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Original Article

Antibiotic Dispensing Practices in Community Pharmacies: Implications for Antimicrobial Stewardship in Resource-Constrained Settings and Role of Pharmacist in Controlling Anti-Microbial Resistance (AMR) in Lahore, Pakistan

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ABSTRACT

Background: Antimicrobial resistance is a growing public health threat in low- and middle-income countries, where community pharmacies frequently serve as the first point of care and may contribute to non-prescription antibiotic use. Objective: This study assessed antimicrobial resistance knowledge and simulated antibiotic dispensing practices among community pharmacy personnel in urban and rural areas of Lahore, Pakistan. Methods: A cross-sectional observational study was conducted among 148 community pharmacy personnel using a structured questionnaire and two simulated scenarios representing upper respiratory tract infection and acute gastrointestinal infection. Knowledge responses, referral behavior, non-antibiotic management, antibiotic recommendation, WHO AWaRe category, and deviation from standard treatment guidance were analyzed using descriptive statistics and chi-square tests. Results: Most participants recognized antimicrobial resistance as a community problem (93.9%), but inappropriate antibiotic recommendation remained frequent. Antibiotics were recommended by 62.2% of participants in the upper respiratory tract infection scenario and 63.5% in the gastrointestinal scenario. Poor knowledge was associated with higher odds of antibiotic recommendation for both upper respiratory tract infection (83.3% vs. 56.5%; OR 3.86, 95% CI 1.25–11.95) and gastrointestinal infection (87.5% vs. 58.9%; OR 4.89, 95% CI 1.39–17.27). Watch-category antibiotics comprised 56.5% of upper respiratory tract infection antibiotic recommendations, and 17.6% of gastrointestinal encounters involved dual-antibiotic combinations. Conclusion: Community pharmacy antibiotic dispensing in Lahore showed a marked knowledge–practice gap, requiring scenario-based training, AWaRe-guided decision support, public awareness, and stronger prescription-only enforcement. Keywords: antimicrobial resistance, antibiotic dispensing, community pharmacy, drug sellers, antimicrobial stewardship, AWaRe classification, simulated patient scenario, Lahore, Pakistan

INTRODUCTION

Antimicrobial resistance is a major and accelerating threat to global public health because it compromises the effectiveness of antibiotics that remain essential for treating infectious diseases, preventing postoperative infections, supporting cancer chemotherapy, and protecting patients with complex medical conditions. The clinical burden is already substantial, with drug-resistant bacterial infections contributing markedly to morbidity and mortality worldwide, while the economic consequences are especially severe in health systems with limited diagnostic, regulatory, and surveillance capacity (1). Low- and middle-income countries carry a disproportionate share of this burden because high infectious disease prevalence, unrestricted access to antimicrobials, variable enforcement of prescription regulations, limited public awareness, and constrained healthcare access collectively create conditions that promote inappropriate antibiotic use and accelerate resistance (2, 3). In such settings, antimicrobial resistance is not only a microbiological problem but also a health-system and behavioral problem shaped by patient demand, commercial pressures, prescribing norms, weak regulatory enforcement, and inadequate stewardship infrastructure.

Inappropriate and non-prescription antibiotic use remains one of the most important modifiable drivers of antimicrobial resistance. Antibiotics are frequently used for self-limiting or viral illnesses, taken in subtherapeutic doses, dispensed for inappropriate durations, or selected without clinical evaluation or microbiological confirmation. These practices increase selective pressure on bacterial populations and facilitate the emergence and spread of resistant organisms. The problem is compounded by broad-spectrum antibiotic use, repeated antibiotic exposure, and the availability of antibiotics through informal or semi-formal channels outside physician-supervised care (4). Although antimicrobial stewardship programs have traditionally focused on hospitals, a substantial proportion of antibiotic exposure occurs in the community, where regulatory oversight is often weaker and where patients may obtain antibiotics directly from pharmacies or drug sellers without a valid prescription.

Community pharmacies are therefore a critical interface between the public and the healthcare system, particularly in resource-constrained settings. In many low- and middle-income countries, pharmacies and drug shops function as the first point of contact for patients seeking rapid, affordable, and accessible treatment for common symptoms such as cough, sore throat, fever, abdominal pain, and diarrhea. Patients may prefer pharmacies over formal clinical consultation because pharmacies are geographically accessible, consultation is inexpensive or informal, waiting times are short, and the interaction is often perceived as less intimidating than a physician visit (5). However, this convenience can become clinically harmful when antibiotics are dispensed without adequate diagnostic assessment, when drug sellers respond to patient expectations rather than guideline-based indications, or when commercial competition encourages medicine sales over referral. Evidence from South Asian and other low-resource settings shows that inappropriate antibiotic dispensing remains common in simulated patient encounters, especially for upper respiratory tract infections and gastrointestinal complaints, despite increasing awareness of antimicrobial resistance (6, 7).

Pakistan faces many of the same stewardship challenges, including high community antibiotic consumption, incomplete enforcement of prescription-only regulations, variable training of pharmacy personnel, and public expectations that antibiotics provide rapid relief for common infections. Lahore, as a large metropolitan district with both urban and peri-urban/rural pharmacy settings, provides an important context for examining how demographic, professional, and setting-related factors influence antibiotic dispensing practices. Community pharmacies in Lahore include registered pharmacists as well as non-pharmacist drug sellers or pharmacy employees who may participate in medicine dispensing in the absence of a pharmacist. This mixed workforce creates a practical stewardship challenge because theoretical knowledge of antimicrobial resistance may not consistently translate into rational dispensing behavior, particularly when drug sellers face patient pressure, economic incentives, or limited access to physician referral pathways.

