

EXPLORING AWARENESS OF ANTIBIOTIC STEWARDSHIP AMONG UNDERGRADUATE NURSING STUDENTS

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DOI: <http://doi.org/10.5281/zenodo.21453210>

Received 31 January 2026	Accepted 16 March 2026	Published 30 March 2026
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ABSTRACT

Background: Antibiotic resistance is a growing global health threat, and nursing students, as future healthcare providers, play a pivotal role in antibiotic stewardship. Antibiotic stewardship was first introduced in the 1990s in response to the growing challenge of antimicrobial resistance (AMR). Initially hospital-focused, stewardship practices have since expanded into outpatient care, veterinary medicine, and agriculture under the broader One Health approach. Nurses play a vital role by administering antibiotics, monitoring patient responses, educating patients, and collaborating with healthcare teams to prevent unnecessary prescribing. The World Health Organization (WHO) has emphasized the importance of undergraduate training programs in promoting responsible antibiotic use. Despite these initiatives, AMR continues to rise, particularly in low-resource countries such as Pakistan, which is among the world's highest antibiotic consumers. Globally, AMR accounted for 1.27 million deaths in 2019 and is projected to cause 10 million deaths annually by 2050, underscoring the urgent need for improved stewardship through education.

Objective: To assess the general and specific knowledge, awareness, and perceptions regarding antibiotic use, resistance, and stewardship among undergraduate nursing students in larkana.

Methods: A descriptive cross-sectional study was conducted among 136 nursing students from all four academic years at affiliated colleges of SMBB Medical University Larkana. Data were collected using a structured questionnaire covering demographics, knowledge, awareness, and perceptions of education. Analysis was descriptive, expressed as frequencies, percentages, and overall knowledge scores (OKS).

Results: Most participants (88.2%) were aged 21–25 years, and 59.6% were female. General knowledge was moderate; 76.1% correctly identified amoxicillin as an antibiotic, while 41.5% misclassified aspirin. Misconceptions included use for viral infections (26.2%) and pain or inflammation (40.3%). Awareness of adverse effects was moderate (57.9% secondary infections; 58.6% allergic reactions), while only 41.0% understood adherence principles. The overall knowledge score (OKS) had a mean of 15.5 (SD $\pm$ 5.9; range 0–28), reflecting wide variability among students.

Perceptions of education revealed gaps, with only 26.5% feeling adequately trained to select antibiotics, though 40.4% strongly supported further training in stewardship.

Conclusion: *Nursing students demonstrated moderate knowledge but substantial misconceptions and gaps in practical application. Strengthening curriculum-integrated training on antibiotics, resistance, and stewardship is essential to better prepare future nurses in combating AMR.*

Keywords: *Antibiotics, Antimicrobial Resistance, Nursing Students, Stewardship, Awareness*

BACKGROUND:

In 1996, an article in New Horizons was the first to introduce the term "stewardship" in reference to the use of antibiotics [1]. The authors emphasized the urgent need to address the then-reported growing issue of antimicrobial resistance (AMR) in hospitals and came to the conclusion that more evidence, in the form of large-scale trials, was needed to determine the best way to control the issue and "optimize antimicrobial use 'stewardship'[1].

The concept of stewardship began gaining attention in the 1990s, especially in response to the growing problem of antibiotic resistance. Initial strategies focused primarily on hospital settings, ensuring antibiotics were prescribed only when necessary, and with the correct drug, dose, and duration. Over time, these practices were expanded to include outpatient care, veterinary medicine, and agriculture, reflecting the broader one Health approach [2].

In the nursing profession, the role of nurses in stewardship is increasingly acknowledged. Nurses are vital in administering antibiotics, monitoring patient responses, educating patients about proper use, and collaborating with healthcare teams to prevent unnecessary prescribing. Empowering nurses through education and leadership opportunities enhances the effectiveness of antibiotic stewardship programs [3].

INTRODUCTION:

The concept of antimicrobial stewardship includes a broad range of actions meant to optimize antimicrobial treatments for specific patients and avoid overuse and abuse of these medications. Optimizing the prescription of antibiotics, enhancing infection prevention protocols, improving diagnostic and control methods, looking for novel antimicrobial medications and treatments, and enhancing professional education

and training are important areas for action. The World Health Organization's (WHO) emphasis on the value of health related undergraduate training programs in promoting responsible antibiotic prescribing and use is especially pertinent [4].

The growing threat of antimicrobial resistance (AMR), which happens when bacteria adapt over time, making antibiotics less effective against them and become resistant to the treatment. It is one of the main factors driving the need for stewardship programs around the world. Because of this, treating common illnesses becomes more difficult and costly, which frequently leads to longer hospital stay, treatment failures, and higher mortality rates [5].

