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The knowledge and perception of undergraduate students on antimicrobial resistance and antimicrobial stewardship in selected faculties in Delta state university, Abraka

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Abstract

Background: Despite successes in antimicrobial discovery, infectious diseases remain a threat due to drug-resistant microorganisms. Antimicrobial stewardship (AMS) is crucial in combating antimicrobial resistance (AMR). This study investigates the knowledge and perception of undergraduate healthcare students at Delta State University (DELSU), Abraka, on AMR and AMS, and their preparedness to implement AMS in clinical practice.

Method: Respondents knowledge of antimicrobial resistance and antimicrobial stewardship was investigated using a virtually administered questionnaire. Chi-square test of Independence was used to evaluate the relationship between specific variables and respondents' knowledge.

Results: A total of 136 responses was received, which represents 93.79% of the sample size of 145. Pharmacy Students represent 51.47% of respondents, while Nursing and MBBS Students represent 28.68% and 19.85% respectively. There was a significant relationship between Students course of study and the level of knowledge of AMR with a p-value of 0.2061 > 0.05 significant level, while a p-value of 0.0461 showed there was no significant relationship between Students course of study and their knowledge of AMS.

Conclusion: The significant relationship between knowledge of AMR and course of study among undergraduate healthcare students of DELSU highlights the knowledge gap that needs to be filled with respect to AMR and AMS. This underlines the need to adjust University curriculum to better equip healthcare students as well as recent graduates on AMR and AMS. Further research may be done to know if these findings hold true for students studying health related courses in other universities within Nigeria.

Keywords: Antimicrobial resistance; Antimicrobial stewardship; Knowledge; Perception; DELSU

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1. Introduction

The discovery and development of antimicrobial agents have led to a drastic change not only in the treatment of infectious diseases but also in the fate of humans. The use of antimicrobial agents in the treatment and management of infectious diseases was a huge success that greatly increased the optimism of mankind that infectious diseases would soon be overcome and completely eradicated [1]. However, the reality is that the development and re-emergence of infectious diseases have made mankind vulnerable to infectious diseases. Infections due to drug-resistant microorganisms still remain an issue of great concern that waits to be solved in clinical practice. The overuse and abuse of antibiotics promote antibiotic resistance [2]. According to the World Health Organization (WHO), drug-resistant diseases cause over 20,000 fatalities each year in the United States and over 25,000 fatalities each year in European countries [3]. In order to reduce this increasing rate of antimicrobial resistance, it is important to put in place strategic plans to fight the incidence of antimicrobial resistance due to misuse and abuse of antimicrobial agents; hence, the World Health Organization (WHO) proposed antimicrobial stewardship as one of the three "pillars" of an integrated strategy for strengthening health systems. Antimicrobial stewardship refers to the responsible use of antimicrobials, ensuring that the appropriate antimicrobial is administered to the appropriate patient at the appropriate time, with the appropriate dose, and through the appropriate channel, causing the least amount of harm to the patient and subsequent patients. Antimicrobial use must be controlled as a result of the widespread rise in resistance and the slowing rates of new antibiotic discoveries. Antimicrobial stewardship is required because of the necessity for tightly controlled use of antibiotics [4]. If an infection caused by a drug-resistant microorganism is treated with the wrong antimicrobial agent, the treatment may be ineffective and may further worsen the patient's prognosis. Additionally, in a situation where multidrug-resistant organisms have spread widely, there may be quite a limited choice of agents for antimicrobial chemotherapy [1]. Also, considering the fact that fewer brand-new antimicrobial agents are being released onto the market [1,5] Taking this situation into consideration, and in light of increasing medication safety, we are faced with the reality that antimicrobial agents have limited use.

