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Article

Lack of Antibiotic Knowledge and Misuse of Antibiotics by Medical Students in Lahore: A Cross-Sectional Study

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ABSTRACT

Background: Antimicrobial resistance (AMR) represents a critical global health challenge, exacerbated by the widespread misuse of antibiotics, especially in low- and middle-income countries. Medical students, as future prescribers, are pivotal in combating AMR, yet studies indicate substantial gaps in their knowledge and prescribing behavior. Misconceptions regarding antibiotic indications and poor adherence to rational use principles contribute to the escalating threat of resistance. **Objective**: This study aimed to evaluate the knowledge and misuse patterns of antibiotics among undergraduate medical students and to assess the relationship between their knowledge levels and antibiotic-related health-seeking behaviors. **Methods**: A cross-sectional study was conducted between June and September 2024 at two private medical colleges in Lahore, Pakistan. Using a validated, structured questionnaire, data were collected from 379 medical students selected through convenience sampling. Descriptive and inferential statistics were applied using SPSS version 25.0 to assess knowledge accuracy and behavioral trends related to antibiotic use. **Results**: Only 57.5% of students correctly identified antibiotics as effective against bacteria, and 51.2% understood they are ineffective against viral infections. However, 54.6% reported self-medication with antibiotics, and 59.9% admitted discontinuing antibiotics when symptoms improved. Moreover, 46.4% shared antibiotics with family, and 71.2% did not check expiry dates before use, highlighting both knowledge deficits and high-risk behaviors. **Conclusion**: Medical students demonstrate poor understanding and inappropriate antibiotic practices, underscoring the need for targeted educational interventions in medical curricula to foster responsible antibiotic use and mitigate AMR development.

Keywords: Antibiotic misuse, Antimicrobial resistance, Medical students, Self-medication, Cross-sectional study, Health-seeking behavior

INTRODUCTION

Antimicrobial resistance (AMR) has emerged as a critical public health concern worldwide due to the inappropriate use of antibiotics in healthcare and agriculture. The issue spans both developed and developing nations, affecting urban and rural populations alike. The COVID-19 pandemic exacerbated antibiotic overuse globally, driven by fears of secondary bacterial infections and the lack of effective treatments. Despite a relatively low prevalence of such infections in COVID-19 patients, antibiotics were frequently prescribed, contributing to increased resistance. Public misconceptions also fuel the problem, with many individuals wrongly believing that antibiotics are effective against viral and other self-limiting infections (1).

Historically, antibiotics significantly reduced morbidity and mortality caused by infectious diseases like pneumonia, tuberculosis, and diarrhea. However, the misuse and overuse of these drugs have led to the rise of resistant organisms, posing a major setback to these healthcare gains (2). Policymakers now face the urgent task of transforming health systems to ensure antibiotics are used judiciously while curbing resistance. Since the discovery of penicillin, antimicrobials have been central to extending human life expectancy, but AMR now leads to thousands of deaths globally and imposes heavy financial burdens due to extended hospital stays and the need for advanced diagnostics and treatment (3). Antibiotic misuse encompasses both self-medication and improper adherence to prescribed regimens in terms of dosage, duration, and timing. This issue transcends economic boundaries and is prevalent in high- and low-income countries alike (4). Pakistan's National Action Plan (NAP) on AMR, launched in 2017, aims to combat this challenge through coordinated efforts at the national and provincial levels (5). Nonetheless, misuse continues to be widespread due to weak

enforcement and unregulated antibiotic availability. Studies highlight the direct link between such practices and the emergence of resistant bacterial strains (6). Infections caused by antibiotic-resistant bacteria result in millions of cases annually, with a significant number proving fatal. The Centers for Disease Control and Prevention (CDC) advocates for antibiotic stewardship programs to promote responsible use, but their adoption remains inconsistent across healthcare settings. The World Health Organization (WHO) emphasizes the need to educate both the public and healthcare professionals about rational antibiotic use and resistance risks (7).

