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Knowledge, Attitudes, and Practices on Antibiotic Use Among Undergraduate Students: Implications for Antimicrobial Stewardship

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ABSTRACT

Antibiotic misuse and overuse have accelerated the emergence of antimicrobial resistance, posing a significant threat to global public health. This study aimed to assess knowledge, attitudes, and practices (KAP) regarding antibiotic use among undergraduate students at Davao Oriental State University and to determine differences by demographic characteristics. The study used a descriptive-comparative research design with proportional stratified sampling, and 387 students participated. Data were collected through a validated questionnaire with acceptable reliability (Cronbach's alpha = 0.785) and analyzed using descriptive statistics and inferential tests, including t-test, one-way ANOVA, and Tukey post hoc analysis. Results revealed that respondents generally demonstrated high knowledge (M = 2.80), positive attitudes (M = 3.05), and high practices (M = 2.98) toward antibiotic use. No significant differences emerged across sex, age, year level, and prior education in most cases; however, faculty affiliation showed significant differences across all KAP domains. Despite generally favorable attitudes and practices, gaps in fundamental knowledge persist. These findings underscore the need for targeted, faculty-specific educational interventions to improve antibiotic literacy and promote responsible antibiotic use, thereby supporting efforts to mitigate antimicrobial resistance.

Keywords: *Antimicrobial resistance (AMR), Antibiotic stewardship, Health education interventions, Prescription adherence, Self-medication behavior*

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INTRODUCTION

Antibiotics play a critical role in preventing and treating bacterial infections (Nwobodo et al., 2022). However, their misuse and overuse have accelerated the emergence of antimicrobial resistance (AMR), a condition in which bacteria evolve mechanisms to survive antibiotic exposure, rendering treatments less effective (Tran et al., 2021). AMR is now recognized as one of the most pressing global public health threats, contributing to prolonged illnesses, increased healthcare costs, and higher mortality rates (Azim et al., 2023). Despite increasing global awareness, inappropriate antibiotic use remains widespread, largely driven by gaps in knowledge, attitudes, and practices (KAP), particularly among young adults and university populations (Nguyen et al., 2022).

Globally, antibiotic misuse continues to exacerbate the AMR crisis. The World Health Organization (WHO, 2023a) reported that resistance to essential antibiotics is increasing at alarming rates, making common infections such as pneumonia, urinary tract infections, and bloodstream infections more difficult to treat. In 2019 alone, AMR directly caused approximately 1.27 million deaths and contributed to 4.95 million deaths worldwide (WHO, 2023a). In the Philippines, the situation is equally concerning, as the country remains one of the highest consumers of antibiotics in Southeast Asia (WHO, 2024). A survey by the Department of Health revealed that one in five Filipinos misuse antibiotics, often by prematurely discontinuing treatment or using leftover medications without proper medical consultation (Diño et al., 2024).

The consequences of antibiotic misuse are evident in both healthcare and community settings. In hospitals, inappropriate prescribing practices contribute to healthcare-associated infections and the emergence of multidrug-resistant organisms, leading to longer hospital stays, increased treatment costs, and higher mortality rates (Abban et al., 2023). In community settings, the easy accessibility of antibiotics without prescriptions promotes self-medication, incorrect dosing, and incomplete treatment courses, all of which accelerate the development of resistance (Abunna et al., 2023). In the Philippine context, antibiotics remain accessible through informal sources such as local stores, further reinforcing unsafe practices such as self-medication and the reuse of leftover drugs.

Several studies have already examined antibiotic-related knowledge, attitudes, and practices among different populations in the Philippines and other Southeast Asian countries. For instance, Cacao et al. (2024) investigated antibiotic misuse among residents in San Pablo City, while Cabuhat et al. (2024) focused on STEM students in the Philippines. Similarly, Haenssgen et al. (2019) explored antibiotic-related behaviors

in rural communities across Southeast Asia. These studies consistently reported that misconceptions and inappropriate practices persist despite growing awareness regarding antimicrobial resistance. However, most existing studies have focused either on community residents, healthcare-related populations, or students from specific academic programs. Limited evidence is available involving undergraduate students from multidisciplinary academic backgrounds in provincial state universities, particularly in the Davao Region.

Despite growing research on knowledge, attitudes, and practices (KAP) regarding antibiotic use, there remains a significant lack of localized evidence among undergraduate students in the Davao Region, particularly across diverse academic disciplines (Azim et al., 2023; Nguyen et al., 2022; Saleem et al., 2025; Sitotaw & Philipos, 2023; Wang et al., 2023). Although university students are often presumed to possess adequate awareness due to their educational exposure, existing studies indicate that knowledge does not always translate into appropriate attitudes and practices (Nguyen et al., 2022), highlighting the persistent KAP gap and the need for context-specific investigations. Addressing this gap is especially important because university students represent a critical population capable of influencing community health behaviors and contributing to antimicrobial resistance (AMR) prevention efforts (Su et al., 2025; Orok et al., 2025). Unlike previous studies that primarily focused on general awareness, the present study examines differences in KAP according to faculty affiliation and demographic characteristics by including students from both health and non-health disciplines. This approach provides localized evidence on how academic exposure shapes antibiotic-related knowledge and behaviors among undergraduate students in Davao Oriental. Although the study does not propose a new theoretical framework, it contributes context-specific findings that can inform nursing-led antimicrobial stewardship initiatives, health education interventions, and community-based awareness programs aimed at promoting responsible antibiotic use and reducing antimicrobial resistance (Zeydani et al., 2023).

This study is anchored on the Knowledge–Attitude–Practice (KAP) Framework, which posits that knowledge serves as the foundation for the development of attitudes that subsequently influence behavioral practices (Wang et al., 2023). According to the KAP framework, individuals who possess accurate knowledge regarding a health issue are more likely to develop favorable attitudes and engage in appropriate health-related behaviors. In the context of antibiotic use, adequate knowledge about the indications, risks, and consequences of antibiotic misuse is expected to foster positive attitudes toward responsible use and ultimately promote appropriate practices that help prevent antimicrobial resistance. The KAP Framework provides the theoretical foundation for examining the relationships among knowledge, attitudes, and practices regarding antibiotic use among undergraduate students and guided the formulation of the research objectives and the interpretation of findings related to antibiotic-use behaviors and antimicrobial stewardship.

Although studies have examined antibiotic-related knowledge and practices in selected Philippine populations, evidence among university students remains limited, particularly in Mindanao and the Davao Region. Moreover, few studies have comprehensively examined antibiotic-related knowledge, attitudes, and practices across multiple academic disciplines within higher education institutions. Consequently, there is limited localized evidence to inform the development of context-specific antimicrobial stewardship, nursing education, and health promotion programs for young adults in provincial university settings. Addressing this gap is important because university students represent future professionals and community leaders whose antibiotic-use behaviors may influence broader community health outcomes.

