

Knowledge, Attitudes, and Practices Regarding Antimicrobial Stewardship Among Bedside Nurses in Selected Tertiary Hospitals in Baguio City, Philippines: A Cross-Sectional Study

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Abstract: Background: Antimicrobial resistance (AMR) is a major global public health threat that compromises the effectiveness of antimicrobial therapy. Nurses play a critical role in antimicrobial stewardship (AMS); however, evidence regarding their knowledge, attitudes, and practices (KAP) in the Philippine setting remains limited. **Objective:** To determine the knowledge, attitudes, and practices regarding antimicrobial stewardship among bedside nurses employed in selected tertiary hospitals in Baguio City, Philippines, and to examine the relationships between selected socio-demographic characteristics and AMS competencies. **Methods:** A quantitative descriptive cross-sectional correlational study was conducted among 119 bedside nurses from two tertiary hospitals in Baguio City. Data were collected using a modified, validated self-administered questionnaire. Descriptive statistics summarized respondents' characteristics and KAP scores. The Shapiro-Wilk test assessed normality. Univariate linear regression examined associations between socio-demographic characteristics and KAP outcomes. Statistical significance was set at $p < 0.05$. **Results:** Most respondents demonstrated moderate knowledge, highly positive attitudes, and favorable antimicrobial stewardship practices. Greater knowledge was significantly associated with better stewardship practices. Likewise, positive attitudes were positively associated with stewardship practices. Previous antimicrobial stewardship education and selected socio-demographic characteristics were associated with improved KAP outcomes. **Conclusion:** Bedside nurses demonstrated positive attitudes and favorable antimicrobial stewardship practices despite moderate knowledge levels. Strengthening competency-based antimicrobial stewardship education may enhance nurses' participation in stewardship initiatives and improve patient safety while contributing to national and global efforts to combat antimicrobial resistance.

Keywords: Antimicrobial Stewardship; Antimicrobial Resistance; Nurses; Knowledge; Attitudes; Practices; Philippines

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1. Introduction

Antimicrobial resistance (AMR) remains one of the greatest threats to global public health, compromising the effectiveness of antimicrobial agents and increasing morbidity, mortality, healthcare expenditures, and the burden on health systems worldwide. The inappropriate and excessive use of antibiotics in hospitals and communities continues to accelerate the emergence and spread of resistant microorganisms despite ongoing international efforts to promote responsible antimicrobial use (Sprenger, 2019) [1]. The COVID-19 pandemic further intensified this challenge because antibiotics were frequently prescribed despite relatively low rates of confirmed bacterial co-infections, contributing to the growing burden of antimicrobial resistance (Rawson et al., 2020) [2].

To address this global concern, antimicrobial stewardship (AMS) programs have been established to optimize antimicrobial prescribing, improve patient outcomes, reduce adverse drug events, and minimize the development of antimicrobial resistance. These multidisciplinary programs emphasize the appropriate selection, dosage, route, and duration of antimicrobial therapy while strengthening infection prevention and control practices (Aricò et al., 2023) [3]. Effective implementation of AMS depends on the coordinated efforts of physicians, pharmacists, microbiologists, infection prevention specialists, and nurses.

Among healthcare professionals, nurses play a pivotal role in antimicrobial stewardship because they spend the greatest amount of time with patients, administer antimicrobial therapy, monitor treatment response and adverse effects, reinforce infection prevention measures, educate patients, and facilitate communication among members of the healthcare team. Recent evidence has emphasized that strengthening nurses' competencies in antimicrobial stewardship can significantly improve stewardship implementation and patient safety outcomes (De Vita et al., 2024) [4]. Likewise, systematic evidence demonstrates that nurses' knowledge, perceptions, and experiences directly influence their participation in stewardship activities and highlights the need for continuous education and organizational support (Blackburn et al., 2025) [5].

Knowledge, attitudes, and practices (KAP) are recognized determinants of successful antimicrobial stewardship implementation. Healthcare professionals with adequate knowledge and positive attitudes are more likely to demonstrate appropriate stewardship practices, including prudent antibiotic administration, adherence to infection prevention protocols, and timely communication with prescribers (Abubakar & Sárváry, 2023) [6]. Educational interventions have likewise been shown to improve nurses' stewardship competencies, suggesting that targeted training remains an essential strategy for strengthening antimicrobial stewardship programs (Bobbitt et al., 2023) [7].

In the Philippines, antimicrobial stewardship has gradually expanded across tertiary healthcare institutions through national policies and hospital-based initiatives. Nevertheless, available local evidence remains limited regarding nurses' knowledge, attitudes, and practices related to antimicrobial stewardship. Existing Philippine studies have largely focused on healthcare workers in general or pharmacy-based stewardship implementation rather than bedside nurses who perform frontline stewardship activities (Bernardo & Padua, 2024; Diño et al., 2023) [8,9]. Consequently, important gaps remain in understanding the preparedness of Filipino nurses to participate effectively in antimicrobial stewardship initiatives.

Although antimicrobial stewardship training opportunities have become increasingly available, practical barriers such as workload, staffing shortages, and competing clinical responsibilities continue to affect nurses' participation in educational activities. These challenges highlight the importance of developing accessible, nurse-focused educational interventions that can strengthen stewardship competencies within the clinical setting.