This epidemic is largely caused by overuse, improper prescribing, and lack of awareness among healthcare providers. In addition to aiding in the fight against resistance, antibiotic stewardship safeguards patient safety by minimizing needless drug exposure and mitigating side effects, including *Clostridium difficile* infection. Additionally, it leads to improved health outcomes and lower healthcare expenditures while maintaining the efficacy of current antibiotics for future generations [4,6].

The World Health Organization (WHO) approved a global action plan in May 2015 to supply safer antibiotics for the prevention and treatment of infectious illnesses [7].

Nonetheless, antimicrobial resistance (AMR) is still spreading around the world, particularly in poor nations like Pakistan [8,9,10,11]. Antibiotic resistance is a major issue for healthcare, and Pakistan is the country with the highest consumer of antibiotics among low-resource nations. In Pakistan, an estimated 35,000 people take antibiotics every day [12].

Antimicrobial resistance (AMR) is an Inducing public health threat, which is worsening by the high and inappropriate use of antibiotics.

Consequently, there is a need to evaluate knowledge regarding antibiotic use, AMR, and the readiness to implement antimicrobial stewardship programs (ASPs) among final year medical, pharmacy and nursing students in Pakistan. This reflects the high and increasing rates of AMR in the country, and students as future healthcare professionals (HCPs) [13].

An estimated 1.27 million deaths were attributable to antimicrobial-resistant infections in 2019 alone, while nearly 5 million deaths were somehow associated with drug-resistant infections, according to a major study published in January 2022. This number is estimated to be increased to 10,000,000 per year by 2050, greatly exceeding deaths from cancer [14].

Antimicrobial stewardship programs have been established globally as a result, with the aim of containing and reducing the emergence of antibiotic resistance [15].

Problem Statement

Antibiotic resistance is a growing global health issue, driven by the misuse and overuse of antibiotics and stewardship is crucial to reduce misuse and preserve antibiotic efficacy. Nurses play a crucial role in implementing antibiotic stewardship principles through medication administration, patient education, and infection control practices. However, there is a growing concern that nursing students, particularly those in their 1st year, 2nd year, 3rd year and 4th year of training, may not be sufficiently prepared or aware of their responsibilities in antibiotic stewardship. In Larkana, where healthcare resources and educational exposure may be limited, the extent of nursing students' awareness, understanding, and readiness to contribute to stewardship efforts remains unclear. This study aims to explore the current level of awareness and perceptions among final-year nursing students in Larkana regarding antibiotic stewardship, identifying gaps in knowledge and training that can be used to improve nursing education and strengthen efforts to combat antibiotic resistance.

Research Question:

What are the levels of awareness, knowledge, perceived responsibility, and preparedness of undergraduate nursing students regarding antibiotic stewardship and their role in mitigating antimicrobial resistance?

Research Objectives:

1. To determine the degree of knowledge and comprehension of antibiotic stewardship among Larkana's undergraduate nursing students.
2. To assess how much and how well nursing students have been taught antibiotic stewardship concepts through their clinical and formal education.
3. To investigate the alleged obstacles and difficulties that prevent the application of antibiotic stewardship procedures during clinical rotations.

LITERATURE REVIEW:

This descriptive cross-sectional study was conducted at Khyber Medical University, Peshawar by recruiting 500 students from twelve different paramedic disciplines. The self-administered questionnaire was distributed online through email and WhatsApp, resulting in 364 completed responses and a response rate of 72.8%. The study revealed that 41.21% of paramedic students were using antibiotics without a prescription, 23.63% admitted that they discontinued their prescribed antibiotic course once they felt better, 95.88% recognized the term 'antibiotics', and 79.67% acknowledged that inappropriate use contributed to resistance. A sex comparison revealed that male students (81.32%) were significantly more likely to complete their prescribed antibiotic courses than their female counterparts were (67.29%) ($p = 0.002$). This study identifies gaps in paramedical students' knowledge, attitudes, and practices related to antibiotic use and resistance [16].

The widespread and improper use of antibiotics exacerbates antimicrobial resistance (AMR), a major public health concern. Therefore, in this regard final year medical, pharmacy, and nursing students in Pakistan were assessed for their understanding of antibiotic use, antimicrobial resistance (AMR), and preparedness to execute

antimicrobial stewardship programs (ASPs). This is a reflection of both students as aspiring healthcare professionals (HCPs) and the high and rising rates of AMR in the nation. 1251 final-year students from 23 public and private educational institutions in Punjab participated in a cross-sectional survey. Most respondents to the study had solid understanding of AMR, antibiotic use, and its possible causes. The most popular sources of information about antibiotics were medical textbooks (30.6%), peers (35.9%), and smartphones (69.9%). Nonetheless, the majority of respondents were not entirely equipped to take part in ASPs. However, they were aware of how to lower AMR through ASP implementation, laboratory facility improvement, and training HCPs on proper prescribing.