This study aimed to assess the knowledge, attitudes, and practices (KAP) on antibiotic use among undergraduate students at Davao Oriental State University (DOrSU). Specifically, it sought to: (1) describe the demographic profile of the respondents; (2) determine the level of knowledge on antibiotic use in terms of use/function and risks/consequences; (3) assess attitudes toward antibiotic use; (4) evaluate practices related to antibiotic use, including self-medication and adherence to medical advice; and (5) examine whether significant differences exist in KAP when respondents are grouped according to demographic characteristics. The study was guided by the null hypothesis that there is no significant difference in the levels of knowledge, attitudes, and practices on antibiotic use when respondents are grouped according to their demographic profile.

MATERIALS AND METHODS

Description of the study area

The study was conducted at the Davao Oriental State University (DOrSU) in the Philippines, a public higher education institution with a diverse undergraduate population representing various academic disciplines and communities within the province. The university comprises several academic units, including the Faculty of Business Management (FBM), Faculty of Computer Engineering and Technology (FACET), Faculty of Teacher Education (FTED), Faculty of Criminal Justice Education (FCJE), Faculty of Agriculture and Life Sciences (FALS), Faculty of Humanities, Social Sciences and Communication (FAHUSCI), Faculty of Nursing and Allied Health Sciences (FNAHS), and the Faculty of Advanced International Studies (FAIS). The university was selected because it provides a heterogeneous student population from both health and non-health disciplines, making it an appropriate setting for examining knowledge, attitudes, and practices regarding antibiotic use. Its diverse academic environment offers an opportunity to explore how educational background may influence antibiotic-related knowledge and behaviors among undergraduate students.

Research design

This study employed a quantitative approach using a descriptive-comparative research design, which is appropriate for examining differences in the knowledge, attitudes, and practices (KAP) regarding antibiotic use among undergraduate students.

Research participants

The respondents of the study were undergraduate students enrolled at a State University during the Second Semester of Academic Year 2025–2026. According to the Office of the Registrar, the total undergraduate student population consisted of 11,474 students. The required sample size was determined using Yamane's formula with a 95% confidence level and a 5% margin of error. Based on the population size, the computation yielded a minimum required sample size of 387 respondents.

A proportionate stratified random sampling technique was employed to ensure adequate representation from all academic clusters. The total population was divided into strata based on faculty affiliation, and the computed sample size of 387 respondents was proportionally allocated to each academic cluster according to its share of the total student population.Within each stratum, respondents were selected through random sampling using a random number generator. This sampling approach minimized

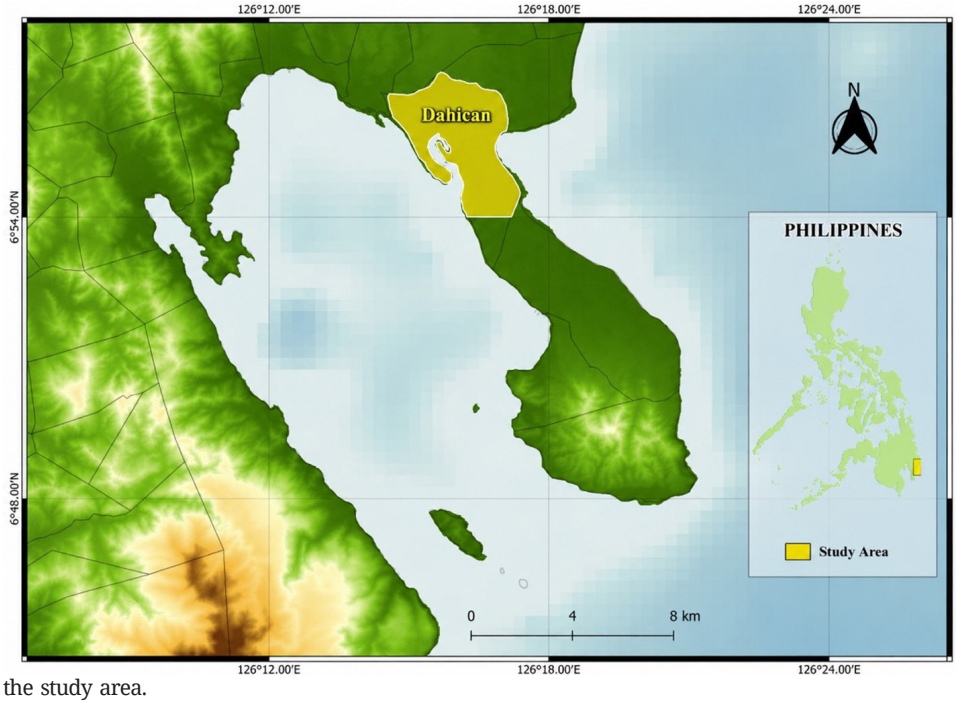

Figure 1. Map of the study area.

selection bias and enhanced the representativeness of the sample.

Table 1 presents the distribution of respondents across the academic clusters. A total of 387 undergraduate students participated in the study and were included in the final analysis, yielding a response rate of 100%. The final sample met the minimum sample size requirement and was considered sufficient to generate reliable and representative findings regarding students' knowledge, attitudes, and practices on antibiotic use.

Table 1. Distribution of academic clusters, total population, and sample sizes.

Academic cluster	Total population	Sample size
FBM	2,774	94
FaCET	2,387	80
FTED	1,725	58
FCJE	859	29
FALS	2,579	87
FAHUSCI	595	20
FNAHS	555	19
Total	11,474	387

Research instrument

The study utilized an adapted survey questionnaire based on the instrument developed by Precha et al. (2024). Prior to data collection, the questionnaire underwent content validation by three experts with backgrounds in nursing, public health, and microbiology. The experts evaluated the instrument for relevance, clarity, appropriateness, comprehensiveness, and alignment with the study objectives. Their comments and recommendations were carefully reviewed, and corresponding revisions were made to improve the wording, organization, and content of selected items before pilot testing. The questionnaire was subsequently modified to suit the local context of Davao Oriental State University (DOrSU) students. The final instrument consisted of 35 items divided into four sections: demographic profile, knowledge, attitude, and practices. The demographic profile section collected information on age, sex, year level, academic cluster, and prior education on antibiotic use. The knowledge, attitude, and practices sections each contained ten items designed to assess respondents' understanding, perceptions, and behaviors regarding antibiotic use and antimicrobial resistance.

A four-point Likert scale (Table 2) was used to measure responses. For knowledge and attitude, the scale ranged from strongly disagree to strongly agree, while for practices, it ranged from never to always. The interpretation of scores followed predefined intervals, where higher mean scores indicated higher levels of knowledge, more positive attitudes, and more appropriate practices.

