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Non-prescription Antibiotic Dispensing in Community Pharmacies of Islamabad Capital Territory, Pakistan: A Simulated Client Study

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Abstract

Background

Antimicrobial resistance (AMR) is a major global health threat with a disproportionate burden in low- and middle-income countries. In Pakistan, rising antibiotic consumption and weak regulatory enforcement contribute to inappropriate antimicrobial use. Despite legal restrictions, community pharmacies frequently dispense antibiotics without a prescription, accelerating resistance.

Objective

To assess the prevalence, patterns of dispensing based on scenario type, and associated factors of non-prescription antibiotic dispensing in community pharmacies of Islamabad Capital Territory (ICT), Pakistan.

Methods

A cross-sectional study using a simulated client methodology was conducted from December 2024 to November 2025. A simple random sample of 121 pharmacies was selected from 176 eligible outlets. Five trained volunteers presented standardized scenarios of upper respiratory tract infection (URTI), urinary tract infection (UTI), and gastrointestinal infection (GIT). The pharmacies were distributed approximately equally across scenarios, with 40 pharmacies assigned to the URTI scenario, 40 to the GIT scenario, and 41 to the UTI scenario. The prevalence, patterns, and associated factors of non-prescription antibiotic dispensing were all assessed directly from these simulated client encounters; data on dispensing practices, clinical inquiry, counselling, and antibiotic types were recorded immediately after each visit using a structured data collection form. Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 26 (Released 2019; IBM Corp., Armonk, New York, United States), with multivariate logistic regression to identify predictors of antibiotic dispensing.

Results

Antibiotics were dispensed without prescription in 101/121 (83.5%) of encounters, most frequently for URTI 39/40 (97.5%), followed by GIT 36/40 (90%) and UTI 26/41 (63.4%). In 72% of all cases, antibiotics were supplied immediately without patient request (demand level 1). Clinical assessment was inadequate: no staff inquired about drug allergies, and counselling was provided in only 14% of visits. Overall watch group antibiotics predominated, particularly ciprofloxacin (32.7%) and azithromycin (25.7%). Logistic regression identified clinical scenario as the only significant predictor of dispensing ($p<0.01$).

Conclusion

Non-prescription antibiotic dispensing in ICT is highly prevalent and antibiotics are readily accessible upon request. The widespread use of broad-spectrum antibiotics poses a significant risk for AMR. Strengthened regulatory enforcement, pharmacist accountability, and targeted antimicrobial stewardship interventions are urgently needed.

Categories: Health Policy, Public Health, Epidemiology/Public Health
Keywords: antibiotic prescription, anti-microbial resistance, global health policy, public health and safety, simulated patients

Introduction

Antimicrobial resistance (AMR) is currently a major problem worldwide; drug-resistant microbes were directly responsible for 2.3% of deaths worldwide in 2019 [1]. The burden is even higher in low-income countries and is one of the leading causes of death in low-resource settings [2]. Mortality rates by 2050 are projected to account for approximately 47.3% in Asia, 41.5% in Africa, and 3.9% in Europe of global AMR-related deaths [3]. According to Centers for Disease Control and Prevention (CDC) projections, AMR may

increase healthcare spending by over $2 billion each year [3]. Furthermore, resistant organisms increase the length of hospital stays and possible outbreaks of such organisms could disrupt surgical procedures [3]. The World Health Organization (WHO) has placed antimicrobial resistance among the top 10 threats to public health [4]. Existing literature suggests that antibiotic use has significantly increased by 65% between 2000 and 2015 in Pakistan [5].

Microorganisms with decreased susceptibility to antibiotics have increased steadily over the previous decade, most of the resistant organisms are acquired through hospitals; for instance, carbapenem resistance in Acinetobacter and Pseudomonas increased from 50% in 2017 to 76.2% in 2021, as reported by a study conducted in Ethiopia [6]. Even worse, bacteria are resistant to last resort antibiotics such as colistin, with pooled colistin resistance in klebsiella of around 2.89% worldwide [7]. Furthermore, a systematic review in Pakistan carried out shows median resistance of Escherichia coli to penicillin at 100, ampicillin at 90.55, and amoxicillin at 85. Furthermore, Klebsiella spp. had high resistance to cefaclor and cefotaxime (median resistances 100 and 82.5). Staphylococcus aureus has high resistance as well with penicillin at median resistance 98, cefoxitin at 83, and levofloxacin at 80 [8].

Pharmacists are responsible for ensuring the safe, effective, and appropriate use of medications through accurate dispensing, patient counseling, and safeguarding against misuse. According to the guidelines provided by Drug Regulation Authority Pakistan, pharmacists cannot dispense antimicrobials to individuals without a relevant prescription. Furthermore, they are also required to provide guidance regarding the responsible use, dosage, dosage form, disposal, and storage conditions of antimicrobials [9]. Yet, these guidelines are loosely followed, further contributing to the issue.

