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"A STUDY OF ANTIBIOTIC UTILIZATION PATTERN IN GENERAL SURGICAL PATIENTS AT A TERTIARY CARE HOSPITAL"

Pharmaceutical Science

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ABSTRACT

Antibiotics play a central role in surgical practice, both in prophylaxis and surgical site infections, which are considered one of the most common hospital-acquired infections. This paper assessed trends of antibiotic use and compliance with institutional policies within the general surgery unit of a teaching hospital, which is a tertiary care unit. The data from patient records indicated a male predominance, with the majority of patients falling within the age range of 41 to 55 years. Combination therapy was actively used, and the most common regimen was cefuroxime + sulbactam, followed by cephalosporins, which were the most prescribed class of antibiotics. Although three-fourths of the prescriptions were in accordance with hospital policy, a large number of agents were in the WHO Watch category and not in the desirable Access group. Weak culture testing, which is often explained by elective procedures, demonstrated the necessity to strengthen diagnostics. The results highlight the need to strengthen antimicrobial stewardship through prescription of Access antibiotics, regular audits and policy revision, and ongoing training of prescribers in order to maximize the use of antibiotics and reduce resistance.

KEYWORDS

Antibiotic Resistance, Antimicrobial Stewardship, Culture Sensitivity Testing, Surgical Prophylaxis, Surgical Site Infections, WHO AWaRe Classification

INTRODUCTION

The use of antibiotics in modern surgical care, especially in preventing and treating surgical site infections (SSIs), is one of the most widespread hospital-acquired infections across the world (Medapati et al. 2025). Surgical antibiotic prophylaxis (SAP) has the potential to substantially decrease postoperative infections, decrease hospitalization, and lower healthcare expenses when used in appropriate scenarios (Medapati et al. 2025). Nevertheless, the practice of the inconsistent and irrational use of antibiotics in the surgical environment is becoming an issue of concern and a significant source of the global antimicrobial resistance crisis (Abula and Kedir 2004; Deb and Dhavalshankh 2024).

Although there are well-developed SAP guidelines related to the timing, choice, and duration of antibiotic use, the literature of various healthcare centers discloses the widespread non-adherence to the recommended practice. These are excessive use of the third-generation cephalosporins and unnecessary and unjustified prolonged prophylaxis, as well as empirical prescribing without microbiological explanations (Baktygul et al. 2011; Sharif et al. 2024; Johora et al. 2024). These trends raise the threat of resistance, adverse drug reaction, and healthcare spending (Al Shimemeri et al. 2011; Parulekar et al. 2020).

The most troublesome aspect of the use of antibiotics in surgical patients is in the low- and middle-income states, where the frameworks of stewardship and guidelines used in national settings are either insufficient or weakly implemented. In Ethiopia, Saudi Arabia, India, and Bangladesh, high prevalence rates of antibiotic usage, polypharmacy, and a prolonged period of use that exceeds clinical need are reported (Abula and Kedir 2004; Sharif et al. 2024; Parulekar et al. 2020). Also, WHO AWaRe classification has shown the trend favoring use of Watch group antibiotics such as ceftriaxone over Access group drugs like cefazolin, which is against the principles of antimicrobial stewardship (AMS) (Medapati et al. 2025).

The scarcity of antimicrobials adds another problem to the situation, and as a result, the use of similar agents is repeated or substitutive, which increases the speed of resistance development. The monitoring of the trends of the antibiotic use and resistance is essential to plan AMS strategies, raise awareness about AMR, and inform specific interventions (Ida et al. 2021).

METHODOLOGY

Study Design

This prospective observational study was carried out at JSS Hospital, Mysuru, a tertiary care teaching hospital, in Surgery department. A total of 390 prescriptions from general surgery inpatients were analysed.

Ethical clearance was obtained from the Institutional Ethics Committee of JSS Medical College, JSS Academy of Higher Education and Research, Mysuru (Approval No. JSS/MC/PG/203/2023-24).

Study Duration

This study has been undertaken from June 2024 to June 2025, for a period of 12 months.

Study Participants

Inclusion Criteria:

- Patients aged >18 years admitted to general surgery wards following surgery.
- Availability of complete medical records during hospital stay.

Exclusion Criteria:

- Incomplete post-operative records (e.g., missing/inadequate culture reports or lack of prophylactic antibiotic details).
- Patients with pre-existing infections at the time of admission.
- Patients on anti-retroviral, anti-tubercular, anti-malarial, anti-helminthic, anti-protozoal, or topical antibiotics.

Data Collection

Eligible patients were enrolled after obtaining informed consent. Data

were collected prospectively from patient case records, including demographic variables (age, gender) and clinical parameters (diagnosis, comorbidities, ongoing treatment). Antibiotic details-generic name, dose, route, and duration-were recorded from the time of administration until discharge.

