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EVALUATION OF ANTIBIOTIC PRESCRIBING PATTERNS, GUIDELINE ADHERENCE, AND CLINICAL OUTCOMES IN HOSPITALIZED PATIENTS AT TERTIARY CARE HOSPITALS

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ABSTRACT

Antibiotic misuse remains a major contributor to antimicrobial resistance, adverse clinical outcomes, and increased healthcare burden. This study was conducted to evaluate antibiotic prescribing patterns, assess adherence to Indian Council of Medical Research (ICMR) guidelines, and examine their association with clinical outcomes in hospitalized patients. A hospital-based observational study was carried out among 400 inpatients receiving antibiotic therapy. Data on demographic characteristics, comorbidities, infection profiles, antibiotic regimens, and clinical outcomes were collected from medical records. Prescriptions were evaluated for compliance with ICMR treatment guidelines, and antimicrobial stewardship practices were assessed. Respiratory infections were the most common indication for antibiotic use. Broad-spectrum β-lactam and β-lactamase inhibitor combinations were frequently prescribed, particularly in moderate to severe infections. Guideline adherence was observed in 83.75% of prescriptions. Clinical improvement was noted in 79.25% of patients, with 78% achieving recovery at discharge and a mortality rate of 4%. Antimicrobial stewardship review was documented in 50.5% of cases, indicating partial implementation. The findings suggest that adherence to national treatment guidelines is associated with favorable clinical outcomes and supports the concept of precision-oriented prescribing. However, gaps in stewardship practices highlight the need for continuous monitoring and

optimization of antibiotic therapy. Strengthening antimicrobial stewardship and promoting evidence-based prescribing may further improve treatment effectiveness and help mitigate antimicrobial resistance.

KEYWORDS: Antibiotic prescribing pattern, ICMR Guideline adherence, Clinical outcomes, Antimicrobial stewardship, Precision of prescription, Hospitalized patients.

INTRODUCTION

Infectious diseases continue to impose a significant burden on global health, remaining a leading cause of morbidity and mortality despite advances in antimicrobial therapy, vaccination, and diagnostic techniques[(1)]. Conditions such as respiratory tract infections, urinary tract infections, bloodstream infections, and sepsis account for a substantial proportion of hospital admissions, particularly in low- and middle-income countries[(2)]. Alongside this persistent burden, antimicrobial resistance (AMR) has emerged as a critical public health challenge, largely driven by inappropriate and excessive antibiotic use[(3)].

The global rise in antibiotic consumption, especially in developing healthcare systems, has contributed to the rapid emergence of resistant microorganisms[(4)]. Although improved access to antibiotics has reduced infection-related mortality, it has also resulted in widespread misuse, including unnecessary prescriptions, inappropriate drug selection, and prolonged duration of therapy[(5)]. Studies have shown that a considerable proportion of antibiotic use in hospital settings is suboptimal, which accelerates resistance development and adversely affects clinical outcomes[(6)].

In clinical practice, antibiotics are among the most frequently prescribed medications, with a large proportion of hospitalized patients receiving at least one antimicrobial agent during their stay[(7)]. Empirical therapy remains essential in the management of severe infections; however, it is often continued without adequate microbiological confirmation or timely de-escalation[(8)]. This gap between empirical prescribing and culture-guided therapy contributes to excessive use of broad-spectrum antibiotics and increases the risk of antimicrobial resistance[(9)].

To address these concerns, antimicrobial stewardship programs and evidence-based clinical guidelines have been developed to promote rational antibiotic use[(10)]. In India, the Indian Council of Medical Research (ICMR) provides standardized recommendations for the management of common infections[(11)]. Adherence to these guidelines is essential to ensure appropriate antibiotic selection, optimize treatment outcomes, and reduce unnecessary

exposure to antimicrobial agents. However, real-world practice frequently demonstrates variability in adherence, influenced by clinical uncertainty, limited diagnostic support, and institutional factors[12].

Most existing studies on antibiotic utilization focus primarily on consumption metrics such as Defined Daily Dose (DDD) or classification systems like AWaRe[13]. While these approaches provide valuable insights into antibiotic use patterns, they do not fully assess the clinical appropriateness of prescriptions or their impact on patient outcomes[14]. There is a need for studies that move beyond descriptive analysis and evaluate antibiotic use in relation to guideline adherence and measurable clinical outcomes.