Self-medication is a major contributing factor to the development of AMR and is potentiated by pharmacies dispensing antibiotics without requiring a prescription thereby bypassing healthcare professionals [9]. While studies from other regions of Pakistan, such as the Hazara division, have documented high rates of non-prescription antibiotic dispensing [10], no study to date has specifically assessed this practice within Islamabad Capital Territory (ICT). Given that determinants of dispensing behaviour and the specific antibiotic classes involved may vary across settings due to differences in regulatory enforcement, pharmacy density, and population health-seeking behaviour, locally generated evidence from ICT is needed to inform targeted stewardship interventions. This study therefore aimed to address this gap.

The primary objectives of this study were to determine the prevalence of non-prescription antibiotic dispensing in community pharmacies in ICT, Pakistan, and to assess dispensing patterns across different clinical scenarios. The secondary objective was to assess factors associated with non-prescription antibiotic dispensing, including pharmacist presence at the time of dispensing, the demand level at which antibiotics were supplied and counselling regarding antibiotic use.

Materials And Methods

A cross-sectional study was conducted with data collected between December 2024 and November 2025. The data were collected using a simulated client method in community pharmacies in ICT.

A simple random sampling technique was used to draw a sample from all the pharmacies in the region. Pharmacies dispensing exclusively homeopathic or alternative medicines were excluded, while all other community pharmacies dispensing conventional medicines were eligible for inclusion. An initial sample of pharmacies was obtained via Google Maps, and a list of 396 pharmacies was compiled. In order to validate the presence of the listed pharmacies, an on-ground survey was conducted. After removing 220 pharmacies that were found to be closed, the total population was 176. The sample size was calculated using OpenEpi (Dean AG, Sullivan KM, Soe MM. OpenEpi: Open Source Epidemiologic Statistics for Public Health, Version 3.01. www.OpenEpi.com, updated 2013/04/06 (accessed Oct 21, 2026)), assuming an estimated frequency of 50% to maximize variability.

From the total population of 176 eligible pharmacies, a sample of 121 pharmacies was selected, providing a 5% margin of error at a 95% confidence level. Simple random sampling was used to select the pharmacies, and the selected pharmacies were then allocated to the three clinical scenarios (upper respiratory tract infection (URTI), urinary tract infection (UTI), and gastrointestinal infection (GIT)). The pharmacies were distributed approximately equally across scenarios, with 40 pharmacies assigned to the URTI scenario, 40 to the GIT scenario, and 41 to the UTI scenario.

A pre-validated questionnaire, previously used in a simulated client study conducted in the Hazara region of Pakistan, was adopted with permission from the original investigators [10]. Data were collected using the simulated client (SC) methodology. Five volunteers from Shifa College of Medicine were recruited and trained to present three standardized clinical scenarios: URTI, diarrhea, and UTI (Table *1*).

Step	Trigger / Pharmacist Question	URTI Scenario Response	GIT Infection Scenario Response	UTI Scenario Response
1	Initial Presentation	22-year-old male presents with fever, throat pain, cough and body aches.	22-year-old presents with symptoms of vomiting watery diarrhea, abdominal cramps.	A 22-year-old says his diabetic mother complains of burning micturition, low-grade fever
2	If asked: Duration of symptoms?	Fever: 4 days Throat pain: 5 days Cough: 5 days Body Aches: 4 days	1 day for all symptoms	7 days for all symptoms
3	If asked: Additional symptoms?	Headache	Fever, lethargy	Flank pain
5	If asked: Previous medication taken?	Paracetamol (Generic)	No	No
6	If asked: Drug allergies?	No known allergies	No known allergies	No known allergies
7	If asked: Visited a doctor / have prescription?	No	No	No
8	If asked: Why no doctor visit?	States do not have the time	States do not have the time	States that mother refuses to go
10	If pharmacist refers to a doctor	State the doctor will prescribe the same medicines you can give to me.	State the doctor will prescribe the same medicines you can give to me.	State the doctor will prescribe the same medicines you can give to me.
11	If asked about past similar episodes	Yes, but long ago	Yes, but long ago	No

TABLE 1: Clinical scenarios explained

URTI: Upper Respiratory Tract Infection; GIT: Gastrointestinal Tract; UTI: Urinary Tract Infection.

Each simulated client visited an assigned pharmacy and presented symptoms according to a fixed script. If an antibiotic was supplied immediately after symptom presentation, the interaction was categorized as demand level 1. If a non-antibiotic was initially offered, the SC requested “an antibiotic” without naming a specific drug; dispensing at this stage was classified as demand level 2. Only the generic English term 'antibiotic' was used in this request; no local colloquial equivalent, brand name, or formal generic drug name was used at any stage of the interaction. If the request was refused again, the SC insisted that they were unable to visit a physician and requested the same medication; dispensing at this stage was recorded as demand level 3 (Figure *1*).