The instrument underwent validation and pilot testing prior to data collection. Reliability testing using Cronbach's alpha showed values of 0.786 for knowledge, 0.780 for attitude, and 0.790 for practices, with an overall reliability coefficient of 0.785. These values indicate acceptable internal consistency, confirming that the instrument was reliable for measuring the variables of the study.

Table 2. Four-point likert scale interpretation.

Scale range	Descriptive rating	Interpretation
3.26 – 4.00	Very High / Very Positive	Indicates a very high level of knowledge/practice or a very positive attitude toward antibiotic use
2.51 – 3.25	High / Positive	Indicates a high level of knowledge/practice or a positive attitude toward antibiotic use
1.76 – 2.50	Low / Negative	Indicates a low level of knowledge/practice or a negative attitude toward antibiotic use
1.00 – 1.75	Very Low / Very Negative	Indicates a very low level of knowledge/practice or a very negative attitude toward antibiotic use

Data collection procedure

Prior to data collection, ethical clearance was obtained from the University Research Ethics Board, and permissions were secured from the university registrar and the deans of the participating faculties. Respondents were selected using proportional stratified random sampling. The total sample size was first determined using Slovin's formula. Before data collection, this sample was proportionally allocated among the participating faculties based on each faculty's share of the total undergraduate population. The number of respondents from each faculty was computed using the formula nh=(Nh/N)n, where Nh is the population of the faculty, N is the total undergraduate population, and n is the total required sample. Questionnaires were then distributed according to the allocated sample for each faculty. Data was not culled and no responses were removed after data collection merely to achieve the required proportions The questionnaire underwent pilot testing among 387 undergraduate students with characteristics similar to those of the target respondents to assess clarity, comprehensibility, and reliability. Specific degree programs or courses was not collected as the reliability testing considered the Faculty as a whole rather than comparing students according to individual programs. Based on participant feedback, necessary revisions were made to improve item wording and questionnaire organization. Reliability testing on behalf of a qualified statistician using Cronbach's alpha indicated acceptable internal consistency, confirming the suitability of the instrument for the study.

During the data collection phase, respondents were informed about the purpose of the study, the voluntary nature of participation, their right to withdraw at any time, and the confidentiality of their responses. Written informed consent was obtained and was signed before participation. The questionnaire, which assessed knowledge, attitudes, and practices regarding antibiotic use using a four-point Likert scale, was administered face-to-face in designated areas within the university. Researchers provided instructions and clarification when necessary while ensuring that responses remained independent and unbiased. Completed questionnaires were checked for completeness, and replacement respondents were selected when necessary to maintain the required sample size.

Following data collection, completed questionnaires were screened for completeness, consistency, and accuracy. Responses with substantial missing data, duplicate entries, or significant inconsistencies were excluded and replaced using the same sampling procedure. Valid questionnaires were encoded into statistical software, cleaned, and verified through frequency checks and cross-validation procedures. A statistician assisted in data verification and analysis. The processed data were analyzed according to the study objectives, and all research records were securely stored in accordance with institutional confidentiality and data management policies.

Data analysis

Data were analyzed using statistical software via Jamovi, Version 2.6; The Jamovi Project, Sydney, Australia. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize demographic characteristics and KAP levels. Inferential statistics were used to examine differences among groups. An independent samples t-test was applied to variables with two groups, such as sex and prior education. For variables with more than two groups, including age, year level, and academic cluster, one-way analysis of variance was used to compare mean KAP scores across demographic variables with three or more groups. Prior to ANOVA, normality and homogeneity of variance were assessed using the Shapiro–Wilk's and Levene's tests, respectively. When homogeneity of variance was satisfied, conventional one-way ANOVA followed by Tukey's HSD was used for significant omnibus results. When homogeneity was violated, Welch's ANOVA was used; in such cases, Games–Howell should be used instead of Tukey HSD. This approach has precedent in related antimicrobial-resistance studies; for example, Kanyike et al. (2022) used one-way ANOVA with Tukey HSD to compare antimicrobial-resistance knowledge across student groups. When significant differences were found, Tukey's post hoc test was conducted to identify specific group differences. A significance level of 0.05 was used in all analyses.

RESULTS

Demographic profile of the respondents

Table 3 presents the demographic characteristics of the respondents. The data show that the largest proportion of respondents were aged 20 years old and below (49.7%), followed by those aged 21–22 years (37.6%), while only 12.6% were aged 23 years and above. In terms of sex, females comprised the majority (59.8%), whereas males accounted for 40.2%. Regarding year level, second-year students represented the largest group (28.1%), followed by third-

Table 3. Demographic profile of the respondents.

Variables		Frequency (F) (N=387)	Percentage (%)
Age	≤20 years old	192	49.7
	21-22 years old	146	37.6
	≥23 years old	49	12.6
Sex	Male	156	40.2
	Female	231	59.8
Year level	First Year	92	23.0
	Second Year	108	28.1
	Third Year	96	24.7
	Fourth Year	91	23.5
Faculty	FBM	94	24.3
	FACET	80	20.7
	FTED	58	14.9
	FCJE	29	7.5
	FALS	87	22.5
	FAHUSCI	20	5.2
	FNAHS	19	4.9
Previous education	No	328	84.8
	Yes	59	15.2

Note: n = 387 respondents. Percentages may not total exactly 100% due to rounding. FBM = Faculty of Business and Management; FACET = Faculty of Applied Computing and Engineering Technology; FTED = Faculty of Teacher Education; FCJE = Faculty of Criminal Justice Education; FALS = Faculty of Agriculture and Life Sciences; FAHUSCI = Faculty of Human and Social Communication; and FNAHS = Faculty of Nursing and Allied Health Sciences. "Previous Education" refers to whether the respondents had prior education or training related to antibiotic use before participating in the study.

year (24.7%), fourth-year (23.5%), and first-year students (23.0%). In terms of faculty distribution, the Faculty of Business Management had the highest proportion (24.3%), while the Faculty of Nursing and Allied Health Sciences had the lowest (4.9%). Lastly, most respondents (84.8%) reported having no prior education on antibiotic use, whereas only 15.2% indicated previous exposure.

Level of knowledge on antibiotic use

Table 4 presents a detailed assessment of the respondents' level of knowledge on antibiotic use in terms of use and function. The overall mean score of 2.56 with a standard deviation of 0.56 is interpreted as high. A closer examination of the individual items reveals important patterns in the respondents' understanding. The statement "antibiotics cannot be used without prior medical consultation" obtained the highest mean score of 3.09 (SD = 0.78), interpreted as high. The standard deviation indicates moderate variability, meaning that while most respondents agreed with the statement, a smallproportion may still hold differing views.

Table 4. Level of knowledge on antibiotic use in terms of use and function.