It is pertinent to note that well-trained, knowledgeable, and competent healthcare professionals are indispensable in the fight against AMR and as such, these set of professionals including but not limited to medical doctors, pharmacists and nurses must be trained to be an effective antimicrobial steward because AMS has proven to be one of the reduction modalities of AMR [2]. In hospitals, a multidisciplinary team is necessary for the successful implementation of antimicrobial stewardship programmes. In low-and middle- income countries (LMICs), practitioners face knowledge gaps due to concerns about personnel and resource constraints that impact the sustainability of interventions [6, 7, 8, 9, 10]. Africa is beginning to address this, and it will continue to do so in light of the high and rising rates of AMR, especially in sub-Saharan Africa, and the growing usage of antibiotics designated as "Watch" and "Reserve." [11, 12, 13, 14, 15]. Despite this, surveys conducted all over the world that have assessed knowledge and/or practices with respect to rational antimicrobial use and antimicrobial resistance along healthcare professionals have reported varying levels of knowledge and/or good practices [8, 16, 17]. Similarly, several studies that have assessed awareness of AMR and related topics among university students studying health-related courses have equally identified several knowledge gaps with respect to these concepts [18, 19]. However, little is known about the knowledge and perception of healthcare students at DELSU concerning AMR and AMS.

In order to fill these gaps, this paper aims to evaluate the knowledge and perception of final-year pharmacy, medicine, and nursing students at Delta State University on antimicrobial resistance and antimicrobial stewardship. We investigate three sets of outcomes (1) the knowledge of undergraduate students with respect to AMR and AMS; (2) the relationship between the level of knowledge and a specific variable; and (3) respondent self-assessment with respect to AMR and AMS. Findings are discussed and compared with similar studies, and recommendations are made with the aim of filling these knowledge gaps.

2. Method

This research is a descriptive, cross-sectional study. The design was used for this study because it is aimed at describing existing problems, which would allow the researcher to obtain factual information on the knowledge and perception of final-year pharmacy, nursing, and medicine students on AMR and AMS. A purposive sampling technique was used in this study, thereby aiding in the selection of three different faculties at Delta State University, Abraka , namely the Faculty of Pharmacy, the Faculty of Basic Medical Sciences, and the Faculty of Clinical Sciences, which were used for the study. The population of this study includes all final-year students of the Faculty of Pharmacy, the Department of Nursing Science, and the Faculty of Clinical Sciences. The population of this study is 228, and the data was obtained from the course adviser for each of the departments or faculties used in this study.

2.1. Sample size determination

The sample size was determined using the Yamane equation for the determination of sample size.

$$n=N/1 + N(e)^2$$

Where; n = sample size, N = population size = 228 (pharmacy = 93, nursing science = 80, medicine and surgery = 55).

e = level of precision

The level of precision was set at 0.05.

$$n = 228/1+228(0.05)^2$$

$$n = 145$$

Calculating the sample size for each department;

$$\text{Pharmacy } n = 93/1+93(0.05)^2 = 75$$

$$\text{Nursing } n = 80/1+80(0.05)^2 = 67$$

$$\text{Medicine and surgery } n = 55/1+55(0.05)^2 = 48$$

2.2. Selection criterion

2.2.1. Inclusion criteria

- Participants; must be a final year. B. Pharm., B. NSc., or MBBS student at Delta State University
- Must be willing to participate in the study.
- Must be able to read and understand English.

2.2.2. Exclusion criteria

- Not a final-year B. Pharm., B. NSc., or MBBS student.
- Not willing to participate in the study.

2.3. Data analysis technique

A 32-item structured questionnaire adapted from similar studies in northern Nigeria and the International Pharmacy Students Forum (IPSF) was used in this study [20, 21]. The questionnaire is made up of five (5) sections (A–E). The first section contains statements about participants' demographics, while sections B and C use closed-ended questions to evaluate participants' knowledge and perceptions of antibiotics, antimicrobial resistance, and antimicrobial stewardship concepts. Section D contains seven statements to be answered using a five-point Likert scale. This section was used to evaluate respondents' knowledge and perceptions towards antimicrobial interventions. The final section, E, was used to investigate respondents' satisfaction with their institution's curriculum on antimicrobial stewardship. The questionnaire was virtually pre-tested among 400-level students of Delta State University's faculty of pharmacy. Prior to the virtual distribution of the questionnaire to participants, an informed consent form was sent virtually to all eligible participants willing to partake in the research. The questionnaire was distributed virtually across the three selected faculties at Delta State University through contact information and social media platforms. Prior to the virtual distribution of the questionnaire to participants, an informed consent form was sent virtually to all eligible participants willing to partake in the research. The questionnaire was distributed virtually across the three selected faculties at Delta State University through contact persons and social media platforms.

