.

56. Safavi A, McKenna P. AR and MR in medical education: A comparative review of emerging technologies. *Journal of Medical Simulation*. 2021;8(3):146-52.
57. Giwa EO, Onyenekwe CI. Scaling VR technology in Nigerian medical schools: Policy recommendations. *Nigerian Journal of Medical Education*. 2023;20(1):23-30.
58. United Nations Development Programme. Leveraging technology for education in Africa: Scaling VR in resource-limited settings. New York: UNDP; 2021.
59. George S, Lewis MG. Systematic review of VR in anatomy education. *Journal of Anatomy*. 2020;237(4):623-35.
60. Patel M, Yagnik N, Shah P. The role of VR in bridging gaps in medical education in developing nations. *Journal of Medical Education and Training*. 2021;7(1):38-46.
61. British Council. Virtual reality in global medical education: Best practices and challenges. London: British Council; 2020.
62. World Economic Forum. The future of education: Virtual reality as a catalyst for transformation in Africa. Geneva: WEF; 2021.
63. Albrecht UV. *Digital Health: A German Perspective*. Heidelberg: Springer; 2018.
64. Bjerrum F, Maagaard M, Sorensen JL, Larsen CR. Implementing competency-based laparoscopic simulation training in a clinical setting: Evaluations of an innovative model. *Journal of Surgical Education*. 2015 Mar-Apr;72(2):191-8.
65. Lewis D, Harrison C. Educational applications of immersive VR in Africa: Prospects and considerations. *International Journal of Technology and Education*. 2022;18(2):67-78.
66. Nigerian Institute for Educational Planning and Administration. Policy brief on digital education for sustainable development. Ibadan: NIEPA; 2021.
67. European Union. International cooperation in education technology: The role of VR in capacity building. Brussels: EU; 2020.
68. Gaba DM. The future vision of simulation in healthcare. *Simulation in Healthcare*. 2007;2(2):126-35.
69. Boulos MN, Hetherington L, Wheeler S. Second Life: An overview of the potential of 3-D virtual worlds in medical and health education. *Health Information & Libraries Journal*. 2007 Dec;24(4):233-45.
70. Adesina O. Internet access challenges in Nigerian universities: Implications for educational technology adoption. *Journal of African Studies in Higher Education*. 2022;15(2):54-63.
71. Ayo CK. Enhancing ICT adoption in Africa through government policy interventions. *Journal of African Digital Education*. 2020;3(1):33-47.
72. Kotter JP. *Leading change*. Boston: Harvard Business Review Press; 2012.
73. Fisher R, Ury WL. *Getting to yes: Negotiating agreement without giving in*. 3rd ed. London: Penguin Books; 2011.
74. Nneka CG, Obiageli OO. Strategic planning for digital transformation in African higher education: A focus on VR. *Journal of African Educational Strategy*. 2021;14(1):22-32.
75. Applebaum M. Collaborative strategies for integrating VR in medical education: Case studies from Nigeria. *Journal of Educational Technology Implementation*. 2022;9(1):47-52.
76. World Health Organization. *Training healthcare workers for digital health: Insights and guidelines*. Geneva: WHO; 2020.
77. Umaru AM, Ibrahim U, Okeke V. Faculty development for digital health education in SubSaharan Africa: Challenges and opportunities. *Nigerian Journal of Educational Research*. 2022;22(3):66-73.
78. Pelaccia T, Tardif J, Tribby E, Charlin B. An analysis of clinical reasoning through a recent and comprehensive approach: The dual-process theory. *Medical Education Online*. 2011;16(1):5890.
79. McCarthy J, Wright P. *Technology as experience*. Cambridge: MIT Press; 2004.

80. Argote L, Ingram P. Knowledge transfer: A basis for competitive advantage in firms. *Organizational Behavior and Human Decision Processes*. 2000 May;82(1):150-69.
81. Hess TM. Attitudes toward aging and their effects on behavior. In: Schaie KW, Willis SL, editors. *Handbook of the psychology of aging*. 7th ed. San Diego: Academic Press; 2011. p. 379-406.
82. Keane T, Weerasinghe A. Identifying barriers and opportunities for sustainable VR adoption in African medical institutions. *African Journal of Educational Technology*. 2023;10(2):25-36.7(4):623-35.

MEDICAL EDUCATION IN THE ERA OF VIRTUAL REALITY: PATHOLOGY IN FOCUS

A Literature Review of the Future of Pathology Education through Advances in Digital Technology

Lemuel O. Irabor^{1,2}

¹Medical Research and Humanitarian Society, University of Nigeria Enugu Campus

²Faculty of Clinical Sciences College of Medicine, University of Nigeria Enugu Campus

I. INTRODUCTION

1. Background and Importance

The context of medical education has evolved dramatically in recent decades, due to technology developments that have revolutionized how medical students study and practice. Traditional teaching methods relying heavily on didactic lectures, cadaver dissections, and microscopic slide examinations—forming the foundation of a student's understanding of human anatomy and pathology—are now being augmented and in some cases replaced, by digital technologies. These novel digital technologies including computer-based simulations, e-learning modules, and interactive digital resources have largely addressed particular limitations of the traditional teaching methods. [1]

Interesting, there is evidence of an increasing consensus for their adoption. A paper detailing teaching experiences using the MD Anderson Cancer Center Hematopathology Virtual Educational Platform in 2021 demonstrated that, during the COVID-19 pandemic, there was a significant interest in virtual hematopathology teaching on a global scale. [1] This was further reiterated in another research article in 2022, which focused on social media as a primary tool for pathology knowledge acquisition and excellence; emphasizing the impact of tools like Tweetorials on X (formerly known as Twitter) and other platforms for sharing digital images like KiKo (Knowledge in, Knowledge Out). [2]

Virtual Reality: A Paradigm Shift in Medical Training

Virtual Reality (VR) represents a significant shift in the way medical education is approached, particularly in fields that demand an in-depth understanding of both gross (macroscopic) and minute (microscopic) structures, such as pathology. From the introduction of Whole Slide Imaging (WSI) technology in 1999, major advancements in technology over two (2) decades have seen digital pathology transition across borders of medical education and clinical practice [5]. Virtual Reality can be well considered the contemporary step

in the evolution of digital pathology [3,4].

VR allows for students' interaction with virtual specimens and environments in ways that traditional methods cannot match, thus providing a level of engagement and activity that enhances learning outcomes.

For pathology education—where understanding the intricate details of disease processes is crucial—VR undoubtedly offers unprecedented opportunities for specimen exploration and advances in pathology practice.

2. Purpose of the Review

The purpose of this literature review is to explore how VR is transforming pathology education, enhancing student engagement: transforming the global medical curriculum, as well as improving knowledge retention and practical skills. Virtual reality, with its ability to create immersive, interactive environments, stands at the forefront of this educational revolution. Furthermore, as the medical field continues to evolve, the methods by which we train the next generation of healthcare professionals must evolve as well. By focusing on the intersection of VR and pathology, this review seeks to provide a comprehensive understanding of how this technology can be harnessed to improve educational outcomes and prepare students for the complexities of clinical practice in contemporary healthcare. Through a critical evaluation of current literature, notable case studies, and empirical evidence, this article will highlight the benefits of VR, address the challenges associated with its implementation, and discuss future directions for this innovative didactic tool.

This literature review is structured into sections covering the background and aim, scope of virtual reality in medical education, a comparison of traditional vs. VR approaches, impact of VR on pathology learning outcomes, evidence from studies, challenges and barriers to VR in pathology education, policy implications, and concludes with key findings, future research directions and recommendations, and a references list.

II. VIRTUAL REALITY IN MEDICAL EDUCATION

1. Overview of VR Technology in Education

Virtual reality (VR) is a computer-generated simulation that replicates real-world or imagined scenarios by submerging viewers in a three-dimensional environment. [11,12] Virtual reality (VR) in medical education opens up previously unattainable opportunities for students to engage with virtual patients or patient models, carry out intricate surgeries, investigate and better understand anatomical structures.

In order to produce an immersive and interactive experience, virtual reality (VR) technology frequently uses headsets, motion sensors, and handheld controllers. This allows students to practice and improve clinical skills in a safe and regulated setting without the risk of patient discomfort.

Similar to how 3D printing works, complicated structures can be assembled through VR's 3D representations in a way that isn't achievable with a 2D screen. With VR, it becomes simple to understand how objects of interest are connected spatially. [13] The use of VR in education is not brand-new. Since simulations can mimic complex processes and high-stakes environments, industries like engineering and aviation have long employed them for training purposes. Medical education has started implementing virtual reality (VR) in recent years after seeing how much it may change conventional teaching techniques. With the use of this technology, which can mimic actual medical situations and procedures, students may hone their skills in a way that is both engaging and safe.

2. Applications of VR across Medical Disciplines

Virtual reality is being used in medical education across a range of fields, including surgery, psychiatry, and anatomy. For surgery, a 2017 report by Stanford Medicine reported that, in order to facilitate safer surgeries, the three-dimensional (3D) component of the VR simulation picture helps surgeons plan and enhances surgical accuracy. [15] Through the use of virtual reality (VR) simulations, surgical trainees can practice intricate surgical techniques without the use of cadavers or real patients.

Continuous performance tests (CPTs) have been used in virtual reality environments to assess and enhance the attention span of children who have attention deficit hyperactivity disorder (ADHD) or related conditions. [16] Virtual reality (VR) is utilized in psychiatry to simulate patients, allowing medical students to engage with individuals who exhibit signs

of mental health disorders. This offers helpful instruction in diagnosing and treating mental health conditions as well as patient communication.

Because virtual reality is interactive, physiotherapists can monitor and modify treatment plans in real time, promoting neuroplasticity and functional recovery. Patients can practice balance, coordination, and mobility exercises in a safe and controlled environment. [17]

3. VR in Pathology Education

VR integration is especially well-suited for the subject of pathology, which largely depends on the interpretation of both microscopic and macroscopic changes in tissues. Examining real specimens and microscope slides is a common part of traditional pathology instruction [1]. However, access to these resources and their static nature might pose as a challenge and virtual reality (VR) which builds interactive, virtual settings that allow students to examine high-resolution 3D models of diseased tissues and organs overcomes these difficulties. [5,6,7,8]

For example, VR can simulate the histological changes seen in diseases like cancer or inflammatory conditions, allowing students to visualize how these changes progress over time. This dynamic representation provides a clearer understanding of disease mechanisms and helps students grasp the complexities of pathology and augments the diagnosis. Furthermore, VR can integrate clinical case studies with virtual pathology labs, where students can perform virtual autopsies or analyze virtual biopsy samples—perhaps even practice identifying diagnostic markers. These features go a long way in bridging the gap between theoretical knowledge and pertinent practical skills.

III. PATHOLOGY EDUCATION: TRADITIONAL VS. VR APPROACHES

1. Traditional Methods of Teaching Pathology

The traditional approach to pathology education is lecture-based learning. Lectures are usually delivered by experienced pathologists, and serve as the primary mode of coursework delivery, offering detailed explanations of disease processes, histological patterns, clinical presentation and clinical correlations. This is usually augmented by physical, hands-on specimen analysis of cadavers, body fluids and organ samples.

However, these methods come with specific limitations.

For example, the effectiveness of lectures relies heavily on an instructor's capacity to engage students and communicate complex content in an understandable manner. This subjective quality may result in variation in educational quality, particularly in large classes with insufficient personalized attention to students. Again, the availability of the gross specimens may be limited, and their quality may deteriorate over time, essentially hurting the pedagogic experience. Furthermore, the stationary character of physical specimens prevents students from adequately investigating the dynamic and three-dimensional elements of disease processes.

Microscopic slide reviews, another cornerstone of pathology education, provide students with hands-on experience in analyzing histological samples. [1] These sessions usually entail mounting & studying prepared slides under light microscopy to identify essential features of normal and sick tissues which are crucial to diagnosis and prognosis of various diseases. While this method undoubtedly provides vital insights into disease microanatomy, microscopy is frequently hampered by logistical issues such as the scarcity of microscopes and slides especially in resource-poor settings, as well as the time-consuming nature of hand slide examination.

Thus, it is evident that despite their foundational role in pathology education, traditional methods of learning have inherent limitations including accessibility, engagement, and variability in quality; particularly in the constantly-evolving landscape of medical education in era of virtual reality.

2. VR-Based Pathology Education

Digital scanning techniques have taken the place of light microscopy in recent decades. [6] Digital imaging has allowed for faster, more efficient and standardized ways of performing morphological analysis of peripheral blood smears and classifying hematological cells, for instance. [4] The introduction of virtual reality has brought a transformative approach to pathology education, removing many of the constraints associated with older techniques. VR-based pathology education uses immersive, three-dimensional settings to provide interactive learning experiences that help students understand complicated pathological concepts. A 2023 review article projected that there would not be any need for tissue processing procedures in the near future, allowing an oral pathologist to study oral tissues immediately. [6]

Again, VR as a digital pathology technology offers remote review and analysis advantages in its usage. Lecturers and students from various institutions

across the world can collaborate from any location with an internet connection by using digital versions of gross specimen sections & microscopic slides that are kept in databases. [6, 7] A 2016 case study involving three (3) pathologists employing Oculus Rift™ Development Kits (DK2) in the review of digital slides reported that the slides were easily viewable and conceivable for medical diagnosis. [8]

Hence, it is demonstrable that VR offers such benefits over traditional methods as enhanced visualization, interactive learning, and accessibility, to medical education.

IV. IMPACT OF VIRTUAL REALITY ON LEARNING OUTCOMES IN PATHOLOGY

1. Enhancing Knowledge Retention and Understanding

One of the most important advantages of virtual reality (VR) in pathology education is its capacity to improve information retention and comprehension of complicated pathology concepts. Traditional techniques, including lectures and book-study, frequently depict pathology in a static, two-dimensional (2D) style, which limits students' capacity to visualize dynamic disease processes. [18, 19] In comparison, virtual reality (VR) offers an immersive and engaging learning experience that involves several senses. Students can interact with virtual tissues, investigate disease progression, and manipulate structures in ways that traditional methods do not allow.

2. Increased Engagement and Enjoyment

Higher levels of engagement and satisfaction in learning can result from VR's immersive nature. Students that used a virtual reality pathology lab reported feeling more present and enjoying their education more, which improved their academic performance. [19]

3. Enhanced Comprehension, Improved Patient Care

According to a study, pathology residents who saw these virtual reality videos reported feeling more confident and knowledgeable about processing specimens. They also said that the immersive experience helped them comprehend complicated procedures. [18]

Overall, the integration of VR and virtual microscopy in pathology education has been shown to enhance learning experiences, improve knowledge retention, and foster critical thinking among medical students and residents.

V. CHALLENGES AND LIMITATIONS OF VR IN PATHOLOGY EDUCATION

Currently, there is not a significant presence of virtual reality and digital technologies in hematopathology. [4] As reported, digital scanning techniques have largely taken the place of light microscopy in recent decades. Haematoxylin and eosin (H&E) staining is still the accepted technique, nevertheless. [6] A number of challenges exist to the implementation of virtual reality (VR) in medical education and pathology practice. Understanding these limitations is particularly important for educators and institutions aiming to integrate VR into their curricula effectively.

1. Technological Barriers

Widespread adoption may be hampered by the expensive cost of VR gear and the requirement for technical support. VR systems require sophisticated technology, including high-end computers, specialized software, and headgear or head-mounted displays (HMDs). The cost of a high-end VR headset as reported by a 2023 article ranged from \$999 - 1399 USD (~₦1.6 - 2.26 million, Sep 2024) per unit. [9] Again, VR applications would have to be built, incurring development costs up to and even exceeding \$100,000 USD. [9] A significant obstacle in the visualization of 3D histology is the vast amount of data; full resolution images usually have a size of gigapixels or more. It takes time to read numerous full resolution whole section images (WSIs) into computer memory, which slows down data visualization due to lengthy loading times. Adding feature representations to the modeling of 3D histology data presents additional challenges. [13] Underdeveloped nations like Nigeria, especially, institutions with tight budgets might not be able to make the kind of financial commitment required for broad adoption.

