International Journal of Preventive, Curative & Community Medicine
Volume 12, Issue 4 - 2026, Pg. No. 9-19
Peer Reviewed & Open Access Journal

Research Article

Knowledge, Awareness and Self-Reported Practices Regarding Antimicrobial Resistance Among University Students: A Cross-Sectional Survey

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DOI: https://doi.org/10.24321/2454.325X.202619

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How to cite this article:
Zam T, Yasmin S, Mollah A, Nasrin T, Pathak D, Ahmed M, Gangmei G, Sangma J N, Moirangthem S. Knowledge, Awareness and Self-Reported Practices Regarding Antimicrobial Resistance Among University Students: A Cross-Sectional Survey. Int J Preven Curat Comm Med. 2026;12(4): 9-19.

Date of Submission: 2026-09-20
Date of Acceptance: 2026-10-21

A B S T R A C T

Background: Antimicrobial resistance (AMR) is a leading global public health threat driven substantially by inappropriate antibiotic use. University students, as both current consumers of antibiotics and, for many, future healthcare professionals, represent a critical population for assessing awareness, knowledge, and self-reported practice gaps that can inform targeted educational interventions.

Objective: To assess self-reported awareness, knowledge, and practices regarding antibiotic use and antimicrobial resistance among university students, and to identify gaps between perceived importance and actual knowledge/practice.

Methods: A cross-sectional, descriptive survey was conducted among 103 university students using a structured, self-administered questionnaire covering socio-demographic characteristics, awareness of AMR, core knowledge items, self-reported antibiotic-use behaviors, and attitudes toward antimicrobial stewardship and education. Data were summarized as frequencies and percentages and presented using descriptive tables, ranked comparisons, and composite domain-level analysis.

Results: Most participants (83.5%) were aged 18–25 years and were predominantly in their 5th semester of study (49.5%). While 79.6% reported having heard of antibiotic/AMR and 70.9% considered themselves aware of AMR, only 45.6% could correctly define antibiotic resistance as bacteria (not the human body) becoming resistant. Composite domain analysis revealed a clear gradient: self-reported awareness scored highest (75.2%), followed by attitude (68.2%), while composite knowledge (46.6%) and appropriate practice (40.0%) scored substantially lower. Risky self-reported behaviors were common: 63.1% had taken antibiotics without a prescription, 66.0% had stopped a course early, 58.3% had shared antibiotics with others, and only 36.9%

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correctly disposed of leftover antibiotics. Despite these gaps, attitudes toward antimicrobial stewardship and AMR education were favorable, with 80.6% supporting compulsory AMR/stewardship training for healthcare students.

Conclusion: University students in this sample demonstrated relatively high self-reported awareness of AMR and favorable attitudes toward stewardship education, but this was not matched by objective knowledge or self-reported practice, mirroring a knowledge–practice gap widely reported in the international literature. Targeted, practice-oriented educational interventions rather than awareness campaigns alone are needed to translate positive attitudes into safer antibiotic-use behavior.

Keywords: Antimicrobial Resistance, Antibiotic Resistance, University Students, Knowledge, Attitude And Practice, Antimicrobial Stewardship, Self-Medication, Cross-Sectional Survey

Introduction

Antimicrobial resistance (AMR) is recognised by the World Health Organization as one of the most urgent global public health threats of the twenty-first century, driven substantially by the inappropriate and excessive use of antibiotics in humans and animals. As resistant organisms continue to spread, previously treatable infections increasingly evade standard therapy, threatening to erode decades of progress in modern medicine. A key strategic objective of the WHO Global Action Plan on AMR is to improve public awareness and understanding of antibiotics and AMR through effective communication, education and training, an objective that places particular emphasis on university and healthcare-professional students as both current antibiotic consumers and future prescribers or dispensers.