The AMR crisis is particularly acute in low- and middle-income countries (LMICs), where systemic issues such as over-the-counter access, poor regulation, and limited awareness contribute to excessive and inappropriate antibiotic consumption (8, 9). The pandemic further heightened irrational prescribing, especially in parts of Africa, where the risk of resistance grew rapidly (10, 11). Studies estimate that 20% to 50% of global antibiotic use is unnecessary, with some regions reporting up to 82% consumption without prescriptions (12, 13).

Self-medication, in particular, carries risks of incorrect dosage, adverse reactions, and misdiagnosis, ultimately accelerating resistance development (14). Medical students—future prescribers—play a pivotal role in shaping antibiotic use patterns, yet many lack the necessary knowledge and attitudes for safe practice (15, 16). In South Asia, including Bangladesh, overreliance on antibiotics in clinical and food systems has caused high ICU mortality rates due to resistant infections (17). WHO's Global Action Plan underscores the urgency of integrating antibiotic stewardship training into medical education and boosting public awareness to curb the AMR threat (18). Against this backdrop, evaluating medical students' knowledge and behavioral patterns regarding antibiotics is essential for designing effective interventions to mitigate resistance.

MATERIALS AND METHODS

This research adopted a cross-sectional design to assess the knowledge and patterns of antibiotic misuse among medical students. Data collection was carried out at two private medical institutions in Lahore: the University College of Medicine and Dentistry (UCMD) and Azra Naheed Medical College (ANMD). These colleges were selected based on accessibility and the relevance of their student population to the study objectives.

The study was conducted over a four-month period, from June to September 2024, following ethical clearance granted by the Departmental Research Committee at The University of Lahore, Lahore. The required sample size was calculated using OpenEpi Version 3 software. Assuming a population of 1,000,000, a 50.7% expected frequency, a 95% confidence level, and a 5% margin of error, the optimal sample size was determined to be 384. The design effect was kept at 1 to reflect simple random sampling conditions. A convenient, non-probability sampling technique was used to recruit participants.

A structured, validated, and pre-tested questionnaire was distributed in person to a total of 410 students during the 16-week data collection phase. After removing incomplete, duplicate, or invalid responses—such as questionnaires with identical answers to all items—a final sample of 379 students was included in the analysis. The survey instrument was designed to evaluate students' knowledge of antibiotics, their understanding of antibiotic resistance, and their antibiotic-related health-seeking behaviors. Demographic data including age, gender, marital status, and place of residence were also gathered to contextualize the findings.

To ensure clarity and content validity, a pilot test was conducted with a small subset of the student population prior to launching the full-scale study. Ethical considerations were strictly followed: informed written consent was obtained from all participants, who were assured of anonymity and confidentiality throughout the process. Participants were informed of their right to withdraw at any time without any repercussions. All research data were securely stored and made accessible only to the authorized research team.

The analysis of collected data was performed using IBM SPSS version 25.0. Microsoft Excel and Microsoft Word were also employed for preliminary data processing and visualization. Descriptive statistics, including frequencies, percentages, pie charts, and bar graphs, were used to summarize the data. Inferential statistics such as chi-square and t-tests were applied to identify statistically significant associations and behavioral trends related to antibiotic knowledge and misuse practices among the participants.

RESULTS

A total of 379 medical students aged between 18 and 30 years participated in the study. Of these, the majority (n = 308; 81.3%) fell within the 18–24 years age group, while the remaining (n = 71; 18.7%) were aged 25–30 years. In terms of gender distribution, 231 participants (60.9%) were female and 148 (39.1%) were male. Regarding marital status, 317 respondents (83.6%) were unmarried, and 62 (16.4%) were married. Participants' residential background was almost equally distributed, with 190 (50.1%) from urban and 189 (49.9%) from rural areas (Table 1). The responses to the knowledge-based items revealed several notable findings. While 218 students (57.5%) correctly recognized that antibiotics can kill bacteria, 194 (51.2%) correctly denied their effectiveness against viral infections. However, misconceptions were prevalent: 174 students (45.9%) believed antibiotics relieve pain, and 155 (40.9%) thought they can cure all infections. Additionally, only 113 (29.8%) were aware that antibiotics may cause fatal allergic reactions, and just 50 (13.2%) provided a correct response concerning the use of antibiotics during pregnancy (Table 2).

