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Original Article

Antibiotic Use Practices and Awareness of Antimicrobial Resistance Among Adult Patients Visiting Outpatient Departments in Pakistan

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ABSTRACT

Background: Inappropriate antibiotic use, self-medication, treatment discontinuation, and limited understanding of antimicrobial resistance (AMR) remain important antimicrobial-stewardship challenges, particularly in settings where antibiotics can be accessed outside formal prescribing pathways. Objective: To assess antibiotic-use patterns, inappropriate practices, antibiotic knowledge, AMR awareness, and factors associated with appropriate antibiotic use among adult outpatients in Pakistan. Methods: A cross-sectional survey was conducted among 160 adults using convenience sampling. Sociodemographic characteristics, antibiotic use during the preceding six months, indications, antibiotics used, acquisition sources, treatment behaviors, knowledge, and AMR awareness were assessed. Antibiotic practice and knowledge scores were calculated. Data were analyzed using IBM SPSS Statistics version 26.0 using descriptive statistics, chi-square tests, Mann–Whitney U test, Spearman correlation, and odds ratios with 95% confidence intervals. Results: Ninety-one participants (56.9%) had used antibiotics during the preceding six months, of whom 50 (54.9%) obtained or used antibiotics through non-prescription pathways. Cough/cold/sore throat and fever/flu-like illness accounted for 52.7% of reported indications. Failure to complete treatment and stopping antibiotics after symptomatic improvement were each reported by 56.0% of users. Although 81.2% met the predefined criterion for good knowledge, only 31.9% demonstrated appropriate practice. Only 44.4% had heard of AMR and 35.0% reported understanding its meaning. Prescription users were substantially more likely to demonstrate appropriate practice than non-prescription users (OR=9.37, 95% CI 3.27–26.85; p<0.001). Conclusion: Antibiotic misuse was common despite relatively favorable knowledge scores. Non-prescription access, poor adherence, and limited AMR awareness represent important modifiable stewardship targets. Keywords: antibiotics; antimicrobial resistance; self-medication; outpatient care; antibiotic knowledge; medication adherence; antimicrobial stewardship; Pakistan

INTRODUCTION

Antimicrobial resistance (AMR) has become one of the most consequential threats to contemporary health systems because it progressively reduces the effectiveness of established antimicrobial therapies, increases the complexity and cost of treating common infections, and contributes to preventable morbidity and mortality. The most recent Global Burden of Disease analysis estimated that bacterial AMR was associated with millions of deaths worldwide and projected a substantial future burden if prevention, access to appropriate treatment, infection

control, and antimicrobial stewardship are not strengthened (1). The burden is also particularly relevant to the World Health Organization Eastern Mediterranean Region, where recent analyses demonstrate persistent and heterogeneous resistance-related mortality and emphasize the need for coordinated improvements in antimicrobial use and healthcare delivery (2).

Antibiotic resistance is driven by multiple interacting biological, clinical, agricultural, environmental, and health-system factors, but unnecessary and inappropriate antimicrobial exposure remains among the most modifiable contributors. At community level, problematic behaviors include antibiotic use without professional consultation, acquisition without prescription, unnecessary treatment of likely viral infections, use of medicines retained from previous episodes, sharing antibiotics with relatives or friends, skipped doses, and premature discontinuation of therapy. A 2025 systematic review and meta-analysis of 71 studies involving more than 63,000 participants estimated a global pooled prevalence of antibiotic self-medication of approximately 43%, although marked heterogeneity occurred between regions and populations (3). A separate mixed-methods systematic review encompassing 242 studies likewise demonstrated substantial global self-medication and identified antibiotic storage at home, non-prescription purchasing, healthcare-related influences, and social networks among important determinants (4).

These observations indicate that antibiotic misuse cannot be understood solely as a deficit in factual knowledge. Recent qualitative synthesis from low- and middle-income countries found that individuals frequently perceive antibiotics as powerful and effective medicines for infection-related symptoms while simultaneously encountering financial, logistical, and accessibility barriers to formal healthcare. In many settings, community pharmacies and medicine outlets provide a faster and more convenient route to antibiotics than medical consultation. Previous prescribing experiences may also reinforce the belief that similar future symptoms warrant the same treatment (5). A recent systematic review of qualitative studies similarly identified previous antibiotic use, recommendations from medicine sellers, economic constraints, limited access to healthcare, interpretation of symptoms, and perceived illness severity as recurring drivers of inappropriate community antibiotic consumption (6). Consequently, education is necessary but may be insufficient unless structural opportunities for inappropriate antibiotic access are simultaneously addressed.