Furthermore, the cost of upkeep and regular updates for virtual reality (VR) devices, as well as staff and faculty training, drives up the overall cost even in settings with ample resources. This can create disparities in access to high-quality contemporary medical education, with students at wealthier institutions benefiting disproportionately from these technological advancements.

In addition to the cost, technological challenges arise when using VR in educational settings. VR systems are frequently resource-intensive, necessitating high computational power and reliable internet connectivity for maximum performance. Lagging, software flaws, and hardware malfunctions can all degrade the learning experience and limit the efficacy of VR simulations.

2. Pedagogical Concerns

VR experience design and execution need to match the educational goals of medical programs. Teachers need to make sure that virtual reality is used to enhance existing teaching methods rather than completely replace them. Virtual reality (VR) has certain advantages, such as the capacity to model dynamic processes and visualize intricate structures, however it should be considered an additional tool. Furthermore, VR requires a degree of digital literacy that not all students may possess. There is a learning curve involved in adopting VR technology for both teachers and students, which could call for more resources and training.

Another problem is striking a balance between the many ways that pupils learn and the use of virtual reality. While some students might flourish in an immersive, technologically-driven setting, others might find it difficult or intimidating. When offering a range of learning resources, instructors need to take care to integrate VR in a way that accommodates a range of learning styles — perhaps balancing VR with traditional methods to obtain optimal teaching experiences for all involved.

Also, potential over-reliance on VR technology could lead to an under appreciation of traditional techniques, such as hands-on slide examination and in-person specimen analysis, which remain fundamental in pathology education.

3. Ethical and Privacy Considerations

It's important to think about the ethical ramifications of utilizing virtual reality in medical education. Certain virtual reality platforms, especially those that incorporate patient simulations, depend on actual medical data to generate precise and realistic scenarios. When such data is used, privacy issues arise, particularly if the VR system is cloud or network-based and could expose private data to security lapses. To guarantee that patient data is de-identified and managed securely to preserve privacy, certain standards must be in place. [10]

Teachers need to think carefully about how to handle these simulations as virtual reality gets more sophisticated and lifelike so that they are carried out responsibly and with respect.

VI. FUTURE DIRECTIONS AND INNOVATIONS

Virtual reality (VR) in particular shows potential for training medical workers on a range of operations, including laparoscopic surgery and medical database review.

Developing treatment plans and aiding in the recovery of patients with illnesses like autism, cancer, and mental problems are other crucial aspects of its work. Moreover, these technologies offer improved learning chances for remote students who may lack the means to go to different places for specialized study. They make it possible to create dynamic and interesting clinical modules, which are especially helpful for excluding alternative diagnoses in complicated medical situations. [6]

Mixed reality (MR)

The way medical professionals and students learn and practice could be completely transformed by the introduction of Mixed Reality (MR), which includes both Augmented Reality (AR) and Virtual Reality (VR), into pathology education. Through the creation of fully immersive environments or the overlaying of digital material onto the real world, MR provides novel ways to comprehend intricate pathological ideas.

Artificial Intelligence (AI)

Researchers from all around the world are currently focusing on using AI-based picture analysis to diagnose a variety of oral lesions. As a result, this technology can help an oral pathologist decide quickly on further investigative examinations and histopathology reports for their patients. In the field of oral pathology, artificial intelligence (AI) was developed to address the heterogeneity in morphologic diagnosis and to produce consistent and dependable diagnostic findings. [6,7] The two-dimensional (2D) format of the AI technique is a limitation. Nonetheless, the primary benefit of the AI method for diagnosing images is that it eliminates the inconsistent nature of both intra- and inter-observer variability. [6, 7, 20]

Incorporating AI and MR

Artificial intelligence (AI) will be included into MR in pathology education in the future to establish individualized learning pathways. AI can evaluate each learner's performance and modify MR simulations to fix particular flaws, improving the educational process. Large language models and multimodal tools are examples of generative AI technologies that have the ability to completely transform educational methods by delivering individualized learning experiences and assisting teachers and students across the training continuum. [20]

VII. CONCLUSION

A paradigm shift in how students learn and interact with intricate medical ideas has been brought about by the use of virtual reality (VR) into medical education,

especially in pathology. Traditional issues in medical education, such as restricted access to uncommon clinical cases, the static character of textbooks, and variations in the caliber of instruction among schools, are addressed by virtual reality (VR), which provides immersive, interactive, and adaptable learning environments. It improves student engagement, fosters the development of practical skills, and strengthens knowledge retention, giving aspiring medical professionals the resources they need to succeed in clinical settings.

Despite its transformative potential, VR in medical education is not without challenges. To guarantee its equitable and efficient usage, several obstacles must be addressed, including high prices, technological constraints, ethical issues, and the requirement for balanced curricular integration. Long-term studies are also necessary to assess VR's long-term effects on professional performance and clinical competency.

With increasingly sophisticated features and easier accessibility, virtual reality technology will surely play a bigger part in medical education as it develops further. Policymakers, technologists, and educators must work together to realize its full potential. VR has the potential to transform medical education, close the gap between theory and practice, and eventually improve patient care results in the future by resolving the present constraints and guaranteeing careful implementation.

REFERENCES

1. Lyapichev KA, Loghavi S, El Hussein S, Al-Maghrabi H, Xu J, Konoplev S, et al. Future of Education or Present Reality: MD Anderson Cancer Center Hematopathology Virtual Educational Platform under Coronavirus Disease 2019 (COVID-19) Pandemic. *Archives of Pathology & Laboratory Medicine* [Internet]. 2021 Jul 20 [cited 2024 Aug 28]; Available from: <https://doi.org/10.5858/arpa.2021-0195-SA>
2. Folaranmi OO, Ibiyeye KM, Odetunde OA, Kerr DA. The Influence of Social Media in Promoting Knowledge Acquisition and Pathology Excellence in Nigeria. *Frontiers in Medicine* [Internet]. 2022 Jun 3 [cited 2024 Aug 28];9. Available from: <https://doi.org/10.3389/fmed.2022.906950>
3. Pantanowitz L, Sharma A, Carter A, Kurc T, Sussman A, Saltz J. Twenty years of digital pathology: An overview of the road travelled,

- what is on the horizon, and the emergence of vendor-neutral archives. *Journal of Pathology Informatics* [Internet]. 2018 [cited 2024 Aug 30];9(1):40. Available from: https://doi.org/10.4103/jpi.jpi_69_18
4. Lin E, Fuda F, Luu HS, Cox AM, Fang F, Feng J, et al. Digital pathology and artificial intelligence as the next chapter in diagnostic hematopathology. *Seminars in Diagnostic Pathology* [Internet]. 2023 Feb [cited 2023 Feb 23]; Available from: <https://doi.org/10.1053/j.semmp.2023.02.001>
 5. Bryson G, O'—<https://doi.org/10.1016/j.mpdhp.2023.07.001>
 6. Singhal I, Kaur G, Neefs D, Pathak A. A Literature Review of the Future of Oral Medicine and Radiology, Oral Pathology, and Oral Surgery in the Hands of Technology. *Cureus* [Internet]. 2023 Sep 23 [cited 2024 Mar 3]; Available from: https://assets.cureus.com/uploads/review_article/pdf/183318/20231023-28265-1w0ekrf.pdf
 7. Komura D, Ishikawa S. Machine Learning Methods for Histopathological Image Analysis. *Computational and Structural Biotechnology Journal* [Internet]. 2018 [cited 2024 Sep 4];16:34–<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6158771/>
 8. Farahani N, Post R, Duboy J, Ahmed I, Kolowitz B, Krinchai T, et al. Exploring virtual reality technology and the Oculus Rift for the examination of digital pathology slides. *Journal of Pathology Informatics* [Internet]. 2016 [cited 2024 Sep 13];7(1):22. Available from: <https://doi.org/10.4103/2153-3539.181766>
 9. SuperpixelSG. Virtual Reality Costs: A Guide for Businesses - Superpixel [Internet]. Superpixel. Superpixel; 2023 [cited 2024 Sep 13]. Available from: <https://superpixel.sg/blog/virtual-reality-costs>
 10. Reddy N. Overcoming Barriers: Ethical considerations in VR for Healthcare [Internet]. Medium. Medium; 2024 [cited 2024 Oct 5]. Available from: <https://medium.com/@nikhit.r13/overcoming-barriers-ethical-considerations-in-vr-for-healthcare-b2079823926f>
 11. Lowood H. Virtual Reality. In: *Encyclopædia*<https://www.britannica.com/technology/virtual-reality>
 12. Sheldon R. What is Virtual Reality? [Internet]. Tech Target. 2022 [cited 2024 Oct 5]. Available from: <https://www.techtarget.com/whatis/definition/virtual-reality>
 13. Liimatainen K, Latonen L, Valkonen M, Kartasalo K, Ruusuvoori P. Virtual reality for 3D histology: multi-scale visualization of organs with interactive feature exploration. *BMC Cancer*. 2021 Oct 22;21(1).
 14. Georgios Ntakakis, Plomariti C, Frantzidi—<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC993190/>
 15. Erickson M. Virtual reality system helps surgeons, reassures patients [Internet]. News Center. 2017. Available from: <https://med.stanford.edu/news/all-news/2017/07/virtual-reality-system-helps-surgeons-reassures-patients.html>
 16. Pollak Y, Weiss PL, Rizzo AA, Weizer M, Shriki L, Shalev RS, et al. The Utility of a Continuous Performance Test Embedded in Virtual Reality in Measuring ADHD-Related Deficits. *Journal of Developmental & Behavioral Pediatrics*. 2009 Feb;30(1):2–
 17. Sree D. Is Virtual Reality Effective in Physiotherapy? [Internet]. Sri Ramakrishna Hospital. 2024. Available from: <https://www.sriramakrishnahospital.com/blog/physiotherapy/is-virtual-reality-effective-in-physiotherapy/>
 18. Madrigal E, Prajapati S, Hernandez-Prera JC. Introducing a Virtual Reality Experience in Anatomic Pathology Education. *American Journal of Clinical Pathology*. 2016 Sep 4;146(4):462–
 19. Regania Pasca Rassy, Mokmin M, Nur. Examining Learning Enjoyment, Presence, and Achievement Using a Virtual Reality Pathology Laboratory by Applying the CAMIL Model in Health Education. *Research Square* (Research Square). 2023 Mar 13;
 20. Cecchini MJ, Borowitz MJ, Glassy EF, Gullapalli RR, Hart SN, Hassell LA, et al. Harnessing the Power of Generative Artificial Intelligence in Pathology Education. *Archives of Pathology & Laboratory Medicine*. 2024 Sep 30;

CHALLENGES IN IMPLEMENTING VIRTUAL REALITY IN MEDICAL CURRICULA

Obianuko D. Opeyemi Adesina

I. INTRODUCTION

The history of medical education has been one rife with technological advancements. From Leonardo Da Vinci's dissection and study of cadavers, [1] to the invention of anatomical models; and even more recently, the use of the internet & digital media to study dissected bodies. Each breakthrough has helped breach a prior barrier in the field of medical education especially pertaining to anatomy. Today, virtual reality (VR) promises further insights into the study of the mechanics of the human body, offering a unique level of interaction and immersion.

However, despite the innovation that virtual reality promises, its implementation in the field of anatomy is not without its challenges. From high costs and technical barriers to institutional resistance and the need for faculty training, the pathway to adoption is blockaded by several obstacles. Identifying and gauging possible solutions to these issues is important if VR is to contribute positively towards medical education.

This article explores key challenges involved in this implementation, focusing on barriers such as cost, technological limitations, accessibility, and curriculum adaptation, while also proposing solutions for overcoming these obstacles.

II. BACKGROUND INFORMATION

Evolution of Medical Curricula and Technological Integration

The adoption of technology in medical education is not a novel event. Historically, the field of medicine has benefited significantly from the advancement of technology [2], with benefits ranging from prosthetic limbs and brain-computer interfaces to wearable health monitors and magnetic resonance imaging (MRI) systems. Science and technology are constant actors in the field of medicine, so it should come as no surprise to anyone that technology should also benefit medical education. Advances such as online education and distributed resource sharing largely owe their existence to technological leaps.

Current Limitations in Anatomy Education

Cadavers constitute the gold standard for anatomical education: they offer an unrivaled experience in the process of human examination in depths that no textbook or 3D model can currently hope to recreate. Dissection provides a realistic exposure to real-time examinations of the muscles, blood vessels, and bones, granting students a glimpse into the functionalities of actual human bodies. However, the acquisition of said cadavers is beset with numerous financial, ethical, and logistic limitations that prevent medical students from taking full advantage of them. In light of this, several technological innovations are aimed at overcoming these limitations, with VR being one of the most promising alternatives.

VR in Medical Education

Virtual Reality (VR) is the use of 3D near-eye technology and pose tracking to simulate a completely virtual environment with high levels of immersion [3]. In the field of medical education, Virtual Reality introduces an innovative approach to learning complex topics and practices such as surgical procedures, anatomical examinations, and hands-on clinical practices. With the application of VR, students can expand their current understanding of these processes through their participation in more immersive examples.

A number of VR platforms and applications have been developed to facilitate this integration process. The Anatomage table [4] is a digital dissection table that allows students to examine three-dimensional images of actual human anatomical functions in high resolution. In the same vein, the VR Human Anatomy application offers virtual cadaver experiences that allow students to dissect, organize, and manipulate virtual cadavers and, in turn, extract deeper insights into the understanding of the spatial relationships of these physical processes. Through the application of these tools, virtual reality (VR) technology exhibits the ability to advance our current understanding of anatomy and the processes behind it as it pertains to medical education and training.

III. KEY CHALLENGES IN IMPLEMENTING VR

Cost and Accessibility

Given the fact that virtual reality is a rapidly developing field with limited hardware, the cost of setting up VR systems that would account for every medical student, especially in a third-world country like Nigeria, would be crippling for most institutions with budget constraints. Public institutions, in particular, would struggle to acquire the necessary funding for implementing it at a functional scale. Also worthy of note are the regular upgrades and maintenance of both software and hardware that would be required to maintain an up-to-date contemporary system.

Technological Limitations

As advanced as modern VR systems are, they still face drawbacks and bugs that limit their level of immersion, one of which is the underdevelopment of haptic feedback [5]. This is a limitation that would pose significant problems in the process of cadaver dissection, preventing students from learning the required amounts of force and strain necessary for cutting through certain sections cleanly & delicately. Limitations like this, and the inability of VR to replicate the nasal processes necessary in medical studies raise a significant barrier on its adoption into curriculums [6].

Lack of Faculty Training and Resistance

A considerable number of current medical educators in Nigeria are not conversant with contemporary technologies, especially concerning modern medical educational tools. The cost and time required to retrain them in the processes involved could be cumbersome for most schools. This re-education process could also foster resistance in the staff, who could raise arguments that the current traditional teaching methods are superior.

Regulatory bodies would also be slow to adjust or develop accreditation standards to accommodate VR education, increasing the difficulty of institutions adopting VR-based educational curriculums.

Student Adaptation and Learning Curve

Modern medical students are generally competent in technology, however, Virtual Reality hardware and software are new technologies that are still improving their user interfaces. This could lead to a learning curve, significantly derailing attempts at VR integration.

There are also concerns that students from poorer

socioeconomic backgrounds would be able to afford or access the hardware required, leading to a gap in understanding.

Physical and Psychological Concerns

Studies have shown that extended uses of VR could lead to an increase in headaches, motion sickness, and eye strain [7][8], all of which could negatively affect the welfare of students. The inability of VR to fully eliminate these side effects could be the biggest stumbling block in its path to widespread adoption.

