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A Cross-Sectional, Questionnaire-Based Assessment of Knowledge, Attitude, and Practice Concerning Antibiotic Use among Medical Undergraduates

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ABSTRACT

Background: Antibiotic resistance is an emerging global health problem and irrational use of the antibiotics is one of its reason. Despite being the future prescribers, there are not many studies that assess the impact of medical education on the KAP of medical students. The study was conducted to assess KAP of medical students in different years of study and also assess gap which persist between great years.

Methods: A survey relying on a cross-sectional questionnaire was carried out on the 1st to 4th-year undergraduate medical students (n = 724). The validated tool gauged students' knowledge, attitude, and practices on antibiotic usage. Kruskal–Wallis test was performed to evaluate difference in scores among years including Chi-square test for categorical variables. In the present study, $p < 0.05$ was considered significant.

Results: As the year of study increases, the knowledge about the use of antimicrobials increased. An example is 98.1% stating antibiotics cure bacteria ($\chi^2 = 35.269$, $p < 0.001$) while 90.8% say antibiotics do not cure viruses ($\chi^2 = 10.650$, $p = 0.014$). The study participants had a constructive attitude towards the issue in question. Nearly all participants, (96.9%) agreed that the abuse of antibiotics causes resistance ($\chi^2 = 27.50$, $p < 0.001$). Moreover, 94.5% of the participants agreed that the curriculum should include rational use of antibiotic courses ($\chi^2 = 50.13$, $p < 0.001$). The practices were not found to be optimal A total of 82.7% used antibiotics for common cold ($\chi^2 = 27.895$, $p < 0.001$); 66.9% for fever ($\chi^2 = 22.108$, $p < 0.001$).

Conclusions: Medical education increases knowledge of antibiotics and promotes a positive attitude; however, it does not ensure rational practice. The knowledge–practice gap (KPG) for antibiotics must be closed with specific curriculum reforms, practical training and awareness campaigns for future health care professionals. KAP and antibiotic resistance.

Keywords: *Knowledge, Attitude, and Practice (KAP), Antibiotic resistance.*

INTRODUCTION

Antibiotics are one of the most prescribed medicines in today's times that are used for the treatment of bacterial infections. The correct and prudent use of antimicrobials will not only lead to optimum treatment outcomes but

it will also limit development and transmission of antimicrobic resistance which is amongst the biggest global health threats as per the World Health Organisation of the United Nations' (UN) [1]. Antimicrobial resistance is a major contributor to disease, death and healthcare costs worldwide. Low- and middle-income countries are especially vulnerable due to weak health infrastructure, regulation and public awareness.

The irrational use of antibiotics that occurs because of self-medication, partial treatment, and misapplication in viral illness is a major contributor to the antibiotic resistance problem [2].

According to the WHO and several organizations, There should be a need for immediate multifactorial intervention especially in countries where antibiotic medicines are sold over the counter without adequate prescription [1].

Medical students, being the future prescribers of antibiotics, are an important target group for interventions on this topic. By engaging in medical education, one can enhance their theoretical knowledge. Despite students in later years of training, many researchers reported that the students still have wrong practices. For instance, an Indian study found that despite being taught clinical pharmacology many medical students were not aware of the antimicrobial stewardship guidelines and often self-medicated [3]. Another study found that many students in health sciences training had misconceptions about antibiotics – some thought they were effective against viral diseases or that the newer, more expensive antibiotics were better – which drove misuse [4].

Besides this, global data corroborates that knowledge (awareness) is not sufficient for behaviour change. A study of university students in Bangladesh has shown that while the respondents were aware of the harm of antibiotic resistance, they were overusing and self-medicating antibiotic due to easy access and social-cultural problems [5]. Jordan and Pakistan exhibited similar trends, where students were aware of the dangers of antibiotic misuse but nevertheless purchased antibiotics over the counter and shared leftover antibiotics with family members [6], [7]. The findings show that the various factors relevant to decision making and health-related behaviours not only concern lack of knowledge but also include psychological, cultural and systemic factors.