The issue is particularly important in Pakistan, where recent population-based evidence repeatedly demonstrates substantial self-medication and non-adherence. Saif et al. reported that 39.2% of participants in a nationwide Pakistani survey had self-medicated with antibiotics during the preceding six months and 42% were non-adherent to antibiotic therapy; inadequate information from healthcare professionals was an important barrier to adherence (7). Aslam et al. reported a self-medication prevalence of 32.5% in Islamabad, with ciprofloxacin frequently used for cough, cold, influenza-like illness, sore throat, diarrhea, and fever (8). Such findings suggest that inappropriate use involves both how antibiotics are acquired and whether the clinical indication reasonably warrants antibacterial treatment.

Large-scale Pakistani evidence also demonstrates frequent antibiotic exposure. Arshad et al., in a population-based cross-sectional survey involving 6,684 respondents, found that approximately half had received antibiotics during the preceding six months. Antibiotics were frequently reported for cough, sore throat, urinary symptoms, and wounds, while antibiotic and multidrug-resistance knowledge remained variable (9). A nationwide survey by Khadka et al. likewise demonstrated important variation in antimicrobial knowledge and practice according to educational, occupational, residential, and other socioeconomic characteristics, emphasizing the multidimensional nature of rational antimicrobial use (10).

Misconceptions regarding antibiotic effectiveness for respiratory and viral-type illnesses remain particularly concerning. Javed et al. reported widespread inappropriate beliefs regarding antibiotics among respondents in Khyber Pakhtunkhwa, including the perception that antibiotics facilitate recovery from coughs and colds. Premature discontinuation after symptomatic improvement was also common (11). Similar patterns are evident in more recent Pakistani studies, indicating that knowledge of the word “antibiotic” does not necessarily equate with understanding appropriate indications, treatment duration, or the mechanisms through which misuse contributes to resistance.

AMR-specific literacy may be even more limited than general antibiotic familiarity. Shahid et al. reported in 2025 that although most participants in Gilgit-Baltistan had heard of antibiotics, 73.2% had never heard of AMR, and self-

medication remained common (12). In Rawalpindi, Javed et al. found that 53.8% of surveyed adults had heard of antibiotic resistance but only 29.5% understood the meaning of antimicrobial resistance (13). These findings illustrate an important distinction between recognition of terminology and meaningful understanding of resistance.

Healthcare encounters, particularly outpatient consultations, provide an important opportunity to assess these behaviors because patients may arrive with previous self-medication, stored antibiotics, expectations for antimicrobial treatment, or incomplete courses from prior episodes. Understanding both knowledge and practice within outpatient populations may therefore help identify intervention points for physicians, pharmacists, and public-health programs. Of particular interest is whether appropriate antibiotic behavior is associated more strongly with demographic characteristics and factual knowledge or with the pathway through which antibiotics are accessed.

The present study therefore aimed to assess antibiotic exposure during the preceding six months, indications for antibiotic consumption, antibiotics used, sources of acquisition, inappropriate medication behaviors, antibiotic knowledge, and AMR awareness among adult patients attending outpatient departments in Pakistan. It further examined associations between sociodemographic characteristics and antibiotic use, the relationship between education and antibiotic knowledge, the relationship between knowledge and practice, and particularly whether prescription versus non-prescription antibiotic access was associated with appropriate antibiotic-use behavior.

MATERIALS AND METHODS

A descriptive analytical cross-sectional survey was conducted among adult patients attending outpatient departments in Bahawalpur, Pakistan, with academic coordination through the Department of Pharmacognosy, Department of Pharmaceutical Sciences, The Islamia University of Bahawalpur. The study assessed antibiotic exposure, access pathways, medication-use practices, antibiotic knowledge, and awareness of antimicrobial resistance at a single period of assessment.

The study included 160 adult participants. Participants were recruited through convenience sampling from individuals accessible during the data-collection period. Adults aged 18 years or older who were attending outpatient services, were able to understand and respond to the survey questions, and voluntarily agreed to participate were eligible. Individuals younger than 18 years, those who declined participation, those unable to provide informed responses to the questionnaire, and respondents whose questionnaires were substantially incomplete for the principal study variables were excluded from the analysis.