University students occupy a distinctive position in the AMR landscape: they are old enough to make independent decisions about antibiotic purchase and use, yet many, particularly those outside health-related programmes, have not received formal training on rational antibiotic use. Knowledge, attitude and practice (KAP) surveys conducted among university and healthcare students across a wide range of countries have consistently found that self-reported awareness of the general concept of AMR tends to be high, but this awareness frequently does not translate into accurate technical knowledge or safe practice. Reported levels of 'good knowledge' vary widely across settings and scoring thresholds, ranging from as low as one-fifth of participants in some pharmacy-student cohorts to over four-fifths in others, reflecting both genuine variation in educational exposure and differences in how knowledge has been operationally defined.[1,2,4,5,9,10,13,14,16,34]

A recurring and clinically important misconception across these studies is confusion about the underlying mechanism of resistance itself, specifically the belief that the human body, rather than the causative bacteria, becomes resistant to antibiotics. This misunderstanding has been documented among general university student populations in Canada, where roughly two-thirds of respondents endorsed this incorrect statement despite otherwise reasonable understanding of antibiotic-related behaviours.[11] Similarly, large proportions of students across multiple settings continue to believe, incorrectly, that antibiotics are effective against viral illnesses such as the common cold or influenza, a misconception documented among nursing students in China, final-year health-sciences students in Ethiopia, and medical students in India and Zambia alike.[7,19,26,32]

Self-reported antibiotic-use practices identified in the literature raise similar concerns. Non-prescription antibiotic use, premature discontinuation of prescribed courses, and retention or sharing of leftover antibiotics have been documented as common behaviours among student populations in Saudi Arabia, Lebanon, Bangladesh, Rwanda and elsewhere, with roughly one-third to two-thirds of respondents in various cohorts reporting at least one such behaviour.[2,8,13,23,25,29] Encouragingly, several studies report that awareness of AMR as a public-health problem is independently associated with a lower likelihood of antibiotic misuse, suggesting that awareness-raising, while not sufficient on its own, remains a meaningful component of any intervention strategy.[13]

Attitudes toward antimicrobial stewardship (AMS) and formal AMR education have generally been reported as positive, even where knowledge itself is limited. Studies among healthcare students in Rwanda, Sri Lanka, Nigeria, Uganda and Saudi Arabia have found strong majority support for compulsory or expanded curricular content on antibiotic use and resistance, alongside a persistent lack of familiarity with the specific concept of antimicrobial stewardship itself.[4,8,9,10,16,34] Educational interventions, including short lecture-based sessions and peer-led 'student ambassador' models, have been shown to produce measurable short-term gains in knowledge scores, supporting the feasibility of structured curricular or co-curricular AMR education.[17,27]

Despite this substantial international evidence base, comparatively few studies have examined the awareness–knowledge–practice relationship among university students in Northeast India, where student antibiotic-purchasing behaviour, pharmacy dispensing practices, and curricular exposure to AMR content may differ meaningfully from the predominantly medical- and pharmacy-student cohorts studied elsewhere. This study was therefore undertaken to assess self-reported awareness, core knowledge, antibiotic-use practices, and attitudes toward antimicrobial

ISSN: 2454-325X
DOI: https://doi.org/10.24321/2454.325X.202619

stewardship and education among university students and to quantify the gap between these domains using a composite, comparative analytical approach.

Materials and Methods

Study Design and Setting

A quantitative, cross-sectional, descriptive study was conducted among university students at Assam Down Town University (ADTU), Guwahati, Assam, India, from July 2026 to September 2026. This design was chosen to provide a structured snapshot of students' self-reported awareness, knowledge and practice regarding antibiotic use and antimicrobial resistance (AMR) at a single time point.

Study Population and Sampling

The study population comprised undergraduate and postgraduate university students who consented to participate. A total of 103 students were included using a convenience sampling approach over the study period. Respondents were predominantly aged 18–25 years (83.5%), and just under half (49.5%) were in their 5th semester of study, with smaller proportions distributed across other semesters and postgraduate years.

