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Assessment of Knowledge, Perception and Factors Affecting the Practice of Antimicrobial Stewardship Among Medical Students, Nursing Students and Pharmacy Students in South-South Nigeria.

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Abstract: ***Antimicrobial resistance (AMR) is a significant global health threat, primarily caused by improper antibiotic use. Antimicrobial stewardship (AMS) programs are vital for improving antibiotic use, but healthcare students—the future prescribers—show varying levels of preparedness. This study evaluated the knowledge, perception, and factors affecting AMS practices among healthcare students in Southern Nigeria. A descriptive cross-sectional survey involved 239 students from medical, nursing, and pharmacy programs. They answered a structured, self-administered questionnaire. We analyzed the data with descriptive statistics and Chi-square tests, using a significance level set at $p < 0.05$. The results indicated that most respondents were aged 21 to 25 years (58.2%) and were mainly medical students (84.5%), with over half at the 400 level. Knowledge of important AMR and AMS principles was generally high; 91.6% agreed that self-medication contributes to resistance, and 94.6% disagreed with stopping antibiotics once symptoms improve. However, there were still knowledge gaps about antibiotic-associated diarrhea, dosing implications, and side effects. Most perceptions were positive, as 76.6% agreed that antibiotics should not be given without laboratory testing, and 66.9% recognized the clinical importance of antibiograms. Even so, only 37.7% correctly identified an example of de-escalation. Key perceived barriers to AMS practices included insufficient diagnostic tests (82%), poor infection control practices (89.1%), and lack of staff education (85.4%). Knowledge was significantly linked to department ($p = 0.006$) and level of study ($p = 0.000$), but not to age or gender. In general, healthcare students showed a solid understanding of AMR and AMS, but they had limited practical skills in stewardship. To improve effective antimicrobial stewardship among future healthcare professionals, targeted curriculum improvements and better diagnostic and health system support are necessary.***

Keywords: ***Antibiotic stewardship, Knowledge, Perception, Healthcare students, Antimicrobial resistance, Factors influencing practice.***

I. INTRODUCTION

Antibiotic resistance (AMR) has become one of the biggest public health issues in the 21st century. It threatens our ability to effectively treat infectious diseases and increases illness, death, and healthcare costs worldwide (WHO, 2015). The misuse and overuse of antibiotics in both healthcare settings and the community are major causes of this problem (Laxminarayan *et al.,* 2013). Antibiotic stewardship programs (ASPs) aim to encourage proper antibiotic use, reduce misuse, and ensure effective treatment while limiting the development of resistant pathogens (Dellit *et al.,* 2007).

Healthcare professionals (HCPs) are crucial in promoting appropriate antibiotic use. Their prescribing habits, knowledge of antibiotics, views on stewardship, and ability to recognize factors influencing proper use directly affect the outcomes of stewardship programs (Dyar *et al.,* 2018a). It is important that healthcare students—medical, nursing, and pharmacy students—are well-prepared with the knowledge and viewpoints needed to support responsible antibiotic use (Courtenay *et al.,* 2018).

Research in various regions shows differing levels of knowledge and awareness of stewardship among healthcare students. Many have gaps in understanding resistance mechanisms, appropriate prescribing practices, and how to interpret antibiograms (Abbo *et al.*, 2013; Jamshed *et al.,*

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2014). Evaluating their current preparedness is essential for improving educational programs and guiding future efforts.

This study looks at the knowledge, perceptions, and factors that influence antibiotic stewardship practices among healthcare students. It also examines demographic variables related to these areas.

II. METHODS

A. Study Design

We conducted a descriptive cross-sectional survey among healthcare students.

B. Study Population

The study involved 239 healthcare students, including those in medical, nursing, and pharmacy programs. Participants were at various levels of study, from 200 to 600 level.

C. Data Collection Instrument

We used a structured self-administered questionnaire with four main sections:

1. Demographics (age, sex, department, level of study)
2. Knowledge assessment (16 items)
3. Perception of antibiotic stewardship (7 items)
4. Factors affecting stewardship practice (6 items)

Responses were measured on a 3-point Likert scale: Agree, Not Sure, and Disagree.

D. Data Analysis

Data were entered into a spreadsheet and analyzed using descriptive statistics, such as frequencies and percentages. Chi-square tests evaluated associations between demographic variables and outcomes, including knowledge, perceptions, and practice-related factors. A p-value <0.05 indicated statistical significance.