Ethical approval for the study was obtained through the relevant ethical authority associated with The Islamia University of Bahawalpur and the Department of Pharmacognosy. Participation was voluntary. The purpose of the study was explained to participants, and informed consent was obtained before questionnaire administration. Participant information was handled confidentially and used for research purposes. Data were collected using a structured questionnaire covering sociodemographic characteristics, antibiotic exposure, indications for antibiotic use, medicines used, sources of antibiotic acquisition, treatment behaviors, antibiotic-related knowledge, and AMR awareness.

Sociodemographic variables included age, sex, residence, and educational level. Age was categorized as 18–24, 25–34, 35–44, 45–54, and ≥55 years. Sex was recorded as male or female. Residence was classified as urban or rural. Educational attainment was grouped as none/primary, secondary, or college level and above. Recent antibiotic exposure was defined as self-reported antibiotic use during the preceding six months. Participants reporting antibiotic use were further questioned regarding the indication, antibiotic consumed, source from which it was obtained, and subsequent medication-taking behavior.

Reported indications were categorized as cough/cold/sore throat, fever or flu-like illness, urinary symptoms, diarrhea, wound or skin infection, and dental problems. Antibiotics reported by participants included ciprofloxacin, amoxicillin-clavulanate, amoxicillin, azithromycin, and metronidazole. Participants unable to identify the medicine were categorized as not knowing the antibiotic name.

Sources of antibiotics were classified as doctor/clinic prescription, hospital outpatient prescription, community pharmacy, leftover antibiotics at home, friend or family member, and informal vendor. For the principal comparative analysis, doctor/clinic and hospital outpatient sources were grouped as prescription use. Antibiotics acquired

outside these formal prescribing pathways were categorized as non-prescription/self-medication use. Antibiotic-use behaviors were evaluated among the 91 participants who had used antibiotics during the previous six months. Individual practices included failure to complete an antibiotic course, discontinuation after feeling better, skipping doses, sharing antibiotics with others, reuse of leftover antibiotics, use of antibiotics for viral illness, and use without consultation with a healthcare professional.

An overall antibiotic-practice score was calculated from six scored items, with possible values ranging from 0 to 6 and higher scores representing more appropriate behavior. Using the predefined study classification, participants were categorized as demonstrating appropriate, mixed, or inappropriate antibiotic practice. Antibiotic knowledge was evaluated among all 160 participants using seven scored items. The total knowledge score ranged from 0 to 7, with higher scores indicating greater antibiotic-related knowledge. Based on the predefined study threshold, scores ≥3 were categorized as good knowledge and scores <3 as poor knowledge. AMR awareness was assessed separately through questions regarding whether participants had heard of antimicrobial resistance and whether they understood its meaning. Participants were also asked about their source of AMR information, categorized as doctor/nurse, pharmacist, social media/internet, television/radio, family/friends, or no previous AMR information.

The principal study outcomes were recent antibiotic use, prescription versus non-prescription antibiotic access, individual inappropriate-use behaviors, overall antibiotic-practice score and category, antibiotic-knowledge score and category, and awareness and self-reported understanding of AMR. Secondary outcomes included reasons for antibiotic use, specific antibiotics consumed, sources of acquisition, and relationships between sociodemographic characteristics and antibiotic-related outcomes.

Data were analyzed using IBM SPSS Statistics version 26.0. Categorical variables were summarized as frequencies and percentages. Continuous scores were summarized as mean ± standard deviation and median where appropriate. Pearson's chi-square test was used to assess associations between categorical variables, including recent antibiotic use and sociodemographic characteristics, antibiotic knowledge and demographic characteristics, practice category and demographic characteristics, and prescription status and practice category.

The association between prescription status and appropriate practice was additionally expressed as an odds ratio with a 95% confidence interval after practice was dichotomized as appropriate versus mixed/inappropriate. The Mann–Whitney U test was used to compare knowledge scores between participants with appropriate and mixed/inappropriate practice. Spearman's rank correlation coefficient was used to examine the relationship between antibiotic knowledge and practice scores. All statistical tests were two-sided, and $p<0.05$ was considered statistically significant.

RESULTS

A total of 160 participants were included. Ninety-one (56.9%) were male and 69 (43.1%) were female. Most participants were urban residents (69.4%). The largest age group was 25–34 years (31.9%), followed by 35–44 years (28.1%). Secondary education was reported by 46.2% of respondents, while 31.9% had college-level or higher education.