Culture sensitivity reports were reviewed to assess bacterial growth in biological samples (e.g., blood, urine, sputum, endotracheal aspirates). Antibiotic therapy was classified as:

- *Prophylactic*: Administered to prevent infection pre/post-operatively
- *Empirical*: Initiated based on clinical suspicion without microbiological confirmation
- *Definitive*: Based on culture-confirmed infection and sensitivity results

Statistical Analysis

The data for the study were entered into Excel 2021 and subsequently the data was analyzed using SPSS version 30.0.0.0 and Excel 2021. The statistical analysis comprised of descriptive statistics to evaluate the demographic and clinical characteristics of the patients' details. All the data was evaluated in order to determine the drug usage pattern in the patients undergoing abdominal surgery and also to assess the compliance of each drug.

RESULTS

A Descriptive statistical analysis of the data was done and indicated it as frequency and percentage in tables and graphs.

Demographic Features

The study is a male predominant study. A total of 390 cases were collected of which 67.12% (262) subjects were male and 32.18% (128) were female.

Among the 390 patients, 144 patients (36%) were from the age group of 41-55 years and were the most frequent group in the study. 5 patients (1.28%) were from the age group of 18-20 years and 111 (28%) from 21-40 years groups. Also 76 (19.48%) patients were from 56-65 age group and 47 (12%) patients were from 66-80 age group and 7 (1.7%) were from >80 age group.

Among various infections, 15 % were Hernia, 8.2 % were Cellulitis, 7.6% were Abscess, 13.9% were Cholecystitis, 5.38% were Appendicitis, 10.02% were Pancreatitis,15.68% were Fissure in Ano-followed by 1.5 % were both Colitis and Pseudocyst and 1.28% Haemorrhoids., followed by 15.42% other infections like follicular neoplasm of thyroid, fibroadenoma, bilateral cervical lymphadenopathy acute necrotising lymphadenitis-kikuchi disease, lower limb critical limb ischemia with wet gangrene of right foot, left lower limb varicose vein with healed venous ulcer and other (**Fig 1**)

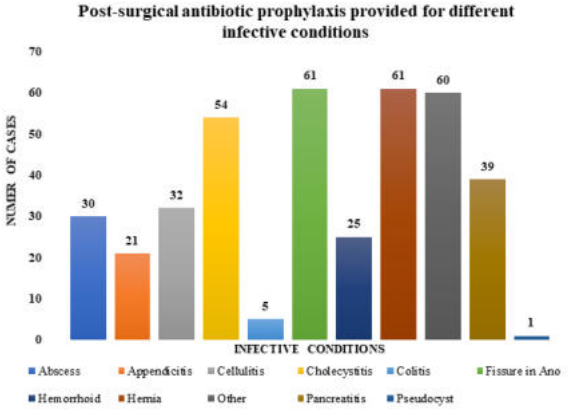

Fig 1: Post-surgical Antibiotic Prophylaxis Provided For Different Infective Condition

B. Characteristics Of Antibiotics And Their Prescription:

The antibiotic prescribing pattern indicated that among the 390 subjects, 132 (33.84%) of them were in monotherapy, 220 (56.41%) were prescribed with two antibiotics and 38 (9.74%) of them were prescribed with three or more than three antibiotics.

C. Culture Sensitivity Test And Various Samples Collected For The Test.

Out of 24 sample investigated 20 were positive with bacterial growth and 4 were negative with no growth

Among the various samples collected for the culture sensitivity test, 14.28% of the samples collected were urine [n=3], 14.28% were blood[n=3], 57.14% were pus[n=12], 9.52% were Tissue[n=2] and 4.76% were Bile [n=1].

The different bacteria isolated from various sample cultures were-*CITROBACTER (Cb)* [n=1,4%] isolated from pus culture, *Enterobacter Cloacae Complex (Ecc)* [n=1,4%] from pus culture, *Enterococci (Ec)* [n=4,16%] from tissue and pus culture, *Escherichia Coli (E .Coli)* [n=3,12%] from bile and pus culture, *Klebsiella Pneumoniae (Kleb .pneu)* [n=8,32%] from urine, tissue, blood and pus culture, *Pseudomonas Aeruginosa (pseudo aeru)* [n=3,12%] from pus culture, *Staphylococcus Aureus (Stap cocous)* [n=4,16%] from pus culture, *Streptococcus Species (Sterp coccus)* [n=1,4%] from pus culture. (**Fig 2**)

