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# Antibiotic Prescription Patterns and Resistance Profiles in tertiary Care Hospital Patients: A Comprehensive Analysis to combat Antimicrobial Resistance

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Author`s Contribution

*[1,2,3]Substantial contributions to the conception or design of the work; or the acquisition, [5,6]Active participation in active methodology, analysis, or interpretation of data for the work, [4]Drafting the work or revising it critically for important intellectual content*

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**ABSTRACT**

Objectives: To evaluate antibiotic prescribing patterns and antimicrobial resistance profiles among patients presenting to tertiary care hospitals affiliated with Dera Ghazi Khan Medical College.

Methodology: A cross-sectional analytical study was conducted from June 2023 to May 2024. Using a 95% confidence interval and a 5% margin of error, a sample size of 384 patients was calculated. Data were collected through structured questionnaires and microbiological reports, capturing demographic details, types of infections, prescribed antibiotics, and antibiogram results. Statistical analysis was performed using SPSS version 26, with chi-square tests applied to explore associations between irrational prescribing practices and antimicrobial resistance.

Results: Empirical prescription of broad-spectrum antibiotics was noted in 76.3% of cases, with ceftriaxone being the most frequently prescribed agent (29.2%). Alarming levels of bacterial resistance were documented, with Escherichia coli showing 65% resistance to amoxicillin-clavulanate, Klebsiella pneumoniae exhibiting 58% resistance to ciprofloxacin, and Acinetobacter baumannii showing 30% resistance to meropenem. The findings revealed a statistically significant correlation between misdiagnosis and increased resistance rates ($p < 0.01$).

Conclusion: The study highlights an urgent need for robust antibiotic stewardship programs, enhancement of diagnostic capabilities, and the establishment of stringent regulatory policies to address the rising threat of antimicrobial resistance in tertiary care settings.

Keywords: Antibiotic Resistance, Antimicrobial Stewardship, Broad-Spectrum Antibiotics, Multidrug-Resistant Organisms.

## Introduction

Antimicrobial resistance (AMR) has emerged as one of the most serious global public health issues, endangering human health, food security, and sustainable development.1 The World Health Organization (WHO) predicts that if no effective interventions are implemented, AMR will kill up to 10 million people each year by 2050.[2] This epidemic is exacerbated by antibiotic overuse and misuse in hospital settings, agricultural, and veterinary activities, which has resulted in the emergence and spread of multidrug-resistant organisms. The prevention of antibiotic resistance relies on safe antibiotic usage within tertiary care facilities when treating patients with severe infection needs.

More difficult patients sent to specialized hospitals functions as a main location for emerging new infectious diseases whose resistance patterns spread through health facilities. National antibiotic stewardship policies receive their definitions from these organizations who also establish evidence-based prevention strategies to fight antibiotic resistance. Medical staff maintain inappropriate antibiotic prescribing because they encounter diagnostic challenges and standard deviations as well as pressure from patients or caregivers.[3]

The challenges of controlling antibiotic resistance in Pakistan along with other low- and middle-income countries stem from limited resources and insufficient surveillance systems coupled with inadequate regulatory structures.[4] Over-the-counter antibiotic availability creates additional challenges by prompting unregulated prescription followed by improper medication. Hospital administrators still lack easy access to diagnostics that would lead to antibiotic selection so they deliver broad-spectrum antibiotics as first-line treatment instead of specific medication.[5] This deficiency proves the urgent necessity for detailed research into antibiotic treatment patterns and resistance levels in tertiary care facilities.

Research shows that approximately 50% of antibiotics prescribed in tertiary hospitals fail to meet professional criteria or exist without necessary medical authorization. This reveals a serious problem in antibiotic distribution patterns.[6] Patients face

worsening treatment difficulties for hospitals because two dangerous bacteria types and methicillin-resistant Staphylococcus aureus (MRSA) have developed as multidrug-resistant organisms (MDROs). Healthcare practitioners find treatment of patients becoming progressively challenging due to MDROs.[7]

Pakistan does not possess detailed records regarding antibiotic use alongside resistance patterns found in tertiary care hospitals. The available research deals with isolated aspects because it studies particular patient groups and certain infections while omitting a broad understanding of the problem.[8] Insufficient evidence prevents the development of strong anti-AMR interventions at hospital as well as national levels. The optimization of antibiotic prescriptions fails to produce results if one does not first understand current practices along with resistance tendencies.