2.4. Data Analysis

Descriptive statistics of the collected data were performed using the Statistical Package for the Social Sciences version 20 (SPSS). Data was presented in frequencies and percentages, while chi-square was used to explore the relationship between relevant variables and the knowledge of antimicrobial resistance (AMR) and antimicrobial stewardship (AMS). The level of significance was set at $p < 0.05$. The level of knowledge was calculated by assigning scores of 1 and 0 to the true and false/unsure responses, respectively. The total score for the 7 items for each of the knowledge of AMR and AMS

was 7. The level of knowledge score was: 0–3 = poor, 4-5 = average, and 6-7 = good. For items in the section of the questionnaire that uses a 5-likert scale statement, “strongly agreed," "agreed," "neutral," "disagreed," and "strongly disagreed" responses were grouped and reported accordingly.

3. Results

We will first document the demographic characteristics of respondents, their knowledge of AMR and AMS before assessing the association between the course of study and the relationship between the knowledge.

3.1. Demographics

A total of 136 responses were received, which represents 93.79% of the sample size of 145.

Details of the demographics of the respondents are shown in Table 1.

Table 1 Respondents' Demographic Characteristics. N=136

Demographic Variables	Frequency(n)	Percentage (%)
Age		
20-25years	113	83.1
26-30years	21	15.4
Above30years	2	1.5
Gender		
Male	60	44.1
Female	76	55.9
Course of Study		
Pharmacy	70	51.47
Medicine and Surgery	27	19.85
Nursing Science	39	28.68
Level		
500	109	80.15
600	27	19.85

3.2. Respondent knowledge of antimicrobial resistance

Table 2 shows a summary of the assessment of students’ knowledge on antimicrobial resistance.

Table 2 Respondents' knowledge of antimicrobial resistance

Items/Statement	True N, (%)	False N, (%)	Unsure N, (%)
There are many classes of antibiotics*	133, (98.5)	2, (1.5)	__
Antibiotics can kill normal bacterial flora in the body	125, (91.9)	8, (5.9)	3, (2.2)
Better use of antibiotics will not have an impact on antimicrobial resistance*	73, (54.1)	56, (41.5)	6, (4.4)
Prescribing broad spectrum antibiotics is always better even if there are narrower spectrum antibiotics that are effective. *	42, (31.3)	78, (59)	13, (9.7)

Antibiotics should be used within the community for prophylaxis of infections like typhoid and pneumonia.*	55, (41)	61, (45.5)	18, (13.4)
Patients should stop taking their prescribed/recommended antibiotics as soon as they start to feel better.	8, (5.9)	126, (92.6)	2, (1.5)
Antibiotic resistance occurs when the human body becomes resistant to antibiotics, and they no longer work.*	116, (85.9)	18, (13.3)	1, (0.7)

*Represents statement without complete 136 responses

3.3. Respondents' knowledge of antimicrobial stewardship

Generally, respondents showed good knowledge of antimicrobial stewardship and related concepts. Details are shown in table 3 and table 4