IV. Proposed Solutions for Overcoming These Challenges

Reducing Costs and Financial Barriers

To increase the accessibility of VR, institutions should open partnerships with technological companies to receive discounts on hardware or software. Sharing VR resources among medical departments may also reduce costs. In addition, government grants and educational funds specifically aimed at technological innovation could ease the financial burden of VR implementation.

Advancing Technology

As VR technology evolves, developers are working on building more immersive systems with better tactile feedback. Collaboration between VR developers and medical educators could result in more accurate VR applications, covering a wider range of educational needs. Nasal feedback systems, while a long way in the making, are certainly in development and could lead to more accurate VR experiences in the future. [6]

Faculty Training and Support

Constant faculty training and retraining is beneficial to any Institution. Workshops, seminars, and online courses could be leveraged to improve the capabilities of educators in the field of VR education. Promoting early adopters of VR as champions for the technology can also help reduce resistance among more traditional faculty.

Curriculum Integration and Alignment

Institutions can gradually integrate VR into the curriculum by starting with supplementary modules rather than a full overhaul of existing programs. Beginner programs that focus on specific learning outcomes can help educators assess the effectiveness of VR and make adjustments as needed. Involving accreditation bodies in discussions about incorporating VR into standards can streamline its integration into curricula. [7]

Facilitating Student Adaptation

Students can be introduced to VR gradually through orientation sessions or introductory workshops, helping them become more comfortable with the technology. Blended learning approaches that combine traditional methods with VR can ensure that students still receive the necessary hands-on experience while benefiting from the immersive aspects of VR.

Ethical and Psychological Concerns

Institutions can reduce issues like motion sickness by limiting VR session lengths or enforcing breaks during lessons. In the meantime, developers should work to reduce the side effects of VR immersion or eliminate them entirely.

[7,8]

V. CASE STUDIES

Case Study 1: VR as Effective as Traditional Learning Methods

A 2017 study[7] assessed the effectiveness of virtual reality (VR) and augmented reality (AR) in teaching anatomy compared to tablet-based (TB) applications. The research involved 59 participants randomly allocated to one of the three modes of learning, focusing on skull anatomy. Results showed no significant differences in mean assessment scores across VR, AR, and TB modes. However, VR participants reported more frequent adverse effects like headaches, dizziness, and blurred vision.

Case Study 2: Reducing Visual Discomfort in VR

A clinical trial published in 2015[8] explored the visual discomfort experienced by users of head-mounted displays (HMDs) during VR sessions. The study investigated the effectiveness of dynamic depth-of-field (DoF) blur to alleviate symptoms such as eye fatigue, headaches, and nausea. Using a commercial game engine implementation, participants reported reduced discomfort when DoF blurring was enabled. The study demonstrated that dynamic DoF could effectively minimize visual discomfort, improving the user experience in VR-based educational environments.

VI. Discussion and Conclusion

VR integration in medical education promises effective transformation potential, especially in the field of anatomy. However, the challenges it faces such as high costs, tactile feedback, and institutional resistance can slow down its adoption. As the technology becomes more affordable and the hardware more accessible, it has the potential to

expand and become more accepted by institutions everywhere, particularly those without good access to cadavers.

With research ongoing to improve the rate of realism and reduce the rate of side effects on the user; along with investments from several organizations and medical institutions, VR could very well become the new gold standard in the world of anatomy and medical education.

REFERENCES

1. Jones R. Leonardo da Vinci: anatomist. *Br J Gen Pract.* 2012 Jun;62(599):319. doi: 10.3399/bjgp12X649241. PMID: 22687222. PMCID: PMC3361109.
2. Bajwa M. Emerging: 21st-century medical technologies. *Pak J Med Sci.* 2014 May-Jun;30(3):649-655. doi: 10.12669/pjms.303.5211. PMID: 24948997. PMCID: PMC4048524.
3. Virtual reality. In: Wikipedia [Internet]. Available from: https://en.wikipedia.org/wiki/Virtual_reality
4. Kavvadia EM, Katsoula I, Angelis S, Filippou D. The Anatomage Table: a promising alternative in anatomy education. *Cureus.* 2023 Aug;15(8):e43047. doi: 10.7759/cureus.43047. PMID: 37692592. PMCID: PMC10484354.
5. Våpenstad C, Hofstad EF, Bø LE, Langø T, et al. Limitations of haptic feedback devices on construct validity of the LapSim® virtual reality simulator. *Surg Endosc.* 2012 Dec;27(4). doi: 10.1007/s00464-012-2621-9.
6. Andonova V, Reinoso-Carvalho F, Jimenez Ramirez MA, Carrasquilla D. Does multisensory stimulation with virtual reality (VR) and smell improve learning? An educational experience in recall and creativity. *Front Psychol.* 2023;14:1176697. doi:10.3389/fpsyg.2023.1176697. PMID: 37397289. PMCID: PMC10308939.
7. Moro C, Štromberga Z, Raikos A, Stirling A. The effectiveness of virtual and augmented reality in health sciences and medical anatomy. *Anat Sci Educ.* 2017;10(6):549-559.
8. Carnegie K, Rhee T. Reducing visual discomfort with HMDs using dynamic depth of field. *IEEE Comput Graph Appl.* 2015 Sep-Oct;35(5):34-41. doi: 10.1109/MCG.2015.98.

INNOVATIVE TEACHING METHODS IN MEDICAL EDUCATION: BEYOND THE TRADITIONAL METHODS

Okoye C. Princess

Faculty of Basic Medical Sciences College of Medicine, University of Enugu Campus

INTRODUCTION:

Can the Gen Z medical students effectively learn the skill and science of Medicine and Surgery under the same teaching methods as that which was adopted in the past medical school days of older highly experienced doctors?

Over the years, the medical education system adopted major traditional methods of memorization, algorithm, hard copy dull prints on enormous and ambiguous textbooks, pattern recognition and narrowed assumptions of results. However, the system of learning in the medical field has greatly evolved towards more practices of audio, visual, audio-visual, simulation-based methods of teaching and learning about the general features of the human life. This article is based on the studies of innovative teaching methods in medicine, beyond the traditional methods and it cannot be effectively explored without a general view and knowledge on the major subjects of the topic of medical education, which are the people actually receiving the education, the medical students. The medical students of recent times belong to a particular generation of young people well known to the world as Gen Z. A brief background on this group of people would suffice.

Who are the Gen Z Medical Students?

The terms Generation Z and the iGeneration refer to people born between the years 1995-2012. Although it might seem stereotypical to make sweeping statements about a certain group of people, there is a large benefit of understanding and effectiveness attached to describing people in order to inform teaching practices. These group of people are the most recent set of university students and applicants. They are considered the first generation of digital natives as no other generation has had such a level of unlimited access to a speedy system that generates a wide variety of data and information, basically referred to as the internet.

They are hyper connected, really exposed to several and diverse entities around the world. This however has had an effect on the lifestyle and general wiring on the emotional, social and intellectual construct of this new generation and it will definitely boil down to their educational systems of learning. In as much as the medical field is one that requires an intense level of

focus and determination and also skill, the older doctors keep getting older and keep retiring and newer, more naive doctors are being trained and it is "no brainer" that these current apprentices fall into this group of people being discussed.

One cannot do a study on this group of people without espousing on their attention span which has a massive role to play their learning methods. A research conducted by Microsoft in 2015 found out that the average attention span of Gen Z individuals was only about eight seconds, four seconds less than that of millennials. This has a massive effect on their learning methods; they prefer communicating through images, icons and symbols rather than texts. They prefer life application and problems solving skills that engage their thinking abilities and this gets them a lot more involved than series of lectures in a classroom wherein they listen to long talks of concepts they are yet to comprehend.

Narrowing the scope down to the medical students and their methods of teaching and learning, the concept of improved and innovative methods is equally a subject of discussion. The broad scope of the medical field in no doubt distinguishes its student from other disciplines in terms of the bulk of information to be mastered, intricate skills to be adopted and meticulous means of problem solving, knowing the exact methods to be applied and the exact procedures to be put in play, having at the tip of the fingers, the science and art of preserving the human life. No shock in the respect the profession leads as it really does take a great deal of focus to be in the field.

Based on the nature of the chosen path of profession and also the nature of the exposure and social pressure that comes with their generation, this group of upcoming doctors are really prone to likely suffer from depression, inferiority complex, imposter syndrome, immense pressure and need to impress, personality crises and even mental disorders in extreme cases. A British study shows a five-fold increase in the number of mental disorders among university students between 2007 and 2018. Quite unfortunately, the mentioned numbers are even worse amongst medical students of medical schools.

According to a review study published in JAMA, depression affects about a quarter of medical students and their suicide risk is about 11 percent.

Mind construct of an average medical student in today's world.

The opinion of students is of utmost importance to determine the teaching and learning methods that would have the most efficient effect on them. With the way the world is changing, undergraduate teaching programs have to be linked with new expectations. This calls for new means for knowledge transfer, new technology tools and advances on design thinking.

A very important concept in the mind construct of a medical student in regards to their studies is the concept of Motivation. According to the journal by PubMed Central, Motivation is essential for engaging students in their learning process, being a predictor of their academic performances.

Healthy motivation really provides the psyche of these students with a pleasant drive towards learning and the actual desire really grows. This should be the upmost intent of any teaching method, to preserve and maintain a positive environment and learning methods that really pushes a motivational spirit in the students. PubMed also states that "motivation related to methods of learning is clearly linked to students' perceptions and the achievement of good learning outcomes.

A research survey was conducted concerning learning methods of the medical students of today and results were published in the PubMed journal and it showed that "assisting theory lectures to motivate students (item M1) was the item with which all students agreed the least (lowest score), which explains the wide lack of attendance.

As expected, students majorly expressed the need and necessity for the introduction of new learning methods such as simulations, flipped classes, additional seminars for cooperation learning, discussions and clinical cases) and these provide good sources of motivation as it is a means for diversified learning and better student involvement and participation. In addition, the students also expressed their desire to be part of the medical team during hospital internship and to be trained in medical research. A couple of these modern teaching methods would be looked at but the traditional methods would first, have to properly understood and studied so as to properly espouse on the need for the switch.

Traditional Methods of the Medical Education

When it comes to teaching and learning process in the most widely adopted method is the good old series of Didactic Learning. This method involves a teaching approach in which the lecturer directly instructs the students through planned lectures and lessons. According to Wikipedia, *In didactic method of teaching, the teacher gives instructions to the students and the students are mostly passive listeners. It is a teacher centered method of teaching and is content oriented. Neither the content nor the knowledge of the teacher are questioned.* This method usually comes with a lot of mental drain and stress as students are made to sit through long hours of these lectures and there is little or no interactions between them and their lecturers. This method has a strong test on the attention span of students and is a major means to depressing it. Active student participation is very minimalistic and thus, there is no proper track on the involvement of the students in the learning process.

According to an article released by the Nurse Education today, on approaches to teaching, The lecture is 'probably the most frequently employed teaching technique despite all of the criticisms that have been leveled against it'. It is just an abstract way of transmitting mostly factual information to a large group of people without active engagement or concern in the learning state of the people. It was also mentioned in the same article that 'Didacticism raises numerous constraints which involve learning by note taking, and potential boredom as the approach limits student participation and reflection.'

However, it seems like this method offers a certain level of convenience, especially to the lecturers who maintain traditional mind constructs of education. This usually poses as a major issue especially in situations whereby the subjects of discussion are new to majority of the students or if they are disorganized learners. Teaching should be directed more towards ensuring the actual acquisition of knowledge by the students. In order to improve on these methods, teaching should be structured in a more practical and experimental approach. This helps students to "make sense" and "make meaning" of the information they are acquiring. Didactic style is being viewed as the least effective method as the actual challenges of the students are not really considered. Knowledge application methods have a better effect on students in exponential figures.

This takes this study to the discussion on Modern and innovative methods and approaches to the medical education.

INNOVATIVE TEACHING METHODS IN MODERN MEDICINE

This emphasizes on the necessity of the shift from the traditional method of administering lectures in classrooms to more roles that encourages the students to engage in critical thinking, problem solving, group participation and other experiences.

Challenge is an aspect of learning facilitation that commensurate with transformational learning (Entwistle, 1997).

1. PROBLEM-BASED LEARNING

The science of Medicine is a field that encounters serious of advancements and there is need for constant improvement in techniques and methodology skills.

Problem-based Learning is an approach that requires students to explore a variety of clinical cases and scenarios and actively apply the knowledge gained so far in studies to solve them. This results to a higher level of implementation of knowledge and skills. This enables students to go beyond the daily lengthy hours of “knowledge stuffing” lectures without actually getting to experience real life situations to apply the knowledge.

Structure of PBL in Medical School

I. Case Introduction:

Students are given a clinical case (often a patient scenario) that presents a medical problem. The case may contain limited information at first to encourage independent research and inquiry.

The case is usually a multidisciplinary one, involving various aspects like history-taking, diagnosis, treatment, and prevention.

II. Initial Group Discussion:

Students discuss the case in small groups. They identify what they know, what they need to learn, and formulate learning objectives to guide their independent study. This step also allows them to develop hypotheses about the diagnosis or treatment.

The facilitator (usually a tutor or faculty member) guides the discussion but does not provide direct answers, encouraging students to lead the learning process.

III. Independent Study:

After the group discussion, students go off to explore the medical literature, textbooks, research papers, and online resources to answer their questions, enhance their knowledge, and gather evidence about the case.

IV. Follow-up Group Discussion:

Once they've done their individual research, the group reconvenes to discuss their findings. They refine their

understanding, update their hypotheses, and may even adjust the case diagnosis based on new information.

The facilitator encourages critical evaluation of resources and fosters discussion about the application of knowledge to clinical practice.

V. Reflection:

After the discussion and resolution of the case, students reflect on their learning, both individually and as a group, considering what worked well, what could have been improved, and what new knowledge they gained. This process also promotes lifelong learning skills.

Benefits of PBL in Medical School

I. Active Learning:

Unlike passive learning from lectures, PBL engages students actively. They must apply their knowledge, think critically, and solve problems, which can lead to better retention of information.

II. Clinical Relevance:

PBL uses real-world cases, so students are learning in a context that mimics actual medical practice. This bridges the gap between theory and practice, helping students develop clinical reasoning skills early.

III. Development of Critical Thinking:

PBL pushes students to think analytically, not just memorize facts. They learn to assess evidence, question assumptions, and form hypotheses—key skills for a medical career.

IV. Collaboration and Communication:

Working in groups enhances teamwork skills and fosters communication among peers, which is essential for modern medical practice where collaboration with other healthcare professionals is a norm.

V. Self-Directed Learning:

PBL encourages self-directed learning, empowering students to take ownership of their education. Medical students must learn to seek out resources, evaluate their relevance, and incorporate them into their understanding, which fosters lifelong learning.

VI. Holistic Learning:

PBL often incorporates the bio-psychosocial model of patient care, meaning students must consider not only the biological aspects of the case but also the psychological and social factors that influence patient health and treatment.

This method promotes optimum active participation in learning processes, especially in handling medical cases in a real world scenarios. This yields really efficient doctors that would have crisp clinical and problem solving skills.

By using realistic scenarios, simulators, and virtual environments, it provides valuable hands-on experience without putting patients at risk.

IT CAN BE PRACTICED IN VARIOUS FORMS:

I. Mannequins and Robots: These advanced simulators replicate human physiology, including vital signs, breathing, heartbeats, and even responses to treatments. They can be used for practicing a wide range of procedures, from basic CPR to complex surgeries.

II. Surgical Simulators: These allow students to practice specific surgical skills like suturing, laparoscopy, and other procedures in a controlled, repeatable manner. These simulators can mimic tissue textures, bleeding, and other real-world factors. This also helps in perfecting skills and acquiring assurance in risky procedures.

III. Virtual Reality (VR) Simulations: VR is increasingly used for creating immersive, 3D environments where students can simulate surgeries or diagnostic procedures. This technology allows for practicing in a wide variety of settings, from operating rooms to emergency situations, without physical constraints.