Antibiotic awareness and AMR causes were significantly correlated with student type, family income, and sex ($p < 0.05$). Among the major characteristics influencing students' training on ASPs were age (OR = 0.524, CI = 0.327–0.842; $p < 0.008$) and attending a public sector university (OR = 4.809; CI = 3.261–7.094; $p < 0.001$). In order to completely prepare students for graduation, educational curricula must be enhanced to include more information about ASPs and appropriate antibiotic usage. Additionally, there must be enough training, workshops, and clinical rotations in the last year [17].

A cross-sectional design was utilised to survey pre-registration nursing students. 321 nursing students from an Australian institution took part in the study. Using both closed-ended and open-ended questions, the survey asked about knowledge and attitudes about the nurse's role in AMS as well as a variety of subjects related to antimicrobial stewardship and antimicrobial resistance. Although 70.7% of participants said they knew very little or nothing about the principles of Antimicrobial Stewardship, 44.5% of participants said they were familiar with the name. Greater awareness was linked to completing courses that focused on nursing practice safety and quality as well as medication use. The results highlight the necessity of involving nursing students in conversations about the issue of antibiotic

resistance and the critical role that nurses play in Antimicrobial Stewardship initiatives [20].

A descriptive cross-sectional study was conducted in Bahauddin Zakariya University, Multan utilizing an online self-administered questionnaire to gauge university students enrolled in biology, veterinary, and pharmacy schools' knowledge and perceptions of AMR and antimicrobial stewardship (AMS). The association between the students' demographics and their perceptions and understanding of AMR and AMS was evaluated using the Chi-square and Fisher exact tests, where appropriate. Of the 496 students who answered the questionnaire, 85.7% were aware of the term antimicrobial resistance (AMR), and 79.4% correctly identified a poorly designed dosage regimen as a contributing cause to AMR. 86.5% of people knew what AMS was for, and the majority (57.9%) knew what the phrase meant. Although the participants demonstrated a good understanding of AMR and AMS, it is recommended that specific modules on antibiotic use and AMS be added to the undergraduate and graduate programs' curricula in order to enhance students' understanding and perception of AMS and AMR [21].

In 2018, a self-administered validated questionnaire was used in a cross-sectional study of students at a private institution in Malaysia. Findings of the 424 participants in this study, 22.6% knew a lot about antibiotics, and 25.7% had taken antibiotics in the preceding month. The only factor linked to the respondents' degree of antibiotic knowledge was the faculty to which they were assigned. Respondents from the Faculty of Health and Medical Sciences were far more likely than those from other faculties to have inadequate understanding of antibiotics ($P < 0.001$). According to the survey, 77.8% of participants were aware that antibiotics were used to treat bacterial infections, while only 27.4% were aware that they were not used to treat viral infections. However, just 35.4% and 9.2% of respondents, respectively, were aware that aspirin and diphenhydramine are not antibiotics, while 46.5% of respondents acknowledged that penicillin is an antibiotic. Over 70% of those surveyed knew that antibiotics have negative side

effects and that using them excessively can cause resistance. However, 33% would not finish their prescription of antibiotics, and 35.6% expected to be administer them for common colds [23].

METHODOLOGY

A descriptive cross sectional study was organized to assess the level of awareness of antibiotic stewardship among undergraduate nursing students. The quantitative method allows for objective measurement and statistical analysis of the data collected.

Study setting: The study setting was conducted at Benazir College of Nursing, Male College of Nursing, and Female College of Nursing, which are affiliated colleges of SMBB Medical University Larkana.

Research Design: A descriptive cross-sectional study design will be used for this research project.

Study population: Undergraduate student nurses, from Benazir College of Nursing Larkana, Male College of Nursing Larkana, and Female College of Nursing Larkana all have 1st year , 2nd year , 3rd year , 4th year nursing students enrolled. There will be 206 nursing students in total.

Sample size: The final sample size was n=136 was determined by applying the proper statistical equations for descriptive research.

HYPOTHESIS

Alternative Hypothesis (H_1): There is a significant association between undergraduate nursing students demographic variables (age, gender, clinical experience) and their level of awareness regarding antibiotic stewardship.

Null Hypothesis (H_0): There is no significant association between undergraduate nursing students demographic variables (age, gender, clinical experience) and their level of awareness regarding antibiotic stewardship.

Variables

Independent variable:

Demographic Characteristics, variables include age, gender and clinical experience(amount of clinical hour ,types of rotation attended)

Dependent variable:

Awareness Regarding Antibiotic Stewardship: This variable shows how much undergraduate nursing students know, comprehend, and feel about antibiotic stewardship. It covers their knowledge of appropriate antibiotic usage, the negative effects of abuse, stewardship program concepts, and their part in encouraging ethical antibiotic use in clinical settings.