Table 3 Knowledge of antimicrobial stewardship

Items/Statements	**True N, (%)**	**False N, (%)**	**Unsure N, (%)**
AMS helps to limit the occurrence and spread of antimicrobial resistance globally.*	121, (90.3)	4, (3)	9, (6.7)
AMS is ensuring the right patient gets the right antimicrobial for the right indication at the right time with the right dose and through the right route.*	128, (94.8)		7, (5.2)
AMS should be implemented only in the hospital settings*	15, (11.8)	111, (82.8)	8, (6)
Only doctors should be involved in antimicrobial stewardship*	8, (6)	121, (90.3)	5, (3.7)
Pharmacists have a role to play in AMS.*	130, (96.3)	2, (1.5)	3, (2.2)

* Represents statements without complete 136 responses

Table 4 Knowledge of antimicrobial stewardship

Area assessed	**Options**	**N, (%)**
Members of AMS team (n=129)	(a)Doctors	0, (0)
	(b)Hospital Pharmacists	1(0.8)
	(c)Nurses	4, (3.1)
	(d)Community Pharmacists	1, (0.8)
	(e)Laboratory technologists	0, (0)
	(f)All of the above	89, (69)
	(g)All except option (e)	34, (26.4)
Scopes of AMS (n=129)	(a)The study of antimicrobials	6, (4.7)
	(b)choosing antimicrobials appropriately	8, (6.2)
	(c)Selecting suitable route	4, (3.1)
	(d)choosing appropriate duration	1, (0.1)
	(e)All of the above	86, (66.7)
	(f)All except option (a)	24, (18.6)

Table 5 Level of knowledge of antimicrobial resistance and antimicrobial stewardship

AMR	**Knowledge**			**AMS**	**Knowledge**		
Course	**Good (6-7)**	**Average(4-5)**	**Poor (0-3)**	**Course**	**Good (6-7)**	**Average (4-5)**	**Poor (0-3)**
Nursing(n)	0	24	15	Nursing(n)	23	11	5
Medicine(n)	13	13	1	Medicine (n)	16	7	4
Pharmacy(n)	11	40	19	Pharmacy (n)	42	26	2

The table above shows the level of knowledge of the respondents on AMR and AMS according to their course of study after being scored based on their responses to items in tables 2, 3, and 4 on antimicrobial resistance and antimicrobial stewardship, respectively.

Table 6 Relationship between course of study and knowledge of AMR

Demographic	**Level of knowledge**					
Course	**Good**	**Average**	**Poor**	**Chi-square**	**Df**	**P-value**
Nursing	0	24	15	28.0303	4	0.2061
Medicine	13	13	1			
Pharmacy	11	40	19			

Table 7 Relationship between course of study and level of knowledge of AMS

Demographic	**Level of knowledge**					
Course	Good	Average	Poor	Chi-square	Df	P-value
Nursing	23	11	5	6.2767	4	0.0461
Medicine	16	7	4			
Pharmacy	42	26	2			

3.4. Knowledge and Perception towards antimicrobial stewardship interventions

Table 8 Knowledge and Perception of antimicrobial stewardship interventions

Statement/Item	**SA N, (%)**	**A N, (%)**	**N N, (%)**	**D N, (%)**	**SD N, (%)**
Antibiotics should be obtained without prescription.	3, (3.2)	3, (3.2)	13, (9.6)	45, (33.1)	72, (52.9)
Healthcare professionals require additional training on antimicrobial prescription and use to be effective antimicrobial stewards.	56, (41.2)	69, (50.7)	0	4, (2.9)	7, (5.1)
Restricting the use of selected antibiotics will preserve their efficacy and limit resistance to them.*	57, (42.2)	61, (45.2)	13, (9.6)	3, (2.2)	1, (0.7)
Pharmaceutical industries contribute to AMS by limiting the advertisement of broad-spectrum antibiotics.*	7, (5.3)	49, (36.8)	45, (33.8)	19, (14.3)	13, (9.8)

AMS involves regular updates, reporting, monitoring and evaluation of antimicrobial use and resistance in a region.*	52, (38.5)	74, (54.8)	6, (4.4)	3, (2.2)	0
Taking cultures and susceptibility tests are essential to AMS.	60, (44.1)	62, (45.6)	9, (6.6)	2, (1.5)	3, (2.2)
A specific dosage of an antimicrobial agent is suitable for all groups of people.	10, (7.5)	21, (15.7)	9, (6.7)	67, (50)	27, (20.1)