Among the 91 recent antibiotic users, cough/cold/sore throat was the most common indication, reported by 28 (30.8%), followed by fever or flu-like illness in 20 (22.0%). Consequently, 48/91 users (52.7%) reported antibiotic use for these two respiratory or viral-type symptom groups combined. Ciprofloxacin was the most frequently reported antibiotic, used by 20 participants (22.0%), followed by amoxicillin-clavulanate in 19 (20.9%), amoxicillin in 16 (17.6%), and azithromycin in 15 (16.5%). Ten antibiotic users (11.0%) could not identify the antibiotic they had taken.

Overall, 91/160 participants (56.9%) had used an antibiotic during the preceding six months. Recent antibiotic use differed significantly by sex ($p=0.030$) and age group ($p=0.003$). Antibiotic exposure was reported by 59/91 males (64.8%) compared with 32/69 females (46.4%). Residence demonstrated a borderline association with recent antibiotic use ($p=0.063$), whereas educational level was not significantly associated with antibiotic exposure ($p=0.687$).

Table 1. Sociodemographic Characteristics of Participants (N=160)

Characteristic	n (%)
Age group	
18–24 years	37 (23.1)
25–34 years	51 (31.9)
35–44 years	45 (28.1)
45–54 years	16 (10.0)
≥55 years	11 (6.9)
Sex	
Male	91 (56.9)
Female	69 (43.1)
Residence	
Urban	111 (69.4)
Rural	49 (30.6)
Education	
None/primary	35 (21.9)
Secondary	74 (46.2)
College+	51 (31.9)

Only 41/91 participants (45.1%) obtained antibiotics through formal prescription pathways, whereas 50 (54.9%) obtained or used antibiotics through non-prescription/self-medication routes. Community pharmacies accounted for 30.8% of all reported antibiotic sources, while 15.4% used leftover antibiotics available at home.

Table 2. Antibiotic Indications, Medicines, and Acquisition Sources Among Recent Users (n=91)

Variable	n (%)
Reported indication	
Cough/cold/sore throat	28 (30.8)
Fever/flu-like illness	20 (22.0)
Urinary symptoms	15 (16.5)
Diarrhea	13 (14.3)
Wound/skin infection	9 (9.9)
Dental problem	6 (6.6)
Antibiotic used	
Ciprofloxacin	20 (22.0)
Amoxicillin-clavulanate	19 (20.9)
Amoxicillin	16 (17.6)
Azithromycin	15 (16.5)
Metronidazole	11 (12.1)
Did not know antibiotic name	10 (11.0)
Source	
Doctor/clinic prescription	32 (35.2)
Community pharmacy	28 (30.8)
Leftover antibiotics at home	14 (15.4)
Hospital outpatient prescription	9 (9.9)
Friend/family	5 (5.5)
Informal vendor	3 (3.3)

Inappropriate Antibiotic-Use Behaviors

Poor adherence and self-directed modification of antibiotic treatment were common. Fifty-one participants (56.0%) did not complete the antibiotic course, and the same proportion stopped treatment after feeling better. Fifty participants (54.9%) reported antibiotic use without consulting a healthcare professional. Antibiotic use for viral illness was reported by 33 (36.3%), while 28.6% skipped doses and 28.6% shared antibiotics with others. Reuse of leftover antibiotics was reported by 24.2%. The mean antibiotic-practice score was 3.71 ± 1.21 out of 6, with a median score of 4.0. Only 29 participants (31.9%) were classified as demonstrating appropriate practice, compared with 46 (50.5%) with mixed practice and 16 (17.6%) with inappropriate practice.

The mean antibiotic-knowledge score across all participants was 3.68 ± 1.32 out of 7, with a median score of 4. According to the predefined study threshold, 130 participants (81.2%) had good knowledge and 30 (18.8%) had poor knowledge. Education was significantly associated with knowledge category (χ^2=13.79, df=2, p=0.001). Good knowledge was identified in 46/51 participants with college-level or higher education (90.2%), compared with 63/74 participants with secondary education (85.1%) and 21/35 participants with none/primary education (60.0%).

Knowledge category was not significantly associated with sex (p=0.858), residence (p=0.564), or age group (p=0.578).

