RESEARCH ARTICLE

An In-depth Analysis of Antibiotic Prescription Patterns and Resistance Dynamics in a Tertiary Care Hospital

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Abstract: Antimicrobials, including antibiotics, antifungals, antiprotozoals, and anti-virals, are pharmaceuticals used to treat microbial infections. The emergence and spread of antimicrobial resistance is a serious public health threat that affects patients, reduces treatment efficacy, and increases healthcare costs. Antimicrobial stewardship programs aim to optimize therapeutic outcomes while minimizing unintended consequences like toxicity, resistance development, and misuse or overuse of antibiotics. They do this by selecting appropriate antimicrobial agents, ensuring prompt and effective treatment of severe infections, and restricting excessive, inappropriate, or improper use. This study evaluated antibiotic prescribing practices over six months at a tertiary hospital, with the goals of preserving antibiotic efficacy for future use, preventing antibiotic resistance, and developing prescribing guidelines aligned with established standards. The study included patients of all genders and age groups. It found that 51% of antibiotic prescriptions were for female patients, with higher prevalence in those aged 31-40 years. The general medicine and ENT departments prescribed the most antibiotics, and overdosing or under dosing were common issues. The study also found that antimicrobial susceptibility testing was only required for 3.333% of cases and antibiotic switches due to resistance occurred in 3.66% of cases. Most cases (161) involved prescribing two antibiotics, highlighting the need for rational use and clinical pharmacists' role in optimizing patient outcomes through antimicrobial stewardship. Rational and judicious antimicrobial use, unintended consequences of misuse, and the value of stewardship programs were some of the themes explored.

Keywords: Antimicrobials; Antibiotics; Prescription pattern; Antimicrobial stewardship; Drug Resistance.

1. Introduction

Antimicrobial resistance is one of the biggest threats to global health today. Effective antimicrobials are crucial for treating common infections and carrying out complex medical procedures like organ transplants, cancer chemotherapy and surgery. However, their overuse and misuse has significantly contributed to rising resistance among bacterial and other pathogens. [1-3] It is estimated that antimicrobial resistance already leads to over 700,000 deaths annually across the world. [4] If left unchecked, resistance could undermine modern medicine and lead to dire health outcomes. Rational and appropriate antimicrobial use through antimicrobial stewardship programs is key to address this challenge. [6-8] The goals of stewardship are to optimize treatment of infections, minimize unintended consequences like toxicity and selection of resistance, while restricting excessive and inappropriate use. Stewardship aims to achieve this through evidence-based guidelines, education, stringent oversight on prescribing and antimicrobial consumption. Several studies have shown that effective stewardship programs can successfully improve prescribing practices and clinical outcomes while curbing resistance. In India, antimicrobial resistance is a major public health concern. Multiple drug resistance has been reported in common community and hospital-acquired pathogens. Studies have documented increasing resistance in key organisms like *Staphylococcus aureus, Klebsiella pneumoniae, Escherichia coli* and *Acinetobacter baumannii*. [9, 10] Irrational antimicrobial use in human and veterinary medicine has been identified as a key driver. While India has published national treatment guidelines, adherence remains a challenge in many clinical settings due to lack of diagnostic support and economic incentives for prescribing.

Tertiary care hospitals play a key role in empiric antimicrobial therapy and management of complex multi-drug resistant infections. However, studies evaluating antimicrobial use patterns in Indian tertiary care hospitals are limited. Given rising resistance trends, it is important to regularly assess prescribing practices and implement targeted stewardship programs. [11] The goals are to promote

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adherence to national guidelines, restrict unnecessary use and ensure optimal treatment outcomes. This study aimed to evaluate antibiotic prescribing and stewardship efforts over a 6 month period in a large tertiary care hospital in India. The objectives were to analyze prescribing patterns, adherence to guidelines, prevalence of under-dosing/over-dosing and irrational use. Findings will help identify current gaps to prioritize interventions like education, restricted formularies and monitoring tools. The goal is to enhance rational antibiotic use and containment of resistance in this setup.