Therefore, this study aimed to determine the knowledge, attitudes, and practices of bedside nurses regarding antimicrobial stewardship in tertiary hospitals in Baguio City, Philippines, and to examine the relationship between selected socio-demographic characteristics and these variables. The findings served as the basis for developing a structured short-course program on infection control designed to strengthen nurses' competencies and support the effective implementation of antimicrobial stewardship in Philippine hospitals.

2. Methods

2.1. Study Design

The researcher employed a **descriptive correlational, cross-sectional research design**. Descriptive (univariate) statistics and simple linear regression analyses were used to analyze the data. Following the descriptive (univariate) statistical analyses, simple linear regression analyses were performed to examine the relationship between each independent variable and the dependent variable individually. In each regression model, one independent variable was entered to predict the outcome variable, allowing the estimation of its individual predictive effect without simultaneously including other independent variables. This approach enabled the identification of variables that were significantly associated with the outcome while maintaining consistency with the descriptive correlational cross-sectional design. Because the study employed a cross-sectional design, the regression analyses were used to evaluate statistical associations and predictive relationships rather than to establish causal relationships (Polit & Beck, 2021; Field, 2024) [10,11].

2.2. Study Setting

The study was conducted in **two tertiary hospitals in Baguio City, Philippines**, both accredited by the Philippine Department of Health and providing specialized inpatient and outpatient healthcare services. These institutions have established infection prevention and antimicrobial stewardship programs, making them suitable settings for evaluating nurses' stewardship competencies.

2.3. Study Population and Participants

The study population consisted of registered bedside nurses assigned to inpatient clinical units. Eligible participants met the following criteria:

- Registered nurses with direct patient care responsibilities.
- Employed in either participating hospital during the study period.
- At least six months of clinical experience.
- Willing to participate and provided written informed consent.

Nurses in purely administrative roles, student nurses, nursing interns, and those on extended leave during data collection were excluded.

2.4. Sample Size and Sampling Technique

The study reached **119 bedside nurses** with no withdrawals from any respondent. However, the data-gathering time was limited due to the inevitable absence of the researcher in the locale where the data were gathered. Thus, the achieved response rate of 119/309 results in a retrieval rate of 38.5%. A **non-probabilistic snowball sampling**, also known as "chain sampling," wherein participants recruit another participant from their professional network and become part of the sample, was used (Makwana et al., 2023) [12].

2.5. Research Instrument

Data were collected using a **modified structured self-administered questionnaire** consisting of four sections:

1. Socio-demographic characteristics
2. Knowledge regarding antimicrobial stewardship
3. Attitudes toward antimicrobial stewardship
4. Practices regarding antimicrobial stewardship

The questionnaire was adapted from previously validated antimicrobial stewardship KAP instruments and modified to suit the Philippine hospital context. Due to the psychometric validity of the adapted tools, there is no need to conceptualize a new questionnaire from the outset. In addition, the researcher used the specified questionnaires mainly due to the similarity of the variables that were tested. Second, the researcher obtained the tool author's response for approval to use the first and second tools through electronic mail. However, the third tool was used because it completes to cover all the components that were discussed, namely, knowledge on AMS. Overall, adopting only one tool is not efficient for covering all the components that were studied.

The first tool is the Parental Perception on Antibiotic (PAPA) Scale that attempts to measure the factors influencing the use of antibiotics. It was authored by Alumran et al. (2014) [13] using a content evaluation panel of experts from Australia and Saudi Arabia. These experts brainstormed and derived a list of the instrument's items from their review of the literature, then 3-round Delphi process to develop the instrument.

Secondly, the researcher obtained approval to use the tool that was used in the study of "Design, reliability, and construct validity of a Knowledge, Attitude and Practice (KAP) questionnaire on personal use of antibiotics" conducted in Spain. Mallah et al. (2020) [14] developed this instrument, designed and validated the questionnaires using the following steps: a systematic review of the literature to generate Knowledge-Attitude-Practice items, followed by identifying a questionnaire design, content validity, face validity, and pilot testing, reliability assessment, construct validity, and questionnaire acceptability.

Finally, the researcher also adapted the Antibiotic Knowledge and Consumption Tool (AKCT) that was developed and validated as a measure of antibiotic knowledge and consumption by Hasan et al. (2022) [15] in the United Arab Emirates.

2.6. Validity and Reliability

Content validity was assessed by experts in nursing, antimicrobial stewardship, infectious diseases, and research methodology. Their recommendations were incorporated into the final instrument.

Internal consistency reliability was evaluated using **Cronbach's alpha**, with acceptable coefficients obtained for the knowledge, attitude, and practice domains before full-scale data collection. The reliability analysis results showed Cronbach's alpha of 0.74 (0.736) for the Knowledge on AMS tool, then 0.88 (0.880) and 0.71 (0.709) for the tools on attitudes and practices towards AMS, respectively.

2.7. Data Collection Procedure

Following approval from the institutional ethics review board and hospital administrators, eligible participants were invited to participate. The study objectives, procedures, risks, benefits, and confidentiality safeguards were explained before obtaining written informed consent.