*Represents statements without complete 136 responses; SA -Strongly Agree, A- Agree, N- Neutral, D- Disagree, SD- Strongly Diasgree

3.5. Self-Assessment of knowledge on AMR and AMS

Table 9 Self-Assessment of knowledge on AMR and AMS

Statement	**True/Agree N, (%)**	**Disagree/False N, (%)**	**Unsure/Neutral N, (%)**
Your university's curriculum includes a lecture or lecture series on AMS.	76, (55.9)	34, (25)	26, (19.1)
You obtained most of your knowledge on AMS via learning materials outside your university's curriculum.*	73, (54.1)	45, (33.3)	17, (12.6)
My current knowledge of antimicrobials is adequate for my future career as a pharmacist/Doctor/Nurse	47, (34.6)	46, (33.8)	43, (31.6)
My current knowledge of AMR and AMS is adequate for my future career as a pharmacist/Doctor/Nurse	35, (25.7)	49, (36)	52, (38.2)
I would like more education on the appropriate use of antimicrobials*	125, (92.6)	3, (2.2)	7, (5.2)
I would like more education on antimicrobial resistance	129, (94.9)	6, (4.4)	1, (0.7)
I would like more education on antimicrobial stewardship	128, (94)	7, (5.1)	1, (0.7)

*Represents statements without complete 136 responses

4. Discussion

The aim of this research was to evaluate the knowledge and perception of final-year pharmacy, medicine, and nursing students at Delta State University on antimicrobial resistance and antimicrobial stewardship. Findings from the study showed that many of the respondents have good knowledge of AMR. Most of the respondents were aware of the objectives and scopes of AMS, as well as its role in limiting AMR. The findings also revealed that respondents have good knowledge of AMR interventions, although the majority of the respondents agreed they would like more education on AMS. This study revealed that respondents generally have average knowledge of AMR, which constitutes 56.62% of the total respondents, while this study revealed that 25.74% of the respondents have poor knowledge of AMR. Although this is an improvement compared to the results obtained from a similar study conducted in Nigeria [22], which involved a larger population size. More than half of the respondents agreed that better use of antimicrobials will not have an impact on antimicrobial resistance, with 54.1% "true" and 4.4% "unsure" responses. Also, almost half of the respondents didn't know if prescribing broad-spectrum antibiotics is always better, even when there are narrower-spectrum antibiotics that are effective, as 37.3% think it is better to prescribe broad-spectrum antibiotics, while 4.7% were not sure of what to do. Also, more than half of the respondents either believed it was true (41%) that antibiotics should be used in the community for prophylaxis of infections like typhoid and pneumonia or were not sure of what to do (13.4%). However, when the results were further analysed, it was revealed that medicine students have better knowledge of AMR, as the majority (85.2%) of them believed antibiotics should not be used in the community for prophylaxis of certain infections like typhoid, while 48.15% of them think the statement "better use of antibiotics will not have an impact on antimicrobial resistance" is false. The pharmacy students showed below-average knowledge with regards to their response to the statement "antibiotics should be used within the community for prophylaxis of infections like typhoid and pneumonia," as 36.8% responded "true" and 44.3% responded "true" to the statement "better use of antibiotics will not have an impact on antimicrobial resistance." Similar findings were reported by Abdu-Aguye *et al*.[20]; the reason for this was, however, not known, as it was expected that pharmacy students would have a good understanding of the importance of rational antibiotics and antimicrobial usage. Nursing students, however,