Table 3. Antibiotic-Use Behaviors and Practice Classification (n=91)

Practice/outcome	n (%) or summary
Did not complete antibiotic course	51 (56.0)
Stopped when feeling better	51 (56.0)
Did not consult healthcare professional	50 (54.9)
Used antibiotics for viral illness	33 (36.3)
Skipped doses	26 (28.6)
Shared antibiotics with others	26 (28.6)
Reused leftover antibiotics	22 (24.2)
Practice score, mean ± SD	3.71 ± 1.21
Practice score, median	4.0
Appropriate practice	29 (31.9)
Mixed practice	46 (50.5)
Inappropriate practice	16 (17.6)

Antibiotic Knowledge and AMR Awareness

Only 71/160 participants (44.4%) had heard of AMR, while 56 (35.0%) reported understanding its meaning. No prior AMR information source was reported by 97 participants (60.6%). Healthcare professionals were relatively infrequent sources of information: doctors or nurses were reported by 15.0% and pharmacists by 5.6%.

Table 4. Antibiotic Knowledge and AMR Awareness (N=160)

Variable	n (%) or summary
Knowledge score, mean ± SD	3.68 ± 1.32
Knowledge score, median	4.0
Good knowledge (≥3)	130 (81.2)
Poor knowledge (<3)	30 (18.8)
Heard of AMR	71 (44.4)
Understood meaning of AMR	56 (35.0)
AMR information source	
No prior AMR information	97 (60.6)
Doctor/nurse	24 (15.0)
Social media/internet	14 (8.8)
TV/radio	9 (5.6)
Pharmacist	9 (5.6)
Family/friends	7 (4.4)

Prescription status demonstrated the strongest association with antibiotic-practice quality. Among 41 prescription users, 23 (56.1%) demonstrated appropriate practice compared with only 6/50 (12.0%) non-prescription users. Inappropriate practice occurred in 2 (4.9%) prescription users compared with 14 (28.0%) participants using antibiotics through non-prescription pathways.

The overall association between prescription status and practice category was highly significant (χ^2=22.56, df=2, p<0.001). When practice was dichotomized as appropriate versus mixed/inappropriate, prescription users had 9.37 times the odds of appropriate antibiotic practice compared with non-prescription users (OR=9.37, 95% CI 3.27–26.85). Mean practice scores were also higher among prescription users (4.34 ± 1.04) than among non-prescription/self-medication users (3.20 ± 1.11).

Table 5. Prescription Status and Antibiotic Practice Among Recent Users (n=91)

Antibiotic-use type	Appropriate n (%)	Mixed n (%)	Inappropriate n (%)	Practice score, mean ± SD
Prescription (n=41)	23 (56.1)	16 (39.0)	2 (4.9)	4.34 ± 1.04
Non-prescription/self-medication (n=50)	6 (12.0)	30 (60.0)	14 (28.0)	3.20 ± 1.11

χ^2=22.56, df=2, p<0.001. Appropriate versus mixed/inappropriate practice: OR=9.37, 95% CI 3.27–26.85.

Antibiotic knowledge showed only a weak relationship with antibiotic practice. Spearman correlation between knowledge and practice scores was ρ=0.206 (p=0.050). Participants demonstrating appropriate practice had a mean knowledge score of 3.79 compared with 3.52 among participants with mixed or inappropriate practice; this difference was not statistically significant (Mann–Whitney p=0.447). Practice category was also not significantly associated with sex (p=0.692), residence (p=0.447), education (p=0.212), or age group (p=0.559). Thus, prescription

status demonstrated a substantially stronger relationship with appropriate antibiotic practice than the demographic factors examined or the overall antibiotic-knowledge score.

DISCUSSION

The present study identifies a coherent pattern of frequent antibiotic exposure, substantial non-prescription access, poor treatment adherence, limited AMR awareness, and a marked discrepancy between knowledge and practice among adult outpatients. More than half of the participants had used antibiotics within the previous six months, and more than half of recent users accessed or used antibiotics through non-prescription pathways. Premature treatment cessation was particularly common, while respiratory and viral-type symptoms accounted for a substantial proportion of reported antibiotic indications. Despite 81.2% of the total sample meeting the predefined threshold for good antibiotic knowledge, fewer than one-third of antibiotic users demonstrated clearly appropriate practice. The strongest association in the study was not with education, sex, residence, age, or knowledge score, but with prescription status.