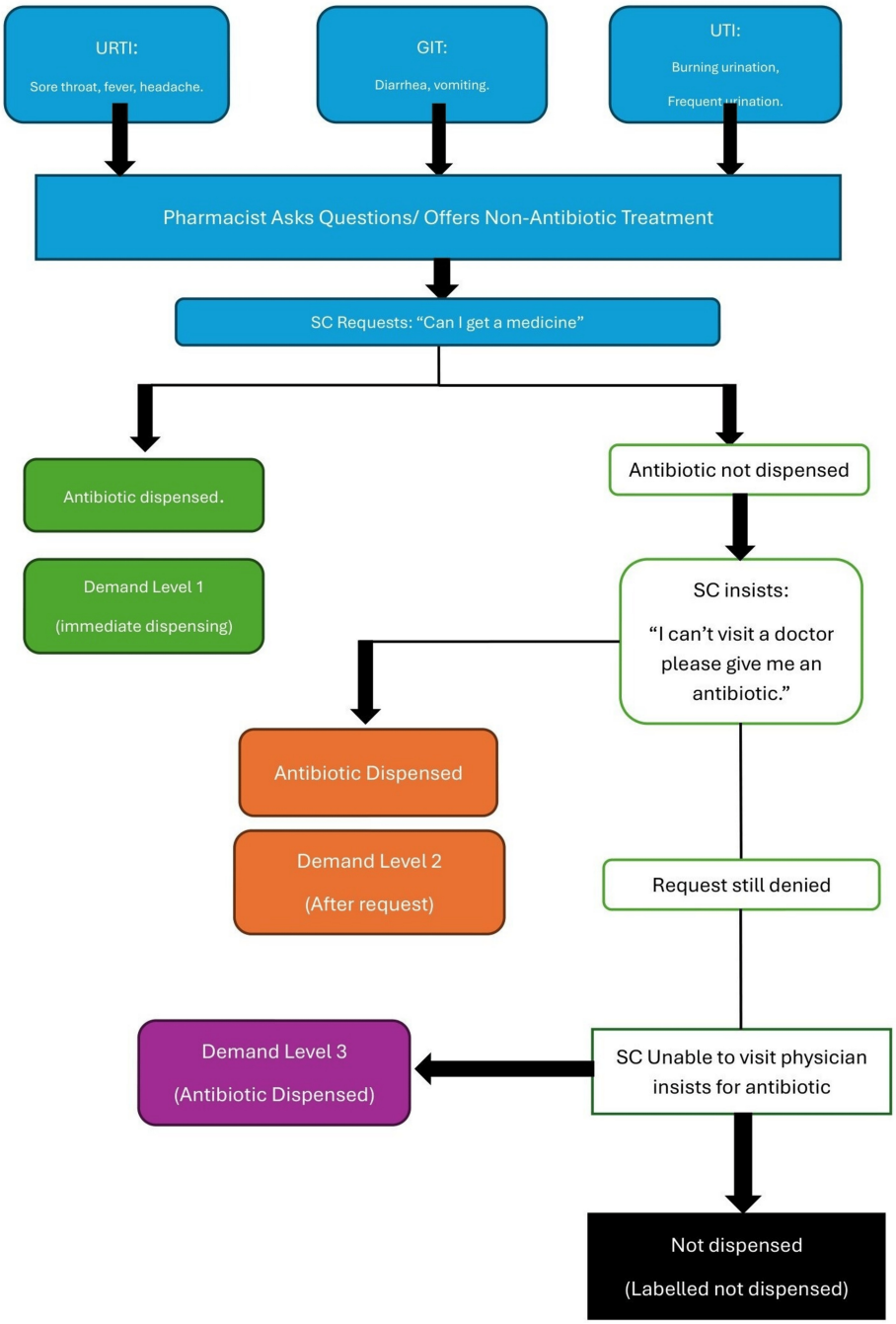


FIGURE 1: Demand levels explained

URTI: Upper Respiratory Tract Infection; GIT: Gastrointestinal Tract; UTI: Urinary Tract Infection; SC: Simulated Client.

All volunteers were in their twenties and underwent structured training prior to data collection. Training sessions covered study objectives, detailed scenario scripts, questionnaire variables, and standardized communication strategies to ensure uniform presentation. Pilot demonstrations were conducted by the research team to model appropriate interaction and documentation. Three reinforcement workshops were held during the study period, and continuous supervision was maintained to address uncertainties and ensure adherence to protocol. Pharmacies were visited according to volunteer availability rather than a predefined time sampling frame; therefore, pharmacist presence at the time of visit varied naturally and was recorded as a study variable.

To enhance standardization, volunteers received explicit instructions on how each questionnaire item should be completed. The same scripts, demand escalation sequence, and interaction patterns were applied across all visits. All SCs were medical students of similar age group and maintained similar styles of dress to

minimize variability in staff responses. Given the structured format, outcomes were expected to remain consistent irrespective of which volunteer conducted the visit.

To minimize recall bias, SCs completed the questionnaire immediately after exiting the pharmacy. No audio recordings were made. Instead, volunteers were trained to memorize key details and discreetly record the drug name, dosage, and regimen on their phones immediately after the interaction to ensure accurate reporting.

Operational definitions were established prior to data collection. Inquiry status referred to whether dispensing staff sought relevant clinical information (e.g., symptom duration, associated complaints, prior medication use) before supplying treatment. Counselling was defined as verbal instructions regarding dose, frequency, duration, precautions, potential adverse effects, storage, or disposal.

The simulated scenarios were reviewed and approved by the Institutional Review Board (IRB) (Reference No. 0457-23), comprising licensed physicians and academic researchers. The IRB evaluated the clinical accuracy, realism, and ethical appropriateness of the scenarios to ensure they reflected plausible community presentations without misleading or compromising professional integrity.

