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Antibiotic Susceptibility Patterns and Antimicrobial Prescription Trends in a Tertiary Care Hospital

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Abstract

Background:

Antibiotics are among the most commonly prescribed drugs in healthcare settings, but their inappropriate use contributes significantly to the rise of antimicrobial resistance (AMR). Monitoring antibiotic utilization patterns in tertiary care hospitals is essential to identify prescribing trends and inform strategies to promote rational use of antibiotics.

Objectives:

This study aimed to analyze the antibiotic utilization patterns and assess their appropriateness in a tertiary care teaching hospital in North India over one year.

Methods:

A prospective, observational study was conducted over 12 months in various clinical departments of the hospital. Patient demographics, clinical diagnoses, and antibiotic prescriptions were recorded and analyzed. Data on antibiotic prescribing were assessed for adherence to institutional and WHO guidelines. Specimens were collected for microbiological analysis, including culture and sensitivity testing, to correlate prescription patterns with susceptibility profiles.

Results:

A total of 100 patients receiving antibiotics were included in the study. The most commonly prescribed antibiotic classes were beta-lactams (40%), fluoroquinolones (25%), and aminoglycosides (15%). Multidrug-resistant organisms, including *Klebsiella pneumoniae* and *Escherichia coli*, were frequently isolated. Inappropriate antibiotic use, including prolonged duration and unwarranted combinations, was observed in cases.

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Conclusions:

The study highlights significant gaps in antibiotic prescribing practices and the need for targeted interventions to reduce empirical antibiotic use and ensure adherence to antimicrobial stewardship guidelines. The findings emphasize the importance of regular prescription audits and microbiological surveillance in combating AMR.

Keywords:

Antibiotic utilization, antimicrobial resistance, prescribing patterns, tertiary care hospital, antimicrobial stewardship

INTRODUCTION

Antimicrobials (AMA) have changed the outlook of physicians about the power of drugs on the diseases. Antimicrobials are the most common drugs, used for various life threatening and trivial infections. Their importance is magnified in the developing countries, where infective diseases are predominant.[1] But inappropriate and indiscriminate use of antimicrobials have lead to the emergence of antibiotic resistant strains, treatment failure and increase in mortality and morbidity.[2]

Antimicrobial treatment is crucial in preventing severe complications and mitigating the devastating consequences of various infections. However, the prescription are frequently administered empirically to provide broad coverage against Gram-positive and Gram-negative infections in surgical and non-surgical procedures.[3,4]

The indiscriminate use of broad-spectrum antibiotics poses additional challenges, including antibiotic misuse, unnecessary antibiotic-related side effects, increased antimicrobial resistance,and inflated treatment costs for hospitalized patients.[5,6] The escalating bacterial resistance poses significant challenge, ex acerbated by a decline in the discovery of new antibiotics.

In India, hospitals are witnessing alarming resistance levels to quinolones and carbapenems. Additionally, the utilization of last-resort antibiotics such as polymyxins has surged, alongside documented rises in resistance levels within healthcare settings. Consequently, there is a growing emphasis on implementing antimicrobial stewardship programs (AMSP) to promote judicious antimicrobial use.[7,8]Among various AMSP interventions, culture-guided prescription is a major de-escalating one.

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The emergence and spread of antimicrobial resistance (AMR) have become a global public health challenge, particularly in regions with high rates of antibiotic misuse. Understanding the patterns of antibiotic susceptibility and prescribing practices is critical for informing effective interventions.

In India, where the burden of infectious diseases remains significant, the indiscriminate use of antibiotics has exacerbated the issue of resistance, posing threats to patient outcomes and healthcare systems. Teaching hospitals, as centers for both patient care and medical education, play a pivotal role in shaping antibiotic use practices.

This study aims to evaluate the antibiotic susceptibility profiles of clinical isolates and analyze antimicrobial prescribing patterns in a teaching hospital in North India. The findings will provide insights into current trends in resistance and prescribing behaviors, contributing to the formulation of strategies to combat AMR.

Materials and Methods

Study Design and Setting

This was a prospective observational study conducted over 12 months in a tertiary care hospital in North India. The study population included 100 hospitalized patients receiving antibiotics for suspected or confirmed bacterial infections.