Although previous literature has documented non-prescription antibiotic dispensing in low- and middle-income settings, important gaps remain in understanding whether antimicrobial resistance knowledge, formal pharmacy training, and urban-rural practice context are associated with actual dispensing decisions in simulated clinical scenarios. Upper respiratory tract infections and acute gastrointestinal infections are particularly relevant because they are common reasons for self-medication and pharmacy consultation, and because antibiotics are often unnecessary or should be restricted to clinically indicated cases. Examining antibiotic recommendations in these scenarios can identify whether drug sellers refuse inappropriate antibiotic requests, recommend non-antibiotic supportive care, refer patients to physicians, or dispense Access and Watch-category antibiotics in ways that deviate from standard treatment guidance (8).

Using a PICO framework, the population of interest in this study comprised community pharmacy personnel, including registered pharmacists and non-pharmacist drug sellers, working in urban and rural areas of Lahore. The key exposures were training status, knowledge level, demographic characteristics, and pharmacy location, while relevant comparison groups included trained versus untrained personnel, poor versus moderate/good knowledge categories, and urban versus rural pharmacy settings. The principal outcomes were antimicrobial resistance-related knowledge and simulated dispensing practices for upper respiratory tract and gastrointestinal infection scenarios, including antibiotic recommendation, non-antibiotic management, referral behavior, Watch-category antibiotic use, and deviation from standard treatment guidance. This study therefore aimed to assess antimicrobial resistance knowledge and antibiotic dispensing practices among community pharmacy personnel in Lahore, Pakistan, and to examine whether training status, knowledge level, and urban-rural setting were associated with inappropriate antibiotic recommendations in simulated upper respiratory tract and gastrointestinal infection scenarios.

MATERIALS AND METHODS

This cross-sectional observational study was conducted among community pharmacies located in urban and rural areas of Lahore, Pakistan, after ethical approval and continuing through May 2026. The design was selected to assess antimicrobial resistance-related knowledge and simulated antibiotic dispensing practices at a defined point in time among pharmacy personnel working in real-world community pharmacy settings. Urban pharmacies were selected from more developed areas of Lahore, while rural or underdeveloped-area pharmacies were selected from less developed localities within the same district context to allow comparison of demographic and dispensing-practice patterns across pharmacy settings. A total of 148 pharmacies were included, with equal representation from rural and urban areas, comprising 74 pharmacies from each setting.

The study population included community pharmacy personnel involved in medicine dispensing at the selected pharmacies. Eligible participants were registered pharmacists, trained pharmacy personnel, or non-pharmacist drug sellers who were actively involved in dispensing medicines at the time of data collection and who provided informed consent to participate. Pharmacy personnel who were not involved in dispensing activities or who declined consent were not included. One participant was approached from each selected pharmacy to avoid duplicate responses from the same retail setting. Participants were categorized according to training status as registered/trained pharmacists or untrained/non-pharmacist drug sellers. Of the 148 participants, 94 were registered or formally trained pharmacists and 54 were non-pharmacist or untrained pharmacy personnel involved in dispensing activities.

The sample size was estimated using the OpenEpi sample size formula for prevalence studies, based on an anticipated prevalence of inappropriate antibiotic dispensing derived from prior community pharmacy literature, with a conventional confidence level and margin of error. The calculated minimum sample size was approximately 150 participants, and 148 completed responses were obtained and analyzed. Pharmacies were selected using convenience sampling from accessible urban and rural areas of Lahore. Although probability sampling was not used, the study intentionally included equal numbers of rural and urban pharmacies to permit descriptive comparison between these settings and to explore whether pharmacy context was associated with differences in participant characteristics and dispensing behavior.

Data were collected using a pretested questionnaire adapted from published community pharmacy and antimicrobial stewardship studies, together with two simulated clinical scenarios representing common pharmacy-presenting conditions. The questionnaire was attached to an informed consent form and administered to participants after the objectives of the study had been explained. Participants were informed that participation was voluntary, responses would remain confidential, and no personally identifying information would be reported in any publication. The questionnaire contained items on demographic and professional characteristics, including sex, age, education level, training or registration status, years of dispensing experience, pharmacy location, and related practice characteristics. It also included antimicrobial resistance knowledge items measured using a three-point response format consisting of agree, unsure, and disagree.

Knowledge was assessed through 12 items addressing key concepts related to antimicrobial resistance, including perceived community significance of resistance, contribution of suboptimal dosing, broad-spectrum antibiotic use, antibiotic use for viral infections, repeated antibiotic exposure, self-medication, law enforcement, combination therapy, and expectations regarding new antibiotic discovery. Correct responses were assigned a score of 1, while incorrect and unsure responses were assigned a score of 0. Total knowledge scores were calculated by summing correct responses and then categorized into poor, moderate, and good knowledge levels according to the predefined scoring distribution used for analysis. For interpretation of dispensing practices, moderate and good knowledge categories were combined where appropriate and compared with poor knowledge to examine whether higher theoretical knowledge was associated with more rational simulated dispensing behavior.

Two simulated patient scenarios were used to assess practical dispensing behavior: one representing an uncomplicated upper respiratory tract infection and another representing acute gastrointestinal infection with watery diarrhea. These scenarios were selected because upper respiratory and gastrointestinal symptoms are common reasons for non-prescription antibiotic requests in community pharmacies and have been widely used in simulated patient research in low- and middle-income settings (8). Each participant was presented with both scenarios in a standardized manner. The data collector described the patient symptoms and asked the participant what treatment or advice would be recommended. If medicines were recommended, the participant was asked to state the drug name, dose, and duration. Participants were allowed to ask clarifying questions, but data collectors did not provide additional symptom information beyond the standardized scenario content, ensuring consistency across encounters.