Data were collected on pharmacy type (chain or independent), location, pharmacist availability, pharmacist presence at time of visit, and gender of dispensing staff. Clinical inquiry practices, antibiotic dispensing with or without prescription, demand level at dispensing, specific antibiotic supplied, dosage regimen, counselling provided, and supplementary medications were also recorded.

Data were analyzed using IBM SPSS Statistics for Windows, Version 26 (Released 2019; IBM Corp., Armonk, New York, United States). Descriptive statistics summarized pharmacy characteristics, pharmacist availability, inquiry status, and dispensing rates overall and by scenario. Demand levels and supplementary medications were also described.

Fisher’s exact test was used to assess the association between pharmacy type and pharmacist availability due to small subgroup sample size. Antibiotic dispensing was specified as the binary dependent variable (dispensed=1, not dispensed=0). Firth's penalized maximum-likelihood logistic regression was used to investigate the association between antibiotic dispensing and pharmacy type, pharmacist availability, pharmacist duty status, inquiry regarding the patient's condition, and clinical scenario. Firth logistic regression was selected because of the relatively small number of non-dispensing observations and sparse cells in the categorical predictors, which may result in biased estimates or separation in conventional maximum-likelihood logistic regression. Odds ratios (ORs) with 95% profile penalized-likelihood confidence intervals (CIs) were reported. For categorical predictors, reference categories were chain pharmacy, pharmacist available, pharmacist on duty, inquiry present, and URTI scenario. Statistical significance was assessed using two-sided tests with $p<0.05$.

Results

A total of 121 pharmacies were visited, including both chain and independent outlets (Table *2*).

Variable	Category	n	%
Pharmacy type	Chain	20	16.5
	Independent	101	83.5
Pharmacist employed	Yes	105	86.8
	No	16	13.2
Pharmacist present at visit	Yes	29	24.0
	No	92	76.0

TABLE 2: Characteristics of pharmacies and their staffing (n=121)

The pharmacies were distributed almost equally across scenarios, with 40 pharmacies assigned to the URTI scenario, 40 to the GIT scenario, and 41 to the UTI scenario. Although most pharmacies reported employing a pharmacist, their on-site availability during visits was notably low.

Clinical assessment practices were suboptimal (Table *3*).

Practice	Yes (n)	Yes (%)	No (n)	No (%)
Detailed symptom inquiry	32	26.4	89	73.6
Asked prior medication history	22	18.2	99	81.8
Explored associated symptoms	26	21.5	95	78.5
Asked about drug allergies	0	0.0	121	100
Recommended physician referral	6	5.0	115	95.0
Provided counselling (use, adverse effects, disposal)	17	14.0	104	86.0

TABLE 3: Clinical assessment and counselling practices

The majority of pharmacy staff did not perform adequate symptom evaluation, medication history taking, or assessment of associated symptoms. Inquiry about drug allergies was entirely absent, and only a small proportion of encounters involved referral to a physician or provision of counselling regarding medication use, adverse effects, or disposal.

Antibiotics were dispensed without prescription in the majority of visits 101/121 (83.5%). Dispensing rates were highest in URTI scenarios, followed by GIT and UTI. Most antibiotics were provided without any explicit request from the simulated client, indicating a low threshold for non-prescription dispensing (Table *4*).

Variable	Category	n	%
Antibiotics dispensed without prescription	Yes	101/121	83.5
	No	20/121	16.5
Scenario-wise dispensing	URTI	39/40	97.5
	GIT	36/40	90.0
	UTI	26/41	63.4
Demand level	Level 1 (no request)	88/121	72.7
	Level 2 (requested)	10/121	8.3
	Level 3 (insisted)	3/121	2.5

TABLE 4: Antibiotic dispensing patterns

URTI: Upper Respiratory Tract Infection; GIT: Gastrointestinal Tract; UTI: Urinary Tract Infection.

The most frequently dispensed antibiotics belonged to the WHO Access, Watch, Reserve (AWaRe) Watch group [11] (Table *5*), with ciprofloxacin and azithromycin being the most common agents.

Antibiotic	AWaRe group	n	%
Ciprofloxacin	Watch	33	32.7
Azithromycin	Watch	26	25.7
Metronidazole	Access	14	13.9
Levofloxacin	Watch	9	8.9
Ciprofloxacin + Metronidazole	Watch + Access	8	7.9
Cefixime + Metronidazole	Watch + Access	1	1.0

TABLE 5: Types of antibiotics dispensed

As per WHO Access, Watch, Reserve (AWaRe) Classification.

Scenario-specific patterns showed azithromycin predominating in URTI cases, ciprofloxacin in UTI, and metronidazole in GIT presentations (Table *6*).

Scenario	Most common antibiotic(s)	%
URTI	Azithromycin	60 (24/40)
UTI	Ciprofloxacin	41.4 (17/41)
GIT	Metronidazole	35.0 (14/40)
GIT	Ciprofloxacin	27.5 (11/40)

TABLE 6: Scenario-specific antibiotic patterns

URTI: Upper Respiratory Tract Infection; UTI: Urinary Tract Infection; GIT: Gastrointestinal Tract.

