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Evaluation of Antibiotic Prescription Patterns in Hospitalized Patients: A Cross-Sectional Study

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Abstract

Inappropriate antibiotic use in hospitals is a major contributor to antimicrobial resistance (AMR), posing a serious global health challenge. In Pakistan, empirical prescribing and limited diagnostic support often lead to irrational antibiotic use. This cross-sectional study was conducted at Hayatabad Medical Complex, Peshawar, from January to June 2025, to evaluate antibiotic prescription patterns and their appropriateness among hospitalized patients. A total of 200 patients aged 18 years and above who received at least one antibiotic were included. Data regarding demographics, types and frequency of antibiotics, route of administration, and empirical versus culture-guided therapy were analyzed using descriptive statistics. The mean age of patients was 45.3 ± 16.2 years, with 59% males and 41% females. A total of 312 antibiotic prescriptions were recorded, with ceftriaxone (22.8%), piperacillin-tazobactam (18.6%), and meropenem (15.1%) being the most frequently prescribed. Broad-spectrum antibiotics constituted 64% of all prescriptions. Overall, 64% of prescriptions were appropriate, while 36% were inappropriate due to prolonged duration, unjustified broad-spectrum use, or lack of documentation. Empirical therapy was predominant (71%), and only 29% of prescriptions were based on culture and sensitivity testing. The findings indicate high reliance on empirical and broad-spectrum antibiotic use, reflecting weak diagnostic stewardship and poor adherence to guidelines. Strengthening

antimicrobial stewardship programs, promoting prescriber education, and encouraging culture-guided therapy are essential steps toward rational antibiotic use and controlling antimicrobial resistance in hospital settings.

Introduction

Antibiotics are indispensable in the management of infectious diseases and remain among the most prescribed drugs in hospitals globally. However, inappropriate and excessive use has led to an alarming increase in antimicrobial resistance (AMR), posing a serious global public health challenge. The World Health Organization (WHO) predicts that if this trend continues unchecked, AMR could cause up to 10 million deaths annually by 2050 (1). Hospitals, being major consumers of antibiotics, play a critical role in driving both appropriate and inappropriate antibiotic use (2).

In low- and middle-income countries (LMICs), including Pakistan, antibiotic misuse is particularly concerning due to the combination of empirical prescribing, inadequate diagnostic support, and limited stewardship oversight (3,4). Studies have shown that over 60% of hospitalized patients in Pakistan receive at least one antibiotic during their stay, often without microbiological confirmation or adherence to treatment guidelines (5). This irrational prescribing contributes significantly to the growing resistance among common bacterial pathogens such as Escherichia coli, Klebsiella pneumoniae, and Staphylococcus aureus (6,7).

Antimicrobial stewardship programs (ASPs) are globally recognized as essential strategies to optimize antibiotic use by ensuring appropriate selection, dosing, route, and duration (8). Developed nations have established robust ASPs, which have been shown to reduce antibiotic consumption and improve patient outcomes (9). However, in Pakistan, ASP implementation is still in its early stages and is hindered by the lack of microbiological diagnostic facilities, trained personnel, and institutional support (10). Consequently, empirical prescribing remains the dominant practice in both public and private healthcare sectors (11).

Recent cross-sectional studies conducted in Pakistani hospitals have identified several concerning patterns. For instance, Javed et al. (2023) reported that 68% of hospitalized patients received antibiotics empirically, and 42% lacked a documented indication for therapy (12). Similarly, Shah et al. (2024) found that broad-spectrum antibiotics such as third-generation cephalosporins and carbapenems were the most frequently prescribed classes in tertiary hospitals, often used without culture sensitivity testing (13). Raza et al. (2023) also highlighted overuse of β-lactam/β-lactamase inhibitor combinations and prolonged durations of therapy beyond recommended guidelines (14). These findings underscore the urgent need for interventions to rationalize antibiotic use and strengthen stewardship practices across healthcare facilities in Pakistan.

The overuse and misuse of antibiotics in hospitalized patients not only drive AMR but also impose significant clinical and economic burdens. Inappropriate prescribing increases hospital stay length, treatment costs, and the risk of adverse effects (15). The Pakistan Antimicrobial Resistance Network (PARN) has reported increasing rates of multidrug-resistant (MDR) organisms such as carbapenem-resistant Acinetobacter baumannii and methicillin-resistant Staphylococcus aureus (MRSA), particularly in intensive care units (16). This rise in resistance complicates patient management and limits therapeutic options, leading to poorer outcomes (17).