The primary outcome variables were antimicrobial resistance knowledge level and antibiotic dispensing response in the simulated upper respiratory tract and gastrointestinal infection scenarios. Scenario-based outcomes included refusal to dispense antibiotics, referral to a registered physician, recommendation of non-antibiotic symptomatic treatment, recommendation of oral rehydration therapy in the gastrointestinal scenario, provision of at least one antibiotic, provision of more than one antibiotic, WHO AWaRe classification of the antibiotic recommended, and deviation from standard treatment guidance. Antibiotic recommendations were categorized as Access or Watch antibiotics according to the WHO AWaRe framework, and deviations from standard treatment guidance were identified when antibiotics were recommended for conditions where antibiotic use was not indicated, when Watch-category agents were used without appropriate clinical justification, or when the selected drug, dose, duration, or combination was inconsistent with recommended practice. In the gastrointestinal scenario, dual-antibiotic recommendations for uncomplicated watery diarrhea were treated as inappropriate combination therapy.

Several steps were used to reduce bias and improve data integrity. The same scenario structure was used across participants to reduce interviewer variability. Data collectors were instructed to avoid prompting participants toward antibiotic or non-antibiotic responses and to record the stated medicines, dose, and duration as provided. No identifying participant information was included in the analysis dataset. Completed questionnaires were checked for completeness before data entry, and responses were coded using predefined numerical categories. Data entry was performed in SPSS and checked for coding consistency before analysis. Knowledge scoring was applied uniformly across all participants, with unsure responses treated as incorrect to avoid overestimating knowledge. Urban and rural groups were analyzed separately where relevant to identify setting-related demographic differences.

Data were analyzed using IBM SPSS Statistics version 26. Descriptive statistics were used to summarize participant characteristics, knowledge responses, and scenario-based dispensing practices. Categorical variables were reported as frequencies and percentages, while continuous or score-based variables were summarized using means and standard deviations where appropriate. Pearson's chi-square test was used to examine associations between categorical variables, including demographic characteristics and knowledge categories, urban-rural pharmacy location and participant characteristics, and knowledge level and simulated dispensing responses. When expected cell counts were small, categories were combined where analytically appropriate to support valid comparison. Statistical significance was set at $p < 0.05$. Missing or incomplete responses were handled by valid-case analysis for the relevant variable, and denominators were reported according to the number of participants with available data for each analysis.

Ethical approval was obtained from the Ethical Review Committee of the Faculty of Pharmaceutical Sciences, University of Central Punjab, Lahore, under approval reference UCP/FOPS/TDF/App#005/2025, with approval effective from 22 December 2025. Written informed consent was obtained from all participants before questionnaire completion. The study maintained participant anonymity and confidentiality throughout data collection, analysis, and reporting. The research was conducted using aggregated data only, and no pharmacy, participant, or patient-identifying information was disclosed.

RESULTS

A total of 148 community pharmacy personnel from Lahore were included in the analysis, with equal representation from rural and urban pharmacy settings. The study population comprised 74 participants from rural pharmacies and 74 from urban pharmacies. Most respondents were male, aged 30 years or younger, and had completed at least a bachelor's degree. Based on corrected denominator alignment, 94 participants were registered or formally trained pharmacists, while 54 were non-pharmacist or untrained drug sellers involved in dispensing activities. The demographic distribution showed statistically significant differences between rural and urban pharmacy personnel for sex, age group, education level, and years of dispensing experience, indicating that the two practice contexts represented distinct workforce profiles rather than demographically similar pharmacy populations.

Table 1. Demographic Characteristics of Community Pharmacy Personnel by Rural and Urban Setting

Characteristic	Category	Total, n (%)	Rural, n (%)	Urban, n (%)	p-value	Effect Size
Sex	Male	112 (75.7)	50 (67.6)	62 (83.8)	0.035	Cramer's V = 0.17
	Female	36 (24.3)	24 (32.4)	12 (16.2)		
Age group	≤30 years	102 (68.9)	43 (58.1)	59 (79.7)	0.019	Cramer's V = 0.26
	31–40 years	42 (28.4)	27 (36.5)	15 (20.3)		
	41–50 years	3 (2.0)	3 (4.1)	0 (0.0)		
	>50 years	1 (0.7)	1 (1.4)	0 (0.0)		
Education level	Below secondary	4 (2.7)	0 (0.0)	4 (5.4)	<0.001	Cramer's V = 0.43
	Secondary completed	10 (6.8)	0 (0.0)	10 (13.5)		
	Diploma	10 (6.8)	1 (1.4)	9 (12.2)		
	Bachelor's degree	120 (81.1)	69 (93.2)	51 (68.9)		
	Master's degree or higher	4 (2.7)	4 (5.4)	0 (0.0)		
Years of experience	<1 year	51 (34.5)	8 (10.8)	43 (58.1)	<0.001	Cramer's V = 0.53
	1–5 years	55 (37.2)	35 (47.3)	20 (27.0)		
	6–10 years	31 (20.9)	20 (27.0)	11 (14.9)		
	>10 years	11 (7.4)	11 (14.9)	0 (0.0)		

Rural and urban pharmacies differed significantly across all measured demographic domains. Male participants predominated overall, but the proportion of women was higher in rural pharmacies than urban pharmacies, at 32.4% versus 16.2%, respectively. Urban pharmacy personnel were younger, with

79.7% aged ≤30 years compared with 58.1% in rural pharmacies. Educational distribution also differed substantially; bachelor's degree holders were more frequent in rural pharmacies than urban pharmacies, at 93.2% versus 68.9%, whereas lower educational categories were concentrated in urban pharmacies. Experience showed the strongest urban-rural gradient, with 58.1% of urban participants having less than one year of experience compared with only 10.8% of rural participants, while all participants with more than 10 years of experience were from rural pharmacies. The effect size was largest for years of experience, suggesting that pharmacy setting was most strongly associated with workforce experience profile.