Statements	Mean	SD	Interpretation
Antibiotics are not effective in preventing illness.	2.70	0.81	High
Antibiotics are not effective in reducing fever and allergies	2.26	0.78	Low
Antibiotics are not effective in the treatment of viral infections.	2.24	0.77	Low
Antibiotics are not anti-inflammatory drugs and should not be used to relieve body aches or pains caused by physical activity.	2.54	0.81	High
Antibiotics cannot be used without prior medical consultation.	3.09	0.78	High
Overall mean	2.56	0.56	High

Similarly, the statement "antibiotics are not effective in preventing illness" obtained a mean score of 2.70 (SD = 0.81), also interpreted as high. However, the slightly higher standard deviation indicates a wider spread of responses, suggesting that some respondents may still have uncertainty or misconceptions about the preventive role of antibiotics. The statement "antibiotics are not anti-inflammatory drugs and should not be used to relieve body aches or pains caused by physical activity" yielded a mean score of 2.54 (SD = 0.81), interpreted as high. However, the mean being closer to the lower bound of the "high" category suggests that this concept is not as strongly understood as others, and the relatively higher standard deviation further reflects variability in responses, indicating partial misconceptions among some respondents.

In contrast, two statements were rated as low, highlighting critical gaps in knowledge. The statement "antibiotics are not effective in reducing fever and allergies" obtained a mean score of 2.26 (SD = 0.78), while "antibiotics are not effective in the treatment of viral infections" had the lowest mean score of 2.24 (SD = 0.77). Both results indicate a low level of knowledge. The relatively similar standard deviations for these items suggest a consistent pattern of misunderstanding across respondents rather than isolated cases.

Table 5 presents the level of knowledge in terms of risks and consequences of improper antibiotic use. The overall mean score of 3.05 (SD = 0.52) indicates a high level of knowledge. The highest-rated item was "taking leftover antibiotics without medical consultation is not safe" (M = 3.16), while the lowest-rated item was "reusing antibiotics for a past illness is not appropriate" (M = 2.97). Meanwhile, Figure 2 illustrates the overall level of knowledge on antibiotic use among the respondents. The figure shows that the overall mean score is 2.80 with a standard deviation of 0.43, which corresponds to a high level of knowledge. A comparison of the two domains reveals that knowledge on the risks and consequences of improper antibiotic use obtained a higher mean score of 3.05. In contrast, knowledge related to the use and function of antibiotics yielded a lower mean score of 2.56, although it still falls within the high interpretation. The figure highlights a noticeable variation between the two domains, suggesting that respondents have a better understanding of the consequences of misuse than the fundamental concepts underlying antibiotic use and function.

Table 5. Level of knowledge on antibiotic use in terms of risks and consequences of improper use.

Statements	Mean	SD	Interpretation
Doubling the next dose of antibiotics after missing one is not a safe and correct practice.	2.99	0.79	High
Completing the full course of antibiotics as prescribed helps prevent antibiotic resistance.	3.15	0.62	High
Reusing antibiotics prescribed for a past illness is not an appropriate way to treat a new illness with similar symptoms.	2.97	0.71	High
Taking leftover antibiotics without medical consultation is not a safe and acceptable practice.	3.16	0.76	High
Sharing antibiotics with another person who shows the same symptoms is not considered appropriate.	3.00	0.78	High
Overall Mean	3.05	0.52	High

Level of attitude on antibiotic use

Table 6 presents a detailed account of the respondents' level of attitude on antibiotic use in terms of use and personal practices. The overall mean score of 2.96 (SD = 0.53) is interpreted as positive. The relatively low standard deviation suggests that the responses are moderately consistent, implying that most respondents share similar views regarding appropriate antibiotic-related behaviors.

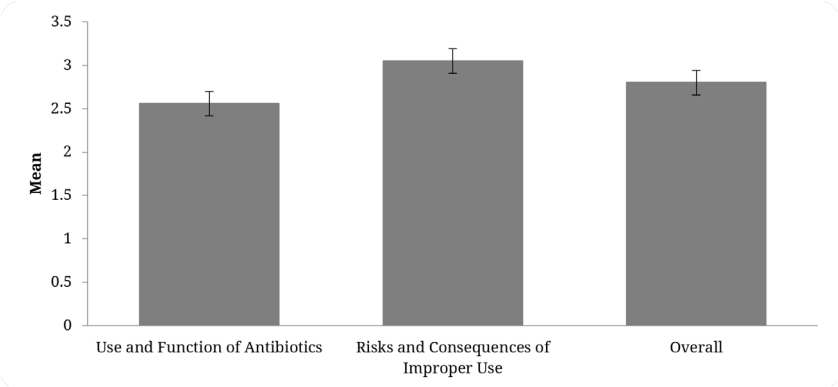

Figure 2. The overall level of knowledge on antibiotic use among the respondents.

A closer examination of the individual items reveals important variations in the strength of these attitudes. The highest-rated statement, "It is necessary to take the full course of antibiotics as prescribed by the doctor, even if a person already feels better" (M = 3.14, SD = 0.69), reflects a strong level of agreement among respondents. The relatively moderate standard deviation further suggests that while most respondents strongly agree, there remains slight variability in the degree of conviction across individuals. Similarly, the statements "Any leftover antibiotics should not be kept for future use to treat other ailments" (M = 3.02, SD = 0.75) and "Inappropriate use of antibiotics contributes to antibiotic resistance" (M = 3.01, SD = 0.73) also received high mean scores within the positive range. The statement "Buying antibiotics without a prescription does affect the control of antibiotic use" (M = 2.88, SD = 0.77) also falls within the positive category, although with a slightly lower mean. The somewhat higher standard deviation indicates greater variability in responses, implying that not all respondents uniformly perceive the impact of non-prescription antibiotic access.

On the other hand, the lowest-rated statement, "People should not buy the same antibiotic that works every time to save money" (M = 2.76, SD = 0.80), while still interpreted as positive, reflects the weakest agreement among the indicators. The relatively higher standard deviation for this item indicates greater divergence in opinions, highlighting that this aspect of antibiotic use remains less consistently understood or accepted among respondents.

Table 6. Level of attitude on antibiotic in terms of use and personal practices.

Statement	Mean	SD	Interpretation
It is necessary to take the full course of antibiotics as prescribed by the doctor, even if a person already feels better.	3.14	0.69	Positive
People should not buy the same antibiotic that works every time to save money.	2.76	0.80	Positive
Buying antibiotics without a prescription does affect the control of antibiotic use.	2.88	0.77	Positive
Any leftover antibiotics should not be kept for future use to treat other ailments.	3.02	0.75	Positive
Inappropriate use of antibiotics contributes to antibiotic resistance.	3.01	0.73	Positive
Overall Mean	2.96	0.53	Positive

Table 7 presents the respondents' attitudes toward antibiotic use in terms of health initiatives and education, with an overall mean of 3.15 (SD = 0.52), interpreted as positive. Among the statements, the highest mean score was recorded for the item stating that public education campaigns on the proper use of antibiotics are necessary to prevent antibiotic resistance (M = 3.26, SD = 0.67), which was interpreted as very positive.