2. Methodology

2.1. Study setting

This retrospective observational study was conducted at Vedantha Hospital, located in Guntur, Andhra Pradesh. Vedantha Hospital is a 300-bed tertiary care hospital with established facilities for surgery, medicine and other specialties. The hospital has 15 practicing physicians, 4 clinical pharmacists, 30 nurses and 40 paramedical staff. [12-14]

2.2. Study design

A retrospective cross-sectional study design was used to analyze antibiotic prescribing practices across different departments of Vedantha Hospital over a 6-month period. [15]

2.3. Study period

The study period was from August 2023 to January 2024 (6 months). [16]

2.4. Sample size

A total of 300 patient prescriptions were randomly selected for the study, including patients of all ages and both genders [17]

2.5. Data collection

Approval was obtained from the Institutional Ethics Committee and hospital administration. Relevant literature was reviewed to develop a standardized data collection form. Prescription records of inpatients who received at least one antibiotic during the study period were retrieved. Details such as demographic profile, diagnosis, antibiotic/s prescribed, dose, duration and clinical outcome were extracted from medical records onto the form over a period of 1 month. [18]

2.6. Inclusion and exclusion criteria

Prescriptions from all departments except emergency, trauma, chemotherapy and psychiatry were included. Outpatient antibiotic prescriptions were excluded. [19, 20]

2.7. Data analysis

Data was analyzed using statistical software to evaluate quantitative and qualitative aspects of antibiotic usage [21, 22] such as:

- Antibiotic consumption pattern in each department
- Adherence to treatment guidelines
- Prevalence of antibiotic misuse, under-dosing and over-dosing
- Occurrence of adverse drug reactions

2.8. Outcome measures

The study aimed to assess common outcome measures related to rational antibiotic use, including antibiotic consumption trends, prescription appropriateness and safety [23]

3. Results

3.1. Gender wise distribution

Among the 300 cases studied, 49% were males and 51% were females. The results are shown in Table 1.

3.2. Age wise distribution

The age group 31-40 years constituted the highest proportion (20.33%) of prescriptions. The lowest was 81-90 years (2%).

3.3. Department wise distribution

General Medicine (12.66%) and ENT (10%) departments accounted for the highest number of cases. Dental department had the lowest (0.3%). The results are shown in Figure 1.
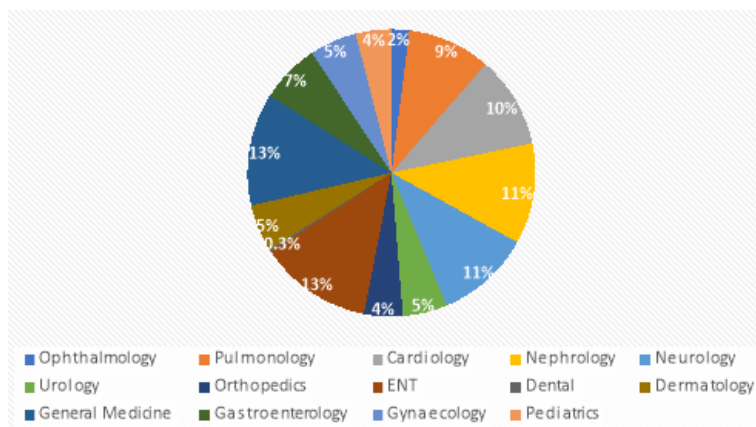

Figure 1. Department wise distributino

3.4. PDD/DDD Ratio of antimicrobials

The average prescribed daily dose (PDD) of each antimicrobial was calculated using ATC classification and defined daily dose (DDD) as per WHO methodology. Overdose was highest in Cardiology (30 cases) and underdose in General Medicine (24 cases).

3.5. Dose deviation

Analysis of 300 cases revealed that 70.49% had overdose while 29.50% had underdose. Highest overdose was seen in Cardiology and highest underdose in General Medicine. The results are shown in Table 1.

Table 1. Results of cases identified in a test for dose deviation indicator

Department	Total no of cases observed (n=300)	Incidents of over dose found	Incidents of under dose found
Ophthalmology	6	-	-
Pulmonology	28	16	8
Cardiology	31	30	8
Nephrology	34	28	10
Neurology	32	15	14
Urology	15	2	-
Orthopedics	13	5	2
ENT	38	15	-
Dental	1	-	-
Dermatology	16	4	1
General medicine	38	29	24
Gastroenterology	20	19	2
Gynecology	16	8	3
Pediatrics	12	1	-

3.6. Antimicrobial Sensitivity Testing

Sensitivity testing was performed for 10 cases (3.33%). Commonly identified organisms were Klebsiella pneumoniae (3%), Klebsiella (20%), Enterococcus faecalis (20%) and others

3.7. Antibiotic resistance

Eleven cases (3.66%) showed antibiotic ineffectiveness requiring change of therapy. Most commonly involved antibiotics were Augmentin, Ceftriaxone and Metronidazole. The results are shown in Table 2.