The 56.9% prevalence of recent antibiotic exposure observed in this study is compatible with evidence indicating widespread community antimicrobial consumption in Pakistan. Arshad et al. found that approximately half of more than 6,600 Pakistani respondents had received antibiotics within the previous six months (9). Saif et al. more recently documented substantial antibiotic self-medication and non-adherence across Pakistan, with 39.2% reporting self-medication in the preceding six months and 42% reporting non-adherence to antibiotic therapy (7). These estimates differ because of sampling strategies, populations, recall periods, and definitions of exposure, but collectively indicate that antibiotics are frequently encountered in community and outpatient settings.

Non-prescription access was especially important in the present study, affecting 54.9% of recent antibiotic users. This proportion exceeds the 32.5% self-medication prevalence reported by Aslam et al. in Islamabad (8) but is broadly compatible with other Pakistani evidence demonstrating substantial availability of antibiotics outside physician-controlled pathways. Javed et al. reported extensive non-prescription antibiotic use in Khyber Pakhtunkhwa together with premature discontinuation after symptom improvement (11). More recently, Mustafa et al. reported that 63% of surveyed Pakistani parents had self-medicated their children with antibiotics, often for self-limiting symptoms such as sore throat, fever, nasal discharge, and cough (14). Although pediatric self-medication differs from adult personal use, it demonstrates that non-prescription antibiotic decision-making is embedded within broader household medication practices.

These observations correspond with international evidence. Gashaw et al. estimated a global pooled prevalence of adult antibiotic self-medication of 43.0%, although regional heterogeneity was substantial (3). Wang et al. similarly found that self-medication was influenced by antibiotic storage, purchasing without prescription, healthcare factors, and social networks (4). Qualitative synthesis by Cabral et al. provides further insight into these behaviors: individuals in low- and middle-income countries may perceive antibiotics as effective medicines for infection-related symptoms but encounter financial or logistical barriers to clinical consultation while simultaneously having comparatively easy access through medicine outlets (5). These contextual factors help explain why increasing knowledge alone may not fully translate into rational antimicrobial behavior.

Community pharmacies were the largest single non-prescription source in the present study, accounting for 30.8% of antibiotic acquisition among users. This finding has direct antimicrobial-stewardship implications. Community pharmacies may function either as safeguards that redirect inappropriate antibiotic demand toward medical assessment or as points of unrestricted access that facilitate self-medication. Recent systematic reviews identify pharmacy accessibility, medicine-seller recommendations, previous antibiotic experience, treatment cost, and perceived minor illness as recurrent determinants of inappropriate antibiotic use (5,6). Consequently, interventions addressing antibiotic misuse in Pakistan should include community pharmacists and medicine retailers rather than focusing exclusively on physician prescribing.

Respiratory and viral-type symptoms represented another major concern. Cough/cold/sore throat and fever/flu-like illness together accounted for 52.7% of indications among antibiotic users, while 36.3% explicitly reported antibiotic use for viral illness. This is consistent with previous Pakistani evidence. Aslam et al. identified ciprofloxacin use for cough, cold, influenza-like symptoms, sore throat, diarrhea, and fever among individuals practicing self-medication (8). Javed et al. found that approximately 60% of respondents believed antibiotics could

improve recovery from coughs and colds (11). These misconceptions are clinically relevant because many uncomplicated upper respiratory infections are viral and do not benefit from antibacterial treatment. Inappropriate exposure in such circumstances offers no antibacterial therapeutic benefit while increasing avoidable drug exposure and selection pressure.

Ciprofloxacin was the most frequently reported antibiotic in the present study, followed by amoxicillin-clavulanate, amoxicillin, and azithromycin. The prominence of ciprofloxacin mirrors the Islamabad findings of Aslam et al., in which ciprofloxacin was commonly used during self-medication (8). Pakistani population studies have also repeatedly identified amoxicillin, co-amoxiclav, azithromycin, metronidazole, and ciprofloxacin among commonly consumed agents (8,11,14). The use of comparatively broad-spectrum antibiotics without clinical assessment is particularly relevant to stewardship because inappropriate agent selection may amplify ecological pressure while exposing individuals to unnecessary adverse effects.