Furthermore, many hospital-based studies are restricted to specific departments or patient groups, limiting their generalizability. Comprehensive evaluations across multiple clinical settings that incorporate demographic characteristics, infection patterns, prescribing practices, and outcome measures remain limited[15]. Additionally, the relationship between prescribing behavior and patient outcomes, including recovery and mortality, is not adequately explored in routine clinical practice.

Given the increasing burden of antimicrobial resistance and variability in prescribing practices, there is a need to adopt a more integrated and outcome-oriented approach to antibiotic evaluation. The concept of prescribing precision—defined as the appropriateness of antibiotic selection, adherence to treatment guidelines, and its impact on clinical outcomes—offers a more meaningful framework for assessing antibiotic use in hospital settings.

Therefore, the present study was undertaken to evaluate antibiotic prescribing patterns, assess adherence to ICMR guidelines, and determine their association with clinical outcomes among hospitalized patients in tertiary care hospitals. By linking prescribing practices with patient outcomes, this study aims to generate evidence that supports rational antibiotic use, strengthens antimicrobial stewardship strategies, and improves the overall quality of patient care.

Fig 1: Global burden of infectious diseases and the role of antimicrobial resistance and antibiotic stewardship in influencing clinical outcomes.

MATERIALS AND METHODS

Study Design:

This study was carried out as a multicenter, hospital-based observational study. It was primarily retrospective, based on review of inpatient medical records, with limited prospective observation of selected cases to better understand ongoing treatment patterns and clinical responses.

Study Setting and Duration:

The study was conducted in the Departments of General Medicine, General Surgery, and Pulmonology at tertiary care teaching hospitals over a period of six months, from July 2025 to December 2025.

Study Population:

The study population consisted of adult inpatients who received at least one systemic antibiotic during their hospital stay in the selected departments.

Sample Size:

A total of 400 patient cases were included. The sample size was determined based on the availability of eligible cases within the study period and to ensure adequate representation of prescribing practices across departments.

Inclusion Criteria:

1.Adult inpatients aged 18 years and above

2.Patients prescribed at least one systemic antibiotic

3.Patients with complete and accessible medical records

Exclusion Criteria:

1.Patients admitted to intensive care units

2.Patients with HIV, tuberculosis, or malignancy receiving long-term antimicrobial therapy

3.Pediatric patients (<18 years)

4.Outpatients

5.Cases with incomplete or unclear medical records

Data Collection:

Data were obtained from inpatient case records, including treatment charts, laboratory reports, and discharge summaries. Information collected included demographic details, comorbid conditions, diagnosis, site of infection, and details of antibiotic therapy.

A structured data collection form developed for the study was used to record antibiotic-related variables such as drug name, class, dose, route, frequency, and duration of therapy. Clinical outcomes and discharge status were also documented.

Study Tools:

A predefined data collection form was used to systematically capture patient and treatment information. Antibiotic prescriptions were evaluated using Indian Council of Medical Research (ICMR) antimicrobial treatment guidelines to determine adherence.

An antimicrobial stewardship evaluation checklist was used to assess key aspects of prescribing, including appropriateness of drug selection, dose, route, duration, and the presence of de-escalation practices where applicable.

Data entry and analysis were performed using Microsoft Excel.

Study Procedure:

Eligible patient records were identified based on predefined inclusion and exclusion criteria. Data were collected and reviewed systematically to evaluate antibiotic prescribing patterns.

Each prescription was assessed for adherence to ICMR guidelines. Clinical outcomes, including patient response to treatment and discharge status, were recorded. Where available, antimicrobial stewardship review practices were also noted.

The combination of retrospective record analysis and limited prospective observation allowed a more complete understanding of prescribing behavior and treatment outcomes.

Data Analysis:

The collected data were entered into Microsoft Excel and analyzed using descriptive statistical methods. Frequencies and percentages were calculated to summarize patient characteristics, infection patterns, antibiotic utilization, guideline adherence, and clinical outcomes.

The analysis focused on identifying prescribing trends and examining the relationship between guideline adherence and treatment outcomes.