Data Collection Instrument

Data were collected using a structured, self-administered, 27-item online questionnaire covering (i) socio-demographic characteristics (age, gender, semester of study); (ii) self-reported awareness and familiarity with the concept of antibiotic/antimicrobial resistance; (iii) knowledge items assessing understanding of antibiotic mechanisms, appropriate indications, and resistance-related concepts; (iv) self-reported antibiotic-use behaviours, including non-prescription use, course completion, and handling of leftover antibiotics; and (v) attitudes toward antimicrobial stewardship and the value of AMR-related education. The questionnaire was administered electronically, and participation was voluntary and anonymous.

Ethical Considerations

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Informed consent was obtained from all participants prior to enrolment, and confidentiality and anonymity of responses were maintained throughout data collection, storage, and analysis.

Statistical Analysis

Data exported from the survey platform were cleaned and analysed descriptively. Categorical responses were summarised as frequencies and percentages and are presented as tables and charts. For knowledge items with an objectively correct response, answers were classified as correct or incorrect; nine such items were used to construct a composite Knowledge domain score. A composite Appropriate-Practice domain score was constructed from five behavioural items (reverse-coded where the item described a risky behaviour), and composite Awareness and Attitude domain scores were constructed from two and five items respectively, each domain score calculated as the unweighted mean of its constituent item percentages. Analysis was performed using Microsoft Excel / SPSS — software; as the analysis was descriptive in nature, formal hypothesis testing was not applicable to the aggregated dataset available.

Results

Socio-Demographic Characteristics

Of the 103 participants, the large majority (83.5%, n = 86) were aged 18–25 years, with smaller proportions aged under 18 (11.65%), 26–30 (3.88%) and over 30 (0.97%) years. Gender distribution was balanced (51.46% female, 47.57% male, 0.97% other; Figure 1). Nearly half of respondents (49.51%) were in their 5th semester of study, with the remaining participants distributed across semesters 1–8 and postgraduate years 1–3 (Figure 2).

Socio-Demographic Characteristics

Self-Reported Awareness of Antimicrobial Resistance Self-reported awareness of AMR was generally high but showed some internal inconsistency across two similarly worded items: 79.61% reported having heard of antibiotic/AMR (Q5), while a somewhat lower proportion, 70.87%, considered themselves aware of antibiotic resistance specifically when asked later in the survey (Q15) (Figure 3). When asked to define the term, however, only 45.63% correctly identified that bacteria, not the human body, become resistant to antibiotics, while 35.92% incorrectly believed the body itself develops resistance, a misconception also widely reported elsewhere in the literature.[11] (Figure 4).

Core Knowledge of Antibiotic Use and Resistance

Table 1 and Figure 5 summarise responses to nine knowledge items with an objectively correct answer. Performance was highly variable and, for several items, fell below the 50% correct threshold: only 29.13% correctly denied that antibiotics are effective against viral infections (Q23), 31.07% correctly rejected antibiotic use for colds/flu (Q10), and 34.95% correctly denied that antibiotics can eliminate viruses (Q17). The best-performing knowledge item was recognising that stopping an antibiotic course early is not a responsible practice (67.96% correct, Q27), followed by recognising that inappropriate antibiotic use can lead to resistance (62.14%, Q7).

ISSN: 2454-325X
DOI: https://doi.org/10.24321/2454.325X.202619

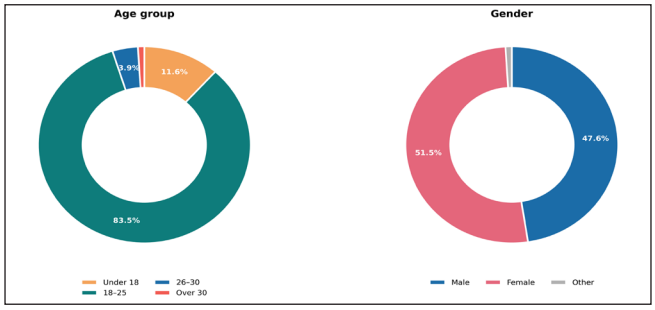


Figure 1.Age and gender distribution of participants (N = 103)