Poor adherence represented another prominent pattern. More than half of recent antibiotic users failed to complete their antibiotic course and 56.0% stopped treatment after feeling better. Javed et al. reported a nearly identical pattern, with 56.9% of self-medicating respondents stopping antibiotics when symptoms improved (11). Saif et al. found 42% non-adherence in a nationwide study and identified inadequate information from healthcare professionals as an important barrier (7). The present results additionally identified skipped doses, sharing antibiotics, and reuse of leftover medicines. These behaviors suggest that stewardship interventions should extend beyond the initial decision to use an antibiotic and address the entire medication-use pathway, including counselling, adherence, storage, and disposal of unused medicines.

One of the most important findings was the discrepancy between knowledge and actual practice. Although 81.2% of participants were categorized as having good knowledge according to the predefined study threshold, only 31.9% of recent users demonstrated appropriate practice. The correlation between knowledge and practice scores was weak, and knowledge scores did not significantly differ between appropriate and mixed/inappropriate practice groups. This finding supports the increasingly recognized concept that factual knowledge is necessary but insufficient to determine antibiotic behavior.

Pakistani studies provide similar evidence. Khadka et al. demonstrated that determinants of antimicrobial knowledge and practice were not identical and that demographic and socioeconomic factors influenced different behavioral domains differently (10). Hussain et al. reported greater antibiotic knowledge among university students than the general population in Peshawar, yet self-prescription and premature treatment discontinuation remained evident even among more knowledgeable respondents (15). Saif et al. showed that an educational intervention could improve knowledge, practice, attitude, and adherence scores (7), indicating that education remains useful; however, the present data suggest that educational approaches should be combined with measures addressing access, prescribing, dispensing, and behavioral reinforcement.

Education was nevertheless strongly associated with antibiotic knowledge in the current study. Ninety percent of participants with college-level education met the good-knowledge threshold compared with 60% of those with none or primary education. This gradient corresponds with Shahid et al., who reported greater antibiotic and AMR knowledge among participants with higher educational and socioeconomic status in Gilgit-Baltistan (12). Khadka et al. also demonstrated socioeconomic and educational differences in antimicrobial-related outcomes (10). Importantly, however, education was not significantly associated with practice category in the present sample. This reinforces the distinction between acquiring information and translating information into medication behavior.

AMR awareness was substantially less favorable than general antibiotic knowledge. Only 44.4% had heard of antimicrobial resistance and only 35.0% reported understanding its meaning. This pattern closely resembles recent Pakistani evidence. Shahid et al. found that 73.2% of participants in Gilgit-Baltistan had never heard of AMR despite widespread familiarity with antibiotics (12). Javed et al. reported in Rawalpindi that 53.8% had heard of antibiotic resistance but only 29.5% understood AMR (13). Such findings suggest that commonly used knowledge scores may capture familiarity with antibiotic treatment without adequately measuring understanding of resistance, transmission, selection pressure, or the population-level implications of misuse.

The comparatively limited role of healthcare professionals as AMR information sources also deserves attention. Only 15.0% of participants identified doctors or nurses as a source of AMR information, while only 5.6% identified

pharmacists. Outpatient consultations therefore represent an underused opportunity for brief stewardship communication. Because many patients encounter physicians or pharmacists at precisely the point when they are deciding whether and how to use antibiotics, concise counselling about indication, expected illness course, dosage instructions, treatment duration, and AMR may be more behaviorally relevant than general public awareness messages delivered independently of a medication decision.

The most clinically important association was between prescription status and antibiotic-practice quality. Appropriate practice was demonstrated by 56.1% of prescription users compared with only 12.0% of non-prescription users. Prescription users had more than nine times the odds of appropriate practice. This large association should not be interpreted causally because of the cross-sectional design, but it suggests that formal healthcare involvement may cluster with several protective processes: assessment of clinical indication, selection of an appropriate medicine, specification of dosing and duration, and professional counselling.

Conversely, acquisition through pharmacies without prescription, leftovers, relatives, or informal vendors eliminates or reduces several of these safeguards. Recent systematic reviews of self-medication similarly identify unrestricted medicine availability, previous successful treatment, social recommendations, treatment costs, and healthcare-access barriers as major influences on antibiotic decision-making (3-6). The present findings therefore suggest that the pathway through which antibiotics are accessed may be a more actionable stewardship target than demographic profiling alone.

Practice category was not significantly associated with sex, residence, education, or age, despite sex and age being associated with recent antibiotic exposure. This distinction is important. Certain groups may be more likely to use antibiotics, but once antibiotics are being used, appropriateness may depend more strongly on how treatment is initiated and supervised. Therefore, interventions aimed solely at demographic “high-risk” groups may be less effective than interventions that strengthen prescription-based access and counselling across the entire outpatient population.

