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BRIEF COMMUNICATION

Antimicrobial Audit and Stewardship Practices among Hospitalised Patients: A Retrospective Study

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ABSTRACT

Background: Empirical broad-spectrum antibiotic use leads to misuse, side effects, antimicrobial resistance, and higher costs. This necessitates antimicrobial stewardship programs (AMSP) to promote judicious antibiotic use. This study aimed to analyze antibiotic prescription patterns and culture request frequencies in surgical wards and intensive care units (ICU).

Methodology: This retrospective study by the department of Microbiology in a tertiary care hospital was undertaken in surgical wards and ICUs. Data on baseline characteristics, antibiotic usage, and culture requests were collected. The microbiology laboratory used Kirby-Bauer disk diffusion for antimicrobial testing. An infection control nurse audited antibiotic administration.

Results: This retrospective study spanned eight months (June 2023 to January 2024) and included 1018 patients from surgical wards and ICUs. Of the 1018 patients, 83.8% were male, with 52% aged 21-40 years. Confirmed infections were found in 25% of patients, predominantly Gram-negative bacteria (94.2%). The most common organisms were *Escherichia coli* (72.2%), *Klebsiella pneumoniae* (10.19%), and *Pseudomonas aeruginosa* (5.8%). Cephalosporins were the most prescribed antibiotics (89.7%). Only 41.5% of antibiotic prescriptions matched culture sensitivity reports, with 58.5% inappropriately prescribed. Hospital stays were under 15 days mostly (86%).

Conclusion: Empirical antibiotic use is prevalent, with infrequent culture-based adjustments. Only 41.5% of antibiotics matched culture reports. AMSPs and education on stewardship principles are essential to address inappropriate antimicrobial use.

KEYWORDS: Antimicrobial stewardship; Culture-guided prescriptions; Empirical treatment; Surgical ward

INTRODUCTION

Antimicrobial treatment is crucial in preventing severe complications and mitigating the devastating consequences of various infections. However, the prescriptions are frequently administered empirically to provide broad coverage against Gram-positive and Gram-negative infections in surgical and non-surgical procedures.[1,2] 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.[3,4] The escalating bacterial resistance poses a significant challenge, exacerbated by a decline in the

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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.[5,6] Among various AMSP interventions, culture-guided prescription is a major de-escalating one.

Hence, the objective of this study was to delineate the antibiotic prescription patterns among patients admitted to surgical wards and intensive care units (ICU) and also evaluate the frequency with which clinicians requested specimen cultures during patients' hospitalization.[7]

METHODOLOGY

This retrospective observational study was carried out at the 750-bed tertiary care centre of North India, spanning the duration of eight months, from June 2023 to January 2024. All consecutive patients on parenteral antibiotics admitted to the Surgical Wards and ICUs were enrolled. Baseline characteristics, including age, gender, duration of stay, and outcome, were documented for each patient.

The centre operates a 24-hour Microbiology laboratory equipped with an automated bacterial culture system (Bact Alert) and conducts antimicrobial susceptibility testing using the Kirby-Bauer disk diffusion method. An infection control nurse from the hospital conducted an audit to assess the types, numbers, and durations of antibiotics administered to each patient until discharge. Concurrently, the details regarding whether any samples were sent for culture and the results of those cultures, if available, were recorded. The hospital utilizes a fully operational hospital information system and indigenously developed software for data entry and reporting in microbiology laboratory.

Patients who received antibiotics based on culture and sensitivity results were categorized as having received appropriately prescribed antibiotics. In contrast, those who did not match these criteria were classified as having received inappropriately prescribed antibiotics.

Ethical permission: Ethical permission was obtained from the Institutional Ethical Board AIIMS, Gorakhpur (IHEC Reference no- IHEC/AIIMSGKP/BMR/164/2023 dated-20/05/2023).

RESULTS

This study included 1018 consecutive patients admitted to the surgical wards (General Surgery, Otorhinolaryngology, Obstetrics & Gynaecology, Orthopaedics, Ophthalmology) and ICU. The baseline characteristics of the patients are outlined in Table 1.

Table 1– Baseline characteristics of patients admitted to the hospital from June 2023- January 2024

CRITERIA	NUMBER	%
Gender		
• Male	854	83.8
• Female	164	16.1
Age		
• <20 years	183	17.9
• 21-40 years	529	52
• 41-60 years	196	19.25
• 61-80 years	97	9.50
• >80 years	13	1.2
Microbiology culture results		
• Positive	255	2
• Negative	458	5
• Culture not done	305	45
		30
Isolation of organisms		
• Gram-negative	240	94.2
• Gram-positive	15	5.8
Isolated organisms		
• *Escherichia coli*	197	77.25
• *Klebsiella pneumoniae*	26	10.19
• *Pseudomonas aeruginosa*	15	5.88
	11	4.3
• *Staphylococcus aureus*	4	1.5
• *Enterococcus spp*	2	0.7
• *Proteus spp*		
Antibiotics prescribed		
• Cephalosporins	913	89.7
• Aminoglycosides	756	74.3
• Metronidazole	492	48.4
• Piperacillin-tazobactum	353	34.7
Number of antibiotics prescribed	12	1.2
• 0	188	188
• 1-2	530	530
• 3-4	288	288
• >5		
Antibiotic prescription as per culture report		
• Yes	106	41.5
• No	149	58.5
Length of stay in the hospital		
• <15 days	875	86
• 16-30 days	119	11.7
• > 30 days	24	2.4

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The study observed a predominance of male patients, with 854 individuals (83.8%) and age group 21-40 years (52%). Overall, confirmed infections through culture were identified in 255 patients (25%). Gram-negative bacteria were more prevalent, accounting for 240 cases (94.2%), compared to Gram-positive bacteria, which were present in only 15 cases (5.8%).