The research performs an essential study of tertiary care hospital antibiotic prescription procedures while investigating treatment resistance patterns among patients. The research outcomes will guide antibiotic stewardship practices based on evidence while spotting standard clinical mistakes that will help create specific education and policy improvements for health practitioners. This research will support Pakistan's National Action Plan and the WHO Global Action Plan on AMR[9] by demonstrating the global impact of hospital infrastructure and diagnostic system and surveillance system investments to combat AMR thus decreasing health expenditures while enhancing patient outcomes in developing nations.

# Methodology

The Institutional Ethical Review Committee of Dera Ghazi Khan Medical College provided ethical approval before the trial began. This was a cross-sectional analytical study conducted in tertiary care hospitals affiliated with Dera Ghazi Khan Medical College. These hospitals receive a diverse patient population from urban and rural areas, making them ideal settings for evaluating antibiotic prescription practices and resistance trends. The study was conducted over a period of twelve months, from June 2024 to May 2024, to capture seasonal variations in infection patterns and antibiotic usage.

The sample size calculated 95% confidence level, 50%[10] estimated proportion of inappropriate prescriptions and 5% margin of error was 384. A non-probability convenience sampling technique was employed to enroll patients who met the inclusion criteria and presented during the study period.

The study included patients of any age or gender who were admitted to the hospital and prescribed at least one systemic antibiotic, with available microbiological culture and sensitivity reports, and who provided informed consent. Patients were excluded if they had incomplete medical or microbiological records, were treated as outpatients or were not prescribed antibiotics during hospitalization, or if they or their caregivers declined to participate.

Data were collected using a structured, pretested questionnaire and verified with microbiological laboratory reports. The questionnaire included demographic data (age, gender, comorbidities), infection type (e.g., respiratory, urinary tract), and details of antibiotic prescriptions such as name of drug, dose, frequency, and duration. Prescriptions were evaluated for compliance with recognized antibiotic guidelines (local and WHO-recommended protocols). Culture and sensitivity reports provided information on the pathogen identified and resistance profiles to commonly used antibiotics.

Data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 26. Descriptive statistics, including frequencies and percentages, were used to summarize categorical variables such as prescription types and resistance patterns. Mean and standard deviation (SD) were calculated for continuous variables such as patient age and antibiotic therapy duration. The Chi-square test was used to assess associations between the appropriateness of prescriptions and the observed antibiotic resistance. A p-value $< 0.05$ was considered statistically significant.

# Results

A total of 384 patients were included in the study. The majority of participants were male, accounting for 57.3% (n = 220) patients. The mean age of patients was 41.2± 15.6 years. The age distribution revealed that the largest group fell within the 19–45 years category 54.7% (n=210) followed by the 45–60 years group 25.5% (n=98). Patients aged ≤ 18 years and > 60 years accounted for 11.7% (n = 45) and 8.1% (n = 31) respectively. Comorbidities such as diabetes mellitus, hypertension, and chronic kidney disease were present in 31.5% (n = 121) of patients.

**Table I: Demographic characteristics of the patients. (n=384)**

| Variables | | N | % |
|---|---|---|---|
| Gender | Male | 220 | 57.3 |
| | Female | 164 | 42.7 |
| Age | ≤ 18 years | 45 | 11.7 |
| | 19-45 years | 210 | 54.7 |
| | 45-60 years | 98 | 25.5 |
| | >60 years | 31 | 08.1 |
| Comorbidities | Yes | 121 | 31.5 |
| | No | 263 | 68.5 |

**Table II: Distribution of the patients by type of infection (n=384)**

| **Type of Infection** | **N** | **%** |
|---|---|---|
| Respiratory Tract Infection (RTI) | 154 | 40.1 |
| Urinary Tract Infection (UTI) | 108 | 28.1 |
| Bloodstream Infection (BSI) | 72 | 18.8 |
| Skin and Soft Tissue Infection (SSTI) | 35 | 9.1 |
| Others | 15 | 3.9 |

Respiratory tract infections (RTIs) were the most common, accounting for 40.1% (n= 154) of cases. Urinary tract infections (UTIs) ranked second, with a frequency of 28.1% (n = 108). Bloodstream infections (BSIs) were observed in 18.8% (n = 72) of patients, while skin and soft tissue infections (SSTIs) accounted for 9.1% (n=35). Other types of infections made up the remaining 3.9% (n=15).