Questionnaires were distributed during scheduled work periods convenient for participants. Completed questionnaires were collected immediately after completion and checked for completeness before data encoding.

2.8. Statistical Analysis

Data were analyzed using **IBM SPSS Statistics**.

Descriptive statistics included:

- Frequencies
- Percentages
- Means
- Standard deviations

- Medians and interquartile ranges, where appropriate

The **Shapiro–Wilk test** assessed normality. Associations between socio-demographic characteristics and KAP outcomes were examined using **univariate linear regression analysis**, while relationships among knowledge, attitudes, and practices were evaluated using appropriate correlation and regression techniques. Statistical significance was set at $p < 0.05$.

2.9. Ethical Considerations

Ethical approval was obtained from the appropriate Institutional Research Ethics Committee before data collection commenced. Administrative permission was secured from both participating hospitals. Participation was voluntary, and written informed consent was obtained from all respondents.

Participant anonymity was maintained through coded questionnaires, and all data were treated confidentially and used solely for research purposes. Respondents were informed of their right to withdraw from the study at any time without penalty.

3. Results

3.1. Socio-demographic Characteristics of Respondents

A total of **119 bedside nurses** participated in the study. The socio-demographic characteristics of the respondents are presented in **Table 1**. The sample consisted of nurses with varying ages, years of clinical experience, educational attainment, and clinical assignments, providing a diverse representation of bedside nurses from the participating tertiary hospitals.

Table 1. Socio-Demographic Characteristics of the Participants (N = 119)

Characteristics	Summary Statistic	Characteristics	Summary Statistic
Age (f, %)		Department (f, %)	
≤23 Years Old	3 (2.52%)	Coronary Ward	3 (2.52%)
24 to 25 Years Old	28 (23.53%)	Coronary ICU	1 (0.84%)
26 to 30 Years Old	30 (25.21%)	Emergency Room	12 (10.08%)
31 to 35 Years Old	21 (17.65%)	Hemodialysis	6 (5.04%)
≥36 Years Old	37 (31.09%)	Medical Ward	22 (18.49%)
Sex (f, %)		Medical ICU	12 (10.08%)
Male	20 (16.81%)	Medical-Surgical Ward	54 (45.38%)
Female	99 (83.19%)	Surgical Ward	13 (10.92%)
Educational Attainment (f, %)		Surgical ICU	9 (7.56%)
Bachelor Degree	118 (99.16%)	Operating and Recovery Room	29 (24.37%)
Master Degree	1 (0.84%)	Pediatric Ward	6 (5.04%)
Duration of Experience (f, %)		Nursery and Neonatal ICU	4 (3.36%)
≥30 Days to 6 Months	7 (5.88%)	Out-Patient Department	1 (0.84%)
≥6 Months to 12 Months	16 (13.45%)	Others (e.g., Cath Lab, etc.)	13 (10.92%)
≥1 Year to 2 Years	30 (25.21%)		
≥2 Years to 5 Years	33 (27.73%)		
≥5 Years to 10 Years	33 (27.73%)		

Results indicated that the majority of the participants were ≥36 years old (31.09%), were female (83.19%), completed a bachelor's degree (99.16%), had a clinical experience of more than 2 years (55.46%), and were assigned to a medical-surgical ward (45.38%).

3.2. Knowledge Regarding Antimicrobial Stewardship

The descriptive statistics of knowledge on antimicrobial stewardship are shown in **Table 2**. Results showed that the overall median knowledge score was 62.00 (IQR = 57.00 to 65.00), and categorizing these scores using k-means clustering, the majority of the participants had a moderate knowledge score (47.06%). Among the dimensions of knowledge on antimicrobial stewardship, the domain of understanding the nurse's roles had the highest median score (Md=22.00, IQR = 21.00 to 24.00), followed by awareness of the existence of AMS efforts (Md=20.00, IQR = 19.00 to 22.00) while awareness of the impact of antimicrobial resistance had the lowest median score (Md=19.00, IQR = 16.00 to 21.00).

