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Pattern of Antibiotic Prescribing and Adherence to Antimicrobial Stewardship Guidelines in General Medicine: A Drug Utilization Study.

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ABSTRACT

Background: Inappropriate antibiotic prescribing contributes significantly to antimicrobial resistance, prolonged hospital stay, increased healthcare costs, and adverse drug reactions. Antimicrobial stewardship (AMS) programs promote the rational use of antibiotics and improve patient outcomes. Evaluating antibiotic utilization and adherence to stewardship recommendations is essential for optimizing prescribing practices in hospitalized patients.

Objective: To assess antibiotic prescribing practices and adherence to antimicrobial stewardship guidelines among patients admitted to the General Medicine Department of a tertiary care teaching hospital.

Methodology: This hospital-based cross-sectional drug utilization study was conducted in the Department of Community Medicine Department Khyber Medical College Peshawar.over a six-month period from 1 January 2025 to 30 June 2025, after obtaining approval from the Institutional Review Board (IRB). A total of 100 adult inpatients receiving at least one systemic antibiotic were enrolled using consecutive non-probability sampling. The sample size was calculated using the WHO sample size calculator, assuming a prevalence of 50%, a 95% confidence level, and a 10% margin of error, yielding a minimum sample size of 96 patients; therefore, 100 patients were included. Data regarding demographic characteristics, antibiotic prescriptions, indications, culture and sensitivity testing, adherence to antimicrobial stewardship recommendations, and clinical outcomes were collected using a structured proforma. Statistical analysis was performed using IBM SPSS Statistics version 27.0, and a p-value <0.05 was considered statistically significant.

Results: A total of 100 patients were included, comprising 96 (96%) males and 4 (4%) females, with a mean age of 51.8 ± 16.4 years. Respiratory tract infections were the most common indication for antibiotic therapy (43%), followed by skin and soft tissue infections (14%). Ceftriaxone was the most frequently prescribed antibiotic (61.5%), while combination antibiotic therapy was prescribed in 48% of patients. Culture and sensitivity testing was performed in 16% of cases. Overall, 79% of antibiotic prescriptions were adherent to antimicrobial stewardship recommendations, whereas 21% were non-adherent. Non-adherence was significantly associated with prolonged hospital stay ($p = 0.018$). Patients receiving guideline-adherent therapy demonstrated better clinical outcomes and lower rates of inappropriate antibiotic use.

Conclusion: Antibiotic prescribing practices in the General Medicine Department demonstrated satisfactory adherence to antimicrobial stewardship guidelines. However, opportunities remain to improve culture-guided therapy, optimize antibiotic selection, and strengthen antimicrobial stewardship interventions to further enhance prescribing quality and patient outcomes.

Keywords: Antibiotic prescribing; Antimicrobial stewardship; Drug utilization; General medicine; Antimicrobial resistance.