Participants

The study participants were undergraduate nursing students enrolled in Benazir College of Nursing, Male College of Nursing, and Female College of Nursing, which are affiliated with Shaheed Mohtarma Benazir Bhutto Medical University (SMBBMU), Larkana, Sindh.

Data was collected online using a convenience sampling method from students.

Inclusion criteria

The inclusion criteria for the study required nursing students enrolled in three government nursing colleges in Larkana, Benazir College of Nursing Larkana, Male College of Nursing Larkana, and Female College of Nursing Larkana. Participants were undergraduate students who completed clinical rotations and gained a lot of exposure to the clinical to ensure adequate exposure to antibiotic use and infection control practices.

Exclusion criteria

The exclusion criteria for the study specified that students enrolled in private nursing colleges, students with mental health issues, who donot have adequate knowledge about antibiotics applications, abuses and possible adverse effects. Students who have been frequently absent their clinical rotations were not included in this study.

Study tool

The data collection tool was a open- access online questionnaire designed to assess the awareness of antibiotic stewardship among final year nursing students. The data was measured as percentages using a five-point Likert scale.

Data collection

The data was collected from nursing students in their undergraduate at Benazir College of Nursing, Male College of Nursing, and Female College of Nursing in Larkana.

Data analysis

Data was analyzed by SPSS version 25.0 in frequency and percentage for demographic and all variables. In inferential analysis, associations were evaluated using chi square test, and mean differences were compared using the independent T test. The participants gender and study year were

taken in to the consideration when performing these analysis

Ethical consideration

The study complies with all ethical standards to protect participants' rights and welfare throughout the research process. Following ethical approval from Shaheed Mohtarma Benazir Bhutto Medical University's Ethical Review Committee (ERC), as well as from Male College of Nursing and Female College of Nursing, Larkana. Participants' informed consent was acquired following a thorough description of the study. The identity of the participants were never revealed, and confidentiality and anonymity are guaranteed by data management protocols. Additionally, each participant's confidentiality was upheld and safeguarded during the data gathering and reporting procedures. These steps guarantee that the study was carried out in a responsible and morally sound manner.

Table 1. Baseline characteristics of the study's participants. All the results were expressed as (n%).

Characteristics		1st Year	2nd Year	3rd Year	4th Year	% of the Total
Gender	Male	3 (5.5%)	10 (18.2%)	10 (18.2%)	32 (58.2%)	55 (40.4%)
	Female	5 (6.2%)	14 (17.3%)	18 (22.2%)	44 (54.3%)	81 (59.6%)
Age	15-20 year	0 (0.0%)	3 (33.3%)	1 (11.1%)	5 (55.6%)	9 (6.6%)
	21-25-year s	7 (5.8%)	20 (16.7%)	25 (20.8%)	68 (56.7%)	120 (88.2%)
	26-30 years	1 (14.3%)	1 (14.3%)	2 (28.6%)	3 (42.9%)	7 (5.1%)
Name of College	Benazir College of Nursing	4 (5.1%)	10 (12.8%)	20 (25.6%)	44 (56.4%)	78 (57.4%)
	Male College of Nursing	1 (3.6%)	5 (17.9%)	4 (14.3%)	18 (64.3%)	28 (20.6%)
	Female College of Nursing	3 (10.0%)	9 (30.0%)	4 (13.3%)	14 (46.7%)	30 (22.1%)
Last Year CGPA	2.6-3 CGPA	0 (0.0%)	0 (0.0%)	1 (25.0%)	3 (75.0%)	4 (2.9%)
	3.1-3.5CGPA	2 (4.2%)	7 (14.6%)	10 (20.8%)	29 (60.4%)	48 (35.3%)

	3.6-4 CGPA	6 (7.1%)	17 (20.2%)	17 (20.2%)	44 (52.4%)	84 (61.8%)
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Table 2. General and specific knowledge and awareness of antibiotics .All the results were expressed as (n%),except the variable OKS which was presented as median. The correct answers have been highlighted as bold.