Table 2. Descriptive Statistics of Knowledge on Anti-Microbial Stewardship

Descriptive Statistics of Knowledge on Anti-Microbial Stewardship among the Participants (N = 119)		
Characteristics	Median (IQR)	Frequency (%)
Overall Knowledge on Antimicrobial Stewardship Score	62.00 (57.00 – 65.00)	
Low Knowledge (Scores ≤59.00)		45 (37.82%)
Moderate Knowledge (Scores 60.00 to 66.00)		56 (47.06%)
High Knowledge (Scores ≥67.00)		18 (15.13%)
Dimensions and Items of Knowledge on Anti-Microbial Stewardship		
Awareness on the Impact of Antimicrobial Resistance	19.00 (16.00 – 21.00)	
I know that bacteria can become resistant to antibiotics.	5.00 (4.00 – 5.00)	
I know antibiotics are needed for common colds.	4.00 (3.00 – 5.00)	
I know antibiotics are needed for sore throat.	3.00 (2.00 – 4.00)	
I know antibiotics treat viral infections.	4.00 (2.00 – 5.00)	
I know that antibiotics can be harmful to one's health.	4.00 (3.00 – 5.00)	
Awareness of the Existence of AMS Efforts	20.00 (19.00 – 22.00)	
I know the importance of the antimicrobial stewardship initiative.	4.00 (4.00 – 5.00)	
I am aware that our institution has a clinical pharmacist dedicated to the management antimicrobial stewardship.	4.00 (4.00 – 5.00)	
I am aware that Infectious Disease Physicians alone can approve restricted antibiotics.	4.00 (4.00 – 5.00)	
I am aware of the existence of our institution's AMS programme.	4.00 (4.00 – 5.00)	
I am aware that either local or national government offers blended courses regarding AMS.	4.00 (4.00 – 5.00)	
Understanding of the Nurse's Role	22.00 (21.00 – 24.00)	
I know that culture specimens should be collected when administering antimicrobials for therapy.	5.00 (4.00 – 5.00)	
I know that our hospital produces a cumulative susceptibility guide regularly (i.e. Antibigram).	4.00 (3.00 – 5.00)	
I know the benefit of inquiring about allergic history to antibiotics.	4.00 (4.00 – 5.00)	
I know that patients should undergo antibiotic allergy tests prior to administration.	5.00 (4.00 – 5.00)	
I understand the importance of administering time-based or concentration-based antibiotics.	5.00 (4.00 – 5.00)	
Note: Knowledge scores were categorized using k-means clustering. Overall knowledge scores range from 15.00 to 75.00, while subscale scores range from 5.00 to 25.00.		

The overall knowledge score indicated that respondents demonstrated moderate knowledge of antimicrobial stewardship. Respondents obtained the highest scores on items related to nursing responsibilities in antimicrobial administration and patient monitoring, whereas lower scores were observed for antimicrobial resistance mechanisms and appropriate antimicrobial prescribing, suggesting areas requiring further education.

3.3. Attitudes Toward Antimicrobial Stewardship

Table 3. Descriptive Statistics of Attitudes on Anti-Microbial Stewardship among the Participants (N = 119)

Characteristics	Median (IQR)	Frequency (%)
Overall Attitudes on Antimicrobial Stewardship Score	48.00 (42.00 – 50.00)	
Low Attitude (Scores ≤ 32.00)		3 (2.52%)
Moderate Attitude (Scores 33.00 to 44.00)		37 (31.09%)
High Attitude (Scores ≥ 45.00)		79 (66.39%)
Dimensions and Items of Attitudes on Anti-Microbial Stewardship		
Acceptance and Agreement	24.00 (21.00 – 25.00)	
I support the principle of AMS.	5.00 (4.00 – 5.00)	
I should participate in antimicrobial stewardship programmes and initiatives.	5.00 (4.00 – 5.00)	
I should always comply with our institution's AMS protocol.	5.00 (4.00 – 5.00)	
I should be positive in gaining updated knowledge regarding AMS through trainings and seminars.	5.00 (4.00 – 5.00)	
I should consider AMS an aspect of care for my nursing service.	4.00 (3.00 – 5.00)	
Reason and Motivation to Comply	23.00 (21.00 – 25.00)	
I should be careful because resistant bacteria can spread from one patient to another.	4.00 (4.00 – 5.00)	
I should refer patients efficiently for antimicrobial therapy with complete laboratory and other diagnostic results.	5.00 (4.00 – 5.00)	
I should be aware of the importance of infection prevention and control practices (standard precautions, hand hygiene, etc.) to prevent hospital-acquired infections.	5.00 (5.00 – 5.00)	
I should promptly identify incorrect antibiotic orders and inform the physician immediately when such prescriptions are received.	5.00 (4.00 – 5.00)	
I should participate in discussions regarding antimicrobial adjustments.	5.00 (4.00 – 5.00)	
Note: Knowledge scores were categorized using k-means clustering. Overall knowledge scores range from 10.00 to 50.00, while subscale scores range from 5.00 to 25.00.		

Table 3 presents the descriptive statistics of attitudes toward anti-microbial stewardship among the participants. It can be noted that the **overall median attitudes score** was **48.00** (IQR = 42.00 to 50.00), and most of the participants had high attitudes toward anti-microbial stewardship (66.39%), after categorizing the scores using k-means clustering. The median score for the domain of *acceptance and agreement* was **24.00** (IQR = 21.00 to 25.00), while the median score for the dimension of *reason and motivation to comply* was **23.00** (IQR = 21.00 to 25.00).

3.4. Practices Regarding Antimicrobial Stewardship

Table 4. Descriptive Statistics of the Practices towards Anti-Microbial Stewardship among the Participants (N = 119)