Overall antimicrobial resistance knowledge was moderate to high for several core concepts, but important knowledge gaps persisted. Most participants recognized antibiotic resistance as a community problem, and large proportions correctly identified suboptimal dosing, frequent broad-spectrum antibiotic use, and antibiotic use for viral infections as contributors to resistance. However, fewer participants correctly rejected misconceptions related to repeated antibiotic use, the limited role of new antibiotic discovery alone, and the belief that correct antimicrobial use has little impact on resistance development. Knowledge responses did not differ significantly between trained and untrained participants across most individual knowledge indicators.

Table 2. Antimicrobial Resistance Knowledge Responses by Training Status

Knowledge Indicator	Correct Response	Total Correct, n (%)	Trained, n (%)	Untrained, n (%)	p-value
Antibiotic resistance is a significant problem in the community	Agree	139 (93.9)	89 (94.6)	49 (90.7)	0.983
Suboptimal antibiotic dose contributes to resistance	Agree	120 (81.1)	78 (83.0)	41 (75.9)	0.493
Frequent broad-spectrum antibiotic use contributes to resistance	Agree	125 (84.5)	80 (85.1)	44 (81.5)	0.989
Antibiotic use for viral infections contributes to resistance	Agree	106 (71.6)	68 (72.3)	37 (68.5)	0.971
Appropriate antimicrobial use has little or no impact on resistance development	Disagree	29 (19.6)	19 (20.2)	9 (16.7)	0.117
Taking the same antibiotic again within 3 months has little or no role in resistance	Disagree	45 (30.4)	27 (28.7)	17 (31.5)	0.615
Combination therapy with two antibiotics can reduce resistance development	Agree	85 (57.4)	51 (54.3)	33 (61.1)	0.743
Discovering new antibiotics will solve the resistance problem	Disagree	27 (18.2)	18 (19.1)	9 (16.7)	0.265
Law enforcement against non-prescription antibiotic sales is necessary	Agree	96 (64.9)	64 (68.1)	31 (57.4)	0.348
Self-medication with antibiotics contributes to resistance	Agree	128 (86.5)	80 (85.1)	48 (88.9)	0.757
Broad-spectrum antibiotics should be used when the cause of infection is uncertain	Disagree	80 (54.1)	56 (59.6)	25 (46.3)	0.283
Antibiotic resistance can develop even when antibiotics are used appropriately	Agree	67 (45.3)	44 (46.8)	22 (40.7)	0.705

The strongest knowledge domains were recognition of antimicrobial resistance as a community problem, reported by 93.9% of participants, and awareness that frequent broad-spectrum antibiotic use contributes to resistance, reported by 84.5%. Knowledge was lower for conceptually more complex items. Only 19.6% correctly disagreed with the statement that appropriate antimicrobial use has little or no impact on resistance development, and only 18.2% correctly rejected the idea that discovery of new antibiotics alone would solve the resistance problem. Although trained participants generally showed slightly higher correct-response proportions for several items, including law enforcement against non-prescription sales and recognition of viral-infection-related misuse, none of the item-level differences between trained and untrained participants reached statistical significance.

The simulated clinical scenarios demonstrated a clear mismatch between theoretical antimicrobial resistance knowledge and dispensing behavior. In the upper respiratory tract infection scenario, 58 participants refused antibiotic dispensing or referred the patient to a physician, while 99 recommended non-antibiotic symptomatic treatment. However, 92 participants recommended at least one antibiotic with or without non-antibiotic therapy. In the gastrointestinal infection scenario, 54 participants refused antibiotic treatment or referred the patient, and 142 recommended oral rehydration therapy, but 94 still provided at least one antibiotic and 26 provided two antibiotics. Knowledge-stratified analysis showed that poor knowledge was associated with higher odds of inappropriate antibiotic provision in both scenarios.

In the URTI scenario, participants with poor knowledge were substantially less likely to refuse antibiotics or refer the patient than those with moderate/good knowledge, at 16.7% versus 43.5%. Conversely, poor-knowledge participants were more likely to recommend at least one antibiotic for URTI, at 83.3%

compared with 56.5% among those with moderate/good knowledge. This corresponded to nearly fourfold higher odds of antibiotic recommendation among poor-knowledge participants. Recommendation of non-antibiotic symptomatic medicine was common in both groups and did not differ significantly by knowledge level.

Table 3. Simulated Scenario Responses by Knowledge Level

Simulated Scenario Response	Total, n (%)	Moderate/Good, n/N (%)	Poor, n/N (%)	Odds Ratio (95% CI)	p-value
Refused antibiotic or referred patient for URTI	58 (39.2)	54/124 (43.5)	4/24 (16.7)	0.26 (0.08–0.80)	0.021
Recommended non-antibiotic medicine for URTI	99 (66.9)	82/124 (66.1)	17/24 (70.8)	1.24 (0.48–3.23)	0.814
Recommended at least one antibiotic for URTI	92 (62.2)	70/124 (56.5)	20/24 (83.3)	3.86 (1.25–11.95)	0.021
Refused antibiotic or referred patient for GI infection	54 (36.5)	51/124 (41.1)	3/24 (12.5)	0.20 (0.06–0.72)	0.010
Recommended oral rehydration therapy for GI infection	142 (95.9)	118/124 (95.2)	24/24 (100.0)	2.69 (0.15–49.30)	0.590
Recommended at least one antibiotic for GI infection	94 (63.5)	73/124 (58.9)	21/24 (87.5)	4.89 (1.39–17.27)	0.010
Recommended two antibiotics for GI infection	26 (17.6)	18/124 (14.5)	8/24 (33.3)	2.94 (1.10–7.88)	0.039

A similar pattern was observed in the gastrointestinal infection scenario. Oral rehydration therapy was recommended by nearly all participants, including 95.2% of those with moderate/good knowledge and 100.0% of those with poor knowledge, indicating broad recognition of supportive care. However, this did not prevent inappropriate antibiotic use. At least one antibiotic was recommended by 87.5% of participants with poor knowledge compared with 58.9% of those with moderate/good knowledge, corresponding to 4.89 times higher odds of antibiotic recommendation. Dual-antibiotic use was also more frequent among poor-knowledge participants, at 33.3% compared with 14.5%, suggesting that poorer theoretical knowledge was associated not only with antibiotic provision but also with more intensive and potentially inappropriate antibiotic combinations.