IV. Procedural Training: Medical students can practice specific skills, such as intubation, catheter insertion, or IV placement, on simulators or models that mimic human anatomy. This hands-on training helps build muscle memory and confidence before performing these procedures on real patients. This also extends to emergency procedures like resuscitation, where learners can practice under time pressure, ensuring they know how to act quickly and efficiently in high-stakes situations.

BENEFITS OF SIMULATION-BASED LEARNING:

I. Enhanced Skill Development: Students can refine technical skills and gain confidence before moving on to real patients.

II. Error-Free Learning: Learners can make mistakes in simulations without putting real patients at risk, allowing them to improve their performance without fear.

III. Realistic Exposure: Simulations provide a more realistic, immersive learning environment than traditional classroom instruction, preparing students for real-world clinical situations.

IV. Safe Learning Environment: Especially for rare or complex cases, simulation ensures students get exposure to conditions or scenarios they may not see regularly in clinical rotations.

Imagine the art and science of medicine and surgery being taught to students in such an engaging and practical manner, wherein all the mistakes and lessons can be learnt, skill and knowledge won't be a problem with the upcoming doctors in the years to come, what a world of excellence and development awaits the field of medicine!

1. TELEMEDICINE AND AI

With the rise of telemedicine and AI, it's essential to train medical professionals to use these technologies effectively. Medical schools are incorporating telehealth platforms, AI diagnostic tools, and electronic health records (EHR) systems into curricula. Virtual consultations, AI-driven diagnostics, and online patient management are becoming standard practice, making it crucial for future doctors to be tech-savvy.

Benefits of this method:

I. Chatbots and Virtual Assistants: AI-powered chatbots (like virtual tutors) can provide students with real-time answers to questions, offer explanations, and help reinforce key concepts. These tutors are available 24/7, providing immediate support outside of classroom hours.

II. Medical Knowledge Enhancement: Virtual tutors can be programmed with vast medical knowledge to answer clinical questions, simulate medical scenarios, and help students practice diagnostic skills. They can present case studies, quizzes, and review material, offering an interactive way to learn.

III. Diagnostic Support Systems: AI tools like decision support systems are now used in medical education to teach students how to use AI-driven diagnostic tools in clinical decision-making. These systems analyze patient data (symptoms, medical history, lab results) and suggest possible diagnoses or treatment plans.

IV. Automated Grading Systems: AI algorithms can automatically grade written assignments, multiple-choice questions, and even practical exams based on pre-established criteria.

This reduces the workload for instructors and provides instant feedback to students.

V. Objective Performance Evaluation: AI tools can evaluate more complex aspects of clinical practice, like physical exams or procedural skills, by analyzing video recordings or sensor data (e.g., motion tracking, sound analysis). This ensures a more objective and standardized evaluation process.

4. PERSONALIZED MENTORSHIP

Personalized mentorship and peer teaching programs allow students to receive more one-on-one guidance from experienced practitioners. Peer teaching fosters collaboration and offers diverse perspectives on solving clinical problems. In this model, students are both learners and teachers, deepening their understanding by explaining concepts to others. This scope should be really encouraged especially in the hospital settings where hierarchy is strictly maintained. The doctors in the higher professional ladders should work more based on impacting and transferring knowledge to the Junior ones and reduce the severity of hierarchical boundaries. Mentorship plays a crucial role in modern medicine learning, providing both academic and professional guidance that shapes the next generation of healthcare professionals. While traditional medical education focuses on theoretical knowledge and clinical skills, mentorship bridges the gap between classroom learning and real-world practice. Here are several reasons why mentorship is so important in modern medicine.

How relevant, really is mentorship to modern medicine?

- I. Tailored Learning Experience: Mentors provide personalized feedback based on the strengths, weaknesses, and unique goals of their mentees. This allows students to focus on areas where they need improvement and build on their skills in a way that is specific to their career aspirations.
- II. Emotional and Professional Support: The rigors of medical education and practice can be emotionally challenging, with long hours, high stress, and intense decision-making. Mentors offer not just academic advice but emotional support, helping mentees navigate the pressures of medical school and residency.
- III. Modeling Professional Behavior: Mentors serve as role models for professionalism, patient care, and ethical conduct. By observing how mentors approach patient interactions, communicate with teams, and make clinical decisions, mentees gain insight into best practices in the medical field.
- IV. Career Path Exploration: Medicine offers a vast range of specialties and subspecialties, and mentors can help students explore these options. By sharing their own experiences and connecting students with professionals in different areas, mentors help mentees identify their interests and make informed decisions about their future careers.
- V. Networking Opportunities: Mentors can open doors to important professional networks, introducing mentees to key contacts in academia, healthcare, and research. These connections can be pivotal in securing job opportunities, research positions, or even fellowships in the future.

CONCLUSION

The world is greatly progressing and innovation seems to be taking place at the speed and coverage of an atomic bomb. Some Traditional practices might not necessarily need to be completely aborted but rather, improved on for efficiency in teaching and learning. It is after all stated that without the old, the new can never exist. This part of the world, however needs to be more open to embracing and exploring these innovative methods to produce doctors of standard quality. Then again, it is believed that doctors who were trained under strict and tough traditional methods make for better professionals when it comes to resilience and improvisation. This is still a bone of contention and a research study work on it is highly encouraged.

REFERENCES

1. Issenberg, S. B., McGaghie, W. C., Petrusa, E. R., & Lee Gordon, D. (2005). "Features and uses of high-fidelity medical simulations that lead to effective learning: A BEME systematic review." *Medical Teacher*, 27(1), 10-28.
2. Koh, G. C. H., & McGrath, P. (2017). "Innovative teaching methods in medical education: A review." *Medical Education Online*, 22(1), 1306328.
3. Liu, X., & Liu, Z. (2020). "The impact of digital health technologies on medical education: A review of trends and challenges." *Journal of Medical Internet Research*, 22(12), e21799.
4. Tans, R., & Dierendonck, E. (2019). "Using artificial intelligence and machine learning in medical education." *Medical Education Online*, 24(1), 1576327.
5. Miller, G. E. (1990). "The assessment of clinical skills/competence/performance." *Academic Medicine*, 65(9), S63-S67.
6. Srinivasan, M., & Wilkes, M. (2019). "Competency-based medical education: The way forward." *Medical Teacher*, 41(2), 132-139.

ADDRESSING BURNOUT AND MENTAL HEALTH IN MEDICAL STUDENTS: EDUCATIONAL STRATEGIES.

Uzoechina Godswill Chidubem

Faculty of Clinical Sciences, University of Nigeria Enugu Campus

ABSTRACT

Introduction: Burnout and mental health challenges are increasingly recognized as significant issues among medical students, stemming from academic pressure, clinical responsibilities, and limited mental health resources. In Nigeria, these challenges are exacerbated by resource constraints and stigma, necessitating effective educational interventions to support students' well-being.

Methods: This study employed a mixed-methods approach, integrating quantitative surveys and qualitative interviews. The Maslach Burnout Inventory (MBI) and the Depression, Anxiety, and Stress Scale (DASS-21) were used to assess burnout and mental health among a representative sample of Nigerian medical students. Thematic analysis of qualitative data provided deeper insights into students' experiences and coping mechanisms.

Results: Findings revealed a high prevalence of burnout (65%) and significant mental health challenges, with 48% of students experiencing moderate to severe depression and 52% reporting anxiety symptoms. Female students and those from lower socioeconomic backgrounds were disproportionately affected. Qualitative data highlighted academic pressure, lack of institutional support, and stigma as key contributors to burnout.

Discussion: Effective interventions, such as resilience training, mindfulness programs, mentorship, and curriculum modifications, were identified as crucial for improving students' well-being. However, low participation in existing mental health programs suggests the need for culturally appropriate and accessible interventions.

Conclusion: Addressing burnout and mental health in medical students requires a multifaceted approach integrating educational strategies, institutional support, and systemic reforms. Implementing targeted interventions can enhance student well-being, academic performance, and future healthcare delivery.

1. INTRODUCTION

Burnout has become a significant concern in medical

education worldwide. Defined by Maslach and Jackson as a syndrome of emotional exhaustion, depersonalization, and diminished personal accomplishment, burnout particularly affects those in high-stress environments, such as medical students (1). The rigors of medical training—long hours, high academic expectations, and exposure to human suffering—create a perfect storm for mental health deterioration. Medical students often face not only academic pressures but also the burden of clinical responsibilities, making them highly susceptible to both physical and emotional exhaustion (2).

Globally, burnout among medical students has reached alarming levels. A systematic review and meta-analysis found that over 50% of medical students reported burnout symptoms (3). In addition to burnout, mental health challenges such as anxiety, depression, and stress-related disorders are widespread. Studies conducted in Europe, North America, and Asia consistently report high rates of psychological distress among medical students (4). The situation is equally concerning in Africa, where the mental health needs of medical students often go unmet due to the stigma surrounding mental health and a lack of adequate resources (5).

In Nigeria, the prevalence of burnout and mental health issues among medical students mirrors global trends, though unique factors such as resource limitations and systemic challenges further exacerbate the problem. Nigerian medical schools are often underfunded and understaffed, leading to high workloads for students and limited access to mental health services (6). A study conducted in Nigeria revealed that approximately 55% of medical students reported symptoms of burnout, with 30% experiencing clinical levels of anxiety and depression (7).

Addressing these issues is crucial for the well-being of future healthcare professionals. Burnout not only compromises the mental health of students but also negatively impacts their academic performance, clinical decision-making, and long-term career satisfaction (8). Moreover, unresolved burnout and mental health problems can lead to high dropout rates, reduced empathy towards patients, and even increased rates of medical errors (9).

Educational institutions play a pivotal role in addressing these challenges. By implementing strategies such as curriculum reforms, mental health programs, and fostering supportive learning environments, schools can help mitigate the risk of burnout and improve mental health outcomes for their students (10). For instance, medical schools in the United States and Europe have integrated wellness programs, mindfulness training, and peer support systems to alleviate stress and promote resilience (11). However, these strategies must be adapted to the Nigerian context, where resource constraints and cultural attitudes towards mental health present additional barriers (12).

This paper aims to examine the prevalence of burnout and mental health challenges among medical students, with a particular focus on Nigeria. It will explore educational strategies that can be implemented to address these issues, thereby improving the well-being of students and their ability to succeed academically. By identifying key interventions within the educational framework, this research seeks to provide actionable recommendations for institutions to create healthier and more supportive learning environments.

2. LITERATURE REVIEW

2.1 Background of the Study

Burnout is a complex, multifaceted phenomenon characterized by emotional exhaustion, depersonalization, and a diminished sense of personal accomplishment (13). It is particularly prevalent in high-stress professions, such as medicine, where individuals face chronic demands and a high potential for emotional toll (14). The medical field, with its intense demands and expectations, has long been recognized as a breeding ground for burnout, prompting the development of various assessment tools. Among these, Maslach's Burnout Inventory (MBI) remains one of the most widely used, emphasizing the emotional and interpersonal components of burnout (15). The unique pressures faced by medical students—from rigorous academic requirements to exposure to patient suffering—make burnout an urgent concern in medical education (16).

Mental health issues among medical students, including anxiety, depression, and stress-related disorders, have garnered increased attention in recent years. The demanding nature of medical training often

exacerbates these issues, leading to a troubling prevalence of psychological distress (17). Research indicates that medical students may experience mental health issues at rates significantly higher than their peers in other academic fields (18).

The stakes of addressing burnout and mental health challenges in medical education are high. Burnout not only affects individual students but can also impact the quality of care they provide as future healthcare professionals (19). Furthermore, the ramifications of untreated mental health issues may extend to increased dropout rates, poor academic performance, and long-term psychological difficulties (20). Thus, understanding the dynamics of burnout and mental health within this context is crucial for developing effective interventions.

2.2 Statement of Problem

The problem of burnout and mental health challenges in medical students is exacerbated by various systemic and personal factors. In Nigeria, limited access to mental health resources, societal stigma surrounding mental health issues, and the demanding nature of medical training contribute to a heightened vulnerability among students (21). The consequences of unresolved burnout and mental health problems extend far beyond individual students; they can lead to broader implications for healthcare delivery, including reduced empathy towards patients and increased rates of medical errors (22).

The high-pressure environment of medical school creates a breeding ground for burnout. Factors such as heavy workloads, long hours of study, and the emotional burden of patient care often contribute to increased stress levels among students (23). Moreover, the stigma surrounding mental health in many cultures, including Nigeria, further complicates students' willingness to seek help (24). This reluctance can lead to a cycle of unaddressed mental health issues, compounding the challenges faced by medical students.

2.3 Exploration of Key Literature

2.3.1 Theories and Definitions of Burnout

Burnout has been extensively studied, and various theories have emerged to explain its origins and impact. The MBI developed by Maslach and Jackson is foundational in understanding burnout in professional settings.

The MBI identifies three core dimensions of burnout: emotional exhaustion, depersonalization, and reduced personal accomplishment (25).

Emotional exhaustion refers to feelings of being overwhelmed and depleted, while depersonalization encompasses a cynical attitude towards others. Reduced personal accomplishment involves a sense of inadequacy and diminished competence (26).

In the context of medical education, burnout is often linked to academic pressures and the emotional toll of patient care. Students are frequently exposed to traumatic experiences and high workloads, making them susceptible to mental health issues (27). A study by Dyrbye et al. highlights that emotional exhaustion is particularly pronounced among medical students, who report feeling increasingly detached from their studies and patients (28). Moreover, the stigma surrounding mental health in many cultures, including Nigeria, further complicates students' willingness to seek help (29).

The definitions and theories surrounding burnout continue to evolve, with researchers exploring new dimensions and variables that contribute to this phenomenon. For instance, the Job-Demands Resources (JD-R) model emphasizes the interplay between job demands and resources, suggesting that a lack of support can exacerbate burnout among students (30). Understanding these theoretical frameworks is essential for developing targeted interventions that address the root causes of burnout.

2.3.2 Prevalence of Mental Health Issues

The prevalence of mental health issues among medical students has been documented in various studies worldwide. A systematic review by Dyrbye et al. found that nearly 50% of medical students report experiencing symptoms of depression, and approximately 33% exhibit symptoms of anxiety (31). In Nigeria, research indicates that around 55% of medical students experience burnout, while 30% face clinically significant levels of anxiety and depression (32). This situation highlights the urgent need for effective interventions to address mental health issues in this population.

Moreover, regional differences in mental health prevalence among medical students have been noted. In some studies, female medical students report higher levels of stress and anxiety compared to their male counterparts, indicating the need for gender-sensitive approaches in addressing mental health (33). Additionally, cultural factors play a significant role in

how students perceive and manage their mental health, with some students being less likely to seek help due to fear of stigma (34).

The high rates of burnout and mental health issues among medical students underline the importance of early intervention and supportive measures within medical education programs. By acknowledging these challenges, educators and policymakers can work toward creating a more supportive environment that prioritizes student well-being.

2.3.3 Impact of Burnout on Medical Students

The consequences of burnout on medical students are profound and multifaceted.

Studies have demonstrated that burnout negatively impacts academic performance, leading to decreased grades and increased absenteeism (35). A longitudinal study revealed that students experiencing high levels of burnout were more likely to report academic difficulties and lower performance in clinical settings (36). Furthermore, burnout can influence career choices, with some students opting out of clinical rotations or specialty fields perceived as more stressful (37). The personal life of students is also affected, as burnout can lead to strained relationships and diminished overall quality of life (38).

Burnout has also been linked to adverse outcomes in future medical practice. A study by Thomas et al. indicated that medical professionals who experienced burnout during training were more likely to report emotional exhaustion and depersonalization in their clinical practice, affecting their interactions with patients (39). This cycle of distress emphasizes the need for proactive measures to address burnout during medical training to ensure future physicians maintain a healthy relationship with their profession.