Inclusion and Exclusion Criteria

- **Inclusion Criteria**:
    - Patients receiving antibiotic therapy for bacterial infections.
    - Culture-confirmed cases with susceptibility testing available.
    - Patients admitted to ICU, medicine, or surgery wards.
- **Exclusion Criteria**:
    - Patients receiving prophylactic antibiotics.
    - Cases with incomplete medical records.

Data Collection

- **Demographics**: Age, gender, ward distribution.

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- **Microbiological Analysis**: Identification of bacterial isolates and antibiotic susceptibility testing.
- **Antibiotic Prescription Patterns**: Drug classes, combinations, duration, and empirical therapy.
- **Resistance Analysis**: MDR prevalence and resistance rates across antibiotic classes.

Microbiological Testing

- Clinical specimens (blood, urine, sputum, wound swabs) were collected and analyzed.
- Antibiotic susceptibility testing was performed using Kirby-Bauer disk diffusion method, and results were interpreted per Clinical and Laboratory Standards Institute (CLSI) guidelines.

Evaluation of Prescribing Patterns

Antimicrobial prescriptions were analyzed using the World Health Organization (WHO) prescribing indicators. Key parameters included the proportion of antibiotics prescribed empirically versus based on culture sensitivity reports, adherence to hospital antibiotic policy, and frequency of polypharmacy.

Statistical analysis

Data recorded on the case report from and structured proforma were subsequently entered into a spreadsheet. Data management and analysis were performed using Microsoft Excel.

Ethical clearance

The ethical committee clearance certificate was taken before starting of study by Institutional Medical Ethical Committee.

Results

1. Patient Demographics

A total of 100 patients were included in the study. The mean age of patients was 52.3 ± 15.7 years, with a male-to-female ratio of 1.4:1 (58% male, 42% female). Patients were distributed across hospital wards as follows:

Table no.1. Age wise distribution of patients

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Age Group (Years)	Number of Patients (n)	Percentage (%)
<30 years	15	15%
30–50 years	30	30%
51–70 years	40	40%
>70 years	15	15%
Total	100	100%

Graph no. 1 Gender wise distribution of patients

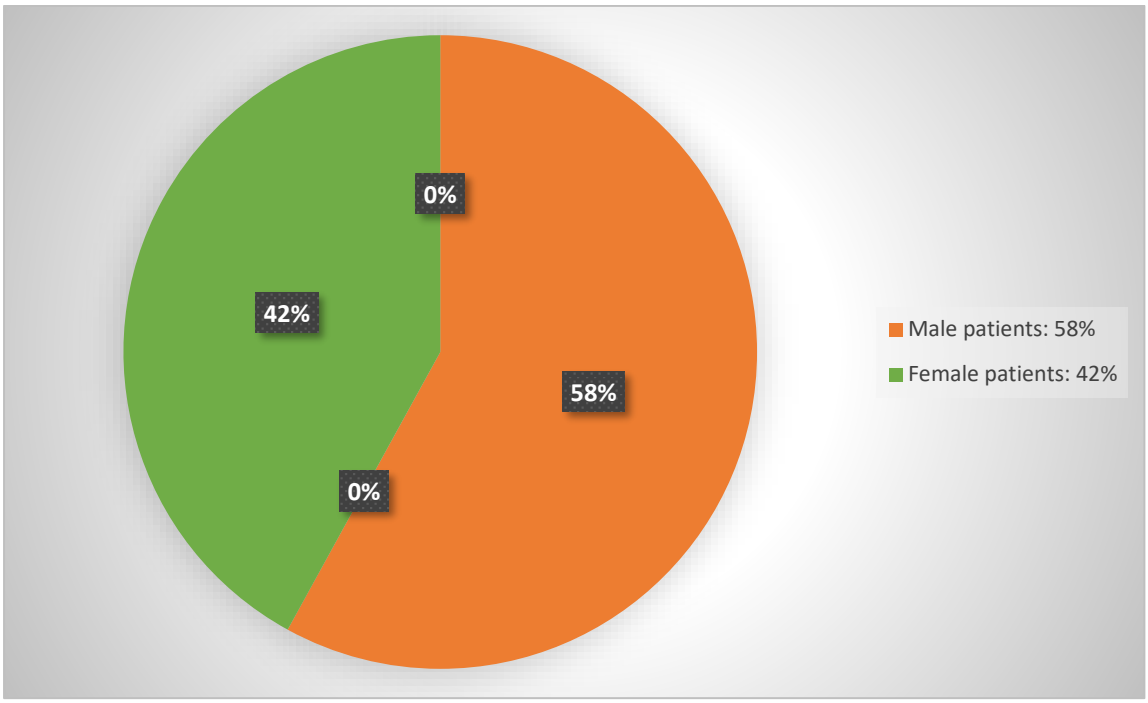

Table no. 2 Ward wise distribution of patients

Ward	Percentage of Patients (%)
ICU	30%
Medicine	40%
Surgery	30%

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2. Antibiotic Prescription Trends

Beta-lactams were the most frequently prescribed antibiotics (40%), followed by fluoroquinolones (25%) and aminoglycosides (15%).