Statement	Overall Key Response (%)	Interpretation	P-value
Amoxicillin is an antibiotic	Agree/Strongly Agree: 76.1%	Good knowledge	>0.05
Aspirin is an antibiotic	Disagree/Strongly Disagree: 59.2%	Good knowledge	>0.05
Cefotaxime is a cephalosporin	Agree/Strongly Agree: 67.0%	Good knowledge	>0.05
Antibiotics treat bacterial infections	Agree/Strongly Agree: 74.4%	Good knowledge	>0.05
Antibiotics treat viral infections	Disagree/Strongly Disagree: 58.9%	Moderate knowledge	>0.05
Antibiotics treat pain/inflammation	Disagree/Strongly Disagree: 47.0%	Misconceptions remain	>0.05
Antibiotics may cause secondary infections	Agree/Strongly Agree: 57.9%	Moderate knowledge	>0.05
Antibiotics can cause allergic reactions	Agree/Strongly Agree: 58.6%	Moderate knowledge	>0.05
Patients can stop antibiotics when feeling better	Disagree/Strongly Disagree: 49.3%	Misconceptions remain	>0.05
Colds and coughs should always be treated with antibiotics	Disagree/Strongly Disagree: 49.7%	Moderate knowledge	>0.05
Antibiotics should always be used prophylactically	Disagree/Strongly Disagree: 44.4%	Misconceptions remain	>0.05
Antibiotics cannot be used to treat flu	Agree/Strongly Agree: 31.4%	Poor knowledge	>0.05
Antibiotic resistance occurs when bacteria become insensitive	Agree/Strongly Agree: 61.8%	Good knowledge	>0.05
Inappropriate antibiotic use causes resistance	Agree/Strongly Agree: 56.6%	Moderate knowledge	>0.05
Broad-spectrum antibiotics increase resistance	Agree/Strongly Agree: 55.1%	Moderate knowledge	>0.05
Poor infection control contributes to resistance	Agree/Strongly Agree: 55.9%	Moderate knowledge	>0.05
Excessive antibiotic prescribing contributes to resistance	Agree/Strongly Agree: 58.1%	Moderate knowledge	>0.05
Appropriate antibiotic use causes resistance	Disagree/Strongly Disagree: 49.3%	Moderate knowledge	>0.05
Antibiotic stewardship is bacterial resistance	Disagree/Strongly Disagree: 40.4%	Knowledge gap	>0.05
Antibiotic exposure promotes resistant bacteria	Agree/Strongly Agree: 55.9%	Moderate knowledge	>0.05
Narrow-spectrum therapy reduces resistance	Agree/Strongly Agree: 53.9%	Moderate knowledge	>0.05

Beta-lactamase breaks down aminoglycosides	Responses widely distributed	Knowledge deficit	>0.05
Efflux pumps expel antibiotics	Agree/Strongly Agree: 51.3%	Moderate knowledge	>0.05
Antibiotic use in livestock contributes to resistance	Agree/Strongly Agree: 46.0%	Moderate knowledge	>0.05
Better bacterial identification helps control resistance	Agree/Strongly Agree: 52.6%	Moderate knowledge	>0.05
Improved hygiene controls resistance	Agree/Strongly Agree: 47.4%	Moderate knowledge	>0.05
Current research will meet future antibiotic needs	Responses divided	Uncertain knowledge	>0.05
Antibiotic resistance will become a major clinical problem	Agree/Strongly Agree: 48.7%	Moderate awareness	>0.05
Formal teaching can minimize antibiotic resistance	Agree/Strongly Agree: 60.5%	Positive attitude	>0.05