In India, accessibility of antibiotics over the counter, weak enforcement of prescription laws and negligence by the authorities at both urban and rural levels is making the situation worse. Studies from south India and others have reported high rates of self-medication among medical and paramedical students, primarily due to the perception of convenience and lower costs rather than clinical requirements [3]. Antibiotic misuse is rising exponentially in the wake of the COVID-19 pandemic. It highlights the need for educational interventions and policy reforms promoting appropriate use.

In view of these facts, WHO Global Action Plan on Antimicrobial Resistance and national antibiotic stewardship programs have demanded for more awareness and training programs targeting health-care students [1], [8]. It has been proposed to close the gap between knowledge and practice through case-based learning, training in hands-on stewardship, and evidence-based guidelines. Despite this, there continues to be a large gap between knowledge and responsible prescribing of antibiotics, requiring specific educational interventions, supportive policies and community support.

In light of these complexities, the present study was conducted to assess the knowledge, attitude, and practices regarding antibiotics among undergraduate medical students and their variation between different years. The purpose of this study is to identify gaps in knowledge, attitude and practice about antibiotic prescription practices so that curriculum reform and intervention can take place. It is likely that the findings would provide useful recommendations for education policy makers, healthcare educators and public health practitioners to reduce the misuse of antibiotics and consequently, AMR burden in India and healthcare settings with similar challenges [3-6].

MATERIALS AND METHODS

Study Design and Participants: A questionnaire-based cross-sectional survey was conducted among undergraduate medical students of first, second, third and fourth year to study their knowledge, attitude and practices regarding the use of antibiotics. Out of a total of 724 students participation was there. Participation in the study was voluntary and a written informed consent was obtained from each respondent.

Questionnaire Design and Grading Standards: A structured and pre-validated questionnaire was used in the study which was adapted based on KAP surveys on antibiotic use among students [5–10]. To ensure content validity, the tool was adapted for local relevance and reviewed by two clinical pharmacologists and one public health expert. It consisted of four key domains. The first section is about the socio-important demographic details such as age, gender and academic year. The second section on knowledge consists of twelve items. They will test the factual knowledge of an antibiotic, their indications and resistance. Participants were asked questions like whether antibiotics work on bacterial or viral infection, whether frequent usage reduces efficacy,

and understanding of resistance as a global health issue. The third section consisted of ten items assessing the attitudes toward the serious clinical threat posed by antibiotic resistance, the significance of rational antibiotic prescribing, willingness to undergo training and support for public awareness campaigns. The last part was the assessment of practices through 10 items on their behaviours, which included self-medication, taking antibiotics for common cold or fever, following the prescribed course, and sharing leftover medicines.
Responses to knowledge, attitudes and practices (KAP) items were scored dichotomously as "1" for the correct answer and "0" for the wrong or "don't know". The questionnaire was pilot-tested on 30 students from different years but these students were excluded from the study. The terms of the items were refined on the basis of pilot feedback. The data collection instrument was reliable as the overall Cronbach's alpha is 0.81 while all subscale reliabilities are above 0.70. Participants took 15 to 20 minutes to complete the questionnaire.

Data Collection: A structured questionnaire was applied to undergraduate medical students through an online platform. Participation was voluntary, and informed consent was obtained from all. Each participant spent 15-20 minutes completing the survey on average.

Statistical analysis: All the answered questionnaires were checked for consistency and coded before entry into SPSS. Initially, the descriptive statistics were applied to compile the socio-demographic characteristics and response distribution on knowledge, attitude, and practice. Frequencies and percentages used to compile categorical variables; continuous variables. Statistical analysis using non-parametric methods was carried out as data had non-normal distribution. The comparison of median score of knowledge, attitude and practice among the four academic year was done by using Kruskal–Wallis test. The Chi-square test (χ^2) was used to analyze the responses on categorical parameters and association of academic year with individual KAP items. The Spearman correlation test also assessed the association among knowledge, attitude, and practice. The reliability testing using Cronbach's alpha has previously established the questionnaire's internal consistency. All analyses considered a p-value of less than 0.05 statistically significant [3, 4].

Ethics: The study was conducted following approval from the Institutional Ethics Committee.