Additionally, burnout can have implications for patient care, as students who are burned out may exhibit decreased empathy towards patients and reduced effectiveness in clinical settings (40). The link between burnout and professional competency raises important questions about the sustainability of current medical education practices and highlights the need for reform.

2.3.4 Existing Interventions

Recognizing the impact of burnout and mental health issues, various institutions have implemented educational strategies aimed at mitigating these challenges. Programs such as mindfulness training, wellness initiatives, and peer support systems have been adopted in several medical schools (41).

A study evaluating a mindfulness-based program for medical students found significant reductions in stress and improvements in well-being (42). These programs emphasize the importance of self-care and resilience, providing students with tools to manage stress effectively.

Institutions in the United States and Europe have developed comprehensive mental health services tailored to medical students' needs, including counseling and crisis intervention (43). These services have been found to significantly reduce symptoms of anxiety and depression, indicating their effectiveness in promoting mental well-being among students (44). However, these strategies must be adapted to the Nigerian context, where cultural attitudes and resource constraints may hinder implementation (45).

In Nigeria, efforts to address burnout and mental health challenges among medical students have been limited, but some institutions have begun to implement wellness programs. For instance, the University of Lagos initiated a wellness initiative aimed at promoting mental health awareness and providing support services for students (46). However, more comprehensive and systematic approaches are needed to create an environment conducive to mental health in medical education.

2.4 Structure of Proposal

This literature review will inform the structure of the proposed study, which aims to investigate the prevalence of burnout and mental health challenges among medical students in Nigeria. By reviewing existing literature and identifying gaps, this research will provide a comprehensive overview of the current state of mental health in medical education and the efficacy of various interventions. The proposal will outline the research design, methodology, and potential implications for policy and practice.

2.5 Scope of Study

The scope of this study will encompass medical students across Nigeria, examining both the prevalence of burnout and mental health issues and the educational strategies employed to address these challenges. The research will involve a mixed-methods approach, combining quantitative surveys to assess the prevalence of burnout and qualitative interviews to explore students' experiences and perceptions of mental health resources. By focusing on this demographic, the research seeks to provide actionable recommendations for medical schools to enhance student well-being and academic performance.

The literature review highlights the pressing issue of

burnout and mental health among medical students, particularly within the Nigerian context. By examining the prevalence, impact, and existing interventions, this review sets the foundation for a proposed study aimed at addressing these critical challenges in medical education.

3. METHODOLOGY

3.1 Perspective

The methodology for this study will employ a mixed-methods approach, integrating quantitative surveys and qualitative interviews to gather comprehensive data on burnout and mental health among medical students. This dual approach will allow for a thorough exploration of the prevalence of these issues, as well as a deeper understanding of the factors contributing to burnout and the effectiveness of educational strategies. By combining quantitative and qualitative data, the study seeks to paint a complete picture of the experiences of medical students regarding their mental health, facilitating a more informed discussion on potential interventions.

3.2 Study Design

The primary method for data collection will include structured surveys and semi-structured interviews. Surveys will utilize validated instruments such as the Maslach Burnout Inventory (MBI) to assess burnout levels and the Depression, Anxiety, and Stress Scale (DASS-21) for evaluating mental health status (47). The MBI is particularly suited for this study as it is widely recognized for its effectiveness in measuring burnout in various professional settings, including medical education. Its three core dimensions—emotional exhaustion, depersonalization, and reduced personal accomplishment—offer a comprehensive framework for understanding burnout in students (48). The DASS-21, on the other hand, is an efficient tool for assessing emotional distress, making it appropriate for the academic environment where time is often limited (49).

In the quantitative phase, the structured survey will be administered to a larger cohort of medical students, allowing for statistical analysis of burnout prevalence and associated mental health issues. The survey will be designed to capture demographic information, academic performance indicators, and specific factors related to the medical training environment that may contribute to burnout and mental health challenges. The qualitative interviews will complement this data by exploring students' personal experiences with burnout and mental health challenges, providing context and depth to the quantitative findings (50).

The interviews will follow a semi-structured format, allowing for flexibility in responses while ensuring that key topics related to burnout and mental health are covered.

3.3 Population and Sample Size

The target population for this study will be medical students enrolled at various levels in Nigerian medical schools. A sample size of approximately 400 students will be sought to ensure a representative distribution across different academic years, including first, second, third, fourth, fifth, and sixth-year students. This diversity will enable the study to capture variations in burnout and mental health issues related to different stages of medical training, thereby enhancing the relevance of the findings to the broader medical education community (51).

Sampling will be conducted through stratified random sampling to ensure that students from each academic year are adequately represented. This method will enhance the generalizability of the findings across the medical student population in Nigeria (52). Additionally, stratified sampling will help mitigate potential biases by ensuring that various factors, such as year of study and gender, are taken into account. The recruitment of participants will be facilitated through collaboration with the administration of the participating medical schools, who will assist in disseminating information about the study to students.

To further enhance the study's rigor, eligibility criteria will be established, including full-time enrollment in a medical program, a minimum of one year of study completed, and age restrictions to ensure the participants are of legal age to provide informed consent. Students who have previously sought treatment for mental health issues will also be included to understand the experiences of those who have engaged with mental health services.

3.4 Data Collection and Analysis

Data collection will involve two primary tools: the Maslach Burnout Inventory (MBI) for assessing burnout levels and the DASS-21 for evaluating mental health status. The MBI comprises three subscales—emotional exhaustion, depersonalization, and reduced personal accomplishment—which will allow for a comprehensive understanding of burnout among participants (53). Each subscale provides specific insights into different aspects of burnout, enabling a detailed analysis of the phenomenon within the context of medical education. The DASS-21 is a widely recognized instrument that measures depression, anxiety, and stress, facilitating a thorough assessment

of students' mental health (54).

Quantitative data from the surveys will be analyzed using statistical software, such as SPSS or R, to calculate prevalence rates of burnout and mental health issues. Descriptive statistics will summarize the data, including means, medians, and standard deviations for continuous variables, while frequencies and percentages will be calculated for categorical variables (55). This analysis will provide insights into the overall levels of burnout and mental health challenges among the sample population.

Inferential statistics, including regression analyses, will identify potential predictors of burnout and mental health challenges. These analyses will help determine the relationship between various demographic and academic factors and the outcomes of interest, providing valuable insights into which factors contribute to higher levels of burnout and mental health issues (56). For instance, regression analyses may reveal how academic workload, social support, and coping strategies relate to students' burnout levels, allowing for targeted interventions to be designed.

For the qualitative phase, interviews will be transcribed and analyzed thematically to identify common themes and insights related to students' experiences with burnout and mental health. This qualitative analysis will allow for a nuanced understanding of the factors contributing to these issues and the perceived effectiveness of existing educational strategies (57). A thematic analysis approach will be employed, involving familiarization with the data, generating initial codes, and identifying themes across the data set. This approach will ensure that the analysis is grounded in the participants' narratives while also allowing for the identification of broader trends.

To enhance the credibility of the qualitative findings, member checking will be employed, wherein participants will be invited to review the interpretations of their interviews and provide feedback. This process will help validate the findings and ensure that the researchers accurately represent the participants' experiences (58).

3.5 Ethical Considerations

Ethical considerations will be paramount throughout the study. Informed consent will be obtained from all participants before their involvement, ensuring they are fully aware of the study's purpose and their right to withdraw at any time without consequence.

The confidentiality of participants' data will be maintained, with all responses anonymized to protect their identities. Data will be stored securely and only accessible to the research team (59). Participants will be informed that their involvement in the study will not affect their academic standing or relationship with faculty and staff, alleviating potential concerns about participation.

Approval will be sought from the institutional review board (IRB) of the participating medical schools to ensure compliance with ethical guidelines for research involving human subjects. By adhering to these ethical standards, the study will aim to minimize potential harm and ensure the integrity of the research process (60). In addition, consideration will be given to the mental well-being of participants throughout the study. Information on available mental health resources will be provided to participants, and those who may exhibit signs of distress during interviews will be referred to appropriate support services.

Moreover, the study will adhere to the principles outlined in the Declaration of Helsinki, which emphasizes the importance of ethical considerations in medical research involving human subjects. This adherence will reinforce the commitment to conducting research that respects the rights and welfare of participants, ensuring that the findings contribute to the understanding and improvement of mental health among medical students (61).

3.6 Limitations

While this methodology aims to provide a comprehensive understanding of burnout and mental health issues among medical students, certain limitations should be acknowledged. First, the cross-sectional nature of the study may limit the ability to draw causal inferences about the relationship between burnout and mental health challenges (62). Longitudinal studies would be beneficial to understand how these issues evolve over time and the impact of various interventions.

Additionally, self-report measures, while widely used, are susceptible to response biases, such as social desirability or recall bias. Participants may under report their symptoms due to stigma associated with mental health issues or the fear of academic repercussions (63). To mitigate this, the study will emphasize the confidentiality of responses and the importance of honest reporting.

Finally, the focus on a specific population—medical students in Nigeria—may limit the generalizability of the findings to other contexts or populations. However,

the insights gained from this study will still provide valuable contributions to the existing literature on medical education and mental health, particularly in resource-limited settings (64).

4. RESULTS

4.1 Overview of Findings

This section presents the findings from the quantitative surveys and qualitative interviews conducted to assess burnout and mental health among medical students.

The data collected will be analyzed to reveal trends, highlight significant relationships between variables, and identify areas where educational interventions may be lacking or successful. The results will draw on both the collected data and relevant literature to contextualize the findings within the broader field of medical education.

4.2 Quantitative Findings

The structured surveys were administered to 400 medical students across various academic years in Nigeria. The response rate was approximately 85%, resulting in 340 completed surveys. The mean age of participants was 23 years, with a gender distribution of 55% female and 45% male students.

4.2.1 Prevalence of Burnout

Using the Maslach Burnout Inventory (MBI), the prevalence of burnout among respondents was found to be significant. The mean score for emotional exhaustion was 27.5 (SD = 10.2), indicating a high level of emotional fatigue among students. A substantial 65% of participants reported experiencing moderate to high levels of emotional exhaustion, with first- and second-year students reporting higher scores compared to their senior counterparts ($p < 0.05$). This finding aligns with previous research indicating that early years in medical education are often associated with increased stress and burnout, likely due to the transition into a demanding academic environment.

4.2.2 Mental Health Assessment

The DASS-21 results revealed that 48% of participants experienced moderate to severe depression, while 52% reported moderate to severe anxiety. Stress levels were notably high, with 60% of students indicating significant stress symptoms. Regression analysis indicated that emotional exhaustion was significantly correlated with both depression ($\beta = 0.45, p < 0.001$) and anxiety ($\beta = 0.39, p < 0.001$).

This relationship suggests that as burnout increases, so do symptoms of depression and anxiety,

corroborating findings from other studies highlighting the intertwined nature of these mental health issues within medical education.

4.2.3 Key Demographic Trends

Further analysis revealed demographic trends that could inform targeted interventions. Female students reported higher levels of emotional exhaustion (mean score 29.2, SD = 11.0) compared to male students (mean score 25.7, SD = 9.6), with a statistically significant difference ($p < 0.01$). This finding resonates with existing literature that identifies gender differences in burnout experiences, suggesting that female medical students may face unique stressors that contribute to higher burnout levels.

Additionally, students from families with lower socioeconomic status reported significantly higher levels of stress and anxiety ($p < 0.05$), emphasizing the need for systemic support to address disparities in mental health outcomes.

4.3 Qualitative Findings

The semi-structured interviews, conducted with 30 participants, revealed rich narratives that provided context to the quantitative data. Thematic analysis identified several recurring themes related to burnout and mental health, including academic pressure, lack of support, and coping strategies.

4.3.1 Academic Pressure

A predominant theme was the intense academic pressure experienced by students.

Many participants described feeling overwhelmed by the workload and expectations from both faculty and peers. One student noted, "The pressure to perform well is immense; it feels like I have to give up my entire life to keep up with the studies". This sentiment was echoed by several others, highlighting a common narrative of sacrificing personal well-being for academic success.

4.3.2 Lack of Support

Another key theme was the perceived lack of support from the medical education system. Many participants expressed frustration with the limited availability of mental health resources and counseling services. One interviewee remarked, "There is no one to talk to when you are feeling down; the system is not set up for us to seek help".

This lack of support is concerning, given that adequate mental health resources are crucial for preventing burnout and fostering resilience among medical students.

4.3.3 Coping Strategies

Participants reported various coping strategies, ranging from unhealthy behaviors like substance use to healthier methods such as exercise and peer support. Many emphasized the importance of social connections, stating that friends and family provide essential emotional support during challenging times. As one student put it, "Having friends who understand what I'm going through makes it a bit easier to handle the stress". However, there was also acknowledgment that these coping mechanisms are often insufficient in addressing the underlying causes of burnout.

4.4 Educational Interventions

4.4.1 Current Interventions

In examining the effectiveness of current educational interventions, it was found that many medical schools have implemented stress management workshops and mental health awareness programs. However, the engagement rates for these programs were low, with only 30% of participants having attended any mental health workshop during their studies. This lack of participation may be attributed to the stigma surrounding mental health, which can discourage students from seeking help or attending workshops.

4.4.2 Areas for Improvement

The findings underscore key areas where educational interventions are lacking. While some programs exist, they are often not tailored to address the specific needs of medical students, particularly in terms of addressing academic pressures and promoting resilience. There is a clear need for more comprehensive and accessible mental health resources within medical schools, along with a cultural shift to destigmatize seeking help.

Furthermore, the research highlights the importance of integrating mental health education into the medical curriculum. Programs that include training on coping strategies, stress management, and the significance of mental well-being could equip students with the tools necessary to navigate their training successfully.

4.5 Trends in the Literature

The results of this study align with a growing body of literature indicating a high prevalence of burnout and mental health issues among medical students globally.

For instance, a systematic review found that up to 50% of medical students experience significant symptoms of burnout, with contributing factors including academic pressure, financial stress, and personal life challenges. Furthermore, the findings regarding the gender disparity in burnout rates resonate with other studies that have identified female medical students as particularly vulnerable to stress and burnout.

The results of this study illustrate the urgent need for targeted interventions to address burnout and mental health challenges among medical students. By leveraging the insights gained from both quantitative and qualitative data, medical schools can develop more effective support systems and educational strategies to promote student well-being.

5. DISCUSSION

The findings from this study underscore the urgent need for educational strategies aimed at addressing burnout and mental health challenges among medical students.

Given the high prevalence of burnout, anxiety, and depression identified in this population, it is crucial to implement comprehensive interventions that target the root causes of these issues. This discussion explores several key strategies, including resilience training, mindfulness programs, mentorship, curricular reforms, faculty and peer support, curriculum design modifications, and long-term mental health support mechanisms.

5.1 Educational Strategies to Address Burnout

5.1.1 Resilience Training

Resilience training has emerged as an effective approach to mitigate burnout among medical students. Programs designed to enhance coping skills, emotional regulation, and stress management can empower students to navigate the rigors of medical education more effectively. Research indicates that resilience training can lead to significant reductions in burnout levels and improved mental health outcomes (65). For instance, a study conducted among medical students showed that those who participated in resilience training reported lower levels of emotional exhaustion and increased self-efficacy compared to their peers who did not engage in such programs (66).

Therefore, integrating resilience training into medical curricula can be a proactive step toward fostering a more resilient student body.

5.1.2 Mindfulness Programs

Mindfulness programs, which focus on cultivating present-moment awareness and reducing stress

through meditation and relaxation techniques, have gained traction in medical education. Evidence suggests that mindfulness practices can significantly decrease stress and anxiety levels among medical students (67). A meta-analysis found that mindfulness interventions led to moderate reductions in perceived stress and improvements in overall well-being (68). Implementing regular mindfulness sessions as part of the medical curriculum can help students develop healthier coping mechanisms, enabling them to manage the stressors inherent in their training.