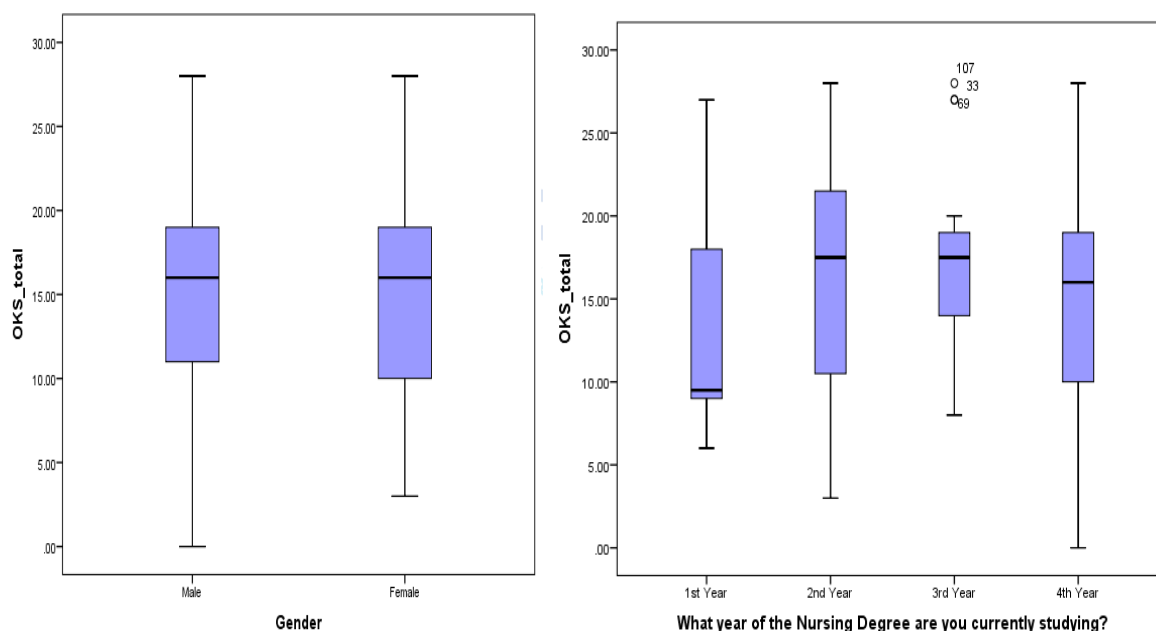


Figure 1. Overall Knowledge Score (OKS)

Figure 1 illustrates the distribution of the overall knowledge score (OKS) according to gender and academic year. The analysis showed no significant difference between male and female students ($p > 0.05$), indicating comparable levels of knowledge.

However, the median OKS increased progressively from the first to the fourth year, suggesting that knowledge about antibiotic use and resistance improved with academic advancement.

Table 3. perception about training on antibiotics received in the nursing degree. All the results were expressed as (n%).

		What year of the Nursing Degree are you currently studying?					
		1st Year	2nd Year	3rd Year	4th Year	% of the Total	P
I have received sufficient training to know how to select the best antibiotic for a given infection	N	3 (37.5%)	5 (20.8%)	8 (28.6%)	20 (26.3%)	26.5%	>0.05
	SD	0 (0.0%)	5 (20.8%)	6 (21.4%)	17 (22.4%)	20.6%	
	DA	3 (37.5%)	4 (16.7%)	3 (10.7%)	15 (19.7%)	18.4%	
	A	2 (25.0%)	9 (37.5%)	6 (21.4%)	9 (11.8%)	19.1%	
	SA	0 (0.0%)	1 (4.2%)	1 (17.9%)	15 (19.7%)	15.4%	
Establish an appropriate regimen (dose, routine, frequency) for antibiotic therapy.	N	2 (25.0%)	5 (20.8%)	1 (3.6%)	16 (21.1%)	17.6%	>0.05
	SD	2 (25.0%)	2 (8.3%)	5 (17.9%)	11 (14.5%)	14.7%	
	DA	1 (12.5%)	4 (16.7%)	4 (14.3%)	19 (25.0%)	20.6%	
	A	2 (25.0%)	10 (41.7%)	10 (35.7%)	11 (14.5%)	24.3%	
	SA	1 (12.5%)	3 (12.5%)	8 (28.6%)	19 (25.0%)	22.8%	
Understand the mechanisms of antibiotic resistance	N	3 (37.5%)	4 (16.7%)	3 (10.7%)	22 (28.9%)	23.5%	>0.05
	SD	1 (12.5%)	2 (8.3%)	2 (7.1%)	11 (14.5%)	11.8%	
	DA	1 (12.5%)	7 (29.2%)	3 (10.7%)	6 (7.9%)	12.5%	
	A	3 (37.5%)	8 (33.3%)	14 (50.0%)	20 (26.3%)	33.1%	
	SA	0 (0.0%)	3 (12.5%)	6 (21.4%)	17 (22.4%)	19.1%	
Manage a patient who demands antibiotic therapy when it is not actually indicated	N	3 (37.5%)	6 (25.0%)	3 (10.7%)	17 (22.4%)	21.3%	>0.05
	SD	3 (37.5%)	2 (8.3%)	3 (10.7%)	15 (19.7%)	16.9%	
	DA	0 (0.0%)	5 (20.8%)	5 (17.9%)	15 (19.7%)	18.4%	
	A	1 (12.5%)	8 (33.3%)	11 (39.3%)	14 (18.4%)	25.0%	
	SA	1 (12.5%)	3 (12.5%)	6 (21.4%)	15 (19.7%)	18.4%	
Understand the appropriate use of antibiotics	N	3 (37.5%)	3 (12.5%)	2 (7.1%)	15 (19.7%)	16.9%	<0.05
	SD	2 (25.0%)	1 (4.2%)	0 (0.0%)	15 (19.7%)	13.2%	
	DA	0 (0.0%)	6 (25.0%)	6 (21.4%)	11 (14.5%)	16.9%	
	A	3 (37.5%)	11 (45.8%)	9 (32.1%)	17 (22.4%)	29.4%	
	SA	0 (0.0%)	3 (12.5%)	11 (39.3%)	18 (23.7%)	23.5%	
I would like to receive more training on the use of antibiotics, resistance, and stewardship.	N	3 (37.5%)	2 (8.3%)	4 (14.3%)	15 (19.7%)	17.6%	>0.05
	SD	0 (0.0%)	5 (20.8%)	1 (3.6%)	8 (10.5%)	10.3%	
	DA	2 (25.0%)	1 (4.2%)	2 (7.1%)	12 (15.8%)	12.5%	
	A	0 (0.0%)	8 (33.3%)	5 (17.9%)	13 (17.1%)	19.1%	
	SA	3 (37.5%)	8 (33.3%)	16 (57.1%)	28 (36.8%)	40.4%	
I would like to receive more training on microbiology and infection control.	N	3 (37.5%)	5 (20.8%)	3 (10.7%)	11 (14.5%)	16.2%	>0.05
	SD	1 (12.5%)	2 (8.3%)	3 (10.7%)	6 (7.9%)	8.8%	
	DA	1 (12.5%)	1 (4.2%)	2 (7.1%)	16 (21.1%)	14.7%	
	A	0 (0.0%)	12 (50.0%)	8 (28.6%)	16 (21.1%)	26.5%	
	SA	3 (37.5%)	4 (16.7%)	12 (42.9%)	27 (35.5%)	33.8%	
A thorough knowledge of Antibiotics is important in my career as a nurse:	N	3 (37.5%)	1 (4.2%)	5 (17.9%)	12 (15.8%)	15.4%	>0.05
	SD	0 (0.0%)	4 (16.7%)	2 (7.1%)	8 (10.5%)	10.3%	
	DA	2 (25.0%)	6 (25.0%)	2 (7.1%)	11 (14.5%)	15.4%	
	A	1 (12.5%)	7 (29.2%)	5 (17.9%)	15 (19.7%)	20.6%	
	SA	2 (25.0%)	6 (25.0%)	14 (50.0%)	30 (39.5%)	38.2%	
	N	3 (37.5%)	2 (8.3%)	2 (7.1%)	9 (11.8%)	11.8%	