RESULTS & DISCUSSION

A total of 400 cases were included in the study based on predefined inclusion and exclusion criteria. And had mainly focused on the parameters like Age, Gender, Residence, Education Status, Occupation, Smoking status, Alcohol Consumption, Infection Site and Diagnosis, Prescribed Antibiotic Use, Other Comorbidities

TABLE 1: DEMOGRAPHIC CHARACTERISTICS

1.1 AGE WISE DISTRIBUTION

Age Group (Years)	Frequency (n)	Percentage (%)
16 - 25	40	10.00
26 - 35	67	16.75
36 - 45	48	12.00
46 - 55	65	16.25
56 - 65	61	15.25
66 - 75	63	15.75
76 - 85	56	14.00

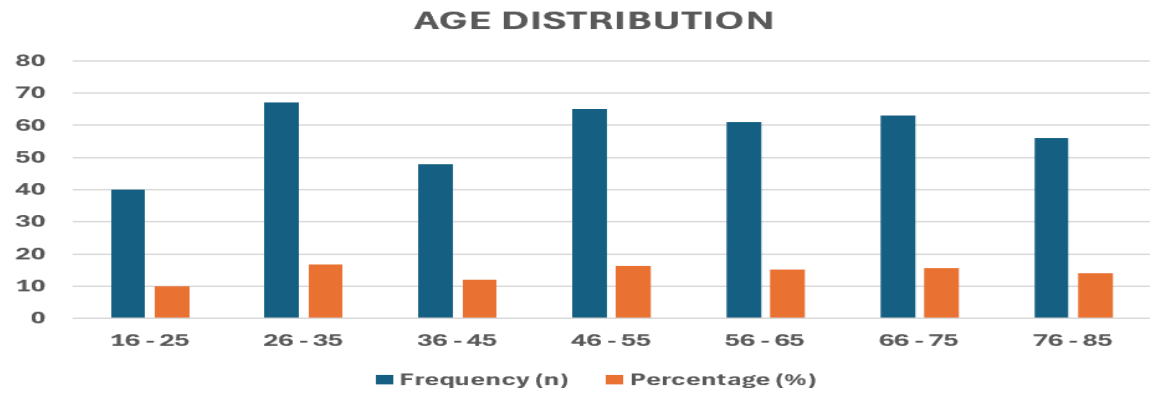

Figure 2: Age Wise Distribution.

Majority of patients were in the 26–35 and 46–55 year age groups. A significant proportion belonged to middle-aged and elderly categories, indicating higher infection burden in these age groups.

1.2 GENDER WISE DISTRIBUTION

Gender	Frequency	Percentage (%)
Male	203	50.75
Female	197	49.25

Gender distribution was nearly equal, showing no major gender predominance in antibiotic utilization.

1.3 RESIDENCE

Residence	Frequency	Percentage (%)
Rural	210	52.50
Urban	190	47.50

Slight predominance of rural population suggests higher hospitalization or infection burden in rural communities.

1.4 EDUCATION STATUS

Education Level	Frequency	Percentage (%)
Uneducated	91	22.75
Primary	87	21.75
Undergraduate	86	21.50
Postgraduate	73	18.25
Secondary	63	15.75

A considerable proportion of patients had lower educational status, which may influence healthcare awareness and medication compliance.

1.5 OCCUPATION

Occupation	Frequency	Percentage (%)
Unemployed	91	22.75
Self-employed	91	22.75
Business	82	20.50
Employed	71	17.75
Dependent	65	16.25

Unemployed and self-employed individuals formed the largest proportion, indicating socioeconomic diversity among hospitalized patients.

TABLE 2: LIFESTYLE FACTORS.

2.1 SMOKING STATUS

Category	Frequency	Percentage (%)
Smoker	109	27.25
Non-smoker	104	26.00
Ex-smoker	97	24.25
Occasional	90	22.50

More than half of the study population had current or past smoking history, which may contribute to respiratory and systemic infections.

2.2 ALCOHOL CONSUMPTION

Category	Frequency	Percentage (%)
Occasional	117	29.25
Alcoholic	103	25.75
Ex-alcoholic	90	22.50
Non-alcoholic	90	22.50

Alcohol consumption was common among patients and may have influenced disease severity and hospital stay.