No antibiotics from the WHO Reserve group were observed [11]. Among the pharmacies that refused to dispense antibiotics, the most common reason was referral to a physician (Table *7*).

Reason	n	%
Referral to physician	13	65.0
Insistence on prescription	4	20.0
General caution	3	15.0

TABLE 7: Reasons for refusal to dispense antibiotics (n=20)

The overall Firth logistic regression model was statistically significant (penalized likelihood ratio $\chi^2(6) = 17.63$, p=0.007). The clinical scenario was significantly associated with antibiotic dispensing. Compared with URTI scenarios, the odds of antibiotic dispensing were significantly lower for UTI scenarios (OR=0.073). In a model using GIT as the reference category, UTI scenarios also had significantly lower odds of antibiotic dispensing than GIT scenarios (OR=0.210, 95% CI approximately 0.058-0.638, p=0.005) (Table *8*).

Predictor	Comparison	Adjusted OR	95% CI	p-value
Pharmacy type	Independent vs Chain*	1.484	0.381–5.226	0.551
Pharmacist availability	No vs Yes*	1.118	0.195–11.653	0.908
Pharmacist on duty	No vs Yes*	1.281	0.371–4.146	0.684
Inquiry	No vs Yes*	0.784	0.231–2.371	0.676
Clinical scenario	GIT vs URTI*	0.349	0.034–1.982	0.245
	UTI vs URTI*	0.073	0.008–0.325	<0.001

TABLE 8: Statistical analysis

URTI: Urinary Tract Infection; GIT: Gastrointestinal Tract; UTI: Urinary Tract Infection.

However, this finding should be interpreted cautiously, as the UTI scenario involved a proxy consultation on behalf of a diabetic mother, unlike the URTI and GIT scenarios, in which simulated clients presented with their own symptoms. This difference in consultation format may have influenced dispensing behaviour and could partly explain the lower dispensing rate observed in the UTI scenario. The difference between GIT and URTI scenarios was not statistically significant (OR=0.349, 95% CI 0.034-1.982, p=0.245). A summary of antibiotics and alternative drugs dispensed by pharmacists for each scenario are summarized in Figures *2*, *3*.

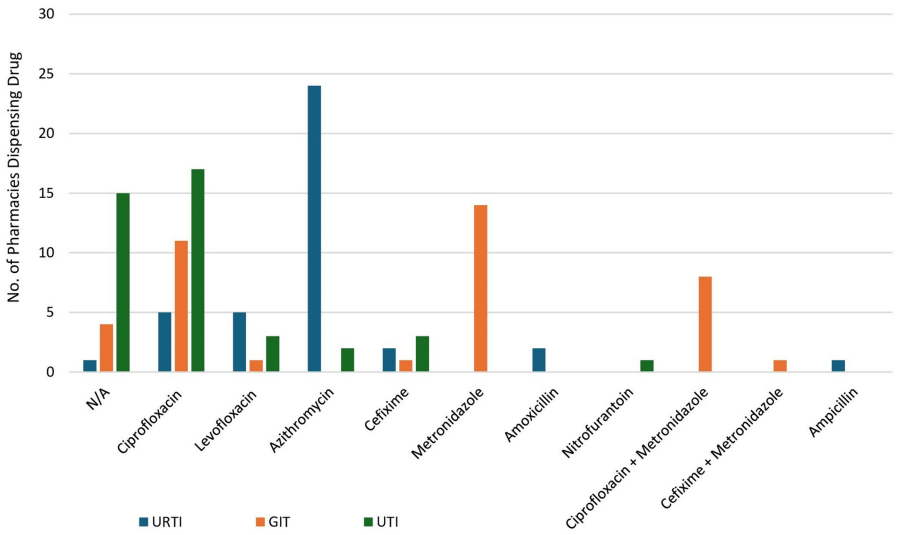


FIGURE 2: Antibiotics dispensed in each scenario

URTI: Upper Respiratory Tract Infection; GIT: Gastrointestinal Tract Infection; UTI: Urinary Tract Infection.

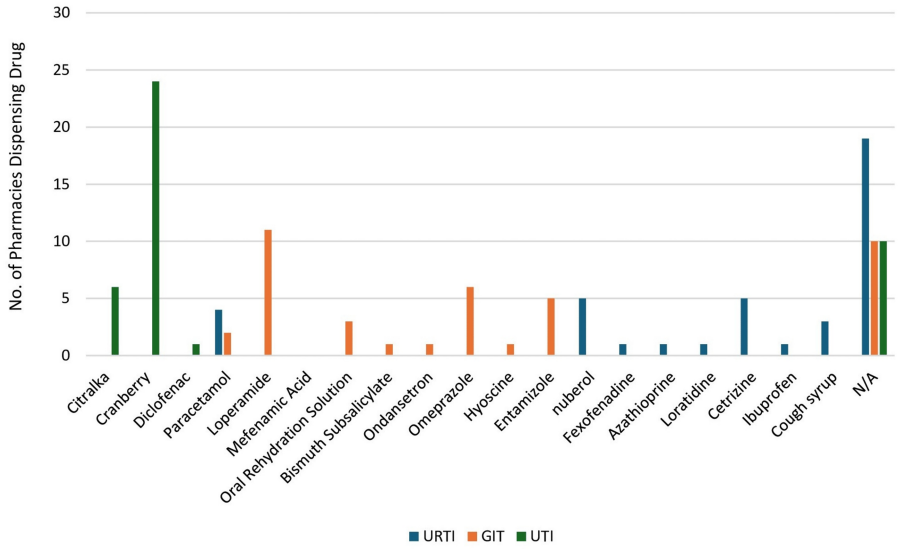


FIGURE 3: Alternative drugs dispensed

URTI: Upper Respiratory Tract Infection; GIT: Gastrointestinal Tract; UTI: Urinary Tract Infection.