E. Ethical Considerations

Participation was voluntary, and we maintained the confidentiality of respondent information. We obtained ethical approval through the appropriate institutional review process.

III. RESULTS

A. Demographic Characteristics of Healthcare Students

Table 1 shows the demographic details for the 239 healthcare students. Most participants (58.2%) were aged 21–25 years, followed by those aged 16–20 years (25.5%). There were slightly more females (54.4%) than males (45.6%). A large majority were medical students (84.5%), while nursing and pharmacy students made up 9.2% and 6.3%, respectively. Most respondents were in their 400-level study (51.5%), followed by 500-level (33.9%). Only 2.1% were in 200 level, indicating that most respondents were in their senior clinical years. Overall, the table highlights a youthful population made up mostly of medical students who are advanced in their studies.

Table 1: Demographic Characteristics of Healthcare Students

VARIABLE	FREQUENCY (%)	PERCENTAGE
AGE		
16-20 years	61	25.5
21-25 years	139	58.2
26-30 years	32	13.4
>30 years	7	2.9
TOTAL	239	100
SEX		
MALE	109	45.6
FEMALE	130	54.4
TOTAL	239	100
DEPARTMENT		
Medical Student	202	84.5
Nursing Student	22	9.2

Pharmacy Student	15	6.3
Total		
LEVEL OF STUDY		
200 Level	5	2.1
300 Level	14	5.9
400 Level	123	51.5
500 Level	81	33.9
600 Level	16	6.7
TOTAL	239	100

B. Knowledge Questions and Responses

Table 2 summarizes the students' knowledge of antimicrobial stewardship. Overall, knowledge was high, particularly in key areas such as recognizing that self-medication causes antibiotic resistance (91.6% agree) and understanding the need for strict control of antibiotics (84.1% agree). Most students (89.1% and 94.6%) disagreed with misconceptions like stopping antibiotics once symptoms improve. However, there were notable gaps: only 51% understood that correct dosing alone does not fully prevent resistance, and responses to questions about antibiotics causing diarrhea, reducing influenza risks, or side effects showed uncertainty (up to 44.4% not sure). Overall, students showed a strong foundational knowledge but varied understanding of complex concepts.

Table 2. Knowledge Questions and Responses

		AGREE (%)	NOT SURE (%)	DISAGREE (%)
Q1	It is not necessary to complete the regimen of an antibiotic as long as symptoms has subsided	9.2	1.7	89.1
Q2	Treatment with antibiotics should be stopped once you feel better especially the expensive ones	1.3	4.2	94.6
Q3	Antibiotics resistance affects only patients on hospital admission	4	3.8	95.8
Q4	Self-medication can cause antibiotics resistance	91.6	6.3	2.1
Q5	All antibiotics should be strictly controlled	84.1	13.8	2.1
Q6	Correct doses of an antibiotic at all times can completely stop the occurrence of bacteria resistance to drugs	51.0	26.4	22.6
Q7	The use of antibiotics contributes to the Diarrhoea in the person taking antibiotics	27.6	44.4	28.0
Q8	The use of antibiotics reduce the risk of influenza	20.9	39.3	39.7
Q9	When antibiotics is prescribed at the recommended dosage it doesn't have side effect	9.6	15.9	74.5
Q10	The use of antibiotics contributes to high quality care	77.0	15.9	7.1
Q11	Healthy people can carry antibiotics resistance	83.7	13.8	2.5
Q12	Every person treated with antibiotics is at an increased risk of antibiotic resistance	71.1	18.8	10.0
Q13	Prescribers pattern can contribute to antibiotic resistance	86.6	12.1	1.3

Q14	For appropriate treatment of malaria, addition of antibiotics as combination therapy is recommended	39.7	19.7	40.6
Q15	It is okay to buy the same antibiotics or request them if you are sick and they helped you get better when you had the same symptoms before	18.4	16.3	65.3
Q16	I believe that other than an allergy to an antibiotics, there are no side effects to taking antibiotics	5.9	11.3	82.8

C. Perception Questions and Responses

Table 3 presents the perception patterns regarding antimicrobial stewardship. A majority (63.6%) recognized the value of antibiograms, and 66.9% agreed they help with decisions on empirical therapy. More than half (56.1%) identified de-escalation as important, yet only 37.7% correctly recognized an example of de-escalation, indicating some confusion. Most students (68.2%) believed that patients hospitalized for five or more days should receive targeted therapy. A high percentage (76.6%) agreed on avoiding antibiotic prescriptions without laboratory investigation, indicating a positive attitude toward stewardship. However, 36.4% supported open-ended prescriptions, showing mixed perceptions overall. Generally, perceptions were positive but with areas needing further clarification.