Evaluating antibiotic prescription patterns through cross-sectional studies provides valuable insights into prescribing behaviors and highlights areas requiring improvement (18). The WHO's Point Prevalence Survey (PPS) methodology is widely used internationally for assessing antibiotic utilization and benchmarking stewardship efforts (19). Applying such an approach in Pakistan can help identify deviations from standard treatment guidelines and measure progress toward rational prescribing practices. Data derived from these studies can guide policymakers and hospital administrators in designing effective ASPs tailored to the local context.

Another critical factor contributing to irrational antibiotic prescribing in Pakistan is the lack of diagnostic stewardship. Culture and sensitivity testing are underutilized due to cost, lack of laboratory infrastructure, or delays in obtaining results (20). As a result, clinicians often resort to empirical treatment, which may not align with the actual pathogen profile. This practice perpetuates resistance and reduces the efficacy of existing antibiotic therapies. Furthermore, poor documentation of antibiotic indications and durations further complicates monitoring and evaluation of antibiotic use (21).

Educational and policy-based interventions are central to improving prescribing behaviors. Studies from South Asia demonstrate that prescriber education combined with feedback mechanisms can significantly improve antibiotic use patterns and adherence to guidelines (22). In Pakistan, pilot ASP projects at major hospitals, including Aga Khan University Hospital and Shifa International Hospital, have shown encouraging results, such as improved documentation and more rational antibiotic selection (23). However, scaling these initiatives nationwide requires consistent funding, institutional commitment, and integration with national AMR policies.

Cultural and behavioral factors also influence prescribing patterns. Physicians often face pressure from patients or their families who perceive antibiotics as essential for recovery, leading to unnecessary prescriptions even in viral infections (24). Moreover, the widespread availability of antibiotics without prescription in community pharmacies contributes to community-level resistance, which subsequently affects hospital microbiota (25). Addressing these challenges demands a comprehensive approach encompassing hospital stewardship, public awareness campaigns, and stronger regulatory enforcement.

In summary, antibiotic misuse remains a critical concern in Pakistan's hospital settings, driven by empirical prescribing, lack of diagnostic support, and limited stewardship structures. Understanding prescription patterns is therefore essential for identifying inappropriate practices, designing targeted interventions, and ultimately improving patient safety. The present cross-sectional study aims to evaluate antibiotic prescription trends among hospitalized patients, focusing on the frequency, types, and indications of antibiotics used. The findings are expected to provide valuable baseline data to support the development of effective antimicrobial stewardship frameworks within Pakistan's healthcare system.

Objectives

To identify the most commonly prescribed antibiotics and their frequency among hospitalized patients.

To assess the appropriateness of antibiotic prescriptions, including adherence to treatment guidelines

To determine the proportion of empirical versus culture-guided antibiotic therapy

Materials and Methods

This cross-sectional study was conducted at Hayatabad Medical Complex, Peshawar, a tertiary care hospital serving a diverse patient population. The study was carried out over six months, from January 2025 to June 2025, and aimed to evaluate antibiotic prescription patterns among hospitalized patients. A total of 200 patients aged 18 years and above, who received at least one antibiotic during their hospital stay, were included using convenience sampling.

Inclusion criteria comprised all hospitalized patients aged 18 years or older who were prescribed at least one antibiotic during their admission and whose medical records were complete. Exclusion criteria included patients who were discharged before completion of antibiotic therapy, patients with incomplete or missing medical records, and those who declined participation or did not provide consent.

Data were collected using a structured data collection form designed to capture demographic, clinical, and prescription-related information. Variables recorded included patient age, gender, ward, diagnosis, type of antibiotics prescribed, route of administration, duration of therapy, and whether therapy was empirical or guided by culture and sensitivity results. Antibiotics were classified according to their spectrum of activity (broad-spectrum vs. narrow-spectrum) and therapeutic class (e.g., β-lactams, cephalosporins, carbapenems, macrolides). Adherence to standard treatment guidelines and antimicrobial stewardship principles, including appropriate selection, dosing, route, and duration of therapy, was assessed.