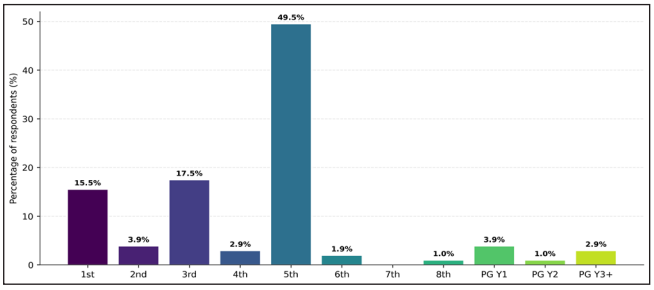


Figure 2.Current semester of study among participants (N = 103)

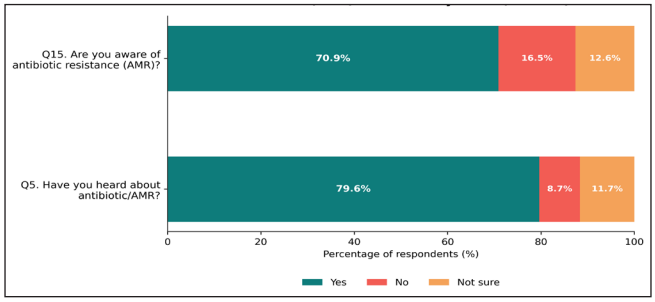


Figure 3.Self-reported awareness/familiarity with antimicrobial resistance (AMR) — two survey items (N = 103)

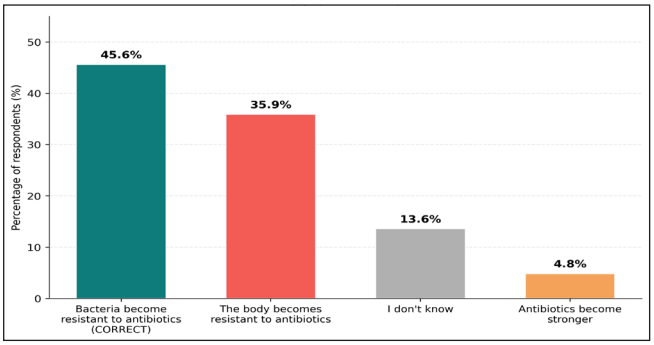


Figure 4.Understanding of the term 'antibiotic resistance' (Q6, N = 103)

Table 1.Core knowledge of antibiotic use and antimicrobial resistance (N = 103)

Knowledge item (correct response)	n	%
Q6. Antibiotic resistance means bacteria (not the human body) become resistant	47	45.63%
Q7. Inappropriate/unnecessary antibiotic use can lead to resistance	64	62.14%
Q10. Antibiotics should NOT be used for viral infections (cold/flu)	32	31.07%
Q17. Antibiotics cannot eliminate viruses	36	34.95%
Q21. Improper self-medication contributes to antibiotic resistance	54	52.43%
Q23. Antibiotics are NOT effective against viral infections	30	29.13%

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Q25. Antibiotics are mainly used to treat bacterial infections	48	46.60%
Q26. Patients should NOT stop antibiotics as soon as they feel better	51	49.51%
Q27. Stopping an antibiotic course early is NOT a responsible practice	70	67.96%