Table 7. Level of attitude on antibiotic use in terms of health initiatives and education.

Statement	Mean	SD	Interpretation
Vaccinations contribute to reducing the use of antibiotics.	2.91	0.60	Positive
Public education campaigns on the proper use of antibiotics are necessary to prevent antibiotic resistance.	3.26	0.67	Very Positive
Implementing solutions to antibiotic misuse is necessary in both the public and private sectors.	3.24	0.72	Positive
Severe recent infectious diseases may require different antibiotics than those used in the past.	3.10	0.68	Positive
Integrating knowledge of antibiotic use and resistance into the curriculum is essential for students.	3.21	0.67	Positive
Overall Mean	3.15	0.52	Positive

Closely following this, the statement on implementing solutions to antibiotic misuse in both the public and private sectors obtained a mean of 3.24 (SD = 0.72. Similarly, integrating knowledge of antibiotic use and resistance into the curriculum was rated positively (M = 3.21, SD = 0.67). The statement indicating that severe recent infectious diseases may require different antibiotics than those used in the past received a mean of 3.10 (SD = 0.68), also interpreted as positive. On the other hand, the statement that vaccinations contribute to reducing the use of antibiotics obtained the lowest mean score (M = 2.91, SD = 0.60), although still within the positive range. The standard deviation values, ranging from 0.60 to 0.72, indicate moderate variability in responses, suggesting that while attitudes are generally consistent, some differences in perception still exist among respondents.

Figure 3 presents the mean scores for respondents' attitudes toward antibiotic use across three domains: Use and Personal Practices, Health Initiatives and Education, and the Overall Mean. All domains were interpreted as having a positive attitude. Health Initiatives and Education obtained the highest mean score (M = 3.15, SD = 0.52). Use and Personal Practices followed with a mean score of 2.96 (SD = 0.53). The overall mean score was 3.05 (SD = 0.46). The standard deviation values for all domains ranged from 0.46 to 0.53.

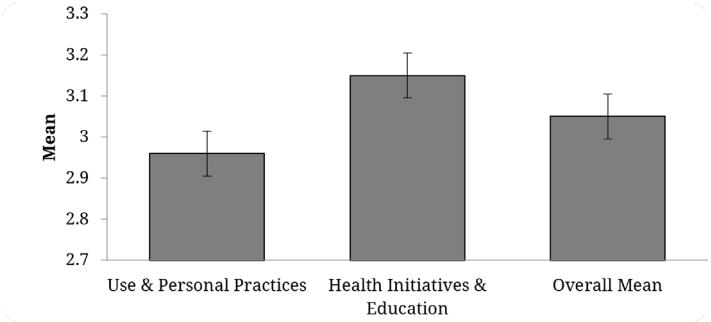

Figure 3. The overall level of attitude on antibiotic use among the respondents.

Level of practices on antibiotic use

Table 8 presents the level of practices on antibiotic use in terms of self-medicating behavior, including the mean, standard deviation, and corresponding interpretation for each statement. All five statements were rated with an interpretation of High. The highest mean score was recorded for the statement "I do not double the next dose if I forget to take an antibiotic" with a mean of 2.95 and a standard deviation of 1.08. This was followed by "I avoid taking antibiotics for muscle or joint pain" with a mean of 2.87 and a standard deviation of 0.92. Two statements shared the same mean score of 2.85: "I complete the full course of antibiotics even after my symptoms disappear" (SD = 0.90) and "I do not keep leftover antibiotics for future use" (SD = 0.99). The lowest mean score among the items was for "I avoid taking antibiotics for a stuffy nose or a headache," with a mean of 2.80 and a standard deviation of 0.93. The overall mean for the table is 2.86 with a standard deviation of 0.71, which is also interpreted as High. The standard deviation values across all items range from 0.90 to 1.08.

Table 8. Level of practices on antibiotic use in terms of self-medicating behavior.

Statement	Mean	SD	Interpretation
I avoid taking antibiotics for muscle or joint pain.	2.87	0.92	High
I avoid taking antibiotics for a stuffy nose or a headache.	2.80	0.93	High
I do not double the next dose if I forget to take an antibiotic.	2.95	1.08	High
I complete the full course of antibiotics even after my symptoms disappear.	2.85	0.90	High
I do not keep leftover antibiotics for future use.	2.85	0.99	High
Overall Mean	2.86	0.71	High

Presented in Table 9 is the level of practices on antibiotic use in terms of adherence to medical advice, showing the mean, standard deviation, and corresponding interpretation for each statement. All items were rated either High or Very High. The highest mean score was recorded for the statement "I take antibiotics only by following the prescription of a doctor" with a mean of 3.29 and a standard deviation of 0.82, interpreted as Very High. This was followed by "I educate my family and friends about the risks of using antibiotics without a prescription" with a mean of 3.14 and a standard deviation of 0.88. The statement "I do not buy the same antibiotics as previously prescribed without consulting a doctor" obtained a mean of 3.07 and a standard deviation of 0.94. Lower mean scores were observed for "I do not buy antibiotics based on old packaging or leftover samples" with a mean of 2.98 and a standard deviation of 0.98, and "I intervene or advise others against self-medicating with antibiotics" with a mean of 2.97 and a standard deviation of 0.87. The overall mean for this set of practices is 3.09 with a standard deviation of 0.67, interpreted as High. The standard deviation values across all items range from 0.82 to 0.98.

Table 9. Level of practices in terms of adherence to medical advice.

Statement	Mean	SD	Interpretation
I do not buy the same antibiotics as previously prescribed without consulting a doctor.	3.07	0.94	High
I do not buy antibiotics based on old packaging or leftover samples.	2.98	0.98	High
I take antibiotics only by following the prescription of a doctor.	3.29	0.82	Very High
I intervene or advise others against self-medicating with antibiotics.	2.97	0.87	High
I educate my family and friends about the risks of using antibiotics without a prescription.	3.14	0.88	High
Overall Mean	3.09	0.67	High

Figure 4 presents the summary of the level of practices on antibiotic use across two domains, including self-medication behavior and adherence to medical advice, along with the overall mean. Among the domains, adherence to medical advice obtained the higher mean score of 3.09 with a standard deviation of 0.67, while self-medication behavior recorded a mean of 2.86 with a standard deviation of 0.71. The overall mean score for the level of practices on antibiotic use is 2.98 with a standard deviation of 0.62. All domains, including the overall mean, are interpreted as High.