RESULTS

Characteristics of Study Participants: A study involving 724 students having an average age of 22.93 ± 2.44 years was analysed. Among these individuals, 436 (60.1%) of them were male while 288 (39.7%) females. In terms of residential area, 324 (44.7%) students were in rural area and 400 (55.2%) in the urban area. Regarding the academic year distribution, 20 (2.8%) were first-year students, 456 (62.9%) second-year students, 176 (24.3%) third-year students, and 72 (9.9%) students were in their final year (Table 1).

Table 1: Demographic Characteristics of Study Population

		Frequency	Percentage (%)
Total		724	
Age	**Mean± S.d**	22.93±2.44	
Gender	**Male**	436	60.1
	Female	288	39.7
Residence	**Rural**	324	44.7
	Urban	400	55.2
Years of Study	**First**	20	2.8
	Second	456	62.9
	Third	176	24.3
	Fourth	72	9.9

Influence of Academic Progression on Students' Antibiotic-Use Knowledge: The findings show that students' knowledge and awareness of antibiotic use improved from the first-year to fourth-year study. Fourth-year correct response was significantly higher than first-year one; almost in all parameters the difference was highly significant (χ^2=35.269, p<0.001; χ^2=19.666, p<0.001; χ^2=27.073, p<0.001). It implies that increasing years of learning closely related to better knowledge and good attitude toward antibiotics. Yet not every comparison reached statistical significance as some areas like χ^2=4.903, p=0.179 could not distinguish between groups clearly hinting that some misconceptions continue despite being in a college. Overall, as the students progressed in their studies they gained substantial knowledge but some important gaps were still not closed (Table 2).

Table 2: Association of Students' Knowledge on Antibiotics with Year of Study

Question	Year of Student	Total	Chi	P

(correct response)	First year	Second Year	Third year	Fourth Year		Square	Value
Can antibiotics cure bacterial infections?(yes)	18/20 (90.0%)	444/456 (97.4%)	176/176 (100.0%)	72/72 (100.0%)	710/724 (98.1%)	35.269	<0.001
Can antibiotic cure viral infections? (no)	17/20 (85.0%)	404/456 (88.6%)	168/176 (95.5%)	68/72 (94.4%)	657/724 (90.8%)	10.65	0.014
Do you think the use of antibiotics will speed up the recovery of cold, cough?(no)	13/20 (65.0%)	284/456 (62.3%)	108/176 (61.4%)	40/72 (55.6%)	445/724 (61.5%)	4.903	0.179
Have you heard of antibiotics resistance?(no)	16/20 (80.0%)	444/456 (97.4%)	176/176 (100.0%)	72/72 (100.0%)	708/724 (97.8%)	35.269	<0.001
Do you think frequent use of antibiotics will decrease efficacy of treatment when using the antibiotic again?(yes)	15/20 (75.0%)	416/456 (91.2%)	172/176 (97.7%)	72/72 (100.0%)	675/724 (93.3%)	19.666	<0.001
Is the efficacy better if the antibiotics are newer and more costly ?(no)	14/20 (70.0%)	260/456 (57.0%)	132/176 (75.0%)	56/72 (77.8%)	462/724 (63.8%)	27.073	<0.001

p <0.05; #Significance after multiple test correction

Influence of Academic Progression on Students' Antibiotic-Use Attitudes: Students' attitudes towards antibiotic use were positively affected with the passage of time. Senior students had more knowledge than their junior counterparts about stopping the antibiotic therapy when the symptoms resolve ($\chi^2 = 19.907$, $p < 0.001$), and using antibiotics as prescribed reduces the resistance ($\chi^2 = 13.402$, $p = 0.004$). Certain perceptions did not vary across the year of study. For example, students from all levels similarly believe that resistance can affect personal and family health ($\chi^2 = 7.205$, $p = 0.066$), and also support for large-scale public campaigns ($\chi^2 = 7.492$, $p = 0.059$). The results indicated that the students' attitudes became more favourable with progression of studies, however, it requires constant reinforcement through awareness speaker programs (Table 3).