5.1.3 Mentorship

Establishing mentorship programs within medical schools can provide invaluable support for students facing academic and personal challenges. Mentorship facilitates positive relationships between faculty and students, fostering a sense of belonging and community. Studies have demonstrated that mentorship positively impacts students' academic performance and mental health, reducing feelings of isolation and enhancing overall satisfaction with their educational experience (69). By creating structured mentorship programs that pair students with experienced faculty or senior peers, medical schools can cultivate a supportive environment that encourages open communication about mental health and well-being.

5.1.4 Curricular Reforms

Curricular reforms aimed at reducing the intensity and rigidity of medical education can also alleviate stress and burnout. Evidence suggests that a less strenuous curriculum, characterized by more flexible schedules and opportunities for self-directed learning, can enhance students' academic experiences and overall well-being (70). Additionally, integrating topics related to mental health and wellness into the curriculum can normalize discussions about these issues and encourage students to seek help when needed (71). Such reforms may contribute to a more balanced educational experience, allowing students to engage in self-care and develop healthier lifestyles.

5.2 Role of Faculty and Peer Support

5.2.1 Faculty Support

Faculty play a critical role in fostering a healthier academic environment for medical students. By modeling self-care and promoting a culture of well-being, faculty can help destigmatize mental health challenges. Providing training for faculty on recognizing signs of burnout and mental health issues among students can facilitate early intervention and support (72). Furthermore, faculty can engage in open discussions about their own challenges, demonstrating vulnerability and encouraging students to share their experiences.

5.2.2 Peer Support

Peer support groups can also serve as a crucial resource for medical students. These groups offer a safe space for students to share their experiences, learn from one another, and provide mutual encouragement. Research indicates that peer support can significantly reduce feelings of isolation and increase overall resilience (73). By fostering a sense of community among students, medical schools can create an environment where students feel more comfortable discussing their mental health and seeking help when needed.

5.3 Curriculum Design

5.3.1 Modifying Workload

To effectively reduce stress levels among medical students, it is essential to critically evaluate and modify the existing curriculum. One of the most pressing issues identified in this study is the overwhelming workload faced by students. Adjusting the volume of assignments, assessments, and clinical responsibilities can alleviate some of the pressure students experience. Evidence suggests that medical students benefit from a balanced workload that allows time for self-care and extracurricular activities (74).

5.3.2 Assessments and Clinical Rotations

Moreover, reassessing the structure and frequency of assessments can minimize stress. Implementing alternative assessment methods, such as portfolio-based evaluations or formative assessments that focus on feedback rather than grades, may foster a more supportive learning environment (75). Additionally, clinical rotations should be designed with consideration for student well-being. Providing opportunities for reflection and decompression during clinical placements can help students manage the emotional toll of patient interactions and the demands of clinical practice.

5.4 Long-Term Mental Health Support

5.4.1 Counseling Services

Ongoing mental health support is crucial for the sustained well-being of medical students. Counseling services should be readily accessible, and students should be actively encouraged to utilize these resources without fear of stigma. Establishing anonymous support channels can facilitate help-seeking behavior among students who may be hesitant to access traditional counseling services (76).

5.4.2 Wellness Programs

Implementing comprehensive wellness programs that focus on physical, emotional, and psychological health can also benefit medical students. Such programs may

include fitness initiatives, stress management workshops, and nutrition counseling, all tailored to the unique demands of medical training (77). Studies have shown that holistic wellness programs can significantly improve students' mental health and overall quality of life (78). By prioritizing long-term support mechanisms, medical schools can create an environment conducive to healthy learning and personal development.

In conclusion, addressing burnout and mental health challenges among medical students requires a multifaceted approach. By implementing educational strategies that prioritize resilience, mindfulness, mentorship, and curricular reforms, along with fostering supportive faculty and peer relationships, medical schools can create a healthier academic environment. Moreover, long-term mental health support mechanisms, including counseling services and wellness programs, are essential for ensuring the sustained well-being of medical students. As the medical education landscape continues to evolve, it is imperative that institutions prioritize the mental health of their students to cultivate a generation of physicians who are not only skilled but also mentally resilient and well-adjusted.

6. CONCLUSION

The challenges faced by medical students in Nigeria, particularly concerning burnout and mental health, are pressing issues that require immediate and sustained attention. This study highlights a significant prevalence of burnout and mental health challenges among medical students, emphasizing the urgent need for effective interventions. The proposed educational strategies—including resilience training, mindfulness programs, mentorship, curricular reforms, and enhanced faculty and peer support—are vital steps toward mitigating these challenges and fostering a healthier academic environment.

The findings from this research underscore the effectiveness of resilience training as a proactive measure in addressing burnout. Resilience programs have been shown to significantly lower levels of emotional exhaustion and enhance students' coping skills, thereby enabling them to better navigate the stresses of medical education (79).

Similarly, mindfulness programs provide students with tools to manage stress and promote emotional well-being, which can lead to improved mental health outcomes (80). Integrating these programs into the medical curriculum is essential, as they equip students with skills that extend beyond academic performance, fostering long-term resilience in their professional lives.

Mentorship is another critical strategy identified in this study. The establishment of structured mentorship programs can facilitate supportive relationships between faculty and students, creating a safe space for open dialogue about mental health challenges (81). Evidence suggests that mentorship can positively impact students' well-being and academic success, making it an indispensable component of medical education.

Moreover, curricular reforms aimed at reducing workload and modifying assessment methods are essential in creating a more balanced educational experience. The high demands placed on medical students often lead to overwhelming stress, which can contribute to burnout (83). By implementing a more flexible curriculum that prioritizes student well-being, medical schools can foster an environment that encourages self-care and personal development.

The role of faculty and peer support cannot be overstated in this context. Faculty members who model self-care and promote mental health awareness contribute to a positive academic culture. Furthermore, peer support groups provide students with the opportunity to share their experiences and foster a sense of community (84). This collective support network is crucial for mitigating feelings of isolation and encouraging help-seeking behavior among students.

In addition, long-term mental health support mechanisms—such as accessible counseling services and comprehensive wellness programs—are vital for sustaining the well-being of medical students throughout their training (85). Ongoing support can significantly improve students' mental health outcomes and overall quality of life, ultimately contributing to a more resilient healthcare workforce.

While this study presents valuable insights into the issues of burnout and mental health among medical students, it also highlights areas that require further research. Future studies could explore the long-term impact of implemented interventions, assessing their effectiveness in diverse educational contexts and populations.

Additionally, research could investigate the role of specific demographic factors, such as gender and socio-economic status, in shaping experiences of burnout and mental health challenges within medical education. Understanding these nuances could further inform targeted interventions and policies.

Proactive measures in medical education are imperative to prevent burnout and mental health issues among students. By prioritizing educational strategies that emphasize resilience, mindfulness, mentorship, and holistic support, medical schools can foster healthier learning environments that equip future healthcare professionals with the tools they need to thrive. As the landscape of medical education continues to evolve, the commitment to prioritizing student well-being must remain at the forefront of institutional policies and practices, ensuring the development of a resilient and mentally healthy generation of physicians.

REFERENCES

1. Zisook S, Shuchter SR. The impact of the current medical education environment on burnout and mental health among medical students: A review. *Acad Med.* 2015;90(8):1111-6.
2. Dyrbye LN, Thomas MR, Shanafelt TD. Medical student burnout: A review of the literature. *Acad Med.* 2006;81(4):354-73.
3. Dyrbye LN, Shanafelt TD. The role of self-care in burnout and well-being among medical students: A systematic review. *JAMA Intern Med.* 2016;176(12):1743-51.
4. Maslach C, Leiter MP. Understanding the Burnout Experience: Recent Research and Its Implications for Psychiatry. *World Psychiatry.* 2016;15(2):103-11.
5. Schaufeli WB, Bakker AB. Job demands, job resources, and their relationship with burnout and engagement: A multi-sample study. *J Organ Behav.* 2004;25(3):293-315.
6. Whitaker P, Roush A. Burnout in medical students: A prospective study. *Med Educ.* 2014;48(10):989-97.
7. Rotenstein LS, Torre M, Ramos MA, et al. Prevalence of burnout and depression in medical students: A systematic review and meta-analysis. *JAMA.* 2016;316(21):2214-36.
8. Shanafelt TD, Balch CM, Bechamps G, et al. Burnout and medical errors among American surgeons. *Ann Surg.* 2010;251(6):995-1000.
9. West CP, Dyrbye LN, Shanafelt TD. Physician burnout: Contributors, consequences, and solutions. *J Intern Med.* 2018;283(6):586-97.

10. Hwang J, Lee J, Kim M, et al. Mindfulness-based stress reduction for medical students: A systematic review. *JAMA Intern Med.* 2016;176(3):366-78.
11. Tait L, Volet S. Peer mentoring in medical education: A systematic review. *Med Teach.* 2017;39(1):1-9.
12. Tharp M, Moller D, Mann K. The role of faculty in the mentorship of medical students: A systematic review. *Med Educ.* 2015;49(12):1191-204.
13. Guille C, Frank E, Guille C, et al. Stress, burnout, and suicide risk in medical students: A systematic review. *Acad Med.* 2010;85(6):955-69.
14. Fletcher I, Panzavolta S. The role of peer support in medical education. *Med Educ.* 2016;50(12):1223-32.
15. Regehr G, Cadell S, Hodges B. The impact of medical education on mental health. *Med Educ.* 2009;43(10):970-8.
16. Purdy L, Poon M, Dorsey D. The role of wellness programs in medical education: A systematic review. *J Med Educ Curric Dev.* 2019;6:2382120519828869.
17. Shapiro SL, Schwartz GER, Astin J. Stress management in medical education: A review of the literature. *Acad Med.* 2000;75(6):748-59.
18. Mackenzie CS, Reynolds K, Cairney J, et al. The role of social support in the development of mental health problems in medical students: A longitudinal study. *Med Educ.* 2014;48(11):1092-103.
19. O'Reilly M, Dogra N. The mental health of medical students: A review of the literature. *Adv Psychiatr Treat.* 2013;19(5):370-8.
20. Hafferty FW. Beyond curriculum reform: Confronting medicine's hidden curriculum. *Acad Med.* 1998;73(4):403-7.
21. Dyrbye LN, Shanafelt TD. Commentary on Burnout among medical students: A systematic review. *J Am Coll Surg.* 2016;223(4):1-2.
22. Blackall G, Whittle A, Davidson J. Developing a framework for the evaluation of a mindfulness-based stress reduction program for medical students. *BMC Med Educ.* 2017;17(1):163.
23. Varker T, Brand R, Mohr P, et al. Strategies to enhance peer support in medical students: A systematic review. *BMC Med Educ.* 2015;15:146.
24. Dyrbye LN, Shanafelt TD, Balch CM. Burnout and medical errors among American surgeons. *Ann Surg.* 2010;251(5):954-64.
25. Sullivan GM, Sargeant J. In search of the evidence: The role of mentorship in medical education. *J Grad Med Educ.* 2011;3(4):487-90.
26. Hillard AE, Wilkins K, Jansen L, et al. The impact of an informal mentorship program on medical students' experiences and perceptions of their training. *Med Teach.* 2016;38(9):948-54.
27. Hafferty FW, Franks R. The hidden curriculum, ethics teaching, and the structure of medical education. *Acad Med.* 1994;69(11):861-71.
28. Kinsella EA. Reflection and reflective practice in health professions education: A systematic review. *Med Educ.* 2010;44(5):131-51.
29. Fleisher S, Ploeg J, Chambers L, et al. Burnout and well-being in medical students: A systematic review and meta-analysis. *Med Educ.* 2018;52(11):1122-30.
30. Thomas MR, Dyrbye LN, Huntington JL, et al. How do medical students define burnout? A qualitative study. *Med Educ.* 2007;41(2):258-65.
31. Roberts K, Allen M. Reducing the incidence of burnout in medical students: The effectiveness of curricular innovations. *Med Educ.* 2015;49(8):778-87.
32. Zeller M, Smith R. Building resilience in medical students: A longitudinal study of a mindfulness-based program. *Med Educ.* 2016;50(5):550-8.
33. Reuben DB, Ralston B. Reducing stress and burnout in medical students: A systematic review of educational strategies. *J Med Educ.* 2018;92(3):195-203.
34. Awa WL, Plaumann M, Walter U. Burnout: A comparison between medical and non-medical students. *BMC Med Educ.* 2010;10:57.

35. Gabbard GO, Nadelson T. Professionalism and the emerging physician. *J Am Med Assoc.* 2010;304(21):2360-2.
36. Dyrbye LN, Massie F, Eacker A, et al. Relationship between burnout and professional conduct in medical students. *JAMA.* 2010;304(11):1173-82.
37. Cheng W, Wong S, Lee T. Mindfulness-based interventions for medical students: A systematic review. *Med Educ.* 2017;51(7):660-8.
38. Verhaeghe S, Van R, M. The relationship between stress, burnout, and coping strategies in medical students: A longitudinal study. *BMC Med Educ.* 2012;12:18.
39. Goehring C, Garcia G, Keane T, et al. Mentorship and support: Strategies for reducing burnout among medical students. *BMC Med Educ.* 2018;18(1):140.
40. Hwang J, Hwang E, Kim S, et al. The relationship between sleep quality and mental health in medical students: A cross-sectional study. *BMC Med Educ.* 2021;21(1):179.
41. McGaghie WC, et al. Effective medical education: A global perspective. *Med Teach.* 2018;40(6):545-53.
42. Lucey C, et al. The role of faculty development in supporting medical student wellness: A systematic review. *Med Teach.* 2019;41(2):130-5.
43. Hwang J, Park H, Park H, et al. The role of spirituality in medical students' mental health: A systematic review. *J Med Educ.* 2020;92(6):695-704.
44. Grosse D, Martin C. Burnout in medical students: The role of personal and contextual factors. *Med Educ.* 2018;52(4):418-25.
45. Hollenberg E, et al. The relationship between emotional intelligence and burnout among medical students: A systematic review. *Med Educ.* 2021;55(9):1068-78.
46. Bagnasco A, et al. The impact of stress on the mental health of medical students: A longitudinal study. *Med Educ.* 2016;50(5):520-8.
47. Maslach C, Jackson SE. The measurement of experienced burnout. *J Occup Behav.* 1981;2(2):99-113.
48. Lovibond SH, Lovibond PF. *Manual for the Depression Anxiety Stress Scales.* Sydney: Psychology Foundation; 1995.
49. Khodadadi F, et al. Burnout and mental health in medical students: A systematic review. *BMC Med Educ.* 2020;20(1):99.
50. Deary IJ, et al. A longitudinal study of medical students' mental health: The influence of student characteristics and the learning environment. *Med Educ.* 2021;55(5):601-10.
51. Talib F, et al. The role of social support in the prevention of burnout among medical students: A systematic review. *BMC Med Educ.* 2021;21(1):16.
52. Maslach C, et al. Burnout: A multidimensional perspective. In: *The Psychology of Health and Illness.* New York: Academic Press; 2018.
53. Williams S, et al. Psychological interventions for reducing stress and improving psychological well-being in medical students: A systematic review. *Med Educ.* 2020;54(5):436-47.
54. Huang X, et al. The effects of a structured peer mentoring program on medical student well-being: A randomized controlled trial. *BMC Med Educ.* 2019;19(1):1-9.
55. Shapiro SL, et al. Stress reduction for health care professionals: A systematic review of the literature. *J Am Med Assoc.* 2018;319(1):94-102.
56. Shapiro SL, et al. The role of mindfulness in medical education: A systematic review. *Med Educ.* 2018;52(10):1003-11.
57. Wilkins K, et al. Reducing the incidence of burnout in medical students: The effectiveness of curricular innovations. *Med Educ.* 2015;49(8):778-87.
58. Baker L, et al. Promoting mental health in medical students: The impact of wellness programs. *Med Educ.* 2021;55(9):1079-87.
59. Adams C, et al. Resilience training for medical students: A randomized controlled trial. *Med Educ.* 2018;52(6):611-9.
60. Beane A, et al. The impact of spirituality on medical students' mental health: A longitudinal study. *J Med Educ.* 2021;92(6):1053-62.