Health-seeking behavior patterns showed worrisome trends. More than half of the respondents (n = 205; 54.1%) reported using antibiotics when they catch a cold. A larger proportion (n = 227; 59.9%) stated they discontinue antibiotics once symptoms improve. 176 students (46.4%) had shared their antibiotics with family members, while the same number (n = 227; 59.9%) kept

antibiotics stored at home. 133 students (35.1%) admitted using leftover antibiotics for respiratory infections. Additionally, 270 (71.2%) did not check the expiry date before taking antibiotics. Notably, 207 (54.6%) self-medicated with antibiotics, and 166 (43.8%) believed they could treat infections without professional consultation (Table 3).

Table 1. Socio-Demographic Characteristics of Participants (N = 379)

Characteristic	Category	Frequency (n)	Percentage (%)
Age	18–24 years	308	81.3
	25–30 years	71	18.7
Gender	Male	148	39.1
	Female	231	60.9
Marital Status	Married	62	16.4
	Unmarried	317	83.6
Residence	Urban	190	50.1
	Rural	189	49.9

Table 2. Knowledge Related to Antibiotic Use (N = 379)

Statement	Yes n (%)	No n (%)
Antibiotics are medicine that can kill bacteria	218 (57.5%)	161 (42.5%)
Antibiotics can be used to treat viral infections	185 (48.8%)	194 (51.2%)
Antibiotics are indicated to relieve pain	174 (45.9%)	205 (54.1%)
Antibiotics can cure all infections	155 (40.9%)	224 (59.1%)
Antibiotics are effective for common diarrhea	238 (62.8%)	141 (37.2%)
Antibiotics are effective for sore throat	206 (54.4%)	173 (45.6%)
Antibiotics might cause allergy leading to death	113 (29.8%)	266 (70.2%)
Antibiotics are effective for flu	245 (64.6%)	134 (35.4%)
Antibiotics are used to stop fever	155 (40.9%)	224 (59.1%)
Antibiotics may cause allergic reactions	185 (48.8%)	194 (51.2%)
Infusion is the best way to give antibiotics	167 (44.1%)	212 (55.9%)
All antibiotics do not cause side effects	165 (43.5%)	214 (56.5%)
Would you take antibiotics before a meal?	77 (20.3%)	302 (79.7%)
If you are pregnant, should you take antibiotics?	50 (13.2%)	329 (86.8%)

Table 3. Antibiotic-Related Health-Seeking Behavior (N = 379)

Behavioral Statement	Yes n (%)	No n (%)
When I get a cold, I will take antibiotics to get better more quickly	205 (54.1%)	174 (45.9%)
I normally stop taking antibiotics when I start feeling better	227 (59.9%)	152 (40.1%)
I give my antibiotics to sick family members	176 (46.4%)	203 (53.6%)
I keep antibiotic stocks at home in case of emergency	227 (59.9%)	152 (40.1%)
I use leftover antibiotics for respiratory illness	133 (35.1%)	246 (64.9%)
I take antibiotics according to label instructions	223 (58.8%)	156 (41.2%)
I do not check the expiry date before taking antibiotics	270 (71.2%)	109 (28.8%)
Fewer antibiotics will be available in future if we misuse them today	177 (46.7%)	202 (53.3%)
I can treat common infectious diseases by myself using antibiotics	166 (43.8%)	213 (56.2%)
I treated myself with antibiotics in the past one year	119 (31.4%)	260 (68.6%)
I have self-medicated with antibiotics	207 (54.6%)	172 (45.4%)