TABLE 3: DISTRIBUTION OF COMORBIDITIES.

Comorbidity	Frequency	Percentage (%)
Diabetes Mellitus	116	29.00
Hypertension	104	26.00
CKD	95	23.75

Diabetes Mellitus was the most prevalent comorbidity. The high prevalence of metabolic disorders likely increased susceptibility to infections and need for broad-spectrum antibiotics.

TABLE 4: INFECTION SITE – ANTIBIOTIC PRESCRIBING PATTERN.

Infection Site	Diagnosis	Antibiotic Prescribed	Class of Antibiotic	Dose	Frequency (n)	Percentage(%)
CNS	Acute Bacterial Meningitis	Ceftriaxone + Vancomycin	Cephalosporin + Glycopeptide	2 g + 1 g	44	11.00
Gastro intestinal	Intra Abdominal Infection	Ceftriaxone + Metronidazole	Cephalosporin + Nitroimidazole	1 g + 500 mg	52	13.00
Respiratory	COPD (Mild)	Amoxicillin + Clavulanic acid	Penicillin + β-lactamase inhibitor	625 mg	46	11.50
	COPD (Severe)	Ceftriaxone + Azithromycin	Cephalosporin + Macrolide	1 g +	49	12.25

				500 mg		
Skin/Soft Tissue	Diabetic Foot Infection	Piperacillin + Tazobactam	Penicillin + β-lactamase inhibitor	4.5g	53	13.25
	Skin and Soft Tissue Infection	Amoxicillin + Clavulanic acid		625 mg	38	9.50
Systemic	Sepsis	Piperacillin + Tazobactam	Penicillin + β-lactamase inhibitor	4.5 g	40	10.00
Urinary Tract	Complicated UTI	Ceftriaxone	Cephalosporin	1 g	36	9.00
	Uncomplicated UTI	Nitrofurantoin	Nitrofuran derivative	100 mg	42	10.05

Respiratory infections constituted the highest proportion of antibiotic prescriptions, followed by gastrointestinal infections, skin and soft tissue infections, systemic sepsis, and urinary tract infections.

Mild COPD cases were treated predominantly with Amoxicillin–Clavulanic acid, whereas severe COPD cases received Ceftriaxone combined with Azithromycin. Intra-abdominal infections were managed with Ceftriaxone and Metronidazole. Diabetic foot infections and sepsis cases frequently received Piperacillin–Tazobactam. Complicated UTIs were treated with Ceftriaxone, while uncomplicated UTIs were managed with Nitrofurantoin.

Broad-spectrum β-lactam–β-lactamase inhibitor combinations were commonly prescribed in moderate to severe infections. Combination therapy was observed particularly in CNS infections, intra-abdominal infections, and severe respiratory conditions. Overall, antibiotic selection appeared diagnosis-specific and severity-adjusted rather than uniform across infection categories.

The predominance of respiratory infections in the present study aligns with global hospital-based prevalence surveys where respiratory tract infections remain the leading indication for antimicrobial therapy[16]. Similar prescribing trends have been reported in tertiary care hospitals where respiratory and intra-abdominal infections account for the majority of empirical antibiotic use[17].The stratified management of COPD—using Amoxicillin–Clavulanate in mild cases and Ceftriaxone-based combination therapy in severe cases—demonstrates severity-adjusted prescribing. In contrast, several prescribing audits have reported broad-spectrum antibiotic overuse even in mild respiratory infections[18].The present findings suggest more rational escalation, consistent with evidence-based recommendations for moderate to severe lower respiratory tract infections[19].

Frequent use of Piperacillin–Tazobactam in diabetic foot infection and sepsis is consistent with international guidelines recommending extended-spectrum coverage for polymicrobial and severe infections[20]. However, literature warns that excessive empirical continuation of such agents without de-escalation contributes to selective pressure and resistance emergence[21]. Although this study did not evaluate de-escalation timing, absence of carbapenem overuse suggests restraint in escalation practices.Management of uncomplicated UTI with Nitrofurantoin reflects adherence to antimicrobial stewardship principles favoring narrow-spectrum agents when appropriate[22]. Several studies have highlighted inappropriate fluoroquinolone use in uncomplicated UTIs; the present findings contrast favorably with those reports[23].