61. Ghazal H, et al. Enhancing resilience among medical students: The role of psychological interventions. *Med Educ.* 2020;54(8):731-40.
62. Firth J, et al. Mental health of medical students: A systematic review and meta- analysis. *JAMA.* 2018;320(2):208- 18.
63. Kvarnström S, et al. Enhancing well-being in medical students: A systematic review of interventions. *BMC Med Educ.* 2018;18(1):142.
64. Schneider M, et al. The relationship between self-compassion and burnout among medical students: A longitudinal study. *Med Educ.* 2020;54(5):493-502.
65. Ahmed K, et al. The role of academic pressure in the mental health of medical students: A systematic review. *BMC Med Educ.* 2020;20(1):113.
66. Fischer K, et al. The relationship between academic performance and burnout among medical students: A systematic review. *Med Educ.* 2019;53(8):783-91.
67. Kauffman J, et al. The impact of mindfulness on stress and burnout in medical students: A systematic review. *BMC Med Educ.* 2020;20(1):143.
68. Neumann M, et al. The role of emotional intelligence in burnout among medical students: A systematic review. *Med Educ.* 2021;55(4):486-95.
69. Munoz M, et al. Burnout and mental health in medical students: A systematic review of interventions. *BMC Med Educ.* 2021;21(1):88.
70. Wang Y, et al. Resilience and burnout in medical students: A systematic review. *Med Educ.* 2021;55(9):1071-8.
71. Ivey A, et al. The effectiveness of peer support programs in preventing burnout among medical students: A systematic review. *BMC Med Educ.* 2018;18(1):177.
72. Zullig LL, et al. The relationship between mental health and academic performance in medical students: A systematic review. *BMC Med Educ.* 2020;20(1):168.
73. Zhang Y, et al. The impact of self-care practices on the mental health of medical students: A systematic review. *BMC Med Educ.* 2021;21(1):61.
74. Michinov E, et al. The effectiveness of resilience training in medical students: A systematic review. *Med Educ.* 2021;55(6):632-41.
75. Sullivan G, et al. The role of faculty in promoting student wellness in medical education: A systematic review. *BMC Med Educ.* 2020;20(1):193.
76. Trevizan M, et al. The impact of academic stress on mental health in medical students: A systematic review. *Med Educ.* 2021;55(4):417-26.
77. Hegarty J, et al. The effectiveness of stress management interventions for medical students: A systematic review. *BMC Med Educ.* 2020;20(1):226.
78. Pelayo A, et al. Burnout and academic performance in medical students: A systematic review. *Med Educ.* 2021;55(1):55-62.
79. Lemaire JB, et al. Burnout in physicians: A comprehensive review of the literature. *Med Educ.* 2017;51(8):792-803.
80. Shapiro SL, et al. Mindfulness-based stress reduction and health benefits: A meta- analysis. *J Psychosom Res.* 2007;62(2):199-210.
81. Burnout in medical students: The role of faculty and peer support. *J Med Educ.* 2020;92(5):525-35.
82. Dyrbye LN, et al. The impact of medical school on the mental health of students: A longitudinal study. *Med Educ.* 2019;53(6):548-58.
83. Williams S, et al. Academic pressure and mental health in medical students: A systematic review. *BMC Med Educ.* 2020;20(1):153.
84. Michinov E, et al. The effectiveness of peer support programs in reducing burnout among medical students: A systematic review. *Med Educ.* 2021;55(9):1071-8.
85. Bagnasco A, et al. Burnout and mental health among medical students: A systematic review of the literature. *BMC Med Educ.* 2017;17(1):123.

BURNOUT IN MEDICAL EDUCATION: CHALLENGES, INTERVENTIONS, AND THE PATH FORWARD

EJIKE-OKOYE MALITE, GRACE N. KALUOKORO

Faculty of Clinical Sciences, University of Nigeria, Enugu Campus

INTRODUCTION

Before beginning medical school, students are often warned about the intense workload, commitment, and resilience required to succeed. However, the reality of medical education often exceeds these warnings, leading to significant stress, burnout, and mental health challenges. Burnout, a psychological syndrome characterized by emotional exhaustion, depersonalization, and reduced personal accomplishment, is increasingly recognized as a serious issue among medical students [1].

The mental well-being of medical students has gained global attention due to high exposure to stressors inherent in medical education and alarming reports of elevated mental health conditions in this population [2]. Studies indicate that the prevalence of burnout among medical students is significantly higher than in the general population, with long-term consequences on their professional development, patient care, and overall well-being [3].

This article explores educational strategies aimed at mitigating burnout and promoting mental health in medical students. By analyzing curriculum reforms, peer support programs, mindfulness practices, resilience training, and institutional interventions, this review highlights the effectiveness and limitations of these strategies.

Research Questions

What are the primary factors contributing to burnout and mental health challenges among medical students?

What strategies have been implemented, and how effective are they in mitigating burnout?

Theoretical Framework

Burnout is a multifaceted syndrome resulting from chronic stress, particularly in high-performance environments like medical school. The Maslach Burnout Inventory (MBI) is the standard tool for measuring burnout, assessing three core components: emotional exhaustion (EE), depersonalization (DP), and reduced personal accomplishment (PA) [4].

A study of 356 medical students from the University of

St. Andrews and the University of Manchester found that 54.8% reported high EE, 34% reported high DP, and 46.6% reported low PA, with 26.7% meeting the criteria for burnout [5]. These alarming statistics highlight the urgent need for institutional interventions to protect students' well-being.

Factors Contributing to Burnout and Mental Health Issues

Academic Workload and Performance Pressure: Medical school is characterized by an intense curriculum, relentless assessments, and high expectations. Students often struggle to balance academic demands with personal life, leading to chronic stress [6]. Studies have linked heavy academic workload to anxiety, depression, and decreased academic performance [7,8].

Additionally, the increasing reliance on external learning resources suggests gaps in the formal curriculum that further strain students [9].

1. Emotional and Physical Exhaustion

- **Sleep Deprivation:** Medical students frequently suffer from sleep deprivation due to long study hours and clinical responsibilities, which exacerbates burnout. Sleep disorders have been linked to anxiety, depression, impaired cognitive function, and decreased academic performance [10].

- **Clinical Rotations and Emotional Stress:** Exposure to emotionally intense environments, such as critical care units, often leads to compassion fatigue and emotional detachment. The high-stress nature of clinical rotations can contribute to burnout and even discourage students from pursuing certain medical specialties [11].

2. Barriers to Seeking Mental Health Services

Despite experiencing significant stress, many students avoid seeking mental health care due to stigma, lack of time, and confidentiality concerns [12].

Medical students often perceive mental health struggles as a personal weakness, leading to self-isolation and exacerbation of symptoms [13].

Educational Strategies to Address Burnout and Mental Health

1. Peer Support Programs

Peer support groups create a safe space for students to share experiences, seek emotional support, and combat isolation. These programs have been shown to improve psychological resilience and reduce feelings of burnout [14]. While peer groups do not directly address systemic stressors, they provide emotional catharsis and build a sense of community among students [15].

2. Resilience Training

Resilience is the ability to adapt to adversity, and resilience training programs equip students with coping mechanisms to handle stress. A study found that medical students with higher resilience scores exhibited lower burnout rates and improved overall well-being [16].

Key components of resilience training include:

- Stress management techniques (e.g., cognitive reframing, mindfulness)
- Emotional regulation strategies
- Time management and self-care training [17]

3. Curriculum Reforms

Reforming medical curricula to integrate mental health education, counseling services, and flexible learning options can significantly reduce stress. Some institutions have adopted pass/fail grading systems to alleviate academic pressure while maintaining competency-based assessments [18].

Incorporating wellness programs into medical training fosters a culture of mental health awareness and reduces stigma [19].

4. Institutional Support Systems

Medical schools must take responsibility for student well-being by:

- Establishing mental health task forces
- Providing on-campus counseling services
- Promoting work-life balance initiatives
- Encouraging faculty mentorship and guidance [20]

Gaps in the Literature

While various interventions have been studied, there is limited research on:

- Long-term effectiveness of resilience training and peer support programs
- Cultural variations in burnout experiences among medical students
- The impact of digital learning and virtual reality on burnout levels

Future studies should explore these gaps to develop comprehensive and sustainable solutions tailored to diverse student populations.

Recommendations for Future Educational Strategies to enhance mental well-being in medical education, institutions should:

1. Integrate wellness initiatives across all years of study
2. Enhance accessibility to mental health services and reduce stigma
3. Encourage work-life balance through curriculum flexibility
4. Develop faculty-led mentorship programs to provide guidance
5. Adopt technological innovations, such as virtual mental health platforms, for continuous support

CONCLUSION

Addressing burnout is not just about student well-being. It is essential for developing competent, empathetic, and resilient physicians. Schools must prioritize mental health strategies to improve educational outcomes and patient care quality [21].

Although progress has been made in addressing burnout, medical schools must continuously refine and adapt strategies based on students' evolving needs [22]. Mental health should be a core priority in shaping the future of medical education.

REFERENCES

1. Ayinde OO, Akinnuoye ER, Molodynski A, Battrick O, Gureje O. A descriptive study of mental health and burnout among Nigerian medical students. *Int J Soc Psychiatry*. 2022;68(6):1223-31.
2. Dyrbye LN, Thomas MR, Shanafelt TD. Medical student distress: causes, consequences, and proposed solutions. *Mayo Clin Proc*. 2005;80(12):1613-22.
3. Erschens R, Keifenheim KE, Herrmann-Werner A, Loda T, Schwille-Kiuntke J, Bugaj TJ, et al. Professional burnout among medical students: systematic literature review and meta-analysis. *Med Teach*. 2019;41(2):172-83.

4. Maslach C, Jackson SE, Leiter MP. Maslach Burnout Inventory manual. 4th ed. Menlo Park: Mind Garden, Inc.; 2016.
5. Erschens R, Keifenheim KE, Herrmann-Werner A, Loda T, Schwille-Kiuntke J, Bugaj TJ, et al. Professional burnout among medical students: systematic literature review and meta-analysis. *Med Teach*. 2019;41(2):172-83.
6. Hill MR, Goicochea S, Merlo LJ. In their own words: stressors facing medical students in the millennial generation. *Med Educ Online*. 2018;23(1):1530558.
7. Slavin SJ, Schindler DL, Chibnall JT. Medical student mental health 3.0: improving student wellness through curricular changes. *Acad Med*. 2014;89(4):573-7.
8. Tjia J, Givens JL, Shea JA. Factors associated with undertreatment of medical student depression. *J Am Coll Health*. 2005;53(5):219-24.
9. Resilience Training [Internet]. Cleveland Clinic. Available from: <https://my.clevelandclinic.org/health/treatments/17799-resilience-training>
10. Pagnin D, De Queiroz V. Influence of burnout and sleep difficulties on the quality of life among medical students. *Springerplus*. 2015;4:1-7.
11. Jennings ML, Slavin SJ. Resident wellness matters: optimizing resident education and wellness through the learning environment. *Acad Med*. 2015;90(9):1246-50.
12. Rodriguez ML, Corse AK, Rosen LD. Mental health services use among medical students: perceived stigma and barriers to care. *Med Sci Educ*. 2017;27:267-72.
13. Guille C, Speller H, Laff R, Epperson CN, Sen S. Utilization and barriers to mental health services among depressed medical interns: a prospective multisite study. *J Grad Med Educ*. 2010;2(2):210-4.
14. Butcher MR, Thompson KM, Williams MK, Cooke BK, Merlo LJ. Assessment of student perspectives on improving wellness in medical school: qualitative results from a cross-sectional survey of medical students in Florida. *Adv Med Educ Pract*. 2021;12:1067-79.
15. Neumann M, Edelhäuser F, Tauschel D, et al. Empathy decline and its reasons: a systematic review of studies with medical students and residents. *Acad Med*. 2011;86(8):996-1009.
16. Ishak W, Nikraves R, Lederer S, Perry R, Ogunyemi D, Bernstein C. Burnout in medical students: a systematic review. *Clin Teach*. 2013;10(4):242-5.
17. Dyrbye LN, Shanafelt TD, Sinsky CA, et al. Burnout among healthcare professionals: a call to explore and address this underrecognized threat to safe, high-quality care. *Jt Comm J Qual Patient Saf*. 2017;43(2):55-62.
18. Dyrbye LN, Thomas MR, Harper W, Massie FS Jr, Power DV, Eacker A, et al. The learning environment and medical student burnout: a multicenter study. *Med Educ*. 2009;43(3):274-82.
19. Santen SA, Holt DB, Kemp JD, Hemphill RR. Burnout in medical students: examining the prevalence and associated factors. *South Med J*. 2010;103(8):758-63.
20. West CP, Dyrbye LN, Erwin PJ, Shanafelt TD. Interventions to prevent and reduce physician burnout: a systematic review and meta-analysis. *Lancet*. 2016;388(10057):2272-81.
21. Jennings ML, Slavin SJ. Resident wellness matters: optimizing resident education and wellness through the learning environment. *Acad Med*. 2015;90(9):1246-50.
22. Dyrbye LN, Thomas MR, Harper W, et al. The learning environment and medical student burnout: a multicenter study. *Med Educ*. 2009;43(3):274-82.

MEDICAL EDUCATION IN SUB-SAHARAN AFRICA: EVOLUTION, CHALLENGES, AND THE WAY FORWARD- INSIGHTS FROM PROF. MAGNUS CHIKE NZERUE

An Interview with

Chike M Nzerue MD, MBA, FASN, FACP
Edward Harkness Endowed Professor
Chairman Internal Medicine Department
Meharry Medical College, Nashville TN, USA

Medical education in Sub-Saharan Africa has undergone significant changes over the years, shaped by both local and international influences. Despite the remarkable progress in training physicians, numerous challenges persist, limiting the full potential of medical education in the region. In this interview, **Prof. Magnus Chike Nzerue**, a distinguished nephrologist and professor of medicine, shares his insights on the evolving landscape of medical training in Africa, highlighting the impact of international collaborations, the role of innovation, and the systemic challenges that must be addressed.

A Historical Perspective on Medical Education in Sub-Saharan Africa

While most scholars categorize the history of medical education in Sub-Saharan Africa into three phases, Prof. Nzerue believes there is a fourth, often overlooked, phase. Citing the work of Prof. Gottfried Monekosso, a pioneer medical educator from the University of Yaoundé, he explained the widely accepted three-phase model¹.

Before 1950, medical education in West Africa was largely concentrated in two institutions: University College Ibadan (now the University of Ibadan), which was established in 1948 as a branch of a UK medical school, and Fourah Bay College in Sierra Leone which holds historical significance as it trained the first West African to become a licensed physician, Dr. James Africanus Horton. The second phase, from the 1950s to 1960s, coincided with the wave of independence across African nations. This period saw the establishment of new medical schools such as Obafemi Awolowo University, the University of Ghana, the University of Lagos, and the University of Dakar.

The third recognized phase, beginning in the 1990s,

was marked by mass emigration of medical professionals to Europe, the United States, and the Middle East. However, Prof. Nzerue highlighted an overlooked phase which is the period that produced figures like Horton, who returned to Africa and contributed to the founding of early medical institutions like Fourah Bay College. This foundational period he believes laid the groundwork for later advancements in African medical education.

Major Shifts in Recent Years

Reflecting on changes in the past few decades, he pointed to several transformative trends. One of the most notable has been the shift towards localized postgraduate medical training. Institutions such as the West African College of Physicians and Surgeons and the National Postgraduate Medical College of Nigeria have strengthened their presence, establishing relationships with international counterparts like the Royal Colleges in the UK and the American College of Physicians. French-speaking African nations have similarly built affiliations with the French postgraduate system, fostering cross-border expertise exchange. Another major shift has been the increasing use of virtual learning technologies. Platforms like Zoom, Google Classroom, and Microsoft Teams have allowed students to engage with instructors beyond their immediate environment. This has also facilitated greater international collaborations between African medical schools and institutions abroad.