Characteristics	Median (IQR)	Frequency (%)
Overall Practices towards Antimicrobial Stewardship Score	48.00 (44.00–53.00)	
Low Practice Level (Scores ≤ 42.00)		22 (18.49%)
Moderate Practice Level (Scores 43.00 to 50.00)		49 (41.18%)
High Practice Level (Scores ≥ 51.00)		48 (40.34%)
Dimensions and Items of Attitudes on Anti-Microbial Stewardship		
Infection Control Measures	14.00 (13.00 – 15.00)	
I inform patients of proper methods and precautions when collecting sputum and urine samples.	5.00 (5.00 – 5.00)	
I observed hospital personnel during specimen collection for appropriate and acceptable techniques.	4.00 (4.00 – 5.00)	
Performs hand hygiene during antimicrobial therapy.	5.00 (5.00 – 5.00)	
Antibiotic Administration	17.00 (15.00 – 19.00)	
I assist doctors in explaining clearly to the patient the reasons for prescribing or not prescribing antibiotics.	4.00 (3.00 – 5.00)	
I initiate administration of antibiotics without delay and document the administration.	5.00 (4.00 – 5.00)	
I assess patients' swallowing function and their ability to take oral medications and recommend switching to oral administration as necessary.	5.00 (4.00 – 5.00)	
	4.00 (3.00 – 5.00)	
I coordinate and discuss antimicrobial therapy with multiple healthcare workers.	14.00 (12.00 – 15.00)	
Patient Monitoring and Referral Post-Antibiotic Administration	5.00 (5.00 – 5.00)	
I monitor and report adverse reactions to antimicrobial treatment.	4.00 (4.00 – 5.00)	
I participate in discussions regarding antibiotic adjustment.	5.00 (4.00 – 5.00)	
Note: Overall knowledge scores range from 11.00 to 55.00. The subscale score for infection control measures and patient monitoring and referral post-antibiotic administration was 3.00 to 15.00, while antibiotic administration had a score range of 4.00 to 20.00.		

Overall practices toward antimicrobial stewardship had a median score of 48.00 (IQR = 44.00–53.00) in Table 4 presented. Based on the predefined score categories, 22 participants (18.49%) were classified as having low practice (scores ≤ 42.00), 49 participants (41.18%) had moderate practice (scores 43.00–50.00), and 48 participants (40.34%) had high practice (scores ≥ 51.00).

3.5. Associations of Knowledge and Attitudes with Practices toward Anti-Microbial Stewardship

Table 5. Univariate Linear Regression Analyses of the Associations of Knowledge and Attitudes with the Practices towards Anti-Microbial Stewardship among the Participants (N = 119)

Characteristics	Practices towards Antimicrobial Stewardship		
	Beta (β) Coefficient	95% CI	p-value(TwoTailed)
Knowledge on Antimicrobial Stewardship	0.30*	0.12 to 0.47	0.001
Attitudes on Antimicrobial Stewardship	0.21*	0.03 to 0.39	0.024

*Significant at 0.05.

The associations between knowledge and attitudes toward antimicrobial stewardship and practices toward antimicrobial stewardship are shown in **Table 5**. Results indicated that both **knowledge** ($\beta=0.30$, $p=0.001$) and **attitudes** ($\beta=0.21$, $p=0.024$) were **significantly and positively associated with practices toward antimicrobial stewardship**. These results indicate that practices scores increase by **0.30-unit** for every one-unit increase in knowledge score, and they increase by **0.21-unit** for every one-unit increase in attitudes score.

Table 6. Associations between socio-demographic characteristics and Knowledge, Attitude, and Practice (KAP) toward Antimicrobial Stewardship

Socio-demographic Characteristic	Knowledge toward AMS	Attitude toward AMS	Practice toward AMS
Age	No significant association (all $p > 0.05$)	Significant association for 24–25 years ($\beta = 0.57$, $p = 0.025$), 26–30 years ($\beta = 0.73$, $p = 0.005$), 31–35 years ($\beta = 0.68$, $p = 0.004$), ≥ 36 years ($\beta = 0.67$, $p = 0.015$) compared with ≤ 23 years	No significant association (all $p > 0.05$)
Sex (Female)	No significant association ($\beta = -0.02$, $p = 0.796$)	No significant association ($\beta = -0.12$, $p = 0.205$)	No significant association ($\beta = 0.06$, $p = 0.533$)
Duration of Experience	No significant association (all $p > 0.05$)	Significant association for 6–12 months ($\beta = 0.35$, $p = 0.024$), 2–5 years ($\beta = 0.40$, $p = 0.030$), and 5–10 years ($\beta = 0.47$, $p = 0.012$). Experience of 1–2 years was not significant ($p = 0.077$).	No significant association (all $p > 0.05$)
Department	No significant association across all departments (all $p > 0.05$). Coronary Ward showed borderline significance ($\beta = 0.18$, $p = 0.052$).	No significant association across all departments (all $p > 0.05$). Medical-Surgical Ward showed borderline significance ($\beta = -0.17$, $p = 0.072$).	No significant association across all departments (all $p > 0.05$).

The table above presents the univariate linear regression analyses of the associations between socio-demographic characteristics and knowledge, attitude, and practices regarding anti-microbial stewardship among the participants. Results showed that age, sex, duration of experience, and department were not significantly associated with knowledge of antimicrobial stewardship ($p < 0.05$). Regression analysis showed that selected respondent characteristics were significantly associated with more positive attitudes toward antimicrobial stewardship, while other variables showed no statistically significant relationship. It can be noted that age, sex, duration of experience, and department were not significantly associated with practices toward anti-microbial stewardship ($p < 0.05$).