A thorough knowledge of microbiology and infection control is important in my career as a nurse.	SD	1 (12.5%)	3 (12.5%)	3 (10.7%)	5 (6.6%)	8.8%	>0.05
	DA	1 (12.5%)	6 (25.0%)	3 (10.7%)	15 (19.7%)	18.4%	
	A	0 (0.0%)	8 (33.3%)	7 (25.0%)	17 (22.4%)	23.5%	
	SA	3 (37.5%)	5 (20.8%)	13 (46.4%)	30 (39.5%)	37.5%	

RESULTS:

1. Description of Sample

The study involved 136 nursing students in total. The majority were between the ages of 21 and 25 (88.2%) and female (59.6%). 5.9% were in their first year of study, 17.6% in their second, 20.6% in their third, and 55.9% in their fourth. Benazir College of Nursing accounted for more than half of the participants (57.4%), with the Male College of Nursing coming in second (20.6%) and the Female College of Nursing third (22.1%). A CGPA between 3.6 and 4.0 was attained by 61.8% of students, 35.3% by those between 3.1 and 3.5, and only 2.9% by those between 2.6 and 3.0. Most were senior female students with excellent academic records who were in their early twenties.

2. Knowledge and Awareness Regarding Antibiotic Use, Resistance and Stewardship

The study found that the majority of nursing students (76.1%) correctly identified amoxicillin as an antibiotic, while 41.5% incorrectly identified aspirin as one. In terms of indications, 74.4% recognized antibiotics for bacterial infections; however, 26.2% thought they were useful for viral illnesses, and 40.3% thought they could be used to treat pain or inflammation. The awareness of side effects was moderate, with 57.9% recognizing secondary infections and 58.6% recognizing allergic reactions. Treatment adherence was low, with only 41.0% disagreeing that antibiotics should be stopped once symptoms improved. Although 61.8% correctly identified resistance and 56.6% linked it to inappropriate use, few understood other contributing factors. Fortunately, 60.5% agreed that formal teaching on stewardship is necessary.

Knowledge and awareness of antibiotic use and resistance among nursing students was moderate, with common misconceptions about indications, side effects, and resistance factors. Limited understanding of treatment adherence and strong

support for formal stewardship training highlight the need for enhanced education in this area.

3. Perception of Education about Antibiotics

The findings revealed notable gaps in students' self-perceived competence and training in antibiotic use and stewardship. Only 34.5% felt adequately trained to select appropriate antibiotics, and less than half (47.1%) were confident in prescribing regimens, while nearly one-third expressed uncertainty. Understanding of resistance mechanisms was moderate (52.2%), with 23.5% admitting a lack of knowledge. Although 43.4% reported confidence in managing patient demands for unnecessary antibiotics, many remained unsure. Encouragingly, more than half (52.9%) reported appropriate antibiotic use, and most expressed strong interest in further learning—59.5% for antibiotics and stewardship and 60.3% for microbiology and infection control. Importantly, nearly four in five students (77.7%) emphasized the relevance of antibiotics and infection control to their nursing careers. Overall, students recognized the importance of antibiotics but highlighted substantial training needs and a desire for structured education in stewardship.