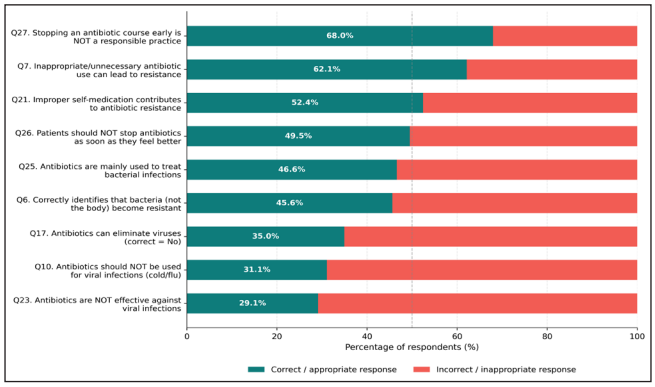


Figure 5.Core knowledge of antibiotic use and antimicrobial resistance (AMR), ranked lowest to highest (N = 103)

Self-Reported Antibiotic-Use Behaviours

Risky self-reported antibiotic-use behaviours were common (Table 2, Figure 6). Nearly two-thirds of respondents had taken antibiotics without a prescription (63.11%) or had stopped a course before completion (66.02%), and over half had shared antibiotics with a family member or friend (58.25%). Only 36.89% reported disposing of leftover antibiotics appropriately; the remainder either kept them for future illness (21.36%), did not know the correct approach (18.45%), used them whenever symptoms returned (13.59%), or gave them to someone with similar symptoms (9.71%) (Figure 7). Among the 65 respondents who had used antibiotics without a prescription, the most commonly cited reasons were advice from a pharmacist (28.16% of all respondents) and reliance on a previous prescription for a similar illness (20.39%) (Figure 8).

Attitudes Toward Antimicrobial Stewardship and Education

Attitudes toward antimicrobial stewardship and AMR-related education were considerably more favorable than either knowledge or practice. A combined 65.05% rated antimicrobial stewardship as very important or important in preventing resistance (Q12), and 80.58% agreed or strongly agreed that healthcare students should receive specific AMR/stewardship training (Q13). Self-rated confidence in one's own knowledge was comparatively modest; however, with only 44.66% reporting themselves confident or very confident (Q14), 45.63% remained neutral (Figure 9).

Most respondents (81.55% combined) agreed that AMR can seriously affect individual and community health (Q28), and 68.93% believed that education on appropriate antibiotic use can help reduce AMR (Q24). Just over half (52.43%) recognised that improper self-medication contributes to antibiotic resistance (Q21), while 30.1% remained unsure (Figure 10).

Ranked Comparison Across All Items

Figure 11 ranks all seventeen awareness, knowledge, and attitude items from lowest to highest positive/correct response, revealing a marked separation between attitude/awareness items (clustered largely above 60%) and objective knowledge items (several of which fell below 40%). The single lowest-scoring item was correctly denying that antibiotics are effective against viral infections (29.13%, Q23), while the highest-scoring item was agreement that AMR seriously affects individual and community health (81.55%, Q28), a gap of over 50 percentage points illustrating the scale of the awareness–knowledge disconnect in this sample.

Composite Domain-Level Analysis

To summarise the survey at a higher level, items were grouped into four a priori thematic domains (Figure 12). Composite Awareness scored highest (75.2%), followed by Attitude (68.2%); composite Knowledge (46.6%) and Appropriate Practice (40.0%) scored substantially lower a difference of more than 25 percentage points between the highest- and lowest-scoring domains. This pattern indicates that, in this sample, self-perceived familiarity with AMR and favourable attitudes toward stewardship education considerably outpace both objective knowledge and self-reported safe practice.

ISSN: 2454-325X
DOI: https://doi.org/10.24321/2454.325X.202619

Table 2.Prevalence of self-reported antibiotic-use behaviours (N = 103)

Item	Behaviour	n (%)
Q8	Taken antibiotics without a prescription	65 (63.11%)
Q18	Stopped an antibiotic before completing the prescribed course	68 (66.02%)
Q19	Used leftover antibiotics from a previous illness	51 (49.51%)
Q20	Shared antibiotics with a family member or friend	60 (58.25%)
Q11	Correctly disposed of leftover antibiotics (appropriate practice)	38 (36.89%)