Table 3. Perception Questions and Responses

		AGREE (%)	NOT SURE (%)	DISAGREE (%)
Q17	Antibiogram is the documentation of the common isolates and antimicrobial susceptibility pattern in an institution	63.6	34.7	1.7
Q18	Availability of Antibiogram will facilitate the process of receiving empirically prescribed antibiotics based on culture results.	66.9	30.5	2.5
Q19	De-escalation is an important practice in antimicrobial stewardship	56.1	40.6	3.3
Q20	A typical example of de-escalation include switching from Meropenem to Ceftriaxone	37.7	54.4	7.9
Q21	A patient who has spent 5 days in hospital should rather be on targeted therapy rather than empirical therapy.	68.2	26.8	5.0
Q22	Open ended prescription may be necessary in some cases to enable patient get antibiotics unhindered	36.4	44.4	19.2
Q23	its a wrong practice to prescribe antibiotics without also requesting for microbiology laboratory investigation	76.6	13.8	9.6

D. Factors Affecting Practice of Antimicrobial Stewardship

Table 4 highlights the main factors seen as hindering antimicrobial stewardship. The strongest contributors identified were poor infection control practices (89.1%), inadequate diagnostic tests (82%), and lack of staff education (85.4%). Easy access to antibiotics without prescriptions (77%) and insufficient documentation (75.7%) were also reported as significant issues. Patient demand (74.1%) was acknowledged as an important reason for inappropriate antibiotic use. These findings suggest that structural, regulatory, and behavioral gaps can undermine stewardship efforts, even among knowledgeable students.

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Table 4. Factors Affecting Practice of Antibiotic Stewardship

		AGREE (%)	NOT SURE (%)	DISAGREE (%)
Q24	Easy access to antibiotics without prescription	77.0	5.4	17.6
Q25	Lack of adequate diagnostic tests	82.0	9.2	8.8
Q26	Lack of start and stop dates documented in the case note	75.7	15.5	8.8
Q27	Patient's demand and expectations	74.1	18.8	7.1
Q28	Poor infection control practices	89.1	7.9	2.9
Q29	Lack of adequate staff education	85.4	8.4	6.3

E. Relationship between Knowledge, Perception, and Factors Affecting Antibiotic Stewardship with Gender, Age, Department, and Level of Study

Table 5 looks at the links between demographic factors and outcomes in antimicrobial stewardship. Gender and age did not show statistically significant associations with knowledge, perception, or awareness of stewardship factors ($P > 0.05$). However, department was significantly related to knowledge levels ($P = 0.006$). This indicates that the field of study affects knowledge, with pharmacy students showing higher levels of understanding. The level of study was also significantly linked to knowledge ($P = 0.000$), where students at higher clinical levels (400–600) had better knowledge. No demographic variable significantly influenced perceptions or awareness of factors affecting stewardship. These results suggest that academic exposure and professional training strongly shape stewardship knowledge.

Table 5. Relationship between Knowledge, Perception and Factors Affecting Antibiotic Stewardship with Gender, Age Group, Department and Level of Study.

		Knowledge			Perception			Factors Affecting Antibiotic Stewardship		
Factors		Poor	Good	P-value	Poor	Good	P-value	Poor	Good	P-value
Gender	Male	43	66	0.284	67	42	0.552	11	98	0.656
	Female	60	70		88	42		9	121	
Age group	16-20	34	27	0.085	41	20	0.373	10	51	0.224
	21-25	57	82		92	47		9	130	
	26-30	9	23		18	14		1	31	
	>30	3	4		4	3		0	7	
Department	Medical student	85	117	0.006	132	70	0.483	17	185	0.410
	Nursing student	13	9		16	6		3	19	
	Pharmacy student	5	10		7	8		0	15	
Level of study	200 level	4	1	0.000	4	1	0.953	0	5	0.173
	300 Level	9	5		10	4		2	12	
	400 Level	53	70		81	42		16	107	
	500 Level	33	48		50	31		2	79	
	600 Level	4	12		10	6		0	16	

$P<0.05$ is statistically significant.