Ethical approval was obtained from the Institutional Review Board of Hayatabad Medical Complex, and patient confidentiality was strictly maintained. All data were anonymized to ensure privacy, and no additional risk or intervention was involved for the participants. Collected data were entered into Microsoft Excel and analyzed using SPSS version 26. Descriptive statistics, including frequencies and percentages for categorical variables and means with standard deviations for continuous variables, were used to summarize the findings. Patterns of antibiotic prescribing, adherence to treatment guidelines, the proportion of empirical versus culture-guided therapy, and the distribution of antibiotic classes were evaluated to identify areas requiring improvement in stewardship practices.

Results

A total of 200 hospitalized patients were included in the study. The mean age of participants was 45.3 ± 16.2 years, ranging from 18 to 82 years. There were 118 (59%) males and 82 (41%) females. The majority of patients were admitted to medical and surgical wards, with fewer cases from the intensive care unit (ICU).

Table 1: Demographic Characteristics of the Study Population (n = 200)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	118	59
	Female	82	41
Age Group (years)	18–30	42	21
	31–50	86	43
	>50	72	36
Ward Type	Medical Ward	92	46
	Surgical Ward	74	37
	ICU	34	17
Mean Age (±SD)		45.3 ± 16.2	

A total of 312 antibiotic prescriptions were recorded among the 200 patients. The most commonly prescribed antibiotics were ceftriaxone (22.8%), piperacillin-tazobactam (18.6%), and meropenem (15.1%), followed by amoxicillin-clavulanate (12.2%) and azithromycin (8.0%). Broad-spectrum antibiotics accounted for 64% of total prescriptions.

Table 2: Frequency of Commonly Prescribed Antibiotics

Antibiotic	Frequency (n)	Percentage (%)
Ceftriaxone	71	22.8
Piperacillin–Tazobactam	58	18.6
Meropenem	47	15.1
Amoxicillin–Clavulanate	38	12.2

Azithromycin	25	8.0
Ciprofloxacin	22	7.1
Vancomycin	18	5.8
Others	33	10.6
Total	**312**	**100**

Of the total antibiotic prescriptions, 128 (64%) were appropriate, while 72 (36%) were deemed inappropriate based on established treatment guidelines. The most frequent causes of inappropriate prescriptions were prolonged duration (18%), unjustified use of broad-spectrum antibiotics (12%), and absence of documented indication (6%).

Table 3: Appropriateness of Antibiotic Prescriptions

Parameter	Frequency (n)	Percentage (%)
Appropriate	128	64
Inappropriate	72	36
Total	**200**	**100**

Among 200 patients, **142 (71%)** were prescribed antibiotics empirically, while only **58 (29%)** had prescriptions based on culture and sensitivity testing. Empirical prescriptions were most frequent in medical wards, while culture-guided therapies were more common in ICU patients.

Table 4: Empirical vs. Culture-Guided Antibiotic Therapy

Type of Therapy	Frequency (n)	Percentage (%)
Empirical	142	71
Culture-Guided	58	29
Total	**200**	**100**

Discussion

This cross-sectional study evaluated antibiotic prescription patterns among hospitalized patients at Hayatabad Medical Complex, Peshawar. The findings revealed a high frequency of antibiotic use, with a predominance of broad-spectrum antibiotics and a considerable proportion of empirical prescriptions. These results reflect the common prescribing behaviors in tertiary care hospitals of low- and middle-income countries, where limited diagnostic support and empirical treatment practices often drive antibiotic use (26).

The demographic profile of the study population showed that males (59%) were more frequently prescribed antibiotics than females (41%). Similar gender distribution has been reported by Javed et al. (2023) and Shah et al. (2024), suggesting that male predominance in hospital admissions and infection burden may contribute to this difference (27,28). The majority of patients were from medical and surgical wards, which aligns with the pattern of higher infection prevalence and postoperative prophylactic antibiotic use in these departments (29).