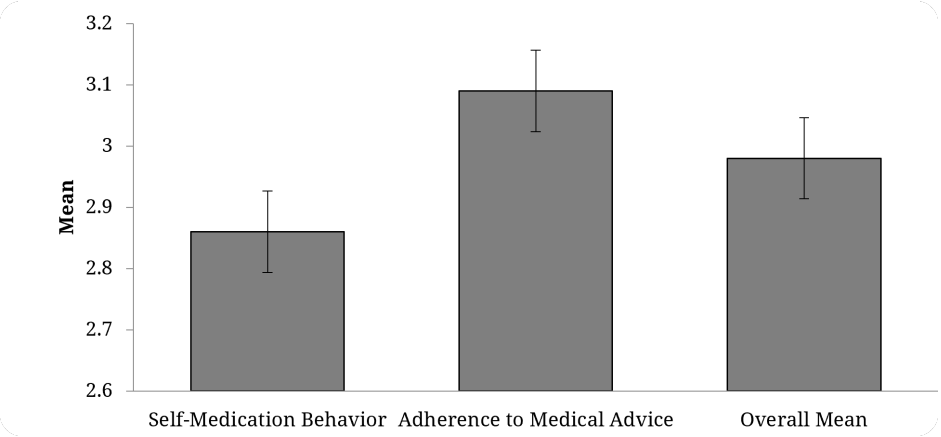

Figure 4. Summary of the practices domain, with an overall mean of 2.98 (SD = 0.62), indicating good practices.

Analysis of differences in knowledge, attitude, and practices

One-way ANOVA and independent samples t-tests were conducted to examine differences in respondents' knowledge, attitude, and practices according to selected demographic characteristics. Inferential statistics are reported with corresponding test values, degrees of freedom, p-values, effect sizes, and post hoc analyses where applicable. As shown in Table 10, one-way ANOVA and independent samples t-tests were conducted to examine differences in respondents' knowledge, attitude, and practices according to selected demographic characteristics. The table presents the corresponding test statistics, degrees of freedom, p-values, effect sizes, and significant Tukey HSD post hoc comparisons where applicable.

Table 10. Summary of inferential analyses and significant post hoc comparisons for knowledge, attitude, and practices according to demographic characteristics.

Demographic variable	Knowledge	Attitude	Practices
Age group	**F**(2,385)=3.82, *p*=.023, ω²=.014 (Significant); **Tukey**: 21–22 years > ≤20 years (*p*=.018)	Welch's **F**(2,131)=1.14, *p*=.323, ω²=.001 (NS)	**F**(2,385)=1.34, *p*=.262, ω²=.002 (NS)
Sex	**t**(386)=-0.067, *p*=.947, *d*=-0.007 (NS)	**t**(386)=-0.978, *p*=.329, *d*=-0.101 (NS)	**t**(386)=-1.520, *p*=.129, *d*=-0.157 (NS)
Year level	F(3,384)=2.97, p=.032, ω²=.015 (Significant); Tukey: No significant pairwise comparisons	**F**(3,384)=2.15, *p*=.093, ω²=.009 (NS)	**F**(3,384)=2.60, *p*=.052, ω²=.012 (NS)
Faculty	**F**(6,381)=3.00, *p*=.007, ω²=.030 (Significant); **Tukey**: FTED < FALS (*p*=.047); FTED < FNAHS (*p*=.037)	**F**(6,381)=5.37, *p*<.001, ω²=.063 (Significant); **Tukey**: FNAHS > FBM, FACET, FTED, FCJE, and FALS (all *p*<.001)	**F**(6,381)=3.74, *p*=.001, ω²=.041 (Significant); **Tukey**: FNAHS > FBM (*p*=.006) and FCJE (p<.001)
Previous education	*p*=.550 (NS)	*p*>.05 (NS)	*p*>.05 (NS)

Note: NS = Not Significant. Welch's ANOVA was used for attitude by age group because the assumption of homogeneity of variances was violated. ω² = omega squared (effect size for ANOVA); d = Cohen's d (effect size for independent samples t-test). Only statistically significant Tukey HSD pairwise comparisons are presented; all remaining pairwise comparisons were not statistically significant (p > .05).

Significant differences in knowledge were observed across age group, $F(2, 385) = 3.82$, $p = .023$, $\omega^2 = 0.014$, year level, $F(3, 384) = 2.97$, $p = .032$, $\omega^2 = 0.015$, and faculty, $F(6, 381) = 3.00$, $p = .007$, $\omega^2 = 0.030$, indicating small effect sizes. Tukey HSD post hoc analysis revealed that respondents aged 21–22 years had significantly higher knowledge scores than those aged 20 years and below ($p = .018$). Likewise, respondents from the Faculty of Teacher Education (FTED) had significantly lower knowledge scores than those from the Faculty of Arts, Letters, and Sciences (FALS) ($p = .047$) and the Faculty of Nursing and Allied Health Sciences (FNAHS) ($p = .037$). Although the overall ANOVA for year level was significant, no significant pairwise differences were identified by the Tukey HSD test. No significant differences in knowledge were found according to sex, $t(386) = -0.067$, $p = .947$, Cohen's $d = -0.007$, or previous education ($p = .550$). These findings may be viewed in relation to the demographic composition of the respondents, who were predominantly below 20 years old (49.7%), female (59.8%), and second-year students (28.1%), with most (84.8%) reporting no previous education on antibiotic use.

No significant differences in attitude were observed across age, Welch's $F(2, 131) = 1.14$, $p = .323$, $\omega^2 = 0.001$, sex, $t(386) = -0.978$, $p = .329$, Cohen's $d = -0.101$, year level, $F(3, 384) = 2.15$, $p = .093$, $\omega^2 = 0.009$, or previous education ($p > .05$). However, attitude differed significantly across faculty, $F(6, 381) = 5.37$, $p < .001$, $\omega^2 = 0.063$, representing a moderate effect size. Tukey HSD post hoc analysis

showed that respondents from FNAHS had significantly higher attitude scores than those from the Faculty of Business Management (FBM), Faculty of Computing, Engineering, and Technology (FACET), FTED, Faculty of Criminal Justice Education (FCJE), and FALS (all $p < .001$). These findings suggest that faculty affiliation contributed more to differences in attitudes than the other demographic variables.

Similarly, no significant differences in practices were observed across age, $F(2, 385) = 1.34$, $p = .262$, $\omega^2 = 0.002$, sex, $t(386) = -1.520$, $p = .129$, Cohen's $d = -0.157$, year level, $F(3, 384) = 2.60$, $p = .052$, $\omega^2 = 0.012$, or previous education ($p > .05$). However, practices differed significantly across faculty, $F(6, 381) = 3.74$, $p = .001$, $\omega^2 = 0.041$, indicating a small effect size. Tukey HSD post hoc analysis further revealed that respondents from FNAHS had significantly higher practice scores than those from FBM ($p = .006$) and FCJE ($p < .001$). This pattern indicates that differences in practices were likewise associated primarily with faculty affiliation rather than other demographic characteristics.