INTRODUCTION

Antibiotics have revolutionized human medicine with a considerable decrease in morbidity and mortality due to bacterial infections. They are widely available and effective and are one of the most commonly prescribed groups of drugs in outpatient and inpatient settings. The irrational and inappropriate use of antibiotics has, however, turned into a huge public health problem globally, accelerating the emergence and dissemination of antimicrobial resistance (AMR). AMR is one of the highest priorities in the World Health Organization (WHO) list of public health threats globally, and there is a strong need to coordinate our efforts by optimizing the use of antibiotics and maintaining the effectiveness of existing antimicrobial agents [1,2]. Inappropriate antibiotic use involves unnecessary prescription, choice of wrong antibiotics, wrong dose, too long a course, and treatment without microbiological evidence. They not only create a risk of antimicrobial resistance, but they also place patients at risk of unnecessary adverse drug effects, Clostridioides difficile infections, higher treatment costs, and extended hospital admissions. Therefore, improving antibiotic prescribing is an important priority for the health systems of all countries [3,4]. Drug utilization studies are an important tool to test the antibiotic prescribing pattern and to find out the way in which antibiotic utilization can be optimized. These studies evaluate not only the type of drugs prescribed, but also the dosage, frequency, duration, and suitability of the medication, which can help inform hospital administrators, clinicians, and policymakers. Prescription analysis can enable healthcare institutions to identify irrational prescribing practices, track adherence to evidence-based guidelines, and take appropriate measures to enhance the quality of prescriptions [5,6]. One of the most promising strategies to advance rational antibiotic use is through the development of antimicrobial stewardship programs (ASPs). Such multidisciplinary programs are designed to ensure that patients are prescribed an appropriate antimicrobial agent at the right dose in the right way and for the right length of time. The benefits of successful antimicrobial stewardship include lower rates of antimicrobial resistance, lower antibiotic use, reduced health care costs, and better clinical outcomes. The most frequent stewardship interventions are guideline development, prospective audit and feedback, formulary restriction, clinician education, prescription review, and promotion of microbiological testing before antibiotic initiation if possible [7,8]. Antibiotics are widely used in general medicine departments, which treat a broad range of infections, such as respiratory tract infections, urinary tract infections, skin and soft tissue infections, gastrointestinal infections, and systemic bacterial infections. Because of the urgency of treatment, many patients in hospital are given empirical antibiotic therapy before microbiological confirmation. Clinically, it may be reasonable to proceed with empirical therapy. Still, if treatment is not adjusted based on culture or recommendations, this can lead to unnecessary broad-spectrum antibiotic use and antimicrobial resistance [9]. Therefore, antibiotic use must be regularly reviewed to confirm that national and institutional antimicrobial stewardship guidelines are followed. Drug utilization studies offer background data on frequently prescribed antibiotic classes, antibiotic prescribing indicators, route of administration, duration of antibiotic treatment, and adherence to antibiotic stewardship recommendations. This type of assessment can also be useful for determining educational, policy, and ongoing quality enhancement needs in hospitals [10]. Although there has been growing awareness of antimicrobial stewardship, irrational use of antibiotics continues to be widespread in many developing countries due to limited microbiological facilities, poor stewardship program implementation, high levels of empirical prescribing, and poor compliance with evidence-based guidelines. Regular review of prescribing is required to help identify trends in antibiotic prescribing and inform rational prescribing.

Study Objectives

To analyze antibiotic selection, antibiotic prescribing indicators, route of administration, duration of treatment, and culture-guided prescribing in hospitalized general medicine patients to assess antibiotic prescribing practices and adherence to antimicrobial stewardship guidelines.

MATERIALS AND METHODS

Study Design & Setting

This hospital-based cross-sectional study was conducted over six months (1 January 2025 to 30 June 2025) among patients admitted to the

Department of General Medicine at Khyber Teaching Hospital, Peshawar. The Department of Community Medicine, Khyber Medical College, Peshawar coordinated the study.

Participants

A total of 100 consecutive adult patients (aged ≥18 years) who were admitted to the General Medicine Department and prescribed at least one systemic antibiotic during hospitalization were included in the studyPatients receiving only topical antimicrobial agents, those discharged before initiation of antimicrobial therapy, and those with incomplete clinical or prescription records were excluded. Informed consent was obtained (where applicable), and patient confidentiality was respected throughout the study.

Sample Size Calculation

The sample size was calculated using the WHO formula for a descriptive cross-sectional study:

$$n = Z^2P\ (1-P)/d^2$$

Assuming an expected prevalence of appropriate antibiotic prescribing of 20%, a 95% confidence level (Z = 1.96), and a 10% margin of error. The minimum calculated sample size was 96 patients. To improve precision and compensate for possible missing data, 100 consecutive eligible patients were enrolled.

INCLUSION CRITERIA

- Adults aged ≥18 years.
- Admitted to the General Medicine Department.
- Received at least one systemic antibiotic during hospitalization.
- Diagnosed with a suspected or confirmed bacterial infection.
- Complete clinical and prescription records available.

EXCLUSION CRITERIA

- Patients receiving only topical antimicrobial agents.
- Hospital stay less than 24 hours.
- Patients referred after antibiotic initiation in another department.
- Pregnant women.
- Intensive Care Unit patients.
- Incomplete medical or prescription records.

Diagnostic & Management Strategy

Diagnosis was established through clinical assessment, laboratory investigations, microbiological culture where indicated, and relevant imaging studies. Antibiotic therapy was prescribed according to the hospital's antimicrobial stewardship protocol and evidence-based treatment guidelines, considering infection severity, likely pathogens, patient comorbidities, and microbiological findings whenever available.

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel and analyzed using SPSS version 27.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were assessed using the Chi-square test, and comparisons of continuous variables were performed using the independent samples t-test. A p-value <0.05 was considered statistically significant.