Table 3: Association of Students' Attitudes toward Antibiotic Use and Resistance with Year of Study

Question (agree)	Year of Student				Total	Chi Square	P Value
	First year	Second Year	Third year	Fourth Year			
There is abuse on antibiotics at present. (yes)	17/20 (85.0%)	440/456 (96.5%)	176/176 (100.0%)	64/72 (88.9%)	697(96.3 %)	31.4	<0.001
Antibiotics resistance has become a problem (agree)	13/20 (65.0%)	332/456 (72.8%)	92/176 (52.3%)	48/72 (66.7%)	485(66.9 %)	30.33	<0.001
Abuse of antibiotics has become the main cause leading to bacterial resistance (yes)	18/20 (90.0%)	436/456 (95.6%)	176/176 (100.0%)	72/72 (100.0%)	702(96.9 %)	27.5	<0.001
Antibiotic resistance affects you and your family`s health (yes)	14/20 (70.0%)	416/456 (91.2%)	152/176 (86.4%)	68/72 (94.4%)	650(89.8 %)	7.185	0.066
Necessary to get more education about antibiotics (Yes)	15/20 (75.0%)	444/456 (97.4%)	176/176 (100.0%)	72/72 (100.0%)	707(97.7 %)	35.26	<0.001
Need to establish course on	13/20 (65.0%)	432/456 (94.7%)	168/176 (95.5%)	72/72 (100.0%)	685(94.5 %)	50.13	<0.001
Necessary to carry out large-scale 'antibiotics campaign' promotion (yes)	16/20 (80.0%)	428/456 (93.9%)	160/176 (90.9%)	64/72 (88.9%)	668(92.3 %)	7.44	0.059

p <0.05; #Significance after multiple test correction

Influence of Academic Progression on Students' Antibiotic-Use Practices: Contrary to knowledge and attitudes, practices pertaining to use of antibiotics did not show consistent improvement across academic years. We find significant differences between several conditions regarding fever ($\chi^2 = 22.108$, $p < 0.001$), common cold ($\chi^2 = 27.895$, $p < 0.001$), coughing with yellow/green sputum ($\chi^2 = 20.402$, $p < 0.001$), cough with fever ($\chi^2 = 14.791$, $p = 0.002$), congested nose with headache ($\chi^2 = 17.757$, $p < 0.001$), requesting antibiotics for common cold ($\chi^2 = 19.927$, $p < 0.001$).Most common inappropriate reporting was observed for students. Nonetheless, no significant year-on-year variations were found for sore throat (χ^2=2.402, p=0.493), coughing with white sputum (χ^2=5.966, p=0.113) and cough for more than two weeks (χ^2=3.766, p=0.288). The results show that students gained more knowledge and better attitude towards antibiotics. However, the practice related to the antibiotics still remained suboptimal with the classes (table 4).

Table 4: Association of Students' Practices toward Antibiotic Use and Resistance with Year of Study

Question (response)	Year of Student				Total	Chi Square	P Value
	First year	Second Year	Third year	Fourth Year			
Use antibiotics when having fever	14/20 (70.0%)	308/456 (67.5%)	132/176 (75.0%)	32/72 (44.4%)	486/724 (67.1%)	22.108	<0.001
Common cold	15/20 (75.0%)	376/456 (82.5%)	160/176 (90.9%)	48/72 (66.7%)	599/724 (82.7%)	27.895	<0.001
Coughing up yellow/green sputum	13/20 (65.0%)	248/456 (54.4%)	120/176 (68.2%)	56/72 (77.8%)	437/724 (60.4%)	20.402	<0.001
Sore throat	10/20 (50.0%)	168/456 (36.8%)	64/176 (36.4%)	20/72 (27.8%)	262/724 (36.2%)	2.402	0.493
Cough with fever	13/20 (65.0%)	256/456 (56.1%)	116/176 (65.9%)	56/72 (77.8%)	441/724 (60.9%)	14.791	0.002
Coughing up white sputum	14/20 (70.0%)	272/456 (59.6%)	100/176 (56.8%)	32/72 (44.4%)	418/724 (57.7%)	5.966	0.113
Congested nose with headache	18/20 (90.0%)	308/456 (67.5%)	100/176 (56.8%)	44/72 (61.1%)	470/724 (64.9%)	17.757	<0.001
Cough lasting 2 weeks or more	15/20 (75.0%)	312/456 (68.4%)	120/176 (68.2%)	56/72 (77.8%)	503/724 (69.6%)	3.766	0.288
Asked doctors to prescribe antibiotics when you catch a common cold	17/20 (85.0%)	273/456 (59.9%)	124/176 (70.5%)	52/72 (72.2%)	466/724 (64.4%)	19.927	<0.001