Overall, Table 4 indicates that antibiotic prescribing was largely diagnosis-driven and aligned with clinical severity. Compared to literature documenting indiscriminate broad-spectrum use, the current findings suggest a structured prescribing approach. However, lack of microbiological correlation limits assessment of resistance-directed therapy, representing an area for future investigation.

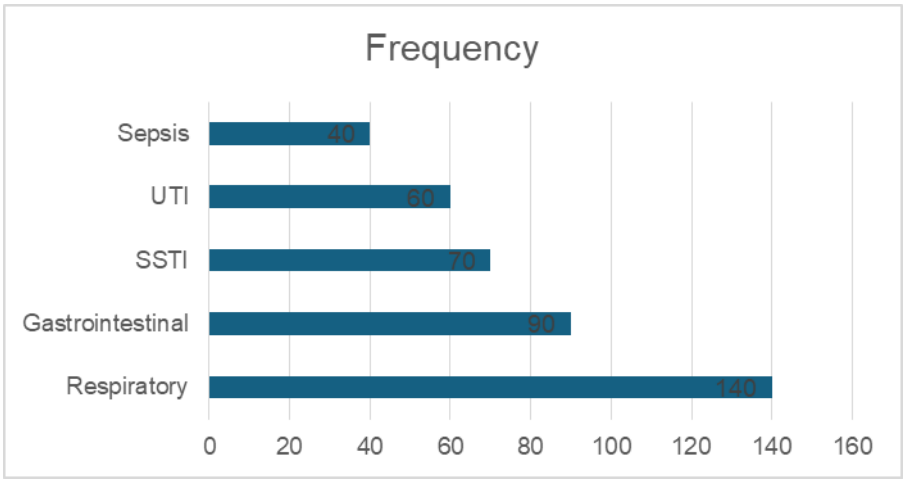

Figure 3: Frequency of Infection Site.

TABLE 5: ICMR GUIDELINE ADHERENCE.

Adherence	Frequency	Percentage (%)
Yes	335	83.75
No	65	16.25

Out of 400 prescriptions analyzed, 335 cases (83.75%) adhered to ICMR antimicrobial treatment guidelines, while 65 cases (16.25%) were non-adherent. At a 50–70% adherence rate, this figure surpasses typical hospital benchmarks. Common deviations found in prior Gyssens-based evaluations include excessive duration, lack of microbiological support, and

poor drug selection[24].The relatively low proportion of non-adherent prescriptions (16.25%) highlights potential for targeted audit and feedback interventions. Structured antimicrobial stewardship programs have consistently demonstrated improvements in prescribing quality through prospective review mechanisms[25].

Overall, while Table 5 demonstrates strong alignment with ICMR guidelines, enhancing dynamic stewardship practices could further optimize prescribing precision and mitigate resistance risk.

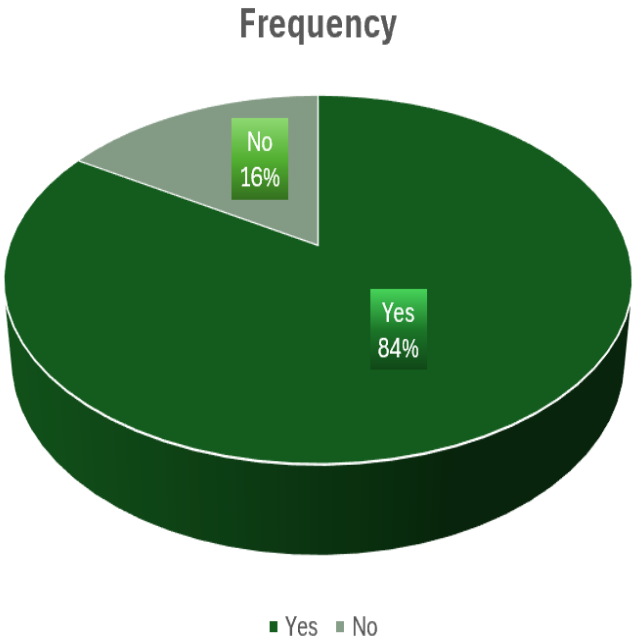

Figure 4: ICMR Guideline Adherence.