Table 2. Antibiotics found ineffective in different departments

Department	Ineffective	Shifted to
gynaecology	Augmentin	Faropenem
Neurology	Cefperazone+sulbactam	Meropenem
gynaecology	Augmentin, clindamycin	Cefperazone+sulbactam
Orthopedics	Cefperazone+sulbactam	Piperacillin+tazobactam
nephrology	Metronidazole	Omidazole
gynaecology	ceftriaxone	cefixime
cardiology	Ceftriaxone	Cefpodoxime
Gastroenterology	Metronidazole	Ornidazole
Cardiology	metronidazole	ornidazole
Orthopedics	Piperacillin+tazobactam	Clindamycin
Gynaecology	Ceftriaxone	Piperacillin+tazobactum

3.8. Number of antibiotics per case

Maximum cases (161) received 2 antibiotics. Minimum received 4-5 antibiotics (8-9 cases each). The results are shown in Figure 2.
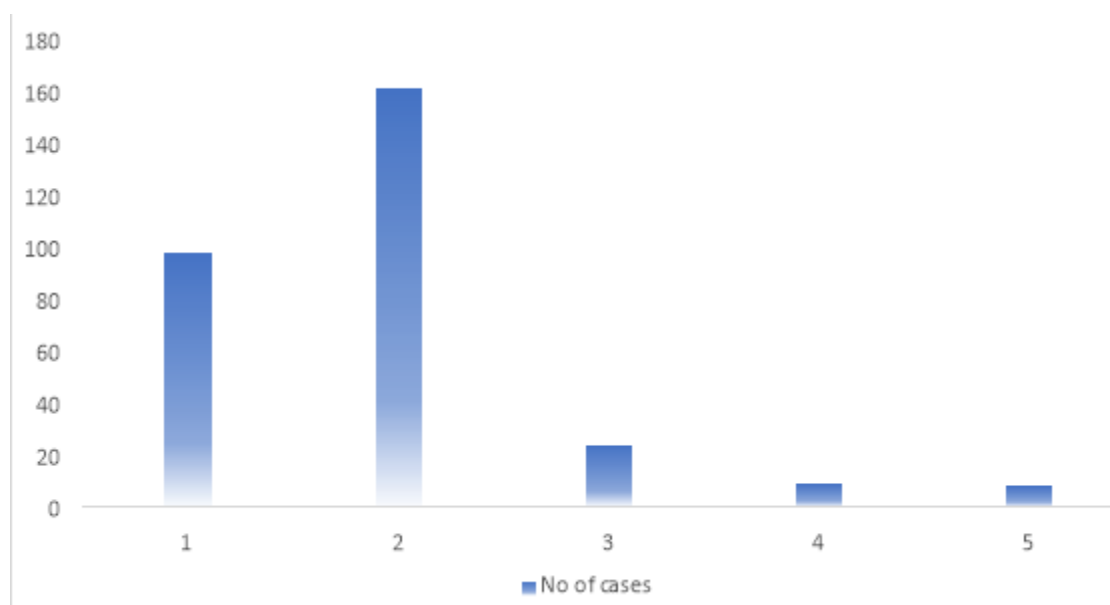

Figure 2. Distribution of antibiotics in each case among total cases

4. Discussion

This retrospective study evaluated antimicrobial prescribing patterns at a tertiary care hospital using both quantitative and qualitative analysis. Parameters such as dosage form, frequency of administration, dose and duration of therapy were assessed using WHO prescribing indicators. [24] The results showed relatively rational prescribing in terms of age and gender distribution of patients receiving antimicrobials. However, dosing errors were prevalent with 70.49% patients receiving overdose and 29.50% underdose. Sensitivity testing was performed in a small fraction of cases indicating lack of microbiological guidance in therapy. Occurrence of antibiotic resistance requiring change in treatment was seen in 3.66% patients.

Polypharmacy with multiple antimicrobials prescribed together was observed in some cases contrary to treatment guidelines. Under-dosing in general medicine department and over-dosing in cardiology demonstrate need for education regarding condition-specific therapeutic regimens. Lack of documentation of clinical indicators, allergies and comorbidities were also noted. [25]

5. Conclusion

In conclusion, while antimicrobials are essential for treating infections, their indiscriminate use promotes antibiotic resistance - a major threat globally. This study highlights the need for strict antimicrobial stewardship programs and adherence to treatment protocols in hospitals. Clinical pharmacists can play a key role in formulary management, dose optimization, antibiotic cycling, guideline development and education. Regular audits of prescribing practices coupled with feedback to physicians can help curb non-rational prescribing patterns and ensure optimal patient outcomes. Multifaceted interventions are warranted to preserve existing drug armamentarium through prudent antibiotic use

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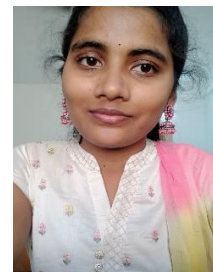
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