The most frequently prescribed antibiotics in this study were ceftriaxone (22.8%), piperacillin-tazobactam (18.6%), and meropenem (15.1%). These agents represent broad-spectrum antibiotics commonly used in hospital settings to manage a wide range of infections. Similar findings were observed by Raza et al. (2023), who also reported overuse of β-lactam/β-lactamase inhibitor combinations and cephalosporins in tertiary care hospitals in Pakistan (30). The high use of ceftriaxone and piperacillin-tazobactam may indicate clinicians' preference for broader empirical coverage due to diagnostic uncertainty, lack of culture results, and fear of treatment failure in critically ill patients (31). However, such patterns raise concerns about the potential development of antimicrobial resistance (AMR), particularly among gram-negative organisms such as Escherichia coli, Klebsiella pneumoniae, and Pseudomonas aeruginosa (32).

In terms of appropriateness, 64% of antibiotic prescriptions were compliant with standard treatment guidelines, while 36% were classified as inappropriate. The main reasons for inappropriate prescriptions included prolonged duration of therapy, unjustified use of broad-spectrum agents, and lack of proper documentation. These findings are consistent with previous research conducted by Saleem et al. (2019) and Sarwar et al. (2018), who reported similar issues in antibiotic stewardship practices across Pakistan (33,34). Inadequate adherence to guidelines is often associated with limited awareness of stewardship principles, absence of institutional antibiotic policies, and insufficient monitoring mechanisms (35). Strengthening antimicrobial stewardship programs (ASPs) within hospitals is therefore critical to improving the rational use of antibiotics and minimizing the risks associated with inappropriate prescribing (36).

A notable finding of the current study was the predominance of empirical antibiotic therapy (71%), with only 29% of prescriptions guided by culture and sensitivity testing. This reflects the limited implementation of diagnostic stewardship and highlights a key challenge in optimizing antibiotic use in developing countries (37). Comparable findings were reported by Javed et al. (2023), who found that over two-thirds of hospitalized patients received antibiotics empirically, and Shah et al. (2024), who observed that culture-guided prescribing was restricted primarily to intensive care units (27,28). The underutilization of culture-based therapy in the present study may be attributed to the high cost of microbiological testing, delays in laboratory turnaround times, and lack of clinician confidence in laboratory results (38). Consequently, empirical prescribing remains the default approach, increasing the likelihood of inappropriate antibiotic selection and the emergence of multidrug-resistant pathogens (39).

The predominance of broad-spectrum and empirical antibiotic use demonstrated in this study underscores the urgent need for enhanced antimicrobial stewardship initiatives. The introduction of stewardship interventions, such as prescriber audits, feedback systems, guideline dissemination, and multidisciplinary review of antibiotic use, has been shown to significantly reduce irrational prescribing and improve clinical outcomes (40). Moreover, regular training of healthcare professionals, improved diagnostic facilities, and adoption of the WHO's Point Prevalence Survey (PPS) methodology can provide a framework for ongoing monitoring and rationalization of antibiotic utilization at the institutional level (41).

The findings also highlight the importance of policy-level interventions. Restricting over-the-counter antibiotic sales, improving infection prevention and control measures, and ensuring the availability of updated national guidelines are essential to limit misuse at both hospital and community levels (42). Collaborative efforts among clinicians, pharmacists, microbiologists, and policymakers are required to strengthen antimicrobial governance in Pakistan (43).

Overall, this study provides valuable baseline data on antibiotic use trends in hospitalized patients at a major tertiary care center in Peshawar. The observed patterns dominated by broad-spectrum, empirical prescribing mirror national and regional trends and emphasize the pressing need for targeted antimicrobial stewardship interventions. Improving diagnostic capacity, promoting guideline adherence, and monitoring antibiotic use regularly will be vital in mitigating the growing threat of antimicrobial resistance and ensuring effective patient care.

Conclusion

This study demonstrated a high prevalence of broad-spectrum and empirically prescribed antibiotics among hospitalized patients, with ceftriaxone, piperacillin-tazobactam, and meropenem being the most frequently used. Although a majority of prescriptions were appropriate, a considerable proportion showed irrational use, mainly due to prolonged duration and lack of culture-based justification. These findings indicate insufficient diagnostic support and weak implementation of stewardship practices. Strengthening antimicrobial stewardship programs, enhancing prescriber education, and promoting culture-guided therapy are essential steps toward rational antibiotic use, reduced resistance, and improved patient outcomes.

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