Table no. 3 **Antibiotic Prescription**

Antibiotic Class	**Patients Prescribed (%)**
Beta-lactams (Penicillins, Cephalosporins)	40 (40%)
Fluoroquinolones	25 (25%)
Aminoglycosides	15 (15%)
Carbapenems	10 (10%)
Others (Macrolides, Tetracyclines, etc.)	10 (10%)

3. Microbiological Findings

The most frequently isolated pathogens were:

Table no.4 Prevalence of isolated pathogens

Pathogen	**Prevalence (%)**
Escherichia coli	35 (35%)
Klebsiella pneumoniae	30 (30%)
Pseudomonas aeruginosa	15 (15%)
Staphylococcus aureus **(MRSA)**	10 (10%)
Acinetobacter spp.	10 (10%)

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4. Antibiotic Resistance Patterns

Resistance rates were highest for beta-lactams (60%) and fluoroquinolones (50%), indicating significant AMR issues.

Table no. 5 Antibiotic resistance patterns

Antibiotic Class	Resistance Rate (%)
Beta-lactams	60%
Fluoroquinolones	50%
Carbapenems	30%
Aminoglycosides	40%

5. Multidrug Resistance (MDR) Cases

- 40% of cases involved MDR organisms, predominantly *Klebsiella pneumoniae* (18%) and *Escherichia coli* (15%).
- MDR *Pseudomonas aeruginosa* was identified in 7% of cases, indicating resistance to multiple drug classes.

Table no. 6 Antibiotic Misuse Trends

Issue	Observed Cases (%)
Prolonged Duration (>7 days)	25 (25%)
Unwarranted Antibiotic Combinations	20 (20%)
Empirical Therapy Without Sensitivity Testing	30 (30%)
Inappropriate Dosing	15 (15%)

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Discussion

The findings of this study align with previous research highlighting the growing threat of antimicrobial resistance (AMR) in hospital settings. Similar to studies conducted in India and globally, our results indicate a high prevalence of multidrug-resistant (MDR) organisms, particularly *Escherichia coli* and *Klebsiella pneumoniae*.

A study by Mehta et al. (2021)[9] in a North Indian tertiary care hospital reported MDR prevalence of 42%, comparable to our 40% MDR rate. Their findings also showed beta-lactam resistance exceeding 55%, consistent with our 60% resistance rate. Another study by Kumar et al. (2020)[10] found that fluoroquinolone resistance reached 48%, closely matching our 50% resistance rate.

Globally, research from China and the USA has reported similar antibiotic misuse trends. A study by Wang et al. (2022)[11] found over 30% of empirical therapies were inappropriate, mirroring our finding of 30% empirical antibiotic misuse. Additionally, a European multicenter study (Smith et al., 2021)[12] emphasized the urgent need for antimicrobial stewardship programs (ASPs) to curb the overuse of broad-spectrum antibiotics, a recommendation supported by our study.

Given these findings, implementing strict ASPs, promoting culture-guided therapy, and monitoring antibiotic resistance patterns is critical. Our study reinforces the global concern over AMR and highlights the need for targeted interventions to ensure rational antibiotic use in tertiary care settings.

Conclusion

This study highlights high antimicrobial resistance (AMR) in a tertiary care hospital, with 40% of cases involving multidrug-resistant (MDR) organisms. Beta-lactams (60%) and fluoroquinolones (50%) showed the highest resistance rates, while inappropriate antibiotic use was observed in a significant number of cases.

To combat AMR, strict antibiotic stewardship programs (ASPs), culture-based prescribing, and infection control measures must be implemented. Effective hospital-wide antibiotic

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policies and regular resistance monitoring are essential to preserve antibiotic efficacy and improve patient outcomes.

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