Analysis of antibiotic selection showed substantial use of Watch-category antibiotics and frequent deviation from standard treatment guidance. In the URTI scenario, 92 antibiotic recommendations were recorded. Access antibiotics accounted for 40 recommendations, while Watch antibiotics accounted for 52 recommendations. Azithromycin was the most frequently recommended Watch antibiotic in URTI, followed by cefixime. In the GI scenario, 94 respondents provided at least one antibiotic, although 95 antibiotic items were recorded because of multiple-drug recommendations in some responses. Metronidazole was the most common Access-category antibiotic, while ciprofloxacin was the most common Watch-category antibiotic. Dual-antibiotic combinations were recorded in 26 responses and were considered guideline-deviant in all cases.

Table 4. Antibiotic Selection and Guideline Deviation in Simulated URTI and GI Scenarios

Scenario and Antibiotic Category	Antibiotic	n (%)	Deviation from Standard Treatment Guidance, n (%)
URTI: Access antibiotics, n = 40/92 (43.5%)	Amoxicillin	32 (34.8)	5 (5.4)
	Amoxicillin/clavulanate	8 (8.7)	1 (1.1)
URTI: Watch antibiotics, n = 52/92 (56.5%)	Azithromycin	39 (42.4)	26 (28.3)
	Cefixime	11 (12.0)	3 (3.3)
	Moxifloxacin	1 (1.1)	1 (1.1)
	Levofloxacin	1 (1.1)	1 (1.1)
GI infection: Access antibiotic items, n = 64/95 (67.4%)	Metronidazole	63 (66.3)	45 (47.4)
	Doxycycline	1 (1.1)	1 (1.1)
GI infection: Watch antibiotic items, n = 31/95 (32.6%)	Azithromycin	7 (7.4)	2 (2.1)
	Cefixime	3 (3.2)	2 (2.1)
	Ciprofloxacin	21 (22.1)	15 (15.8)

In the URTI scenario, Watch-category antibiotics represented the majority of antibiotic recommendations, accounting for 56.5% of all URTI antibiotics. Azithromycin alone accounted for 42.4% of URTI antibiotic recommendations and contributed the largest share of guideline-deviant antibiotic use. Overall, 38 of 92 URTI antibiotic recommendations were classified as deviating from standard treatment guidance, corresponding to 41.3% of URTI antibiotic recommendations. This indicates that inappropriate URTI antibiotic dispensing was driven not only by the decision to provide antibiotics but also by selection of broader-spectrum or non-guideline-concordant agents.

In the GI scenario, Access antibiotics accounted for most antibiotic items, largely due to frequent metronidazole recommendation. However, guideline deviation remained high because antibiotic use was often not clinically indicated for the simulated uncomplicated watery diarrhea scenario or was prescribed with inappropriate drug choice, dose, duration, or combination. Among 95 GI antibiotic items recorded, 65 were classified as guideline-deviant, corresponding to 68.4% of antibiotic items. Ciprofloxacin accounted for 22.1% of GI antibiotic items and was the most frequently used Watch-category agent in this scenario.

Table 5. Dual-Antibiotic Combinations Recommended in the GI Scenario

Combination Type	Antibiotic Combination	n/N (%)	Guideline-Deviant, n (%)
Access + Watch	Metronidazole + Ciprofloxacin	14/26 (53.8)	14 (53.8)
Access + Watch	Metronidazole + Azithromycin	6/26 (23.1)	6 (23.1)
Access + Access	Metronidazole + Amoxicillin	1/26 (3.8)	1 (3.8)
Watch + Watch	Ciprofloxacin + Azithromycin	1/26 (3.8)	1 (3.8)
Access + Watch	Doxycycline + Ceftriaxone	1/26 (3.8)	1 (3.8)
Watch + Watch	Cefixime + Azithromycin	1/26 (3.8)	1 (3.8)
Watch + Access	Ciprofloxacin + Amoxicillin	2/26 (7.7)	2 (7.7)
Total	Any dual-antibiotic combination	26/148 (17.6)	26 (100.0)

Dual-antibiotic dispensing occurred in 17.6% of all simulated GI encounters and represented a clinically important pattern of inappropriate treatment escalation. The most common combination was metronidazole plus ciprofloxacin, which accounted for 53.8% of all dual-antibiotic responses. Metronidazole plus azithromycin was the second most frequent combination, accounting for 23.1%. All dual-antibiotic combinations were classified as guideline-deviant because the simulated scenario represented uncomplicated watery diarrhea without features requiring empiric combination antibiotic therapy. These findings suggest that a subgroup of drug sellers responded to common gastrointestinal symptoms with excessive antimicrobial coverage rather than supportive care and referral when clinically indicated.

Overall, the Results demonstrate three consistent patterns. First, antimicrobial resistance awareness was high at the conceptual level, with 93.9% recognizing resistance as a significant community problem, but this awareness was not sufficient to prevent inappropriate simulated dispensing. Second, poor knowledge was associated with significantly higher odds of antibiotic provision in both URTI and GI scenarios, including nearly fivefold higher odds of antibiotic recommendation in the GI scenario. Third, inappropriate dispensing was not limited to whether antibiotics were provided; it also involved clinically important issues of antibiotic selection, including Watch-category use, guideline deviation, and dual-antibiotic prescribing for uncomplicated gastrointestinal symptoms.