TABLE 6: CLINICAL OUTCOMES

6.1 CLINICAL RESPONSE

Response	Frequency	Percentage (%)
Improved	317	79.25
No Change	61	15.25
Worsened	22	5.50

6.2 OUTCOME AT DISCHARGE

Outcome	Frequency	Percentage (%)
Recovered	312	78.00
LAMA	72	18.00
Deceased	16	4.00

Majority of patients showed clinical improvement and recovery. Mortality rate was low (4%), suggesting effective antimicrobial management.

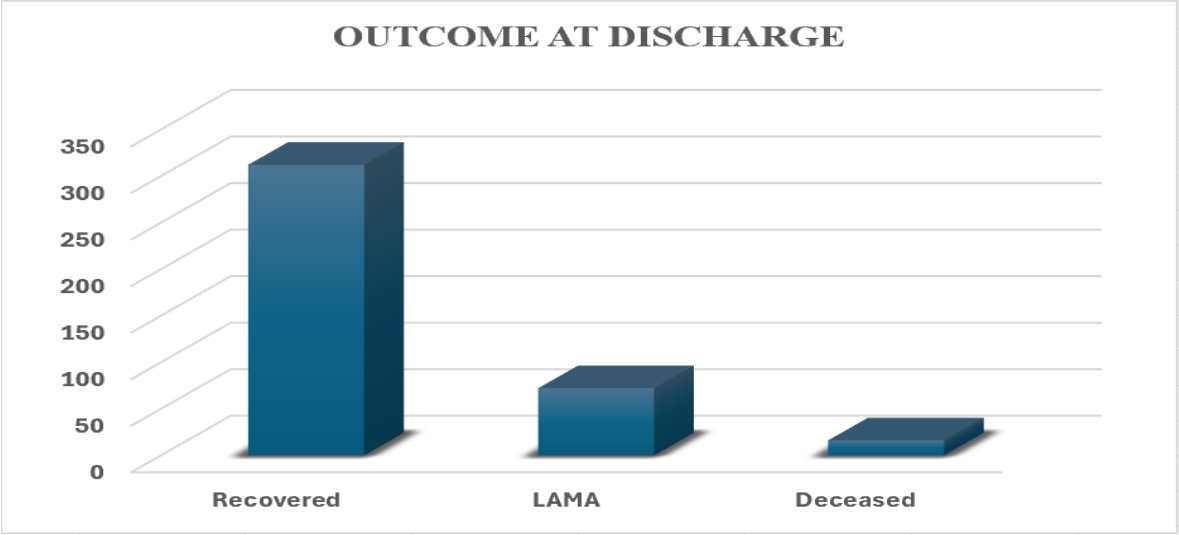

Figure 5: Outcomes.

TABLE 7: STEWARDSHIP REVIEW

STEWARDSHIP REVIEW

Review	Frequency	Percentage (%)
Yes	202	50.50
No	198	49.50

Among 400 hospitalized patients, 50.5% experienced documented stewardship review was conducted in an equal proportion of cases. Partial stewardship coverage suggests that while prescribing precision at initiation may be adequate, ongoing review and optimization were not uniformly implemented. Evidence shows that structured audit and feedback reduce inappropriate prescribing and antibiotic-related adverse events[26];thus, expanding continuous stewardship oversight may help minimize preventable drug-related harm and strengthen patient safety. This indicates partial implementation of antimicrobial stewardship practices and highlights the need for institutional strengthening of stewardship oversight.

DISCUSSION

The present study evaluated antibiotic prescribing patterns, guideline adherence, and clinical outcomes using a precision-oriented framework that integrates prescribing behavior with patient outcomes. Unlike conventional antibiotic utilization studies that primarily focus on consumption metrics such as Defined Daily Dose (DDD) and AWaRe classification, the

current approach provides a more clinically meaningful assessment of therapeutic effectiveness[27,28]

The demographic distribution, with a predominance of middle-aged and elderly patients, is consistent with previous hospital-based studies reporting increased infection susceptibility due to comorbidities and immunological decline[29]. However, unlike several reports where advanced age is associated with indiscriminate use of broad-spectrum antibiotics, the present study demonstrated that antibiotic selection largely remained aligned with guideline recommendations, suggesting rational prescribing practices[30].