Overall, the inferential analyses indicate that age group, year level, and faculty were associated with differences in knowledge, whereas faculty was the only demographic variable significantly associated with differences in attitude and practices. The Tukey HSD analyses further identified the specific faculty groups responsible for these differences, particularly the consistently higher attitude and practice scores of FNAHS respondents and the higher knowledge scores of FALS and FNAHS respondents relative to FTED. Nevertheless, the observed effect sizes ranged from negligible to moderate ($\omega^2 = 0.001–0.063$; Cohen's $d = -0.007$ to -0.157), suggesting that although several differences reached statistical significance, their practical magnitude was generally small, except for the moderate effect observed for attitude across faculty.

DISCUSSION

The findings of this study provide important insights into the knowledge, attitudes, and practices (KAP) regarding antibiotic use among undergraduate students and their implications for antimicrobial stewardship in higher education. The respondent profile, characterized by predominantly young adults and a high proportion of students without prior education on antibiotic use, reflects a population that is increasingly responsible for making independent health decisions yet may lack adequate antimicrobial literacy (Arnett, 2023; Wood et al., 2023). This observation supports global concerns that formal education on antibiotic use and antimicrobial resistance remains insufficiently integrated into educational systems (World Health Organization, 2023; Kühn et al., 2022). Similar concerns have been documented among Philippine populations, where misconceptions and inappropriate antibiotic practices persist despite general awareness of antibiotic resistance (Cacao et al., 2024), and among STEM students who continue to demonstrate gaps in antibiotic-related knowledge and behaviors (Cabuhat et al., 2024). These findings suggest that university students represent a critical population for antimicrobial stewardship interventions because they are at a developmental stage where lifelong health behaviors are being established and may subsequently influence the health practices of their families and communities.

The study revealed generally high levels of knowledge, particularly regarding the risks and consequences of improper antibiotic use, which is consistent with evidence suggesting increased public awareness of antimicrobial resistance (AMR) through public health campaigns, media exposure, and educational initiatives (Orok et al., 2025; Sharma et al., 2025; WHO, 2023). However, respondents demonstrated weaker understanding of the fundamental functions of antibiotics, particularly their ineffectiveness against viral infections and their inappropriate use for symptoms such as fever and allergies. Similar findings have been reported in previous studies, where individuals recognized the consequences of misuse but lacked a clear understanding of the scientific principles governing appropriate antibiotic use (Gebeyehu et al., 2023; Alrasheedy et al., 2024; Cuevas, 2021).

The persistence of these misconceptions may indicate that awareness campaigns have been more successful in communicating warnings about antimicrobial resistance than in fostering a deeper understanding of infectious diseases and antibiotic mechanisms. Students may be familiar with messages encouraging responsible antibiotic use yet still struggle to distinguish between bacterial and viral infections or to recognize situations in which antibiotics are unnecessary. Moreover, information obtained from social media, family members, peers, and previous self-medication experiences may reinforce inaccurate beliefs regarding the effectiveness of antibiotics for common symptoms such as fever and colds. Comparable knowledge gaps have been reported among populations in Southeast Asia and among university students despite exposure to health information and formal education (Haenssgen et al., 2019; Cabuhat et al., 2024). These findings suggest that educational interventions should move beyond simple awareness campaigns and place greater emphasis on conceptual understanding, critical health literacy, and informed decision-making regarding antibiotic use.

Respondents generally exhibited positive attitudes and appropriate practices regarding antibiotic use, particularly in adhering to prescribed treatments and supporting public health initiatives. These findings are consistent with studies indicating that exposure to health information promotes favorable attitudes and responsible antibiotic-use behaviors (Alzard et al., 2024; Dopelt et al., 2023; Easwaran et al., 2025; Azim et al., 2023). Nevertheless, lower agreement with statements related to cost-saving behaviors and lower consistency in completing antibiotic courses suggest that favorable attitudes do not always translate into optimal practices. Similar observations have been reported in studies demonstrating that economic considerations, convenience, forgetfulness, perceived recovery, and the absence of immediate adverse consequences frequently contribute to antibiotic misuse and non-adherence (Centers for Disease Control and Prevention, 2024; Masud et al., 2025; Ndaki et al., 2025; Iuhas et al., 2025; Wahab et al., 2023).

These findings reinforce the well-established KAP gap, wherein knowledge and positive attitudes alone are insufficient to ensure sustained behavioral compliance (Kang and Bagaoisan, 2024). From the perspective of the Health Belief Model, individuals may understand the benefits of appropriate antibiotic use yet remain influenced by perceived barriers such as cost, accessibility, convenience, and personal beliefs about illness and recovery (Alyafei and Easton-Carr, 2024). Likewise, studies in the Philippines and Southeast Asia have shown that antibiotic practices are often shaped by social norms, accessibility, and informal healthcare behaviors rather than scientific understanding alone (Cacao et al., 2024; Haenssgen et al., 2019). This suggests that antimicrobial stewardship efforts should not focus solely on knowledge enhancement but should also address behavioral and contextual factors that influence decision-making related to antibiotic use.

The inferential findings further demonstrated that knowledge varied significantly according to age, year level, and faculty affiliation, while attitudes and practices differed significantly across faculty. These results suggest that academic

exposure and disciplinary background play important roles in shaping antibiotic-related competencies (Jamil et al., 2025; Precha et al., 2024). Students enrolled in health-related programs exhibited more favorable KAP outcomes, likely due to their exposure to microbiology, pharmacology, and public health courses (Bonna et al., 2024; Lim & Bang, 2024; Al-Haifi et al., 2025). This finding is consistent with global evidence demonstrating disparities in antibiotic literacy between health and non-health students (Precha et al., 2024; Shitindi et al., 2024). Beyond simple exposure to health-related content, these findings suggest that repeated engagement with disease prevention, medication management, and evidence-based healthcare concepts may strengthen students' ability to critically evaluate antibiotic use and resist misinformation.

By including respondents from multiple academic disciplines rather than focusing on a single student group, the present study extends previous findings reported by Cabuhat et al. (2024) and provides broader evidence that faculty affiliation significantly influences antibiotic-related knowledge and behaviors in higher education settings. Conversely, the absence of significant differences across sex, previous education, and most demographic variables suggests that attitudes and practices may be shaped more strongly by shared social, cultural, and environmental influences than by individual characteristics. The widespread availability of health information through digital media and public campaigns may contribute to these relatively homogeneous patterns (Shehadeh et al., 2011; Essack et al., 2023), while accessibility of antibiotics, cultural norms, and healthcare system factors continue to influence antibiotic-related behaviors (Masud et al., 2025; Ndaki et al., 2025; Shutt et al., 2025; Haenssgen et al., 2019).

An important contribution of this study is the observation that generally positive practices may exist even among students who have not received formal education on antibiotic use. This finding suggests the influence of informal learning sources such as peers, family members, social networks, and media exposure. While these sources may contribute to positive behaviors, they may also facilitate the spread of misinformation and misconceptions regarding antibiotic use (Berdida et al., 2022; Cuevas, 2022). Similar observations have been reported by Cacao et al. (2024) and Haenssgen et al. (2019), highlighting the substantial role of informal and community-based information sources in shaping antibiotic-related behaviors. This finding underscores the need for educational interventions that not only disseminate accurate information but also equip students with the skills needed to critically evaluate health information obtained from informal sources.