Discussion

Our findings demonstrate that antibiotics are widely dispensed without a prescription in community pharmacies in ICT, with an overall rate of 83.5%. These results signal substantial non-compliance with national regulations issued by the Drug Regulatory Authority of Pakistan (DRAP) [12]. Although pharmacists are formally expected to act as gatekeepers of rational medicine use, critical safety steps were frequently omitted; none of the staff screened for drug allergies, and counseling occurred in only a small minority of encounters. The dominance of broad-spectrum agents such as ciprofloxacin, azithromycin, and metronidazole is particularly concerning given the importance of preserving their effectiveness.

Among examined associated factors, only the clinical scenario significantly influenced dispensing behavior, whereas pharmacy type, pharmacist availability, physical presence on duty, and inquiry practices did not. Similar patterns have been documented in simulated client studies elsewhere in Pakistan, including Lahore, where high proportions of antibiotics were supplied for pediatric diarrhea and respiratory infections despite absence of prescription [13]. International evidence from low- and middle-income countries shows comparable trends, including higher non-prescription access in parts of Eastern Europe compared with Western regions [14]. Multicenter work from Ethiopia documented widespread availability without authorization [15], and a broader systematic review across Sub-Saharan Africa identified routine supply without prescription as dominant practice [16]. A study in Arar, Saudi Arabia, reported that 77.5% of participants engaged in self-medication with antibiotics [17].

Multiple interacting drivers underpin these behaviors. Self-medication has repeatedly been identified as a central contributor to resistance, reinforcing inappropriate demand at pharmacy counters [9]. Qualitative studies from Iraq and Pakistan highlight strong customer expectations, fear of losing business, and commercial competition as motivators for dispensing despite regulatory restrictions [18]. Knowledge gaps among pharmacy staff also persist; surveys reveal uncertainty regarding appropriate indications, duration, and risks of antimicrobial therapy [19]. Where physician access is limited or costly, pharmacies often become the default first point of care, normalizing antibiotic supply for minor or viral illnesses.

Prescribing norms within the formal healthcare sector may further amplify this cycle. When patients receive antibiotics for conditions unlikely to benefit from them, they may interpret such treatment as routine and later seek the same drugs directly from pharmacies. Over time, this reinforces community beliefs that antibiotics are necessary solutions, particularly for respiratory symptoms.

In rural Pakistan, primary clinical care is largely delivered through Basic Health Units (BHUs) and Rural Health Centres (RHCs), which manage common infectious illnesses and issue prescriptions through on-site dispensaries [20]. Although pharmacies are not formally designated as primary healthcare providers, our findings indicate that they frequently function as de facto first-contact facilities for infectious complaints, undertaking clinical decision-making without the diagnostic capacity or safeguards expected in formal primary care environments.

A critical structural issue identified was the frequent absence of licensed pharmacists at the point of

dispensing, despite formal registration. Multiple surveys in Pakistan document low on-site pharmacist availability and frequent dispensing by non-pharmacist personnel [21]. This discrepancy between regulatory compliance "on paper" and operational reality represents a significant implementation gap in pharmaceutical governance. The absence of a qualified pharmacist increases the likelihood of inappropriate antibiotic supply, as non-pharmacist staff may lack the training necessary to evaluate indications, screen for contraindications, or enforce prescription requirements.

These findings underscore the need for stronger enforcement by DRAP and provincial health authorities to ensure pharmacist presence during operating hours [12]. Regulatory bodies must move beyond documentation-based compliance toward active inspections, attendance verification, and penalties for non-compliance. At the same time, dispensing staff should receive structured antimicrobial stewardship training, particularly for scenarios such as viral upper respiratory tract infections where antibiotics are not indicated.

However, regulatory interventions must be implemented cautiously. An immediate, strictly enforced ban on non-prescription antibiotic dispensing without improving access to qualified prescribers could unintentionally restrict treatment access in underserved areas. In many rural settings, pharmacies represent one of the few accessible healthcare touchpoints. Abrupt enforcement without strengthening BHUs, RHCs, and physician availability could delay care and worsen outcomes [22].

Public awareness remains a cornerstone of antimicrobial stewardship. Misconceptions regarding antibiotic effectiveness are widespread, with many individuals incorrectly believing antibiotics treat viral infections such as influenza and the common cold [23]. To address this concern, public education campaigns have been shown to improve knowledge and reduce inappropriate antibiotic use [24]. Global antimicrobial stewardship initiatives led by the WHO emphasize public education as a critical strategy to prevent antimicrobial resistance [25].