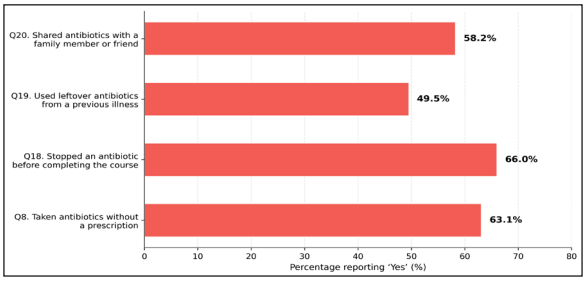


Figure 6.Prevalence of self-reported risky antibiotic-use behaviours among participants (N = 103)

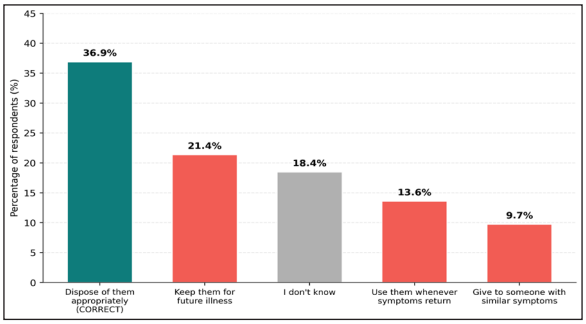


Figure 7.Reported handling of leftover antibiotics after completing treatment (Q11, N = 103)

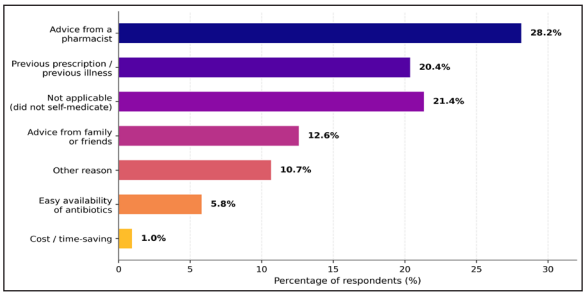


Figure 8.Reasons given for using antibiotics without a prescription (Q9, N = 103)

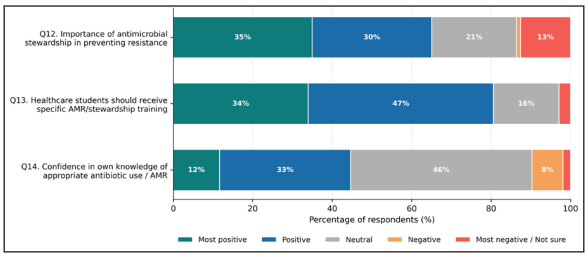


Figure 9.Attitudes toward antimicrobial stewardship, AMR training and self-rated knowledge confidence (N = 103)

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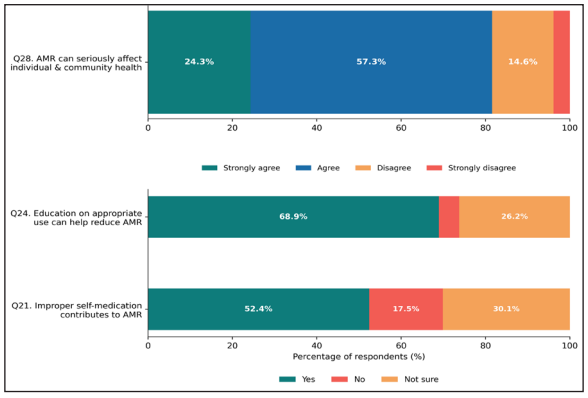


Figure 10.Perceived seriousness of AMR and perceived value of self-medication awareness and education (N = 103)