p <0.05; #Significance after multiple test correction

Results of study found that with an increase in the academic year, the knowledge of medical students has improved regarding the use of antibiotics. Most of the senior students believe that antibiotics can be used to treat only bacterial infection. Many of them are aware of dangers of frequent use of antibiotics. More senior students agreed to the statement of 'Antibiotics will not work on new and expensive antibiotics due to resistance' (all $p < 0.05$). However, misconceptions still persist among students like antibiotics will help speed-up recovery in the case of cold and cough ($p = 0.179$). Attitudes also showed significant improvement, with higher-year group students agreeing more that antibiotics should not be stopped when symptoms resolve and adherence reduces resistance ($p < 0.05$). However, there was no significant variation in whether they felt resistance was an issue that affected their family ($p = 0.066$) or support for public campaigns ($p = 0.059$). In other words, conditions like fever, common cold, yellow sputum, cough with fever, congested nose, and requests for antibiotics were significantly associated with inappropriate use of antibiotics ($p < 0.01$). In contrast, sore throat, white sputum, and prolonged cough did not show significant differences ($p > 0.05$). Given the improved knowledge and attitudes and ongoing irrational practices of the participants, our findings highlight the need for practice-oriented and behaviour training in the curriculum.

Correlation between Knowledge, Attitude, and Practice: The correlation analysis revealed a moderate positive and significant correlation between knowledge and attitudes (r = 0.55), which indicates that better understanding of the antibiotics was associated with a higher level of favourable attitudes regarding the rational use of antibiotics. In contrast, the correlations between knowledge and you practices (r=0.25) and between attitudes and you practices (r=0.30) were weak to moderate, largely non-significant, and indicated higher levels of knowledge and positive attitudes did not always lead to practices. Accordingly, having just made an error, the researchers engaged in a careful discussion of the results, followed by a description of the study limitations.

Comparison of Responses from Different Grades (Academic Year) of the Medical Students: The Kruskal–Wallis test showed that with more advanced academic years, the knowledge and attitudes toward the use of antibiotics improved significantly. Nevertheless, the antibiotic usage practices were comparable among the studied groups indicating that awareness may not translate to practices. This means that while with time students learn and develop more appropriate attitudes, it is not equivalent to rational practices. Strategies have widely recognized role in fighting against antimicrobial resistance (AMR). However, there is lack of availability of medical educational intervention for undergraduate and post-graduate medical students to address the knowledge, attitude, and practice (KAP) towards appropriate antibiotic use.

DISCUSSION

In our study, knowledge on antibiotics was found to be good among the senior students, as all (100%) of the third-year and fourth-year students answered correctly that the antibiotics treat bacterial infection and 97.4% second-year students answered correctly ($p < 0.001$). In the same way, a positive attitude was observed across years for the statement that antibiotic misuse results in resistance (96.9%) ($p < 0.001$). Similarly, the practice was observed as poor among earlier years who admitted to using antibiotics for fever (67.1%) ($p < 0.001$). The findings are in compliance with the Reena et al (2022) where only 56.2% of students had correct knowledge, it was indifferent attitude and irrational use of antibiotics were common. This comparison shows that knowledge and attitude gleaned from academia and training do not translate into practice [11].