In addition to educational interventions, preventive public health measures should form part of national antimicrobial resistance strategies. Expanding vaccination coverage may complement antimicrobial stewardship efforts by preventing infections that would otherwise require antimicrobial treatment, thereby reducing antibiotic consumption and the selective pressure that drives antimicrobial resistance [26].

Digital transformation offers additional solutions. Electronic prescribing, centralized dispensing databases, and integrated medical records enable real-time surveillance and improve prescribing quality [27]. Evidence demonstrates that digital systems reduce antimicrobial use through clinical decision support and monitoring mechanisms [28]. Over time, integration of dispensing data into centralized platforms could strengthen accountability and regulatory oversight. In addition, stewardship programs may benefit from adopting structured quality-improvement methodologies that facilitate ongoing performance monitoring, identification of process variation, and continuous optimization of antimicrobial utilization practices [29].

A key finding was that approximately 70% of antibiotics were dispensed at demand level 1, immediately upon symptom presentation and without explicit patient request. This shows that dispensing was frequently unprompted by explicit patient demand, which may reflect habitual practice. Our data do not allow us to identify the underlying motivations, such as inventory or commercial pressures. Therefore, interventions focused solely on reducing patient demand may be insufficient; greater emphasis must be placed on pharmacy-level accountability and oversight.

Adaptive, risk-mitigation models may provide a pragmatic approach. Pharmacy-based testing-and-treat strategies using rapid antigen detection tests for streptococcal pharyngitis have demonstrated reductions in inappropriate prescribing while maintaining timely access [30]. Such models acknowledge existing care-seeking patterns while embedding objective safeguards.

A positive finding was that approximately 65% of antibiotic refusal cases involved referral advice to consult a physician. Identifying determinants of appropriate referral, such as pharmacist presence, stronger compliance culture, or affiliation with formal healthcare networks, could inform targeted stewardship interventions.

A phased regulatory strategy aligned with the WHO AWaRe classification [11] offers a scalable pathway. Monitoring and documentation requirements for Watch group antibiotics, stricter controls for Reserve group antibiotics, and preservation of Access group availability would balance stewardship with access. Pakistan's effective prescription controls for certain controlled substances demonstrate that structured regulatory mechanisms can function in pharmacy settings.

The economic burden of inappropriate dispensing is also measurable. In the viral URTI scenario, azithromycin, costing approximately PKR 480-600 per course (USD 1.72 to 2.15) under DRAP Maximum Retail Price notifications [31], was frequently supplied without indication. Across multiple encounters, this represents substantial unnecessary household expenditure. Conversely, inappropriate management of UTIs without adequate screening risks progression to severe infection, potentially leading to hospitalization and much higher costs. The WHO has emphasized that inappropriate antibiotic use accelerates resistance,

increases healthcare costs, and worsens outcomes globally [32].

Multiple defensive layers, including patient consultation behavior, pharmacist presence, clinical safety checks, and regulatory enforcement, appear simultaneously compromised. When these systemic gaps align, inappropriate antibiotic supply becomes highly probable. Strengthening each defensive layer is therefore essential.

Evidence indicates that change is achievable. Regulatory enforcement combined with educational interventions reduces non-prescription sales [33]. Multifaceted strategies involving training, supervision, and public engagement demonstrate measurable impact [34]. Addressing broader economic incentives and market pressures is also necessary to sustainably modify dispensing behavior [35].

This study has limitations. The lack of an official, up-to-date database of pharmacies and their locations. Despite repeated attempts, we were unable to obtain this information from the relevant health authorities. Therefore, Google Maps was used to identify pharmacies and determine their locations. This approach may have resulted in some pharmacies being missed, particularly those that were not listed or had outdated information on the platform.

Use of multiple simulated clients introduces potential inter-observer variability, and ICT-based findings may not capture nationwide heterogeneity. Additionally, all simulated encounters were conducted by male data collectors; gender dynamics may influence dispensing behavior. Future research should incorporate both male and female simulated clients. Furthermore, an additional limitation is that all simulated clients were medical students, which may have introduced clinical-familiarity bias not fully captured by scenario scripting. Despite standardized training on both symptom presentation and responses to pharmacist questioning, medical students may have unconsciously conveyed greater composure, precision, or health literacy than a typical lay patient, potentially altering pharmacist assessment and dispensing behavior. This limitation, compounded by the previously noted use of only male data collectors, may affect the generalizability of the observed dispensing rates to the broader patient population presenting at community pharmacies. Furthermore, simulated client identity was not included as a covariate or random effect in the regression analysis, so systematic differences in presentation style between the five volunteers cannot be excluded. Although all volunteers followed identical scripts, escalation sequences, and dress standards, and received structured training and supervision, residual inter-observer variability may have influenced dispensing outcomes.