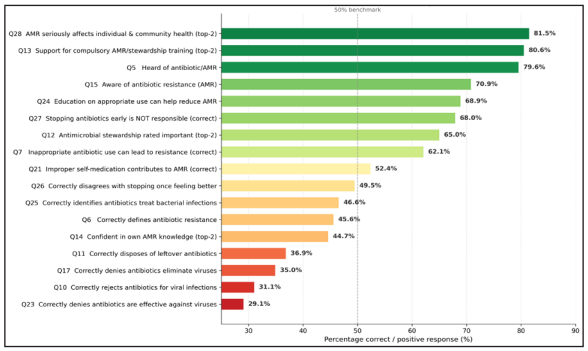


Figure 11.Ranked comparison of all knowledge, awareness and attitude items, lowest to highest (N = 103)

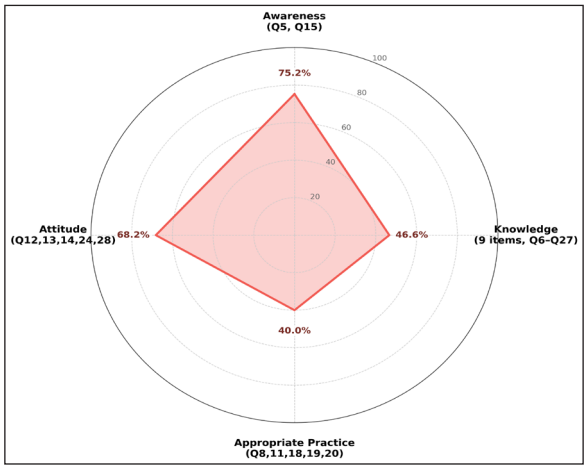


Figure 12.Composite domain-level scores: Awareness, Knowledge, Appropriate Practice and Attitude toward AMR (N = 103)

Discussion

This cross-sectional survey of 103 university students found a pronounced gap between self-reported awareness of, and attitudes toward, antimicrobial resistance (AMR) on the one hand, and objective knowledge and self-reported safe practice on the other a pattern consistent with a substantial body of international KAP literature on antibiotic resistance among student populations.[1,2,4,5,9,10,30,32,34] While approximately three-quarters of respondents reported having heard of or being aware of AMR, fewer than half could correctly identify that resistance develops in bacteria rather than in the human body a specific misconception also documented in a general university-student survey in Canada, where roughly two-thirds of participants endorsed the same incorrect belief despite otherwise reasonable understanding of antibiotic-related behaviours.[11] This suggests that broad, campaign-style awareness of the term 'antibiotic resistance' does not reliably indicate a correct mechanistic understanding of the phenomenon.

ISSN: 2454-325X
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Several core knowledge items in this study particularly those concerning antibiotic effectiveness against viral infections fell below 35% correct, a pattern echoed by findings among nursing students in China, where just under half correctly recognised that antibiotics are ineffective against viruses.[32] and among final-year health-sciences students in Addis Ababa, where a majority incorrectly believed antibiotics were effective against colds and flu.[26] Comparable misconceptions regarding indications for antibiotic use have also been reported among medical students in Zambia and India.[7,19] Taken together with the present findings, this indicates that misunderstanding of antibiotic spectrum and indications is a persistent, cross-national gap that is not resolved simply by general AMR awareness.

The self-reported behavioural patterns observed here non-prescription antibiotic use (63.1%), premature discontinuation of treatment (66.0%), and sharing of antibiotics with others (58.3%) are broadly consistent with rates reported among student populations in Saudi Arabia, Lebanon, Bangladesh and Rwanda, where roughly one-third to two-thirds of respondents reported comparable risk behaviours.[2,8,13,23,25,29] Notably, in this study the most commonly cited reason for non-prescription antibiotic use was advice from a pharmacist rather than self-initiated purchase, an important nuance for intervention design, as it implicates community dispensing practices alongside individual patient behaviour a dynamic also highlighted in prior work on antibiotic misuse and its association with reduced awareness of AMR as a public-health problem.[13]