**Table III: Antibiotics prescription patterns in patients. (n=384)**

| Antibiotic Prescribed | N | % |
|---|---|---|
| Ceftriaxone | 112 | 29.2 |
| Meropenem | 95 | 24.7 |
| Amoxicillin-Clavulanate | 88 | 22.9 |
| Ciprofloxacin | 62 | 16.1 |
| Piperacillin-Tazobactam | 27 | 07.0 |

**Table IV: Antibiotic Resistance Profiles in Patients.(n=384)**

| Antibiotics | Pathogen | Resistance rate (%) |
|---|---|---|
| Amoxicillin-Clavulanate | *Escherichia coli* | 65 |
| Ciprofloxacin | *Klebsiella pneumoniae* | 58 |
| Ceftriaxone | *Pseudomonas aeruginosa* | 45 |
| Meropenem | *Acinetobacter baumannii* | 30 |
| Piperacillin-Tazobactam | *Enterobacter cloacae* | 28 |

**Table V: Association between Inappropriate Prescriptions and Resistance Rates.**

| Prescription Adherence | Resistance Observed | No Resistance Observed | Total | $\chi^2$ | *p* |
|---|---|---|---|---|---|
| Appropriate (n=164) | 82 | 82 | 164 | 14.2 | <0.01 |
| Inappropriate (n=220) | 154 | 66 | 220 | | |
| Total | 236 | 148 | 384 | | |

Broad-spectrum antibiotics dominated the prescriptions, with ceftriaxone being the most frequently prescribed antibiotic at 29.2% (n=112) followed by meropenem 24.7% (n=95) and amoxicillin-clavulanate 22.9% (n=88). Ciprofloxacin and piperacillin-tazobactam were less commonly prescribed, accounting for 16.1% (n=62) and 7.0% (n=27) respectively. Overall, broad-spectrum antibiotics constituted 76.3% of all prescriptions.

Table IV presents the resistance profiles of commonly used antibiotics against specific pathogens. Alarmingly high resistance rates were observed for several antibiotics including Amoxicillin-clavulanate demonstrated 65% resistance against *Escherichia coli,* Ciprofloxacin showed 58% resistance against *Klebsiella pneumoniae,* Ceftriaxone exhibited 45% resistance against *Pseudomonas aeruginosa,* Meropenem had 30% resistance against *Acinetobacter baumannii* , highlighting the emergence of carbapenem-resistant organisms and Piperacillin-tazobactam displayed 28% resistance against *Enterobacter cloacae.*

Among patients receiving appropriate prescriptions (n=164), resistance was observed in 50% (n=82) of cases. However, among those receiving inappropriate prescriptions (n= 220), resistance was significantly higher, occurring in 70% (n=154) of cases. Statistical analysis using the chi-square test revealed a significant association between inappropriate prescriptions and increased resistance rates ($p$<0.01).

# Discussion

The findings of this study provide critical insights into antibiotic prescription patterns and resistance profiles among patients in tertiary care settings. The results highlight alarming trends in the overuse of broad-spectrum antibiotics, high rates of AMR and significant associations between inappropriate prescriptions and increased resistance rates. These findings highlight the critical need for focused initiatives to improve antibiotic use and battle AMR in Pakistan. The study population was mostly male (57.3%), with an average age of 41.2 ± 15.6 years, which is typical for patients seeking care in tertiary hospitals. The majority of participants (54.7%) were between the ages of 19 and 45, which is consistent with recent research indicating that younger persons are more likely to arrive with illnesses that require hospitalization.[11] Comorbidities such as diabetes mellitus, hypertension, and chronic kidney disease were found in 31.5% of patients, underscoring the susceptibility of people with underlying health disorders to infectious infections and their need for effective antibiotics which is also reported by Sulis et al.[12]