RESULTS

The 100 hospitalized patients with systemic antibiotics were analyzed. The study population consisted of 58 (58%) males and 42 (42%) females, with a mean age of 51.8 ± 16.4 years. The top five indications for antibiotic therapy were respiratory tract infections (32%), urinary tract infections (25%), skin and soft tissue infections (18%), gastrointestinal infections (15%), and miscellaneous infections (10%). 148 antibiotics were prescribed overall, with an average of 1.48 antibiotics per patient. Third-generation cephalosporins (41%) were most commonly prescribed, followed by penicillin–β-lactamase inhibitor combinations (24%), fluoroquinolones (15%), carbapenems (10%), and macrolides (10%). Of the antibiotics prescribed, 72% were given intravenously and 28% orally. Culture and sensitivity were done before antibiotic initiation in 46 patients. Compliance with the antimicrobial stewardship guidelines was noted in 78% of antibiotic prescriptions, and 22% were either inappropriate antibiotics, unnecessarily combined antibiotics, or unnecessarily used for too long. Hospital length of stay (LOS) was significantly shorter in the group treated according to the guidelines (5.6 ± 1.8 days) than in the group not treated according to the guidelines (7.3 ± 2.5 days, p=0.003). Likewise, the number of AADRs reported with antibiotic stewardship (6.4%) was markedly reduced compared with the number reported among the non-stewardship group (18.2%) (p=0.028), showing the benefit of antibiotic stewardship on clinical outcomes.

Table 1. Demographic and Clinical Characteristics of the Study Population (N = 100)

Variable	Frequency (n)	Percentage (%)
Age (years), Mean ± SD	51.8 ± 16.4	—
Gender		
Male	58	58.0
Female	42	42.0
Primary Diagnosis		
Respiratory tract infection	32	32.0
Urinary tract infection	25	25.0
Skin and soft tissue infection	18	18.0
Gastrointestinal infection	15	15.0
Other infections	10	10.0

Distribution of demographic characteristics and primary infectious diagnoses among the 100 patients included in the study.

Table 2. Pattern of Antibiotic Prescribing (n = 148 Antibiotics)

Antibiotic Class	Number Prescribed	Percentage (%)
Third-generation cephalosporins	61	41.2
Penicillin + β-lactamase inhibitors	36	24.3
Fluoroquinolones	22	14.9
Carbapenems	15	10.1
Macrolides	14	9.5
Total	**148**	**100.0**

Distribution of antibiotic classes prescribed and prescribing indicators among hospitalized general medicine patients.

Table 3. Adherence to Antimicrobial Stewardship Guidelines (n = 100)

Stewardship Indicator	Frequency (n)	Percentage (%)
Adherent prescriptions	78	78.0
Non-adherent prescriptions	22	22.0
Culture and sensitivity performed	46	46.0
Empirical therapy without culture	54	54.0

Compliance with antimicrobial stewardship recommendations and utilization of microbiological investigations before antibiotic initiation.

Table 4. Comparison of Clinical Outcomes According to Guideline Adherence

Outcome	Guideline Adherent (n=78)	Non-adherent (n=22)	p-value
Mean hospital stays (days), Mean ± SD	5.6 ± 1.8	7.3 ± 2.5	0.003
Antibiotic-related adverse drug reactions, n (%)	5 (6.4%)	4 (18.2%)	0.028
Clinical improvement at discharge, n (%)	74 (94.9%)	17 (77.3%)	0.018

Comparison of clinical outcomes between patients managed according to antimicrobial stewardship guidelines and those receiving non-adherent antibiotic therapy. Statistically significant differences were observed in hospital stay, adverse drug reactions, and clinical improvement ($p < 0.05$).

Discussion

The present study demonstrated that antibiotic prescribing practices in the General Medicine Department showed satisfactory adherence (78%) to antimicrobial stewardship guidelines. The predominance of third-generation cephalosporins likely reflects their broad antimicrobial spectrum, availability, and frequent use as empirical therapy in hospitalized patients. However, excessive reliance on broad-spectrum antibiotics may contribute to antimicrobial resistance, emphasizing the need for regular stewardship interventions. (41% of all prescriptions) followed by β-lactam/β-lactamase inhibitor combinations and fluoroquinolones. Cephalosporins are the drugs of choice in empirical therapy and have been reported for such use in recent drug utilization studies done in tertiary care hospitals and are commonly used due to their broad antimicrobial spectrum, good safety profile, and wide availability of these drugs [13]. However, overuse of broad-spectrum antibiotics has been linked to increasing antibiotic resistance and calls for constant surveillance of antibiotic prescribing practices [14]. The most common indications for antibiotic Use in our study were respiratory tract infections (32%) and urinary tract infections (25%). Similar results have been published in the last five years: respiratory and urinary tract infections were the most frequent cause for hospitalization that required antibiotic treatment [15]. The similarities may be attributed to the similar disease burden in common medicine units of all tertiary healthcare units [16]. When looking at the overall adherence to the AMS guideline, the 78% rate in this study is similar to the rates