Table 6 illustrates that sex ($p=0.205$) and department ($p>0.05$) were not significantly associated with attitudes toward antimicrobial stewardship. In contrast, results showed that age and duration of experience were significantly associated. In particular, those who were 24 to 25 years old ($\beta=0.57$, $p=0.025$); were 26 to 30 years old ($\beta=0.73$, $p=0.005$); were 31 to 35 years old ($\beta=0.68$, $p=0.004$); and ≥ 36 years old ($\beta=0.67$, $p=0.015$) had attitude scores that were 0.57-unit, 0.73-unit, 0.68-unit, and 0.67-unit higher, respectively, than those who were ≤ 23 years old. For duration of experience, results showed that experience of ≥ 6 months to 12 months ($\beta=0.35$, $p=0.024$); ≥ 2 years to 5 years ($\beta=0.40$, $p=0.030$); and ≥ 5 years to 10 years ($\beta=0.47$, $p=0.012$) have an attitudes score which is 0.35-unit, 0.40-unit, and 0.47-

unit, respectively, significantly higher than those with an experience of ≥ 30 days to 6 months.

4. Discussion

This study found that bedside nurses demonstrated satisfactory knowledge, positive attitudes, and appropriate practices regarding antimicrobial stewardship (AMS), indicating that they are well positioned to contribute to efforts aimed at combating antimicrobial resistance (AMR). Although respondents showed overall competency, the variation in knowledge scores suggests the need for continuous professional education to address existing knowledge gaps. Similar findings were reported by Abubakar and Sárváry (2023) and Blackburn et al. (2025) [5,6], who emphasized that nurses' knowledge is fundamental to effective antimicrobial stewardship implementation.

The respondents' positive attitudes toward AMS highlight their recognition of the importance of responsible antimicrobial use and patient safety. Positive professional attitudes encourage nurses to participate actively in antimicrobial monitoring, infection prevention, and interdisciplinary collaboration. These findings are consistent with those of Bobbitt et al. (2023) and Bonacaro et al. (2024) [7,16], who concluded that positive attitudes and supportive organizational environments enhance stewardship participation among nurses.

The study likewise demonstrated good antimicrobial stewardship practices among bedside nurses. Routine adherence to medication administration protocols, infection prevention measures, and effective communication with physicians reflects the integration of stewardship principles into everyday nursing care. Similar observations were reported by De Vita et al. (2024) and Briquet et al. (2023) [4,17], who recognized nurses as key contributors to antimicrobial stewardship through continuous patient monitoring and safe medication management.

Significant relationships among knowledge, attitudes, and practices indicate that these domains collectively influence stewardship competency. Nurses with better knowledge tended to demonstrate more favorable attitudes and stronger stewardship practices, supporting the importance of competency-based education. Comparable findings were reported by Camerini et al. (2024) and Courtenay et al. (2025) [18,19], who highlighted the value of continuous learning and interdisciplinary collaboration in strengthening nursing participation in AMS.

The relationships between selected socio-demographic characteristics and stewardship competencies further suggest that professional experience and educational exposure contribute to nurses' preparedness for antimicrobial stewardship. Continuous education, institutional support, and access to updated clinical guidelines remain essential for sustaining competency. These findings agree with those of Hamilton et al. (2024), Nie et al. (2024), Diño et al. (2023), and Khan et al. (2026) [9,20-22], who recommended ongoing educational initiatives to improve antimicrobial stewardship knowledge and practice among healthcare professionals.

Overall, the findings reinforce the expanding role of nurses in antimicrobial stewardship programs. Because bedside nurses are directly involved in medication administration, patient education, and infection prevention, strengthening their stewardship competencies can contribute to safer antimicrobial use and improved patient outcomes. Similar conclusions were reached by Merrill et al. (2019), Mohana et al. (2026), Mula et al. (2021), Padigos et al. (2023), and Perez et al. (2024) [23-27], who emphasized that continuous professional development and institutional commitment are essential for sustaining effective stewardship programs.

Clinical Implications

The findings support strengthening antimicrobial stewardship through nurse-focused educational programs, continuing professional development, and interdisciplinary collaboration. Healthcare institutions should integrate antimicrobial stewardship competencies into orientation programs, annual competency assessments, and infection prevention initiatives to improve antimicrobial use and patient safety. These strategies are consistent with recommendations by Zhao et al. (2023) and Olans et al. (2016) [28,29], who emphasized the importance of organizational support and competency-based stewardship education.

Strengths and Limitations

A major strength of this study is its focus on bedside nurses, whose perspectives are critical yet frequently underrepresented in antimicrobial stewardship research. The study also provides local evidence that may guide the development of targeted educational interventions within tertiary hospitals. However, the descriptive-correlational design limits causal inference, while the use of self-reported questionnaires may introduce response bias. In addition, the findings are limited to selected tertiary hospitals and may not be generalizable to other healthcare settings.

Recommendations

Healthcare institutions should implement structured antimicrobial stewardship training programs and provide regular continuing education to strengthen nurses' knowledge and clinical competencies. Future research should employ multicenter and longitudinal designs to evaluate the effectiveness of educational interventions and examine organizational factors influencing antimicrobial stewardship implementation. Qualitative studies exploring nurses' experiences and perceived barriers may also provide valuable insights for improving stewardship practices.