Despite these knowledge and practice gaps, attitudes toward antimicrobial stewardship and structured AMR education were strongly favourable in this sample, mirroring similarly high levels of support for compulsory AMR/stewardship curricula reported among healthcare students in Rwanda, Sri Lanka, Nigeria, Uganda and Saudi Arabia.[4,8,9,10,16,34] This consistent finding across very different educational and geographic contexts suggests that students themselves widely recognise the inadequacy of their current training and are receptive to structured intervention. Encouragingly, brief educational interventions and peer-led teaching models have been shown elsewhere to produce measurable short-term improvements in AMR knowledge scores.[17,27] suggesting that the favourable attitudes documented here could realistically translate into improved knowledge if matched with accessible, practice-oriented educational content rather than awareness messaging alone.

The composite domain analysis in this study with Awareness and Attitude domains scoring 25–35 percentage points higher than Knowledge and Practice provides a compact, comparative illustration of this awareness–practice disconnect that complements item-level findings reported elsewhere in the KAP literature. This framing is consistent with findings from final-year medical and pharmacy students in East Africa, where composite 'good knowledge' was achieved by little more than one-third of participants despite widespread recognition of AMR as an important clinical issue.[4] and reinforces calls in the literature for antibiotic-education strategies that move beyond general awareness-raising toward specific, applied instruction on antibiotic indications, dosing, and course completion.

Limitations

This study has several limitations. First, the cross-sectional, single-institution design and convenience sample of 103 students limit the generalisability of findings to other university settings, and the sample was not restricted to health-related disciplines, which may explain some of the knowledge gaps relative to studies conducted exclusively among medical or pharmacy students. Second, all data were self-reported, and antibiotic-use behaviours were not independently verified, which may be subject to social-desirability or recall bias. Third, because the dataset available for analysis was pre-aggregated at the question level rather than provided as individual-level (row-per-respondent) records, it was not possible to conduct inferential statistical comparisons (e.g., knowledge scores by gender, semester, or discipline) or to construct a validated composite knowledge score with formal reliability testing; the composite domain scores reported here are unweighted descriptive summaries rather than psychometrically validated indices. Finally, two item numbers in the original questionnaire (Q16, Q22) were not part of the analysed dataset, and the instrument's knowledge items, while covering several key AMR concepts, cannot fully characterise the breadth of students' antibiotic-related knowledge. Future studies should employ validated, multi-item knowledge instruments with individual-level data across multiple institutions and disciplines, enabling formal statistical comparison of KAP domains across demographic and academic subgroups.

Conclusion

University students in this sample demonstrated relatively high self-reported awareness of antimicrobial resistance and strongly favourable attitudes toward antimicrobial stewardship and structured AMR education, but this was not matched by objective knowledge or self-reported safe antibiotic-use practice, with composite Knowledge and Appropriate Practice domain scores roughly 25–35 percentage points below Awareness and Attitude. This pattern, consistent with a substantial body of international KAP literature on antibiotic resistance, suggests that general awareness-raising alone is unlikely to be sufficient to change antibiotic-use behaviour. Targeted, practice-orientated educational interventions addressing specific

ISSN: 2454-325X
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misconceptions about antibiotic indications, the importance of completing prescribed courses, and safe disposal of leftover medication supported by engagement with community pharmacists as a key point of student contact, are recommended to translate favourable attitudes into safer antibiotic-use behaviour.

Declarations

Availability of Data and Materials

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request.

Sources of Funding: None

Conflict of Interest: None

Author Contributions

TZ, SY, AM, TN, DP, and MA contributed to the conceptualisation, methodology, data collection, investigation, and analysis of the study. SM contributed to the study's conceptualisation, supervision, validation, interpretation of the findings, and critical revision of the manuscript. TZ and SM drafted the manuscript, while all authors contributed to reviewing and editing the manuscript. All authors read and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

Acknowledgements

The authors thank all the university students who participated in this survey.

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ISSN: 2454-325X
DOI: https://doi.org/10.24321/2454.325X.202619

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DOI: https://doi.org/10.24321/2454.325X.202619