A further limitation concerns the generalizability of our findings. ICT is Pakistan's highly urbanized federal capital and is likely to differ from many other parts of the country in ways that could influence dispensing behavior, including better access to healthcare facilities and qualified prescribers, higher literacy levels, and potentially closer proximity to regulatory authorities and oversight mechanisms. Where physician access is more limited and regulatory enforcement is weaker, pharmacies may function even more as first-contact providers, and the pressures to dispense without prescription may be greater. Our finding of 83.5% may therefore represent a conservative estimate of non-prescription antibiotic dispensing nationally, an interpretation that is consistent with the higher rate reported in the Hazara division [10]. However, we did not measure these contextual factors, and this interpretation remains speculative. Multi-region studies, including rural and peri-urban settings across provinces, are needed to establish the true national burden and to examine how healthcare access and regulatory context shape dispensing.

A notable finding was the comparatively lower non-prescription dispensing rate observed for the UTI scenario relative to URTI and GIT. However, this comparison should be interpreted with caution, as the UTI scenario differed structurally from the other two: it was presented as a proxy consultation on behalf of a diabetic mother, whereas the URTI and GIT scenarios were direct consultations for the simulated client's own symptoms. Both the proxy nature of the request and the disclosed comorbidity of diabetes represent potential confounding factors independent of the UTI symptom presentation itself. Pharmacists may exhibit greater caution when dispensing to a third party rather than the person present, and the disclosure of a chronic illness such as diabetes may prompt more conservative dispensing behaviour irrespective of the presenting complaint. Consequently, the lower dispensing rate observed for the UTI scenario cannot be attributed with confidence to a specific reluctance to dispense antibiotics for UTI symptoms, and may instead reflect pharmacist responses to the proxy consultation format or the stated comorbidity. This structural difference across scenarios limits the extent to which scenario-specific dispensing patterns can be directly compared, and future studies should consider standardizing consultation type (direct vs. proxy) and comorbidity disclosure across all clinical scenarios to isolate the effect of symptom presentation alone.

Despite these limitations, consistently high dispensing rates across scenarios indicate that unauthorized antibiotic supply is entrenched. Unnecessary antibiotic use for viral illnesses imposes avoidable financial burdens, absence of allergy screening increases risk of severe adverse reactions, and widespread exposure accelerates antimicrobial resistance. Coordinated regulatory strengthening, pharmacist oversight, public awareness, digital surveillance, and phased stewardship policies are urgently required to safeguard antibiotic effectiveness in Pakistan.

Conclusions

This study demonstrates widespread non-prescription antibiotic dispensing in community pharmacies of Islamabad, reflecting significant gaps in regulatory enforcement and antimicrobial stewardship. Despite existing guidelines by DRAP, antibiotics, particularly WHO Watch group agents, are routinely supplied without adequate clinical assessment, counseling, or pharmacist oversight. Dispensing behavior appears largely demand driven, with minimal influence from structural factors. These practices contribute to rising antimicrobial resistance and unnecessary economic burden. Addressing this issue requires a balanced, multi-level approach, including strengthened regulation, ensured pharmacist presence, targeted education, and public awareness initiatives aligned with WHO recommendations to preserve antibiotic effectiveness while maintaining access to care.

Appendices

DATA COLLECTION FORM

Number ( ) Scenario ( )TIME: Morning ☐ ☐ Noon Afternoon ☐

	Section A: Pharmacy Demographics			
1	Pharmacy Name:_____			
2	Pharmacy Type	☐ Chain Pharmacy	☐ Independent Pharmacy	
3	Pharmacy Location	☐ Urban	☐ Rural	
		☐ High Economic Level Area	☐ Lower Economic area	
		☐ Community	☐Shopping Mall ☐Medical Centre	Other_____
4	Pharmacist Availability	☐ Yes	☐ No	
	Section B: Information regarding Pharmacy Staff			
5	Gender	☐ Male	☐ Female	
	Age(Year)	☐ < 30	☐ 30-50	☐ >50
6	Is qualified person (Pharmacist) On duty?	☐ Yes	☐ No	
	Section C: Drug Information Related to Antibiotic Dispensing			
8	Any advance inquiry about patient's conditions	☐ Yes	☐ No	
9	Antibiotics dispense without prescription	☐ Yes	☐ No	
10	Below which demand lever were the antibiotic dispensed without a prescription?	1. Dispense antibiotics under first demand level i.e., level 1 2. Dispensed under second demand level 3. Dispensed under third demand level		
11	Generic Name(Brand) of dispensed antibiotic	_____Dose_____Duration_____Dosage Form____ _____Dose_____Duration_____Dosage Form____ _____Dose_____Duration_____Dosage Form____		Ask reason if not dispensed 1. Need Prescription to dispensed 2. Visit to physician 3. Be caution in using antibiotic 4. Other reason_____
12	Asked few more or less relevant questions	12.1 Asked for weather had used another drug 12.2 Asked for any other symptoms 12.3 Asked question regarding patient drug allergy		☐ Yes ☐ No ☐ Yes ☐ No ☐ Yes ☐ No
13	Any referral recommendation	☐ Yes	☐ No	
14	Counseling or advice provided on dispensed medication	Yes_____ Please record		☐ No
15	Alternative medicines dispensed in place of antibiotic	_____Dose_____Duration_____Dosage Form___ _____Dose_____Duration_____Dosage Form___ _____Dose_____Duration_____Dosage Form___		☐ No

FIGURE 4: Questionnaire used in the study

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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