Diabetes mellitus was identified as the most prevalent comorbidity, which aligns with existing literature highlighting its role in increasing infection risk and severity[31]. Previous studies often report extensive empirical use of higher antibiotics, including carbapenems, in such patients[32]. In contrast, the present findings suggest that escalation to broader-spectrum therapy was guided by clinical severity rather than routine overuse, indicating a more structured and evidence-based prescribing approach.

Respiratory infections were the most common indication for antibiotic use, consistent with global prescribing trends[33]. However, inappropriate antibiotic use in respiratory conditions, particularly in mild or viral infections, has been widely documented[34]. The present study demonstrated severity-based prescribing, where antibiotic selection varied according to disease severity, reflecting better adherence to clinical guidelines compared to earlier reports.

The observed guideline adherence rate (83.75%) is higher than that reported in many hospital-based studies, where adherence is often suboptimal[35]. More importantly, the association between guideline adherence and favorable clinical outcomes supports the concept of precision-oriented prescribing as a key determinant of therapeutic success. This aligns with findings from antimicrobial stewardship research demonstrating improved patient outcomes with guideline-based therapy[37,38].

Clinical outcomes in the present study were favorable, with high improvement rates and low mortality. Previous studies have similarly shown that appropriate antibiotic use and stewardship interventions are associated with reduced mortality, shorter hospital stays, and improved clinical recovery[38,39]. Unlike many earlier investigations that assess prescribing independently, the present study directly links prescribing practices with patient-level outcomes, strengthening its clinical relevance.

Despite these strengths, antimicrobial stewardship review was documented in only half of the cases, indicating incomplete implementation. Effective stewardship requires continuous monitoring, including de-escalation, dose optimization, and duration control, which have

been shown to reduce inappropriate antibiotic use and adverse drug events[40,41]. The gap between appropriate initiation and ongoing therapy optimization represents an important area for improvement.

The absence of microbiological correlation in antibiotic selection represents a significant limitation, as culture-guided therapy plays a critical role in optimizing antimicrobial use and reducing resistance[42]. Additionally, antibiotic duration was not evaluated, which is a well-established factor contributing to antimicrobial resistance and unnecessary drug exposure[43]. Incorporating these parameters in future studies would provide a more comprehensive evaluation of prescribing practices.

From a broader perspective, this study contributes to the evolving shift from traditional antibiotic utilization research toward a precision-based prescribing model. While earlier studies primarily focused on quantifying antibiotic consumption, the present study emphasizes clinical appropriateness and outcome relevance[44]. This approach provides a more accurate representation of real-world prescribing quality.

Importantly, the findings highlight that rational antibiotic use can coexist with the use of broad-spectrum agents when guided by clinical severity and standardized treatment protocols[45]. However, strengthening antimicrobial stewardship infrastructure, including real-time audit and feedback mechanisms, remains essential to sustain and further improve prescribing quality[46].

Overall, the study demonstrates that guideline-directed antibiotic therapy is associated with favorable clinical outcomes, while also identifying key areas for improvement, particularly in stewardship continuity and microbiological integration. These findings reinforce the importance of combining evidence-based prescribing with ongoing monitoring to ensure safe, effective, and sustainable antibiotic use in hospital settings[47].

CONCLUSION

This study demonstrates that antibiotic prescribing in hospitalized patients was largely aligned with national treatment guidelines, reflecting a rational and evidence-based approach to antimicrobial use in routine clinical practice. The high level of guideline adherence observed was associated with favorable clinical outcomes, highlighting the importance of precision-oriented prescribing in improving patient care. Antibiotic selection was predominantly guided by clinical presentation and infection severity rather than indiscriminate use of broad-spectrum agents. However, gaps were identified in the continuity of antimicrobial stewardship practices, particularly in terms of consistent review and

optimization of therapy. These findings emphasize the need to strengthen stewardship interventions, promote culture-guided therapy, and ensure ongoing monitoring of antibiotic use. Overall, adopting a structured and outcome-focused approach to antibiotic prescribing can enhance treatment effectiveness, improve patient outcomes, and contribute to the containment of antimicrobial resistance.

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