A key contribution of this study is the provision of localized evidence from a provincial state university in Davao Oriental, where empirical data on antibiotic-related knowledge, attitudes, and practices remain limited. The findings offer practical insights for nurses, educators, and public health practitioners in designing contextually relevant antimicrobial stewardship and health promotion programs. In particular, the identified knowledge gaps regarding viral infections and inappropriate antibiotic use can serve as focal areas for nursing-led educational interventions within both academic and community settings. As frontline health educators, nurses are uniquely positioned to promote antimicrobial literacy, correct misconceptions regarding antibiotic use, and encourage evidence-based health behaviors among young adults. Integrating antimicrobial stewardship concepts into student health programs, campus health campaigns, and community outreach initiatives may strengthen students' capacity to make informed decisions regarding antibiotic use and resistance.

The findings reveal a critical paradox: although awareness, attitudes, and reported practices regarding antibiotic use are generally favorable, important gaps in conceptual understanding and behavioral consistency remain. This underscores the limitations of awareness-based interventions that focus primarily on information dissemination without addressing deeper cognitive, behavioral, and contextual determinants of antibiotic use. Consistent with global recommendations, effective antimicrobial stewardship requires a multifaceted approach that combines education, behavioral change strategies, and systemic support mechanisms (WHO, 2025; CDC, 2024; Ferrara et al., 2024). Universities therefore have a critical role in integrating antimicrobial stewardship concepts into curricula, particularly for non-health disciplines, while implementing peer-led programs, digital health campaigns, and behavior-focused interventions that reinforce responsible antibiotic use. Such initiatives may be particularly effective when they address common misconceptions, encourage critical evaluation of health information, and promote behavioral skills necessary for appropriate antibiotic use. By addressing both knowledge deficits and behavioral barriers, higher education institutions can contribute meaningfully to efforts aimed at reducing antimicrobial resistance and promoting rational antibiotic use among future professionals and community leaders.

The present study contributes to the growing body of evidence on antibiotic-related knowledge, attitudes, and practices among university students and underscores the continuing importance of antimicrobial stewardship in higher education settings. Given the increasing global threat of antimicrobial resistance, the findings are relevant to public health practitioners, nurse educators, and researchers engaged in health promotion and antibiotic stewardship initiatives. The study also provides context-specific evidence that may be useful for future KAP investigations, intervention studies, and university-based educational programs aimed at improving antibiotic literacy and promoting responsible antibiotic use among young adults.

CONCLUSION

This study examined the knowledge, attitudes, and practices (KAP) regarding antibiotic use among undergraduate students and revealed generally favorable outcomes across all three domains. Students demonstrated awareness of antibiotic resistance and expressed positive attitudes toward responsible antibiotic use, which were reflected in generally appropriate practices such as adherence to prescribed medications. However, the findings also revealed important misconceptions regarding the appropriate indications for antibiotic use, particularly the ineffectiveness of antibiotics against viral infections and their inappropriate use for symptoms such as fever and allergies. These findings suggest that while awareness of antibiotic-related issues is present, important gaps in conceptual understanding remain. Beyond describing antibiotic-related knowledge, attitudes, and practices, this study contributes localized evidence that may guide the development of nursing-led antimicrobial stewardship and health education strategies tailored to undergraduate student populations in Davao Oriental.

The findings also highlight the influence of demographic factors. Knowledge varied significantly across age, year level, and faculty, while attitudes and practices were significantly influenced by faculty affiliation. Students from health-related programs consistently demonstrated more accurate knowledge, more positive attitudes, and better practices, emphasizing the role of academic exposure in shaping antibiotic-related competencies.

Meanwhile, the absence of significant differences across sex and previous education suggests that awareness of antibiotic use may be widespread, although the depth and accuracy of that knowledge vary across student groups.

The results support the Knowledge–Attitude–Practice (KAP) framework, which posits that knowledge serves as a foundation for developing positive attitudes that may subsequently influence behavior. However, the persistence of misconceptions and inconsistent adherence behaviors indicates that awareness and positive attitudes alone are insufficient to ensure appropriate antibiotic use. The findings underscore the need for antimicrobial stewardship initiatives that move beyond awareness-raising and focus on strengthening conceptual understanding, correcting misconceptions, and addressing behavioral factors that contribute to inappropriate antibiotic use. For nursing education and practice, the results highlight opportunities for nurse-led health education, campus-based stewardship programs, and community outreach initiatives aimed at promoting antimicrobial literacy among young adults. The findings may also serve as a useful reference for future KAP studies, antimicrobial stewardship research, and university-based health education programs designed to promote responsible antibiotic use and help address the continuing challenge of antimicrobial resistance. However, important gaps remain, particularly in understanding the ineffectiveness of antibiotics against viral infections and in consistently completing prescribed treatment regimens.

RECOMMENDATIONS

- Integrate antimicrobial stewardship into general education curricula, especially for non-health programs.
- Address key misconceptions through targeted awareness campaigns.
- Use interactive learning approaches to improve practical application of knowledge.
- Promote nurse-facilitated and peer-led antimicrobial stewardship initiatives to reinforce responsible antibiotic use and improve antibiotic literacy among students.
- Continuously evaluate and enhance educational strategies based on student KAP outcomes.
- Develop nursing-led health education programs that specifically address misconceptions regarding viral infections, self-medication, and antibiotic resistance.

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AUTHOR CONTRIBUTIONS

All authors contributed equally to the conceptualization and design of the study, data collection, analysis, interpretation of results, and manuscript preparation. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

DECLARATION

Informed consent statement

The study adhered to the principles of the Data Privacy Act of 2012. Participation was voluntary, and informed consent was obtained from all respondents. Confidentiality and anonymity were strictly maintained throughout the study. Personal identifiers were removed, and data were presented in aggregate form. All research data were stored securely and accessed only by authorized personnel. Respondents were informed of their right to withdraw at any time without penalty. Measures were taken to minimize risk and ensure the welfare of participants. The questionnaire was designed to avoid discomfort, and clear explanations were provided using simple language. Inclusion criteria ensured that participants were appropriate for the study, while exclusion criteria minimized bias. The researchers declared no conflict of interest, and the study was conducted with integrity, transparency, and adherence to ethical research standards. Vulnerable respondents, particularly those with limited health literacy, were given additional support through clear and understandable instructions to ensure accurate participation.

Conflicting interests

The authors have no conflict of interest in the result of the study.

AI Declaration

The authors declare that no Artificial Intelligence (AI) or AI assisted technologies were used in the preparation of this manuscript.

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