Recent evidence from Pakistan also demonstrates that AMR understanding varies substantially across geographic and social groups. Ikram et al. reported persistent misconceptions regarding antibiotic use and resistance among the general population of Lahore, while acknowledging important sampling and representativeness limitations (16). Taken with evidence from Rawalpindi, Gilgit-Baltistan, Khyber Pakhtunkhwa, Islamabad, and nationwide surveys, these studies indicate that antibiotic misuse is a geographically widespread but context-dependent challenge rather than a behavior confined to a single province or educational group (7-13,16).

The findings support a multidimensional stewardship response. First, access to systemic antibiotics through non-prescription routes should be addressed through stronger dispensing stewardship and prescription verification. Second, community pharmacists should be integrated into antimicrobial-stewardship programs through symptom assessment, referral pathways, patient education, and discouragement of unnecessary antibiotic sales. Third, outpatient clinicians should routinely provide concise counselling regarding bacterial versus viral illness, expected symptom duration, medication adherence, and the risks of saving or sharing antibiotics. Fourth, AMR communication should move beyond simple awareness of the term toward practical understanding of how individual antibiotic-use decisions contribute to resistance.

Educational interventions remain valuable, especially because education was associated with greater antibiotic knowledge. However, the weak knowledge–practice relationship observed here indicates that education should not be treated as a stand-alone solution. Recent evidence from low- and middle-income settings suggests that successful stewardship must simultaneously address healthcare access, pharmacy practice, affordability, previous treatment experience, social norms, and expectations regarding antibiotics (4-6). This integrated approach is particularly relevant in outpatient care, where much antibiotic use begins before hospitalization and where patients, physicians, pharmacists, and medicine sellers interact with different levels of clinical oversight.

The study has several limitations. Its cross-sectional design permits identification of associations but cannot establish temporal or causal relationships. Convenience sampling and the relatively modest sample of 160 participants limit representativeness and may introduce selection bias. The study was conducted within an outpatient population in Bahawalpur, and findings should therefore not be generalized to the entire Pakistani population without caution. Antibiotic exposure, indications, adherence, source of medication, and knowledge

were self-reported and may be affected by recall and social-desirability bias. The six-month recall period may particularly affect accurate identification of antibiotic names or circumstances surrounding previous treatment.

The predefined knowledge threshold also requires cautious interpretation because a score of ≥3 on a seven-item scale classified participants as having good knowledge. The high resulting prevalence of "good knowledge" should therefore not be interpreted as evidence of comprehensive antibiotic literacy. In addition, 30 participants reportedly indicated that they had not heard of AMR while also stating that they understood its meaning. This internal response inconsistency suggests that the two AMR items may have been interpreted independently and should not be combined into a single awareness construct without further validation.

Despite these limitations, the study has important strengths. It simultaneously evaluated recent antibiotic exposure, indication, specific antibiotics, acquisition pathways, multiple inappropriate-use behaviors, knowledge, AMR awareness, and practice scores. It also moved beyond descriptive prevalence estimates by directly comparing prescription and non-prescription users and quantifying the association with appropriate practice. The resulting pattern consistently identifies the medication-access pathway as a potentially more influential and modifiable determinant of appropriate antibiotic behavior than knowledge or routine demographic characteristics alone.

CONCLUSION

Antibiotic exposure and inappropriate antibiotic-use behaviors were common among the surveyed adult outpatient population. More than half of recent antibiotic users obtained or used antibiotics through non-prescription pathways, while premature discontinuation, treatment without professional consultation, use for viral illness, skipped doses, sharing, and reuse of leftover antibiotics were frequently reported. Although most participants met the predefined threshold for good antibiotic knowledge, appropriate practice was substantially less common and the association between knowledge and practice was weak. AMR awareness was also limited, with fewer than half of participants having heard of antimicrobial resistance and only about one-third reporting understanding of its meaning. Prescription-based antibiotic use showed the strongest relationship with appropriate practice, with prescription users having markedly greater odds of appropriate behavior than non-prescription users. These findings support antimicrobial-stewardship strategies that combine improved public and patient education with prescription-based antibiotic access, stronger community-pharmacy stewardship, adherence counselling, appropriate management of respiratory and viral illnesses, and more effective communication regarding antimicrobial resistance.

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