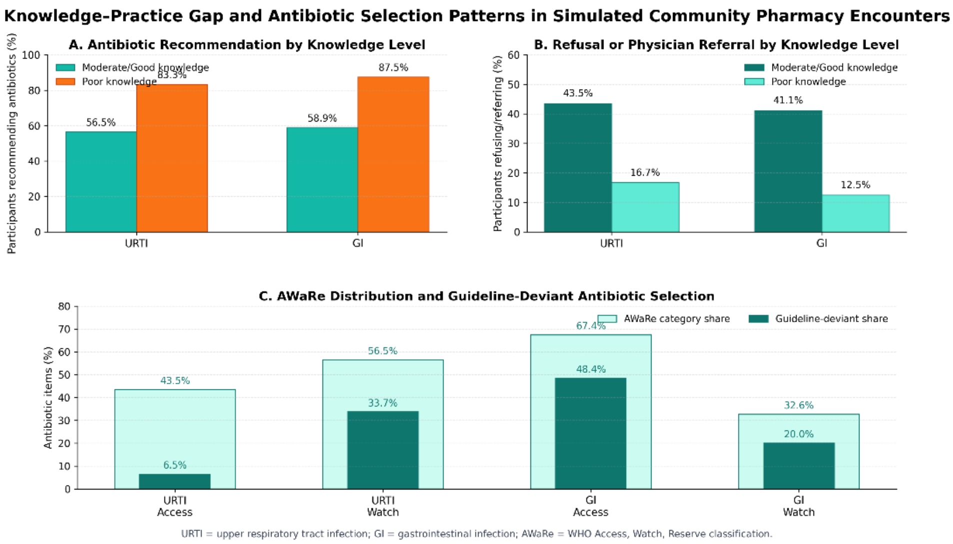

Figure 1. Knowledge–Practice Gap and Antibiotic Selection Patterns in Simulated Community Pharmacy Encounters.

The panelled figure demonstrates a consistent knowledge–practice gradient across both simulated clinical scenarios. Participants with poor antimicrobial resistance knowledge recommended antibiotics more frequently than those with moderate/good knowledge in both the URTI scenario (83.3% vs. 56.5%) and the GI scenario (87.5% vs. 58.9%), while refusal or physician referral was markedly lower among poor-knowledge participants for URTI (16.7% vs. 43.5%) and GI infection (12.5% vs. 41.1%). Antibiotic selection patterns further showed clinically important guideline deviation, with Watch-category agents comprising 56.5% of URTI antibiotic recommendations and 32.6% of GI antibiotic items. Guideline-deviant antibiotic use was especially prominent for GI Access-category antibiotics, largely driven by inappropriate metronidazole use, and for URTI Watch-category antibiotics, reflecting frequent azithromycin and cephalosporin selection in a scenario where antibiotic treatment was generally not indicated.

DISCUSSION

This cross-sectional study demonstrates a clinically important mismatch between antimicrobial resistance awareness and antibiotic dispensing behavior among community pharmacy personnel in Lahore. Although most participants recognized antimicrobial resistance as a significant community problem and correctly identified several major contributors, including suboptimal dosing, broad-spectrum antibiotic use, and antibiotic use for viral infections, inappropriate antibiotic recommendation remained frequent in both simulated clinical scenarios. Antibiotics were recommended by 62.2% of participants in the upper respiratory tract infection scenario and by 63.5% in the gastrointestinal infection scenario, despite both scenarios representing common community presentations in which supportive care, physician referral, or non-antibiotic management would often be more appropriate than empirical antibiotic dispensing. This finding suggests that awareness alone is insufficient to ensure rational antibiotic use in community pharmacy settings, particularly where patient expectations, commercial pressures, and limited regulatory enforcement shape dispensing behavior.

The observed knowledge–practice gap is consistent with evidence from Pakistan and other resource-constrained settings, where community-level antimicrobial stewardship remains difficult to implement because antibiotic use is influenced by structural, economic, and behavioral determinants rather than knowledge alone (9). Community pharmacies often serve as highly accessible healthcare contact points, especially when formal consultation is perceived as costly, inconvenient, or unnecessary. In such settings, drug sellers may provide antibiotics to preserve customer satisfaction, avoid losing clients to competing pharmacies, or respond to patient demand for rapid symptom relief. International evidence from community pharmacy studies similarly indicates that non-prescription antibiotic supply remains common despite awareness of antimicrobial resistance and despite formal restrictions on over-the-counter antimicrobial sales (10, 11). Therefore, the findings from Lahore should be interpreted as part of a broader pattern in which community pharmacies are positioned between healthcare access and antimicrobial stewardship responsibility.

The scenario-based findings are especially important because they assess applied dispensing behavior rather than knowledge alone. Participants with poor antimicrobial resistance knowledge were significantly more likely to recommend antibiotics than those with moderate or good knowledge in both scenarios. In the upper respiratory tract infection scenario, antibiotic recommendation was 83.3% among poor-knowledge participants compared with 56.5% among participants with moderate/good knowledge, corresponding to 3.86 times higher odds of antibiotic provision. In the gastrointestinal infection scenario, antibiotic recommendation was 87.5% among poor-knowledge participants compared with 58.9% among those with moderate/good knowledge, corresponding to 4.89 times higher odds. These findings indicate that poor knowledge remains a relevant risk factor for inappropriate dispensing, although the persistence of antibiotic provision even among moderate/good-knowledge participants shows that educational interventions alone are unlikely to be sufficient. This interpretation aligns with previous evidence that antimicrobial use behavior is shaped by attitudes, perceived customer expectations, professional accountability, and local market dynamics in addition to technical knowledge (12–14).