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IV. DISCUSSION

This study examined the knowledge, perceptions, and factors affecting antimicrobial stewardship (AMS) practices among healthcare students in Southern Nigeria. The findings show that students have a good basic understanding of antimicrobial resistance (AMR) and stewardship principles, but they still struggle with clinical application, interpreting stewardship tools, and recognizing systemic barriers that hinder effective AMS implementation. These results align with global studies about stewardship preparedness among future prescribes, particularly among students in low- and middle-income countries (LMICs) (Jackson *et al.,* 2023; Okereke *et al.,* 2025).

The demographics of the respondents, mostly senior medical students, suggest they have significant exposure to clinical settings where antibiotics are frequently used. Previous research indicates that being in a higher year and the specific study program greatly affects AMS knowledge due to accumulated coursework and clinical experience (Jamshed *et al.,* 2014; Courtenay *et al.,* 2018; Dyar *et al.,* 2018b). This supports the significant relationship found between knowledge and both department and level of study in this research. Similar results were noted by Pulcini *et al.* (2013) and Jamshed *et al.* (2014), and more recently by Jackson *et al.* (2023), who found that medical and pharmacy students at advanced levels have a better theoretical grasp of AMR than their junior peers. Likewise, Okereke *et al.* (2025), in a multicentre study of dental students, emphasized that while theoretical understanding improves with level, applied AMS competency remains uneven.

The knowledge assessment revealed that a large majority recognized the main drivers of AMR, which include self-medication, misuse of antibiotics, and improper prescribing practices. This is consistent with findings from global KAP studies where students pinpointed human behavior and prescribing habits as major factors of resistance (Abbo *et al.*, 2013; Jamshed *et al.,* 2014; Dyar *et al.,* 2018a). Encouragingly, most respondents rejected misconceptions such as stopping antibiotics when symptoms improve or using them for viral infections, showing that key AMR concepts were effectively conveyed during their training. However, uncertainty about specific clinical issues—like antibiotic-associated diarrhea, side effects, and the importance of accurate dosing—shows there are critical gaps similar to those reported in other settings. Dyar *et al.* (2018a), Efthymiou *et al.* (2020) and Jackson *et al.* (2023) all found that students often understand general AMR principles but struggle with practical stewardship concepts such as pharmacodynamics, risk-benefit analysis, and appropriate antimicrobial choices.

Regarding their perceptions, students held positive views on key stewardship practices. Most understood the value of antibiograms and felt confident using them to inform treatment decisions. These views align with stewardship guidelines that emphasize the need for institution-specific antibiograms to optimize antibiotic therapy (Dellit *et al.,* 2007). However, many students couldn't provide a clear example of de-escalation, highlighting a disconnect between theoretical understanding and real-world application. Pulcini *et al.* (2013) pointed out that junior doctors often misinterpret or inconsistently implement de-escalation guidelines, while Okereke *et al.* (2025) found that even senior dental students struggled with stewardship procedures requiring clinical judgment. Akande-Sholabi *et al.* (2023) similarly noted that community pharmacists, despite good theoretical knowledge, often lacked clarity on key AMS strategies such as de-escalation and step-down therapy.

Students also recognized the necessity of switching from empirical to targeted therapy after extended hospital stays, indicating an increasing awareness of how diagnostic confirmation impacts stewardship. However, the fact that nearly one-third agreed or were uncertain about open-ended antibiotic prescriptions points to enduring cultural norms influenced by systemic issues. In contexts where diagnostics are unreliable, costly, or delayed, broad-spectrum empirical therapy often becomes standard practice—an issue documented in AMR research in Africa (Okeke *et al.,* 2005; Ayukekbong *et al.,* 2017). Chukwu *et al.* (2021), in a national survey of Nigerian healthcare workers, similarly identified diagnostic delays and uncertainty as major drivers of inappropriate prescribing.

The study also highlighted a strong awareness of the structural and behavioral obstacles that weaken AMS efforts. Respondents noted inadequate laboratory diagnostic capabilities, poor infection prevention and control practices, lack of staff training, deficient documentation of antibiotic use, patient demands,

and unrestricted access to over-the-counter antibiotics as major challenges. These factors closely match those identified in the World Health Organization's Global Action Plan on AMR (WHO, 2015) and are reinforced in various studies focused on lower-middle-income countries (Okeke *et al.,* 2005; Ayukekbong *et al.,* 2017, Obasanya, 2022). For instance, Okeke *et al.* (2005) extensively detailed how the absence of functional microbiology labs encourages empirical prescribing and misuse in African hospitals. Ayukekbong *et al.* (2017) emphasized how unregulated community access to antibiotics drives misuse outside clinical settings. Obasanya (2022), in an appraisal of AMS programs in Nigerian facilities, highlighted these systemic deficits as central obstacles to stewardship implementation. Akande-Sholabi *et al.* (2023) also found that community pharmacists were frequently faced with pressure from patients and had to work within a structurally weak regulatory environment, making antibiotic misuse commonplace.