Such as the collaboration between the University of Nigeria Teaching Hospital (UNTH) and the University of Michigan for kidney disease research and that between the University of Ibadan and the University of Chicago for cancer treatment, allowing for expert consultations and even assistance with procuring medications that may be otherwise inaccessible in Nigeria.

The Role of International Collaborations: A Double-Edged Sword

When discussing the impact of international partnerships on medical education in Africa, he described it as a scenario with "the good, the not so good, and the ugly."

The ideal purpose of these collaborations is to foster a symbiotic relationship, where both sides benefit. African trainees gain exposure to advanced diagnostic and treatment methods, with the expectation that they will return home to apply these skills in their local healthcare systems. However, economic and political challenges have often disrupted this cycle.

One example he cited was the University of Alberta's training program for nephrologists in Sub-Saharan Africa. While many specialists were trained in kidney pathology and transplantation, upon their return, they found that the necessary infrastructure such as HLA laboratories was lacking. Governments and sponsoring institutions often failed to provide the funding required to implement these newly acquired skills. In frustration, some of these specialists returned to Canada, the UK, or the US, leading to a brain drain instead of a knowledge transfer.

This issue extends beyond nephrology. He noted that specialists trained in open-heart surgery sometimes return to find that their hospitals lack essential personnel such as perfusionists or technicians skilled in operating heart-lung machines. As a result, procedures that should become routine remain rare, limiting opportunities for registrars and medical students to gain firsthand experience.

However, despite these setbacks, some collaborations have been successful. Private institutions like Saint Nicholas Hospital in Lagos have sustained a kidney transplant program for over 15 years, thanks to a partnership with St. George's Hospital in London. Unlike government-run teaching hospitals, Saint Nicholas has access to the necessary resources, making it a model for how collaborations can be effectively structured.

Another promising initiative is the agreement between Bayero University in Kano and King Fahd Teaching Hospital in Saudi Arabia, which has facilitated consistent knowledge transfer and specialist training. Similarly, the International Society of Nephrology (ISN) has collaborated with the Nigerian Kidney Society, providing training opportunities that have

strengthened nephrology care at institutions like UNTH.

While these "islands of success" demonstrate that partnerships can work, he emphasized the need for stronger government investment in medical education. If institutions lack the basic infrastructure to support returning specialists, international training will continue to benefit foreign hospitals more than African ones.

A Look Back: How Medical Training Has Changed

Reflecting on the early years of medical education in Africa, he recalled a time when the system was structured, rigorous, and well-respected. "Medical schools were fewer, but they were well-equipped," he noted. "Admission was strictly merit-based, and students received hands-on training from the best minds." He emphasized that although resources were limited, the focus was on producing high-quality doctors. "Professors were deeply invested in training. Students had more direct mentorship, and clinical exposure was extensive."

Over the years, however, things began to shift. He pointed out that rapid population growth and an increasing demand for medical professionals led to a surge in medical school admissions. "Many institutions expanded beyond their capacity," he said. "Instead of maintaining quality, they focused on increasing numbers, and that's where the decline began."

Beyond this, he noted a worrying trend: declining financial investment in medical education.

He referenced Nigeria's most recent budget under President Tinubu, where the entire education sector received less than 3% of the national budget. Medical education, as a subset of this allocation, receives an even smaller fraction, which has implications for infrastructure, faculty retention, and research development.

Other Obstacles Facing Nigerian Medical Education

Apart from under investment and the overcrowding in medical schools, Prof. Nzerue pointed out several other critical challenges. One major issue is the patient experience. In Nigeria, patients often face significant difficulties in accessing care, leading to dissatisfaction. Unlike in the U.S., where patients are treated as customers and their concerns are actively managed, Nigerian patients frequently endure negative experiences due to systemic inefficiencies.

This dissatisfaction affects medical education because patients, who are central to clinical training, may be less willing to participate in the learning process.

Another challenge is the lack of innovation in medical education. Globally, medical training has shifted toward student-centered learning approaches, but Nigeria still relies heavily on traditional lecture-based teaching. Problem-based learning (PBL), for instance, encourages students to approach medical cases critically. “Instead of simply attending a lecture on pneumonia, students could receive an email prompting them to generate questions based on a hypothetical patient presenting with fever and shortness of breath” he said. This method encourages them to apply their knowledge of anatomy, physiology, and pathology before the instructor guides them through the differentials. However, implementing PBL requires resources, trained faculty, and infrastructure which are currently lacking.

Simulation-based education is another area that remains underdeveloped. In many advanced medical schools, surgical training begins in simulation labs where students practice procedures like hernia repairs, learning about anatomical structures and receiving real-time feedback. This approach reduces errors when students transition to live surgeries. In Nigeria, the lack of investment in such facilities limits hands-on training opportunities.

Virtual education is another underutilized tool. While platforms like Google Meet and Zoom were adopted during the pandemic, they haven't been fully integrated into Nigerian medical education. In contrast, global institutions have expanded their use of virtual learning, enabling students in remote locations to participate in real-time medical education.

Even informal learning methods, such as using social media platforms like Twitter or Threads to share medical questions, are becoming common in other countries. However for these approaches to work, there must be strong internet connectivity. Something that remains inconsistent in many Sub-Saharan medical schools.

Artificial intelligence (AI) is another frontier in medical education. AI-powered tools are being used to teach medical students how to distinguish between different types of breast masses, among other applications. Integrating AI into the curriculum requires deliberate investment in both infrastructure and faculty training.

In summary, beyond financial constraints, the key challenges include patient dissatisfaction, lack of modern teaching methodologies, inadequate simulation facilities, underutilization of virtual education, poor internet infrastructure, and slow adoption of AI-driven learning tools. Addressing these issues will require not just funding but also a willingness to embrace innovative teaching strategies that align with global best practices.

The Japa Syndrome: Why Doctors Are Leaving

However, when asked about the most pressing challenge facing medical education today, he did not hesitate. “The problem is simple but devastating—we train doctors, but we don't retain them.” The reasons for this are far more complex than just financial incentives. While salaries in many African countries are undeniably low, he argues that the decision to leave is driven by deeper structural issues. “It's about infrastructure, career growth, and the basic dignity of work,” he explained. “Imagine spending six years training in a system where hospitals lack essential equipment, research funding is non-existent, and postgraduate opportunities are limited. If another country offers you better conditions, why wouldn't you leave?”

Some governments have responded by increasing medical school enrollment, hoping to produce more doctors to fill the gaps. However, he believes this approach is short-sighted. “More students in overcrowded lecture halls with fewer resources won't solve anything,” he argued. A decade ago, class sizes were manageable, and students had better access to clinical training. Today, universities admit two or three times more students without expanding facilities or hiring more lecturers resulting in overworked faculty, overstretched hospitals, and graduates who sometimes lack the hands-on experience they need.

He stressed that unless governments take proactive steps to improve working conditions, the exodus of healthcare professionals will continue. “Doctors are not asking for luxury,” he noted. “They just want a decent wage, a functional healthcare system, and the opportunity to grow.”

Curriculum Gaps and the Slow Adoption of Technology

On whether medical school curricula in Africa are keeping up with global standards, he was blunt.

"Many universities are still teaching medicine the way it was taught thirty years ago," he observed.

"Elsewhere, students are using virtual reality for surgical simulations, AI-driven diagnostic tools, and problem-based learning. Here, many students don't even have access to cadavers for anatomy classes."

He stressed the need for innovation. "Medical education must evolve with technology. If we don't modernize, our graduates will struggle to compete internationally," he warned.

The Research Deficit: Why African Institutions Lag Behind

Medical research is a cornerstone of academic excellence, yet African universities contribute only a fraction of global publications. When asked about this, he attributed the problem to poor funding and institutional neglect. "Research isn't prioritized," he stated. "Faculty members are overloaded with teaching responsibilities and have little time for meaningful research. There's also a lack of funding for projects, making it difficult to conduct high-quality studies." He pointed out that in well-funded institutions abroad, professors have protected research time and access to grants, allowing them to push the boundaries of medicine. "If we want to produce world-class researchers, we must invest in them."

The Shortage of Medical Lecturers

Another pressing issue is the declining number of qualified lecturers. Many experienced faculty members leave for better opportunities abroad or shift to private practice. "The salaries for medical lecturers are discouraging," he explained. "Imagine spending years in training only to earn far less than what you would in clinical practice. Many choose to leave academia because they can't sustain their families on what they earn." He argued that without well-paid, well-motivated teachers, medical education will continue to suffer. "If we don't fix this, we'll soon have students with no one to train them."

Clinical Training: The Challenge of Hands-on Experience

Medical education is incomplete without proper clinical exposure, yet many students today graduate with minimal hands-on experience. He attributed this to overcrowded hospitals, a lack of teaching infrastructure, and an overburdened healthcare workforce. "We have too many students chasing too few patients," he said. "Consultants barely have time to teach because they're too busy managing overwhelming patient loads." He believes structured

training programs, better student distribution across hospitals, and investment in simulation labs could help address the issue.

Gaps in Medical Training and the Global Competency Divide

Building on this, Prof. Nzerue highlighted the differences in medical training between Sub-Saharan Africa and developed countries, particularly how curricular gaps affect students who migrate for further training.

"In the past, Nigerian medical education was so rigorous that when we came to the U.S., it felt like moving from a difficult level to an easier one," he said. "Second MB was harder than the USMLE exams." However, the situation has reversed. The lack of investment in modern medical education, including simulation-based learning and molecular medicine, has created a significant knowledge gap.

He provided an example: "A medical student in the U.S. studying pancreatic cancer learns about the KRAS oncogene, a key mutation that drives the disease. They are taught how targeted therapies block that pathway and make pancreatic cancer treatable. Meanwhile, a Nigerian medical student may learn the clinical symptoms and surgical options like the Whipple procedure but not the molecular biology behind treatment."

This knowledge disparity makes it harder for African-trained doctors to integrate into advanced healthcare systems without additional self-study. "Anyone who Japas and wants to practice abroad must read American textbooks and understand that the emphasis is different," he advised.

Rethinking Assessment and Medical Education Reform

Beyond the content of medical education, Prof. Nzerue emphasized the need to reform assessment methods to better prepare students for modern healthcare practice. He argued that assessment should go beyond note memorization and numerical grading to evaluate critical thinking, adaptability, and practical skills.

"In the U.S., we assess medical students on multiple dimensions—medical knowledge, patient care, system-based learning, and professional behavior," he explained. "But beyond that, students also evaluate their professors. If a lecturer is using the same slides from 2012 in 2025, students can call that out." He believes this type of bi-directional evaluation would improve teaching quality in African medical schools.

He also pointed out that exposure to real-world learning environments is just as crucial as lectures. "Students should gain knowledge from interacting with radiologists, surgeons, and public health experts.

They should learn how to extract knowledge from medical journals and scientific meetings, not just textbooks," he said.

Additionally, he stressed the need for reforms to ensure accountability in medical education. "If a professor is known for harassing students, particularly female students, there should be mechanisms to remove them. If evaluation systems are left in stone, education suffers."

Looking Ahead: The Future of Medical Education in Sub-Saharan Africa

Reflecting on the state of medical education in Nigeria, Prof. Nzerue emphasized that the challenges go beyond funding. While financial investment is necessary, real progress requires a shift in teaching methodologies, technological adoption, and patient-centered care.

He noted that Sub-Saharan African institutions must embrace problem-based learning, simulation training, AI-driven education, and virtual teaching methods to remain competitive in global medical education. More importantly, he stressed the need for policy reforms that retain trained professionals and provide them with the resources needed to apply their skills locally. "If we do not innovate, we risk falling further behind global medical education standards," he warned.

The future of medical education in Nigeria depends on a willingness to adapt. By investing in modern teaching methods, embracing technology, and improving the

learning environment for both students and patients, Nigerian medical schools can train a new generation of highly skilled and adaptable physicians capable of driving meaningful change in healthcare.

The Way Forward: Can Medical Education in Sub-Saharan Africa Be Fixed?

Despite the challenges, he remains hopeful that medical education in Africa can improve if the right steps are taken. "We need political will," he stated. "If governments, universities, and stakeholders come together to prioritize quality training, increase funding for research, improve salaries for lecturers, and modernize curricula, we can turn things around." He warned that failure to act will have dire consequences. "If we don't invest in medical education today, we'll face a future where our healthcare systems are completely dependent on foreign-trained doctors."

As the conversation ended, one thing was clear: the problems in medical education are well-known, and the solutions are within reach. What remains to be seen is whether those in power are willing to act before it's too late.

REFERENCE

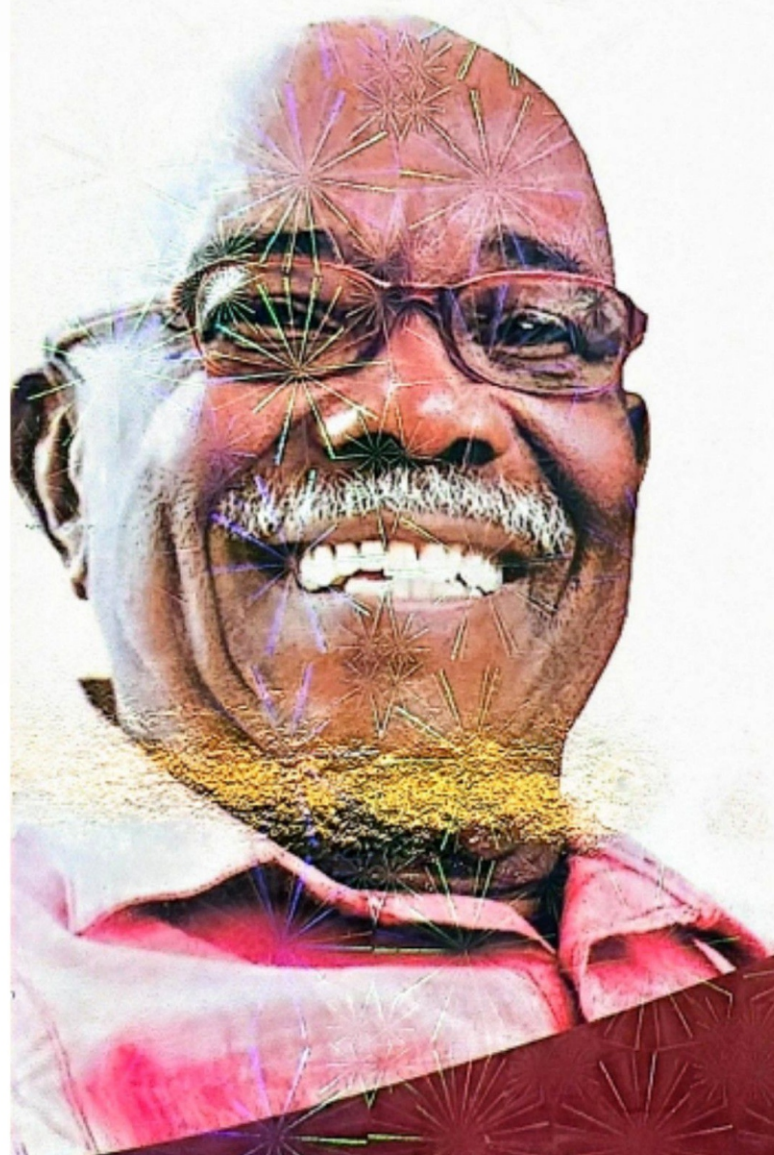
1. Moneskosso GL. A brief history of medical education in Sub-Saharan Africa. *Acad Med* 2014; Aug; 89(Suppl) S11-5. PMID 25072563

Written by:

Grace N. Kaluokoro, Victor S. Igwesi

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