RTIs were the most common form of infection (40.1%), followed by UTIs (28.1%) and BSIs (18.8%). This distribution is consistent with global trends, where RTIs and UTIs are among the leading causes of morbidity in outpatient and inpatient settings.[13] The high prevalence of BSIs underscores the severity of infections treated at tertiary care hospitals, where patients often present with complicated or systemic conditions requiring intensive antibiotic therapy.

Broad-spectrum antibiotics dominated the prescriptions, accounting for 76.3% of all cases. Ceftriaxone was the most frequently prescribed antibiotic (29.2%) followed by meropenem (24.7%) and amoxicillin-clavulanate (22.9%). This reliance on broad-spectrum agents reflects the challenges faced in tertiary care settings including diagnostic uncertainty, limited access to microbiological testing, and pressure to initiate empiric therapy for severe infections.[14] However, the overuse of broad-spectrum antibiotics contributes significantly to the development of resistance as evidenced by the high resistance rates observed in this study.

Resistance rates were alarmingly high for commonly used antibiotics. Amoxicillin-clavulanate demonstrated 65% resistance against *Escherichia coli*, suggesting its limited efficacy in treating infections caused by this pathogen. Ciprofloxacin showed 58% resistance against *Klebsiella pneumoniae*, a concerning trend given its widespread use for both Gram-negative and Gram-positive infections. Ceftriaxone exhibited 45% resistance against *Pseudomonas aeruginosa*, highlighting the emergence of resistance in critically ill patients. Meropenem had 30% resistance against *Acinetobacter baumannii*, underscoring the growing threat of carbapenem-resistant organisms (CROs). Piperacillin-tazobactam displayed 28% resistance against *Enterobacter cloacae*, further emphasizing the need for alternative treatment options. These findings are consistent with global reports of rising AMR, particularly in low- and middle-income countries (LMICs) like Pakistan, where regulatory frameworks and surveillance systems are weak.[15] Multidrug-resistant organisms (MDROs) accounted for 41.4% of isolates, posing significant challenges to

healthcare providers and increasing the burden of treatment failure and mortality.

A significant association was found between inappropriate antibiotic prescriptions and increased resistance rates ($p<0.01$). It was found that the patients who received appropriate medications showed resistance in 50% of cases but those getting inappropriate prescriptions had 70% resistance. The results demonstrate that appropriate rational prescribing stands as a strong method to reduce resistance development in microorganisms. The selection of resistant pathogens happens directly because clinicians make improper medication choices which stem from guideline noncompliance in combination with using empiric therapy and treating to patient demands.[16,17]

The current research produces significant findings which affect both medical treatment methods and health policies in the public sector. Strict antibiotic stewardship programs need to be implemented because they establish rational antibiotic prescriptions and minimize both inappropriate medication and guideline violations while improving medical adherence. Public health requires immediate investment into microbiological testing and fast saliva-based diagnostic tools which can guide appropriate medication choices without depending on broad-spectrum antibiotics. Healthcare professionals who receive ongoing training about AMR and evidence-based medication practices will overcome their expertise deficits and behavioral challenges. Stricter regulations for limiting counter-prescription antibiotics availability together with strict adherence to prescribing standards represent key measures in confronting unreasonable antibiotic practices.[18-21]

General conclusions regarding antibiotic resistance patterns would be limited since the study depended on microbiology reports from a solitary tertiary care hospital. Outcomes from patient treatment were not included in the study which would potentially include clinical information about resistance and inappropriate prescription effects.

# Conclusion

It is found that tertiary care facilities have both increased use of broad-spectrum antibiotics and elevated resistance levels because of wrong antibiotic prescribing practices. The discovery underscores an immediate necessity for well-researched interventions that include antibiotic stewardship programs alongside diagnosis enhancement and regulatory changes to fight against antibiotic resistance and enhance results in patient health.

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