Based on our finding, there was 97.8% knowledge about antibiotic resistance. Similarly, there was overwhelming support for more education (97.7% agreed, $p < 0.001$). However, self-medication was common with 82.7% use of antibiotics for common cold. In the study carried out by Bonna et al., in 2024, it was observed that knowledge level was moderate, attitude towards responsible antibiotic use was present, but practice revealed high rates of inappropriate use (70% self-medication). According to both studies, only awareness will not be enough to stop the irrational practices if behavioural interventions are not included [4].
Our study also demonstrated that while knowledge regarding the misuse of antibiotics was high, attitude depicted a need for structured learning (97.7% were in favour of more education, $p < 0.001$). Widespread practices like using antibiotics for viral infections was common (82.7% for common cold). According to Sharma et al. (2020), the situation in India was the same, textbooks contained knowledge, attitudes were not being reinforced and self-medication was being reported by 68% of students. The studies' consistency points to the disparity of learning theorized and put into practice, signalling the value of steward program and regulated teaching [12].

The knowledge of the participants in this area was rather uneven. Only 61.5% of them rejected the misconception that antibiotics speed up recovery in case of cold-cough ($p = 0.179$). The attitude was weakly supportive of the correct use of antibiotics. Practices reflect the misuse of antibiotics. A considerable percentage of participants reported the use of antibiotics in the last one year without consulting a doctor. Yang et al. (2024) in East China, similarly, noted an improvement in knowledge from 52% to 81%, but still underdevelopment in attitude towards antibiotic stewardship and practices such overprescribing. This comparison indicates that knowledge improvement without correcting beliefs and habits will not lead to practice changes [13].

Regarding antibiotic resistance, our study had strong knowledge component, where 96.9% agreed that misuse causes resistance ($p < 0.001$), attitude was shown to be endorsement of need for campaigns and courses (94%), and practices showed that misuse is still occurring in fever and cough (67.1%, 82.7%). Alshehri and Khawagi (2025) noted similar trends in Saudi Arabia when the initial study level of knowledge was only 36%. While the knowledge and attitude improved by 28%, in practice, the misuse took place. Despite some positive impact through awareness generation, there must be practical training to change the antibiotic use behavior [9].

The results of our study are consistent with those of recent the study on knowledge, attitude and practice of antibiotics. For example, Ndagire et al. (2025) among urban slum dwellers in Uganda noted weak or non–significant associations between knowledge and practices ($r = -0.039$, $p = 0.457$), and knowledge and attitudes ($r = 0.008$, $p = 0.879$). Yang et al. (2024) study among nursing students in Hubei, China also revealed positive correlation of knowledge and attitudes with practices but the correlation were weak-to-moderate and not statistically significant. The presence of a knowledge–practice gap in the antibiotic use has been reported in the literature in addition to our study. There may need to be targeting guidelines and educational interventions to overcome the gap and promote rational use of antibiotics [14-15].

Finally, in our study, knowledge of antibiotic resistance was nearly universal, attitude showed strong favour for awareness campaigns and education reforms, practices exhibited misuse at certain clinical settings. In a study in Romania, Orok; et al. (2025), revealed moderate knowledge levels, underdeveloped attitudes towards appropriate use of antibiotics, and irrational prescribing remains common. The comparison of both studies indicates that while awareness must be promoted through campaigns, practical skills and mentorship must become a part of campaigning to ensure that responsible usage is used [10].

Conclusions

The present study revealed that although the majority of students demonstrated adequate knowledge regarding the role of antibiotics in bacterial infections and antibiotic resistance, notable misconceptions persisted, particularly regarding the use of antibiotics for viral illnesses and recovery from common cold and cough. Attitudinal assessment showed that most students acknowledged antibiotic abuse and resistance as significant public health issues, with a strong consensus on the need for more education and structured courses on the rational use of antibiotics. However, gaps were evident in actual practices, as a considerable proportion of students reported using antibiotics inappropriately for conditions such as fever, sore throat, and common cold, and some even requested antibiotics from physicians.

Overall, the findings indicate a clear discrepancy between knowledge and practice, underscoring the need for targeted educational interventions, curriculum-based training, and awareness campaigns to promote rational antibiotic use among students. Strengthening these measures will be vital in reducing inappropriate consumption and combating the growing threat of antimicrobial resistance.

Declarations:

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Ethics

The study was conducted following approval from the Institutional Ethics Committee.

Conflict of Interest:

There are no conflicts of interest.

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AI Declaration: AI-assisted tools were used only for grammar and spelling correction.

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