Discussion

The current study examined the knowledge and awareness of antibiotic use, resistance, and stewardship among nursing students at three affiliated colleges of Shaheed Mohtarma Benazir Bhutto Medical University in Larkana. Similar studies have been conducted in Pakistan and other countries, but the current findings provide valuable insight into the educational gaps that exist among nursing students in this region. Overall, the findings showed that while students had a basic understanding of antibiotics, their knowledge of antibiotic resistance and stewardship was limited. The majority of students correctly identified antibiotics like amoxicillin and

understood their role in treating bacterial infections; however, a sizable proportion thought antibiotics could be used to treat viral illnesses like influenza or the common cold. These misconceptions have also been reported among nursing and medical students worldwide, indicating ongoing deficiencies in pharmacological education. The presence of such misunderstandings among future healthcare professionals is concerning because it may lead to inappropriate antibiotic use and contribute to antimicrobial resistance. Additionally, the study demonstrated that nursing students' awareness increased as their academic standing increased, with senior students showing a higher level of comprehension than their predecessors. According to this research, more clinical experience and challenging coursework improve understanding. However, only 61.8% of people acknowledged antibiotic resistance as a serious problem, and only 56.6% of people correctly linked it to abuse. Still, awareness of antibiotic resistance was only moderate. Many students had a particularly poor understanding of treatment adherence because they did not know that stopping antibiotics too soon leads to resistance. The perception of antibiotic education and stewardship highlighted pre-existing gaps. Less than half of the participants felt adequately prepared to select or prescribe antibiotics, and a significant proportion expressed uncertainty or lack of confidence in making antibiotic-related decisions. Despite these limitations, it was encouraging to see that most students recognized the importance of antibiotic knowledge in nursing practice, with nearly four out of five (77.7%) expressing a strong willingness to receive additional training. This motivation reflects a positive attitude toward learning and the potential efficacy of targeted educational interventions. Antibiotic resistance is a major global health issue with serious clinical and economic consequences. This study's findings reinforce the urgent need to incorporate comprehensive antibiotic education and antimicrobial stewardship modules into nursing curricula. Such initiatives should emphasize both theoretical instruction and clinical application, such as case-based discussions,

infection control practices, and interprofessional collaboration. Strengthening these components will prepare nursing students to take an active role in promoting rational antibiotic use and lowering the burden of antimicrobial resistance in healthcare settings.

Limitations

Our study had several limitations. The main limitation of the study was its scope and sampling. Although the sample size of 136 nursing students was adequate, participants were drawn solely from three affiliated institutions, which may limit the findings' generalizability to other regions or nursing programs. Another limitation was the use of self-administered questionnaires, which could have resulted in self-report bias if participants overestimated their knowledge or provided socially acceptable responses. Furthermore, the study emphasized theoretical understanding over practical application of antibiotic use and stewardship in clinical settings. Data was also collected manually, which limited the possibility of widespread participation; an online approach could have improved accessibility and response rates. Despite these limitations, the study provides important baseline data on nursing students' knowledge and awareness of antibiotic use, resistance, and stewardship, making it a useful reference for future, larger-scale studies.

Recommendations

The results of this study suggest that comprehensive modules on antibiotic use, resistance, and stewardship should be incorporated into nursing education programs. Curriculum designers should ensure that these subjects are reinforced through practical instruction and clinical demonstrations in addition to being covered theoretically. Regular workshops, seminars, and case-based discussions can help nursing students improve their skills in antibiotic administration and resistance prevention. Furthermore, inter professional learning opportunities for nursing, pharmacy, and medical students should be encouraged in order to promote collaborative stewardship practices. Health institutions should also provide ongoing

professional development sessions to keep nursing staff up to date on new antibiotic prescribing guidelines.

Conclusion

Although nursing students showed a fair understanding of antibiotic use, the study found that their general knowledge and awareness were moderate, with clear misconceptions. Most people correctly identified amoxicillin, but many people misunderstood its indications, side effects, and treatment compliance. Few people knew about stewardship principles, and few were aware of antibiotic resistance. Even so, students demonstrated a keen interest in pursuing higher education and acknowledged the importance of antibiotics in their careers. The urgent need for better antibiotic education in nursing curricula is highlighted by these findings. Students will become more competent and be able to make valuable contributions to the fight against antibiotic resistance in healthcare practice by combining structured training with clinical stewardship exposure.

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