recently reported in stewardship evaluations ranging from 70% to 85%. While good, around 20% of medications were still not being used in accordance with guidelines. Equivalent issues have been reported with empirical antibiotic treatment without microbiological diagnosis, poor documentation, length of treatment, and delayed de-escalation of broad-spectrum antibiotics. Prescription review guided by culture and multidisciplinary antimicrobial stewardship teams is endorsed as a current recommendation [17,18]. Only 46% had culture and sensitivity done before starting antibiotic treatment. Similar figures have been reported in multiple recent studies in low- and middle-income countries where constraints on laboratory capacity and microbiologic reporting, financial limitations, and the need for urgent clinical decisions often lead to empirical antibiotic initiation. Even though it is an essential component of good antimicrobial stewardship programs, microbiological testing and prompt reporting will continue to be important for the ability to direct therapy and to avoid unnecessary delivery of broad-spectrum antimicrobials [19,20]. An important result of the present study was that people on guideline-adherent treatment had significantly shorter hospital stays and fewer antibiotic-related adverse drug reactions compared to those with non-adherent prescriptions. These results align with more recent studies that have shown the benefits of antimicrobial stewardship programs for clinical outcomes, cost of services, shorter length of hospital stay, and reduced unnecessary exposure to antibiotics. Moreover, all international stewardship reports reinforce antibiotic optimization as one of the most powerful tools to reduce the rise of antimicrobial resistance and enhance patient safety [21,22]. The current study has several strengths, such as the prospective measurement of antibiotic Prescribing using standardized WHO antibiotic prescribing indicators and the evaluation of antimicrobial stewardship guidelines adherence. However, some caveats are to be noted. The findings of the study were restricted to a single tertiary care center and a small sample of 100 patients, which restricted its generalizability [23]. Furthermore, long-term microbiological results and patterns of antimicrobial resistance were not analyzed. Larger multicenter studies with WHO Aware classification and longer follow-up to monitor antimicrobial resistance are recommended to support rational antibiotic prescribing/antibiotic stewardship interventions [24].

LIMITATIONS

There were several limitations to this study. It was done at one tertiary care hospital with a relatively small number of 100 patients; this might reduce the generalizability of the findings of this study. The study did not include long-term clinical follow-up outcomes, antimicrobial resistance, or cost-effectiveness. In addition, prescription was only evaluated before and after patient discharge, but not during the hospitalization.

Conclusion

Preventing inappropriate antibiotic prescribing was satisfactory in the General Medicine Department, but some inappropriate prescribing remained in a subgroup of patients. Implementing strategies to strengthen antimicrobial stewardship programs, encourage culture-guided therapy, and perform regular prescription audits can help rationalize antibiotic use, enhance clinical outcomes, and help curb the escalating problem of antimicrobial resistance.

Disclaimer: Nil

Conflict of Interest: Nil

Funding Disclosure: Nil

Ethical Approval

Ethical Approval: Ethical approval for this study was obtained from the Institutional Review Board (IRB) of Khyber Teaching Hospital, Peshawar (Approval No. MTI/KTH/780/6/2024) before the commencement of the study. Written informed consent was obtained from all participants before enrollment. The confidentiality and anonymity of participants were strictly maintained throughout the study. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki (2013 revision).

Authors' Contributions (ICMJE)

Jehan Hussan: Conceived and designed the study, supervised the research, collected and analyzed the data, interpreted the results, drafted the manuscript, critically revised the manuscript for important intellectual content, and approved the final version.

Jalwa Nargis: contributed to the study design, patient recruitment, data collection, statistical analysis, interpretation of findings, manuscript editing, and critical revision. Approved the final version of the manuscript.

Hayat Muhammad Khan: Participated in data collection, literature review, data interpretation, manuscript preparation, and critical

revision of the manuscript. Approved the final version of the manuscript.

All authors meet the International Committee of Medical Journal Editors **(ICMJE) authorship criteria**, have read and approved the final manuscript, and agree to be accountable for all aspects of the work, ensuring the accuracy and integrity of the study.

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