demonstrated poor knowledge of AMR with respect to the statements earlier mentioned. 74.4% of nursing students think better use of antibiotics will not have an impact on antimicrobial resistance, while 71.79% believe antibiotics should be used in the community for prophylaxis of infections like typhoid and pneumonia, and 33.3% believe it is better to prescribe broad-spectrum antibiotics even if there are narrower-spectrum antibiotics. A very good number of pharmacy students (38.2%) also think it is better to prescribe broad-spectrum antimicrobials even when there is an effective narrower-spectrum antimicrobial agent. This is an indication that the majority of the nursing students have a misconception about the rational use of antibiotics and their indication for community prophylaxis of infectious diseases. This is a huge knowledge gap that could contribute to the incidence or rate of antimicrobial resistance, considering the fact that nurses tend to have more contact with patients when administering antimicrobials. Also, in developing countries like Nigeria, where the drug distribution process is not well regulated, nurses tend to go beyond mere administering antimicrobials. It has been reported that some nurses prescribe antibiotics in some regions [23], so it is important to fill these knowledge gaps. The chi-square test showed there was a significant relationship between respondents' knowledge of AMR and their course of study. This was evident as a higher percentage of medicine students had good knowledge of AMR, followed by pharmacy students. Although pharmacy students showed a better understanding of antimicrobial resistance than their nursing counterparts, only a few of them were graded as having good knowledge of antimicrobial resistance, while the majority of them had average knowledge of AMR. While Chi-square test of independence showed no association between respondents' knowledge of AMS and the course of study, majority of the respondents correctly understood the aim of AMS and its role in limiting antimicrobial resistance globally. Almost all of the respondents showed good knowledge of AMS, including pharmacy students, which is consistent with findings in similar studies [21]. The majority of the respondents rightly agreed that antimicrobial stewardship should not be limited to hospital settings only, and most of them also correctly identified the members of the AMS team, although about one-third didn't think the laboratory scientist was a member of the AMS team. Prescribers and non-prescribers, laboratory staff, microbiologists, epidemiologists, information technology (IT) experts, data analysts, veterinarians, farmers, infectious disease specialists, doctors, nurses, clinical pharmacists, and health care leaders are all involved in antimicrobial stewardship [24]. The majority of the respondents showed good knowledge and perceptions of antimicrobial stewardship interventions. Despite their knowledge of AMS, more than half (54.1%) of the respondents indicated that they got most of their knowledge of AMS via learning materials outside their university curriculum, similar to findings by Popoola et al[21]. About 91.7% of the respondents strongly agreed or agreed that health care professionals require additional training on antimicrobial prescription and use to be effective antimicrobial stewards. This corresponds to their willingness to take additional training on antimicrobial resistance and antimicrobial stewardship, as over 90% of them wanted more education with respect to AMR and AMS. This finding correlates to findings from similar studies [3, 20, 21, 25]

5. Conclusion

Conclusively, this study revealed that there is a significant relationship between the course of study of undergraduate students in health-related courses at DELSU and their knowledge of AMR. The study also revealed that there is no significant relationship between the respondents' knowledge of AMS and their course of study. The study also identified the need for curricular updates, as more than 50% of the respondents agreed they sought materials outside their university curriculum to get knowledge on AMR and AMS.

This survey was voluntary, anonymous, and had no impact on the respondent, which probably reduced the tendency of respondents to give biased responses. The limitations of this study include the poor response rate of both nursing science and medicine and surgery students, as less than 50% of their sample size participated in the research. The researcher did not get data on the materials sourced by respondents to get information on AMR and AMS. Also, the possibility of respondents searching for answers to knowledge-based assessments cannot be ruled out, as they were allowed to fill out the questionnaire virtually and at their leisure.

Compliance with ethical standards

Acknowledgement

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Disclosure of conflict of interest

All authors declare they have no conflicting interest.

Statement of ethical approval

Ethical approval for this study was obtained from the Delta State Ministry of Health, Asaba, with reference code HM/596/T^2/89. No data that could be used to identify respondents was collected, and all information collected was handled securely and used for research purposes only.

Statement of informed consent

Informed consent was obtained from respondents before going ahead to answer the questionnaire.

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