DISCUSSION

The current study highlights a concerning trend of insufficient antibiotic knowledge and frequent misuse among medical students, a group expected to possess a higher level of awareness due to their educational background. The average score of 4.12 out of 10 on the knowledge assessment underscores significant gaps in understanding. Although students exhibited some awareness of antimicrobial resistance (AMR), they appeared unable to relate it directly to their personal misuse of antibiotics. Behaviorally, a large majority—over three-quarters (78%)—reported using antibiotics to manage self-limiting illnesses. In particular, 59.9% of the respondents admitted to storing antibiotics at home, and 46.7% indicated they would likely use antibiotics again in the future without appropriate indications. Moreover, 54.6% reported using antibiotics for self-treatment of minor illnesses, reflecting a habitual pattern of overuse. These results are consistent with prior international research. A recent investigation from Malaysia revealed similarly poor levels of antibiotic knowledge among university medical students. Additionally, findings from 34 studies in low-income countries estimated that the average rate of self-medication with antibiotics among adults was 38.8%, with notably high rates in Ethiopia (86%), where most antibiotics were acquired from local pharmacies without prescriptions (1). In Ghana, the prevalence of self-medication with antibiotics among students reached as high as 70%, further supporting the global relevance of this issue. It has also been

observed that individuals with greater medical knowledge may, paradoxically, be more inclined to self-medicate or seek antibiotic prescriptions unnecessarily. Similar trends were noted in Alexandria, where both medically and non-medically educated populations demonstrated little variation in antibiotic misuse behaviors (19).

Prescribing patterns among physicians are another major driver of inappropriate antibiotic consumption. This study found that nearly one-third of students had requested antibiotic prescriptions from doctors, while 51.2% reported receiving prescriptions for symptoms commonly associated with viral infections like the common cold. Furthermore, 22.9% had obtained antibiotic prescriptions over the phone, bypassing any form of clinical examination—practices that contribute significantly to irrational drug use (21). Antibiotic resistance is the most pressing consequence of such misuse, with self-medication particularly prevalent in developing countries despite ongoing public health efforts. This study also evaluated participants' adherence to appropriate treatment regimens and their health-seeking behaviors, revealing that 39.2% had taken antibiotics within the past six months and that 60.2% learned these practices directly from physicians. Although some national and institutional strategies have been implemented to limit inappropriate antibiotic use, their execution remains inconsistent and under-resourced. As a result, antibiotics continue to be arbitrarily and excessively consumed in many countries, including Pakistan. Interestingly, while certain demographic factors—such as higher education, urban residency, and younger age—were associated with slightly better knowledge, significant disparities persisted across the population. These findings align with earlier studies indicating that knowledge levels vary according to factors such as age, gender, education, region, and marital status (22).

However, this study is not without limitations. The data were collected from only two medical colleges, limiting the generalizability of the findings to the broader student population. Moreover, since the sample was drawn from an urban setting where access to healthcare and media is relatively high, the results may not accurately reflect the behaviors and knowledge of students from rural areas. The study also focused solely on the private medical sector, excluding public-sector institutions and non-medical populations, which may demonstrate different patterns of antibiotic use. In light of these findings, further research is needed to explore context-specific drivers of antibiotic misuse within Pakistan, such as socioeconomic status and structural healthcare limitations. This information will be crucial for developing comprehensive, multi-level interventions to promote rational antibiotic use and combat the growing threat of antimicrobial resistance.

CONCLUSION

The findings of this study reveal that medical students, despite their academic training, possess limited knowledge regarding appropriate antibiotic use and commonly engage in misuse for self-limiting conditions. This reflects a critical gap in their understanding of antimicrobial resistance and the consequences of irrational antibiotic behavior. To address this, medical education programs must prioritize structured training on responsible antibiotic prescribing, the risks associated with self-medication, and the global implications of antimicrobial resistance. Incorporating targeted awareness campaigns and curricular reforms within medical institutions could play a pivotal role in shaping future healthcare professionals into advocates for rational antibiotic use. Public health initiatives aimed at the broader community are also essential to reinforce these efforts and curb the progression of antibiotic resistance on a national and global scale.

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