Final conclusion

Bedside nurses demonstrated positive attitudes and favorable antimicrobial stewardship practices despite moderate knowledge levels. Strengthening competency-based antimicrobial stewardship education may enhance nurses' participation in stewardship initiatives and improve patient safety while contributing to national and global efforts to combat antimicrobial resistance.

References

- [1] Sprenger, M. (2019). The journal of global antimicrobial resistance meets the World Health Organization (WHO). *Journal of global antimicrobial resistance*, 18, 305–308. <https://doi.org/10.1016/j.jgar.2019.07.022>
- [2] Rawson, T. M., Moore, L. S., Zhu, N., Ranganathan, N., Skolimowska, K., Gilchrist, M., ... Holmes, A. (2020). Bacterial and fungal coinfection in individuals with coronavirus: A rapid review to support COVID-19 antimicrobial prescribing. *Clinical Infectious Diseases*, 71(9), 2459–2468. <https://doi.org/10.1093/cid/ciaa530>
- [3] Aricò, M., O., Valletta, E., & Caselli, D. (2023). Appropriate Use of Antibiotic and Principles of Antimicrobial Antimicrobial Stewardship in Children. (Basel, Switzerland), 10(4), 740. <https://doi.org/10.3390/children10040740>.
- [4] De Vita, E., Segala, F., V., Fragonard, L., Civile, G., De Scisciolo, D., Nova, R., ... Saracino, A. (2024). Knowledge, Attitudes, and Practices Toward Antimicrobial Resistance Among Young Italian Nurses and Students: A Multicenter, Cross-Sectional Study. *Annals of Global Health*, 90(1), 46. <https://doi.org/10.5334/aogh.4488>.
- [5] Blackburn, J., Avsar, P., Patton, D., Moore, Z., & Ousey, K. (2025). What is the knowledge, perceptions, and experiences of nurses regarding antimicrobial stewardship?: A systematic review. *Wound Practice & Research: Journal of the Australian Wound Management Association*, 33(2), 64–75. <https://search.informit.org/doi/10.3316/informit.T2025061000012290021202353>.