This difference was found to be statistically significant ($P < 0.001$). The most common organism isolated was *Escherichia coli* 197 (72.2%), followed by *Klebsiella pneumoniae* 26 (10.19%), *Pseudomonas aeruginosa* 15(5.8%), *Staphylococcus aureus* 11 (4.3%), *Enterococcus spp* 4 (1.5%) and *Proteus* spp. 2 (0.7%). A total of 2850 antibiotic prescriptions were made for the 1018 patients, i.e., an average of 2.79/group antibiotics/patient included in the study. The most commonly used antibiotic was cephalosporins, administered to 913 patients (89.7%), followed by aminoglycosides, prescribed for 756 patients (74.3%), metronidazole for 492 patients (48.4%), and piperacillin-tazobactam for 353 patients (34.7%). Twelve patients (1.2%) did not receive antibiotics, while 188 (18.5%) received monotherapy. Additionally, 530 patients (52%) were treated with two to four antibiotics, and 288 patients (28.3%) received more than five antibiotics during their hospital stay.

Among the total admitted patients, microbial culture yielded positive results in 255 individuals (25%), negative results in 458 individuals (45%), and samples were not sent for culture in 305 individuals (30%). This may be due to clinical decisions based on the patient's stable condition, logistical issues, and empirical treatment decisions without microbiological confirmation. Among those with positive cultures, appropriate antibiotics, i.e., those matching the culture sensitivity report, were prescribed to 106 patients (41.5%), while inappropriate antibiotics were administered to 149 patients (58.5%). This difference was found to be statistically significant ($P < 0.001$). The duration of hospital stay was primarily less than 15 days for 86% of the total admitted patients. This was followed by hospitalizations lasting between 16 to 30 days, accounting for 11.7% of patients, while 2.3% required a hospital stay exceeding one month.

DISCUSSION

This study focuses on regulating the frequency with which antimicrobial prescriptions fall in together with culture-based reports. We found that antibiotic prescriptions predominantly relied on empirical choice; adjustments to antibiotics post-initiation were infrequent.

This study emphasized that 41.5% of antibiotics were prescribed on culture-based reports. In contrast, antibiotics were prescribed in 58.5% of cases without depending on culture-based reports due to clinical judgment, logistical issues, and empirical treatment preferences. These findings were similar to a study stating that antibiotics were empirically administered in 64% of cases, while in the rest, they were administered after microbiological confirmation.[8]

In the present study, it was observed that Gram-negative bacteria were predominant at 94.2%, which was similar to a study in which infections instigated by Gram-negative organisms surpassed Gram-positive organisms in frequency.[9] *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Enterococcus spp* and *Proteus spp* were our study's most common isolated organisms.

To handle this non-compliance to culture-guided prescriptions, attention should be directed towards educating medical students, post-graduate trainees, pharmacy students, and residents on established principles of antimicrobial stewardship. Hospitals in India must promptly establish antibiotic policies due to the widespread challenge of antimicrobial resistance. Crucially, there is a necessity to develop stringent antibiotic restriction policies and enact protocols for antibiotic utilization to streamline the judicious use of antimicrobials.[10,11]

Clinicians prescribing antibiotics must ensure that the initial antibiotic selection aligns with the hospital's antibiogram and undergoes continuous evaluation as part of antimicrobial stewardship efforts. Routine audits and feedback assessments serve as effective mechanisms for monitoring irrational antibiotic usage in both ward and intensive care unit settings. Educating antibiotic prescribers is fundamental to the success of any antibiotic stewardship program, and imparting guidelines and clinical pathways will significantly enhance antimicrobial prescribing practices.

There are few limitations: The study is a single center retrospective study, dependent on a single nurse for collecting the data making it prone for information bias. Antibiotic audit was carried out by microbiologists without clinician and pharmacologist inputs, and there was a lack of comparison with culture negative empirical treated patients and their outcomes.

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CONCLUSION

This study found culture-confirmed infections in 25% of patients who had received antibiotics in surgical wards and ICUs. Notably, 58.5% of patients with positive cultures received inappropriate antibiotics ($P < 0.001$). These results highlight the need for better AMSP and adherence to culture sensitivity to improve treatment efficacy, patient outcomes, and reduce inappropriate antibiotic use.

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CONFLICTS OF INTEREST STATEMENT

The authors declare no conflict of interest.

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AUTHOR'S CONTRIBUTION

PS: Conceptualization; Data curation; Analysis; Writing the draft; Investigation; Methodology

KA: Analysis; Writing the draft; Methodology

ARR: Validation; Review & Editing

VH: Validation; Review & Editing

AM: Supervision; Validation; Review & Editing

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