The antibiotic selection pattern further strengthens the stewardship concern. In the upper respiratory tract infection scenario, Watch-category antibiotics accounted for 56.5% of antibiotic recommendations, with azithromycin forming the largest share. This is clinically relevant because uncomplicated upper respiratory symptoms are commonly viral or self-limiting, and unnecessary use of macrolides or cephalosporins increases selection pressure for resistant organisms. In the gastrointestinal infection scenario, Access-category antibiotics represented the majority of antibiotic items, largely because metronidazole was frequently recommended, but guideline deviation remained high because antibiotic treatment was often not indicated for uncomplicated watery diarrhea and because several recommendations involved inappropriate drug choice, dose, duration, or combination. These findings are consistent with wider evidence that inappropriate antibiotic selection in community practice is not limited to whether antibiotics are dispensed, but also includes the use of broader-spectrum agents, non-guideline-concordant regimens, and antimicrobial combinations without clear clinical indication (15–17).

The use of dual-antibiotic combinations in 17.6% of gastrointestinal simulated encounters is particularly concerning from a stewardship perspective. All dual-antibiotic combinations were classified as guideline-deviant because the simulated case represented uncomplicated watery diarrhea without features supporting empirical combination therapy. The most frequent combination was metronidazole plus ciprofloxacin, followed by metronidazole plus azithromycin. This pattern suggests that some drug sellers respond to gastrointestinal symptoms with excessive antimicrobial coverage rather than prioritizing oral rehydration therapy, clinical assessment, and referral when red flags are present. Although oral rehydration therapy was recommended by 95.9% of participants, this did not prevent concurrent antibiotic dispensing, showing that correct supportive-care knowledge may coexist with inappropriate antimicrobial escalation.

The urban-rural comparison also provides important contextual insight. Rural and urban pharmacy personnel differed significantly in sex distribution, age, educational attainment, and years of experience. Urban pharmacies were characterized by a younger and less experienced workforce, with 58.1% of urban participants reporting less than one year of experience compared with 10.8% in rural pharmacies. In contrast, rural pharmacies had a higher proportion of participants with longer dispensing experience and a higher proportion of female staff. These differences imply that a uniform stewardship intervention may be less effective than a context-specific strategy. Urban pharmacies may require rapid induction training, early-career dispensing supervision, and standardized decision aids for common infections, whereas rural pharmacies may require continuing professional development, regulatory engagement, and behavior-change strategies directed toward established dispensing routines. Similar concerns have been reported across low- and middle-income settings, where stewardship strategies must be adapted to local provider roles, patient access barriers, and the informal structures through which medicines are obtained (18–21).

The findings have direct implications for antimicrobial stewardship in Pakistan. First, training should move beyond general AMR awareness and focus on scenario-based decision-making for common pharmacy presentations, particularly upper respiratory tract symptoms and acute diarrhea. Second, regulatory enforcement of prescription-only antibiotic sales should be strengthened, but punitive enforcement alone is unlikely to succeed unless accompanied by public education that reduces patient demand for antibiotics and by mechanisms that reduce the economic disadvantage faced by pharmacies that refuse inappropriate sales. Third, pharmacy-level stewardship interventions should include practical tools such as symptom triage algorithms, red-flag referral checklists, AWaRe-based antibiotic guidance, and periodic audit or mystery-shopper feedback. Fourth, mandatory certification or competency verification for all personnel involved in antibiotic dispensing may be necessary because non-pharmacist staff participate in medicine supply in many community pharmacies.

This study has several limitations. The cross-sectional design prevents causal inference, and convenience sampling from Lahore limits generalizability to all community pharmacies in Pakistan. The study relied on a finite number of simulated scenarios, which may not fully reproduce the complexity of real pharmacy encounters, including patient insistence, financial constraints, prior medicine use, and time pressure. The presence of data collectors and the informed consent process may have influenced participant behavior, potentially underestimating inappropriate dispensing. Knowledge scoring treated unsure responses as incorrect, which may have lowered knowledge estimates but provided a conservative assessment of practical understanding. Some analyses were based on aggregate data, and small cell counts in certain demographic categories limited the precision of subgroup interpretation. Despite these limitations, the study provides useful evidence on the applied knowledge–practice gap in community pharmacy antibiotic dispensing and identifies actionable targets for stewardship interventions in Lahore.

CONCLUSION

This study found that inappropriate antibiotic dispensing remains common among community pharmacy personnel in Lahore despite generally high awareness of antimicrobial resistance. Antibiotics were recommended in more than three-fifths of simulated upper respiratory tract and gastrointestinal infection encounters, and poor antimicrobial resistance knowledge was associated with significantly higher odds of antibiotic provision in both scenarios. The findings also showed substantial Watch-category antibiotic use, frequent deviation from standard treatment guidance, and unnecessary dual-antibiotic combinations for uncomplicated gastrointestinal symptoms. Significant urban-rural differences in workforce characteristics indicate that stewardship strategies should be tailored to pharmacy context rather than implemented as a single generic intervention. Strengthening community-level antimicrobial stewardship in Lahore will require scenario-based training, mandatory competency standards for dispensing personnel, improved public awareness, practical AWaRe-guided decision tools, and stronger but context-sensitive enforcement of prescription-only antibiotic regulations.