- [6] Abubakar, B., & Sárváry, A. (2023). Knowledge, attitude, and practice on antibiotics use among healthcare workers: A cross-sectional study in Niger State, Nigeria. *Journal of Infection Prevention*. <https://doi.org/10.1177/17571774231165407>.
- [7] Bobbitt, L., J., Cimino, C., Garvey, K., V., Craft, L., S., Eichenseer, N., A., & Nelson, G. E. (2023). An app a day: Results of pre- and post-surveys of knowledge, attitudes, and practices (KAP) regarding antimicrobial stewardship principles among nurses who used a novel learning platform. *Antimicrobial Stewardship & Healthcare Epidemiology*, 3(1), e41. <https://doi.org/10.1017/ash.2023.131>.
- [8] Bernardo, A., C. & Padua, J. O. (2024). Antimicrobial stewardship: Attitudes, perceptions, and practices of healthcare workers in a pediatric tertiary hospital. *The PCMC Journal*, 20(1), 1-21. ISSN 2704-3665. <https://ejournals.ph/article.php?id=24083>.
- [9] Diño, P., E. T., Aquino, S., S., Depante, D., D. M., & Peña, I. G. (2023). Determination of the Enablers and Challenges in the Implementation of Pharmacy-based Antimicrobial Stewardship (AMS) Program in a Level 3 Hospital in Manila. *Acta Medica Philippina*. <https://doi.org/10.47895/amp.vi0.6658>.
- [10] Polit, D. F., & Beck, C. T. (2021). *Nursing research: Generating and assessing evidence for nursing practice* (11th ed.). Wolters Kluwer. (original work published 2008).
- [11] Field, A. (2024). *Discovering Statistics Using IBM SPSS Statistics* (6th ed.). Sage. (original work published 2014).
- [12] Makwana, D., Engineer, P., Dabhi, A., & Chudasama, H. (2023). Sampling Methods in Research: A Review. *International Journal of Trend in Scientific Research and Development*, 7(3), 762-768. <https://www.ijtsrd.com/papers/ijtsrd57470.pdf>
- [13] Alumran, A., Hou, X., Y., Sun, J., et al. (2014). Assessing the construct validity and reliability of the parental perception on antibiotics (PAPA) scales. *BMC Public Health*, 14(1), 73. <https://doi.org/10.1186/1471-2458-14-73>.
- [14] Mallah, N., Rodriguez-Cano, R., Figueiras, A., & Takkouche, B. (2020). Design, reliability and construct validity of a Knowledge, Attitude and Practice questionnaire on personal use of antibiotics in Spain. *Scientific reports*, 10(1), 20668. <https://doi.org/10.1038/s41598-020-77769-6>
- [15] Hasan, S., Sulieman, H., Babi, H., & Bloukh, S. (2022). Development and psychometric evaluation of the Antibiotic Knowledge and Consumption Tool (AKCT). *Antibiotics*, 11(12), 1744. <https://doi.org/10.3390/antibiotics11121744>
- [16] Bonacaro, A., Solfrizzo, F., G., Regano, D., Negrello, F., Domeniconi, C., Volpon, A., Turchini, S., Toselli, P., & Baesti, C. (2024). Antimicrobial stewardship in healthcare: Exploring the role of nurses in promoting change, Identifying Barrier Elements and Facilitators-A meta-synthesis. *Healthcare (Basel, Switzerland)*, 12(21), 2122. <https://doi.org/10.3390/healthcare12212122>.
- [17] Briquet, C., Khaouch, Y., & Yombi, J. C. (2023). Perceptions, attitudes, and practices of a Belgian teaching hospital's physicians, pharmacists, and nurses regarding antibiotic use and resistance: Survey toward targeted actions for antimicrobial stewardship. *Antimicrobial Resistance & Infection Control*, 12(1), 19. <https://doi.org/10.1186/s13756-023-01228-w>.
- [18] Camerini, F., G., Cunha, T., L. Fassarella, C., S. de Mendonça Henrique, D., & Fortunato, J. G. S. (2024). Nursing strategies in antimicrobial stewardship in the hospital environment: A qualitative systematic review. *BMC Nursing*, 23(1), 147. <https://doi.org/10.1186/s12912-024-01753-y>.
- [19] Courtenay, M., Hawker, C., Gallagher, R., Castro-Sanchez, E., Gould, D., J., Al Salti, F., ... & Weaver, S. L. (2025). The application of antimicrobial stewardship knowledge to nursing practice: A national survey of the United Kingdom pre-registration nursing students. *Journal of Advanced Nursing*, 81(1), 198-209. <https://doi.org/10.1111/jan.16195>.
- [20] Hamilton, R., A., Williams, N., Ashton, C., Gilani, S., A. D., Hussain, S., Jamieson, C., ... & Jenkins, A. (2024). Nurses' attitudes, behaviours, and enablers of intravenous to oral switching (IVOS) of antibiotics: A mixed-methods survey of nursing staff in secondary care hospitals across the Midlands region of England. *Journal of Hospital Infection*, 150, 9-16. <https://doi.org/10.1016/j.jhin.2024.05.007>
- [21] Nie, H., Yue, L., Peng, H., Zhou, J., Li, B., & Cao, Z. (2024). Nurses' Engagement in Antimicrobial Stewardship and its Influencing Factors: A Cross-Sectional Study. *International Journal of Nursing Sciences*, 11(1), 91–98. <https://doi.org/10.1016/j.ijnss.2023.12.002>
- [22] Khan, D., Amin, A., Akbar, S., Khan, N., Shaikh, M., Shah, M. A., & Hussain, M. B. (2026). Nurses' knowledge, attitudes, and practices toward antimicrobial stewardship in tertiary hospitals. *Frontier in Medical and Health Research*, 4(2), 643–664. <https://fmhr.net/index.php/fmhr/article/view/2259>
- [23] Merrill, K., Hanson, S. F., Sumner, S., Vento, T., Veillette, J., & Webb, B. (2019). Antimicrobial stewardship: Staff nurse knowledge and attitudes. *American Journal of Infection Control*, 47(10), 1219-1224. <https://doi.org/10.1016/j.ajic.2019.03.022>
- [24] Mohana, S. T., Rani, J. J. G., Vijayalakshmi, K., Gnanapriya, R. S., Mary, B., & Raja, M. (2026). Effectiveness of nurse empowerment program on Antibiotic Stewardship: Impact on Nurses' Knowledge and perceived patient outcomes in a selected hospital. *International Journal of Drug Delivery Technology*, 16(14S), 224–239. <https://doi.org/10.25258/ijddt.16.14s.28>
- [25] Mula, C. T., Middleton, L., Muula, A., Solomon, V., & Varga, C. (2021). Nurses' Role in Antibiotic Stewardship at Medical Wards of a Referral Hospital in Malawi: Understanding Reality and Identifying Barriers. *International Journal of Africa Nursing Sciences*, 15, 100311. <https://doi.org/10.1016/j.ijans.2021.100311>

-
- [26] Padigos, J., Reid, S., Kirby, E., Anstey, C., & Broom, J. (2023). Nursing Experiences in Antimicrobial Optimisation in the Intensive Care Unit: A Convergent Analysis of a National Survey. *Australian Critical Care*, 36(5), 769–781. <https://doi.org/10.1016/j.aucc.2022.09.005>
 - [27] Perez, R., Hayes, J. E., Winters, A. R., Wrenn, R. H., & Moehring, R. W. (2024). Antimicrobial Stewardship Knowledge, Attitudes, and Practices (KAP) among Nurses. *Antimicrobial Stewardship & Healthcare Epidemiology*, 4(1), e51. <https://doi.org/10.1017/ash.2024.63>
 - [28] Zhao, W., Xu, Y., Liu, R., Zhao, T., Ning, Y., Feng, Y., ... Shang, L. (2023). Knowledge, attitudes, and practices of bedside nurses regarding antimicrobial stewardship in China: An explanatory sequential mixed-methods study. *Journal of Nursing Management*, 2023, 9059920. <https://doi.org/10.1155/2023/9059920>
 - [29] Olans, R. N., Olans, R. D., & DeMaria Jr., A. (2016). The Critical Role of the Staff Nurse in Antimicrobial Stewardship—Unrecognized, but Already There. *Clinical Infectious Diseases*, 62(1), 84–89. <https://doi.org/10.1093/cid/civ697>