Students' recognition of these barriers is important as it indicates an understanding of the health system dynamics that influence prescribing behaviors. Social factors, particularly patient expectations and demands, were also widely acknowledged. Abbo *et al.* (2013) and Dyar *et al.* (2018a) noted that patient pressure for antibiotics can lead clinicians to prescribe inappropriately, especially when patient satisfaction is wrongly tied to antibiotic provision. Findings from Ayinbuomwan *et al.* (2021) among medical students in the University of Benin reinforce this behavioral influence; students often resorted to empirical treatments due to systemic constraints and patient-related expectations.

Interestingly, the study found no significant connection between perception scores and awareness of systemic factors with demographic attributes. This indicates that students from different disciplines and levels had similar experiences within the same teaching hospitals and faced similar health system constraints. This uniformity supports arguments by Dellit *et al.* (2007) and Courtenay *et al.* (2018) that AMS training must extend beyond just sharing knowledge to address structural realities, promote interprofessional collaboration, and tackle specific contextual barriers. Kpokiri (2019) further emphasizes that improving AMS in Nigerian hospitals requires coordinated education, strengthened infrastructure, and policy-driven enforcement—elements that must be introduced early in professional training.

Overall, the results point to a dual challenge: enhancing clinical competence in stewardship principles while simultaneously advocating for broader system improvements. While students show solid theoretical knowledge and favorable attitudes, their uncertainty in applying these concepts reflects flaws in the curriculum and infrastructure reported in earlier studies (Pulcini and Gyssens, 2013; Courtenay *et al.,* 2018; Obasanya, 2022). To close these gaps, practical AMS training—like workshops on interpreting antibiograms, case-based simulations, and supervised de-escalation sessions—should be integrated into healthcare curricula. Interprofessional education is vital since effective stewardship requires teamwork among prescribers, pharmacists, and nurses (Abbo *et al.*, 2013; Courtenay *et al.,* 2018; Kpokiri, 2019; Okereke *et al.,* 2025).

At the system level, boosting diagnostic microbiology capacity, enforcing antibiotic prescription policies, regularly developing institutional antibiograms, and improving infection prevention and control measures are crucial. These initiatives align with the foundations of antimicrobial stewardship and international recommendations (Dellit *et al.,* 2007; WHO, 2015) and the recommendations of national AMR studies (Kpokiri, 2019; Chukwu *et al.,* 2021; Obasanya, 2022). Without these supports, even well-trained clinicians may struggle to implement effective stewardship due to contextual constraints.

In summary, this study shows that healthcare students have a solid foundational understanding and positive attitudes towards AMS. However, significant gaps remain in their applied stewardship skills and awareness of systemic challenges impacting antibiotic prescribing. These findings are consistent with international literature, emphasizing the need for improved curriculum reforms, practical training, and stronger health system support to ensure effective stewardship practices among future healthcare professionals. Strengthening AMS training at the undergraduate level, along with institutional and regulatory reforms, will be essential for tackling AMR and enhancing the quality of antimicrobial use in Nigeria and similar resource-limited environments.

V. CONCLUSION

This study highlights a significant gap in knowledge, attitudes, and practices related to antimicrobial stewardship among the surveyed population, reflecting widespread global concerns about increasing antimicrobial resistance. While some awareness exists, the overall findings suggest a limited understanding of proper antibiotic use, inadequate exposure to stewardship principles, and persistent misconceptions that could lead to misuse. These weaknesses, coupled with systemic issues like limited diagnostic capabilities and insufficient stewardship training, underscore an urgent need for targeted educational interventions and enhanced institutional support.

Improving antimicrobial stewardship demands a comprehensive approach. Strengthening both undergraduate and postgraduate training, increasing access to diagnostic services, and promoting responsible prescribing practices are key steps toward preserving antibiotic effectiveness. By addressing these gaps through coordinated policy changes, education, and practice improvements, healthcare systems, especially in resource-limited settings, can make significant strides in slowing the rise of antimicrobial resistance. This research contributes to the growing evidence supporting a sustained commitment to AMS initiatives as a cornerstone of global public health protection.

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