REFERENCES

1. Morrison L, Zembower TR. Antimicrobial resistance. Gastrointest Endosc Clin N Am. 2020;30(4):619-635.
2. Shamas N, Stokle E, Ashiru-Oredope D, Wesangula E. Challenges of implementing antimicrobial stewardship tools in low- to middle-income countries. Infect Prev Pract. 2023;5(4):100315.
3. Roope LSJ, Smith RD, Pouwels KB, Buchanan J, Abel L, Eibich P, et al. The challenge of antimicrobial resistance: what economics can contribute. Science. 2019;364(6435):eaau4679.
4. Tacconelli E, Sifakis F, Harbarth S, Schrijver R, van Mourik M, Voss A, et al. Surveillance for control of antimicrobial resistance. Lancet Infect Dis. 2018;18(3):e99-e106.
5. Luo A, Qin L, Yuan Y, Yang Z, Liu F, Huang P, et al. The effect of online health information seeking on physician-patient relationships: systematic review. J Med Internet Res. 2022;24(2):e23354.
6. Allen MR, Webb S, Mandvi A, Frieden M, Tai-Seale M, Kallenberg G. Navigating the doctor-patient-AI relationship: a mixed-methods study of physician attitudes toward artificial intelligence in primary care. BMC Prim Care. 2024;25(1):42.
7. Bustos-Hamdan A, Bracho-Gallardo JI, Hamdan-Partida A, Bustos-Martínez J. Repositioning of antibiotics in the treatment of viral infections. Curr Microbiol. 2024;81(12):427.

8. Al Masud A, Walpola RL, Sarker M, Asaduzzaman M, Islam MS, Mostafa AT, et al. Antibiotic dispensing practices in community pharmacies: implications for antimicrobial stewardship in resource-constrained settings. Explor Res Clin Soc Pharm. 2025;19:100606.

9. Alam M, Saleem Z, Haseeb A, Qamar MU, Sheikh A, Abuhussain SSA, et al. Tackling antimicrobial resistance in primary care facilities across Pakistan: current challenges and implications for the future. J Infect Public Health. 2023;16:97-110.

10. de Souza EV, Vieira LJSC, dos Santos SNP, Cerqueira-Santos S, Rocha KSS, de Lyra DP Jr. Antimicrobial dispensing process in community pharmacies: a scoping review. Antimicrob Resist Infect Control. 2022;11(1):116.

11. Llor C, Benkő R, Bjerrum L. Global restriction of the over-the-counter sale of antimicrobials: does it make sense? Front Public Health. 2024;12:1412644.

12. Ferrara F, Castagna T, Pantolini B, Campanardi MC, Roperti M, Grotto A, et al. The challenge of antimicrobial resistance: current status and future prospects. Naunyn Schmiedebergs Arch Pharmacol. 2024;397(12):9603-9615.

13. Mudenda S, Mukosha M, Godman B, Fadare J, Malama S, Munyeme M, et al. Knowledge, attitudes, and practices of community pharmacy professionals on poultry antibiotic dispensing, use, and bacterial antimicrobial resistance in Zambia: implications on antibiotic stewardship and WHO AWaRe classification of antibiotics. Antibiotics (Basel). 2022;11(9):1210.

14. Hossain MJ, Jabin N, Ahmmed F, Sultana A, Rahman SA, Islam MR. Irrational use of antibiotics and factors associated with antibiotic resistance: findings from a cross-sectional study in Bangladesh. Health Sci Rep. 2023;6(8):e1465.

15. Panda PK. Wrong diagnosis—wrong antimicrobials: rise in antimicrobial resistance in developing countries. IDCases. 2025;41:e02313.

16. Wongkattiya N. Antibiotic resistance, characterization and biological control of bovine mastitis caused by Streptococcus uberis [dissertation]. Melbourne: RMIT University; 2024.

17. Khadse SN, Ugemuge S, Singh C. Impact of antimicrobial stewardship on reducing antimicrobial resistance. Cureus. 2023;15(12).

18. Davwar P, Bitrus N, Nyam D, Ioramo K, Zawaya K, Agboghoroma O. Knowledge, attitudes, and practice of doctors in Nigeria regarding antimicrobial resistance. Niger Med J. 2023;64(4):492.

19. Sajjad U, Afridi AU, Kazmi T, Afzal N, Asif M, Rehman MB. Evaluation of antibiotic prescription patterns using WHO AWaRe classification. East Mediterr Health J. 2024;30(2):156-162.

20. Li J, Zhou P, Wang J, Li H, Xu H, Meng Y, et al. Worldwide dispensing of non-prescription antibiotics in community pharmacies and associated factors: a mixed-methods systematic review. Lancet Infect Dis. 2023;23(9):e361-e370.

21. Sono TM, Yeika E, Cook A, Kalungia A, Opanga SA, Acolatse JEE, et al. Current rates of purchasing of antibiotics without a prescription across sub-Saharan Africa: rationale and potential programmes to reduce inappropriate dispensing and resistance. Expert Rev Anti Infect Ther. 2023;21(10):1025-1055.

22. Addo HO, Barimah AJ, Usman AS, Kuu-Arah P, Agyepong N. Utilisation of antibiotics in the management of urinary tract infections among women of reproductive age at a district hospital in Ghana. Sci Rep. 2026.

23. Albano D, Lauri C, Signore A, Treglia G. Nuclear medicine imaging to guide antibiotic therapy: an expert review. Br J Radiol. 2026:tqag068.

24. Siachalinga L, Mufwambi W, Lee IH. Impact of antimicrobial stewardship interventions to improve antibiotic prescribing for hospital inpatients in Africa: a systematic review and meta-analysis. J Hosp Infect. 2022;129:124-134.

25. Gao H, Li L, Zhang H, Ma W, Wang Y. RAD-SHIP: a new model called rational antibiotic use-stewardship to control antimicrobial use intensity and effectiveness in hospitals. J Clin Pharm Ther. 2026;2026(1):4429079.

26. Berkhout C, Berbra O, Favre J, Collins C, Calafiore M, Peremans L, et al. Defining and evaluating the Hawthorne effect in primary care: a systematic review and meta-analysis. Front Med (Lausanne). 2022;9:1033486.