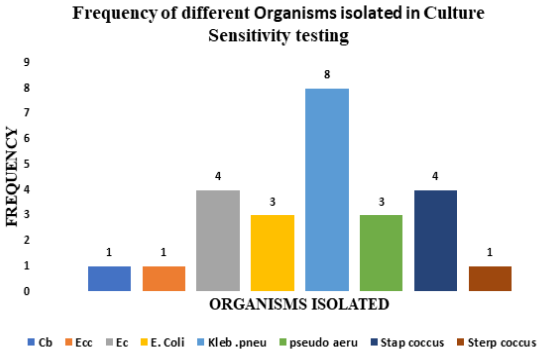

Fig 2: Bar chart Depicting the Frequency of different Organisms isolated in Culture Sensitivity testing: *Citrobacter* (***Cb***), *Enterobacter Cloacae Complex* (***Ecc***), *Enterococci* (***Ec***), *Escherichia Coli* (***E.Coli***), *Klebsiella Pneumoniae* (***Kleb. Pneu***), *Pseudomonas Aeruginosa* (***Pseudo Aeru***), *Staphylococcus Aureus* (***Stap Cocous***), *Streptococcus Species* (***Sterp Coccus***)

D. WHO Core indicators

When the WHO core indicators were analysed, it showed that about 1.66% was the average number of antibiotics prescribed per prescription and about 62.5% of the antibiotics were prescribed from National List of Essential Medicine (NLEM- 2015). 70.83% of antibiotics were listed in WHO- Essential Medicine List (EML) 2021.

E. Classification of the Prescribed antibiotics with Fixed dose combinations (FDC's)

Of the total 390 antibiotics prescribed, 180 i.e. 46% were single antibiotics and 210 i.e. 54% were fixed dose combinations. Among the 210 FDCs, 70 were Cefoperazone + Salbactum (33.33%), followed by 10 Ceftriaxone + Sulbactam (4.76%), 60 of them were Cefuroxime+ Sulbactam (11.42 %), 24 of them were Piperacillin + Tazobactam (11.42 %), followed by 28 Amoxiciliin + clavulanate (13%) and 18 Ceftazidime+Tazobactam (8.51%). (**Fig 3**)

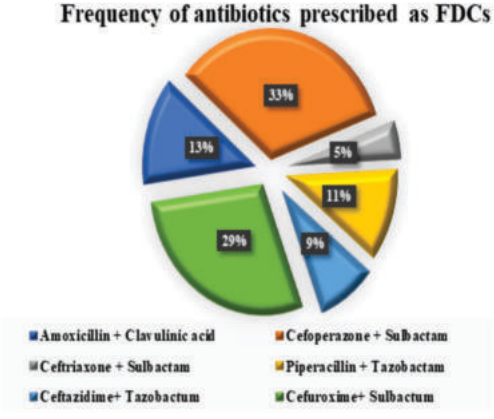

Fig 3: Pie Chart Depiciting The Frequency Of Antibiotics Prescribed As Fixed Dose Combinations (FDCs)

F. Depiction of the classification of antibiotics based on Anatomical Therapeutic chemical (ATC) classification, Essential Medicine List (EML) 2015 and WHO-AWaRe category

According to the Anatomical Therapeutic Chemical classification (ATC), antibiotics were arranged as per the standard ATC code. The pharmacological group of systemic antibiotics (J01) was analysed, and the data were assessed using WHO quality indicators; they were also classified based on WHO-EML 2021 and AWaRe categorization.

Among the prescribed antibiotics, 87.5% of them were included in the AWaRe category. About 45.83 % of the antibiotics prescribed for the Surgical patients were coming under the Watch category and 33.3% in Access, followed by 8.33% in Reserve. 12.5 % of the antibiotics prescribed were not recommended by WHO.

About 70.83% of the antibiotics prescribed were listed in the WHO-EML 2021, while 29.17 of % antibiotics were not included in the EML (Essential Medicines List). The percentage of antibiotics that were included in the NLEM-2015 was about 60% and about 40% were not listed in the NLEM (National List of Essential Medicines)-2015 list. Among the 390 prescriptions analysed, approximately 293 prescriptions were compliant with the hospital's antibiotic policy, and 97 were non-compliant.

DISCUSSION

Rational antibiotic use is also required so that infections can be treated or post-operative complications can be prevented effectively, and the development of antibiotic resistance can be avoided. Hospital-acquired antibiotic misuse has been cited as the root cause of the development of multidrug-resistant organisms, thus escalating morbidity, mortality, and health care costs. Conscientious use of antibiotics can be encouraged by formal antibiotic stewardship programs that consist of regular internal audits assessing non-compliance. Such programs may be applied to track resistance patterns that will assist in future decision-making. In addition, special therapy under the guidance of performed culture sensitiveness under the consultation of a clinician would also be instrumental in averting the incidence of resistance (Goossens 2009).

As per our current study analysis, we came up with 390 case records of a surgical inpatient with a demographic of middle-aged males, as per the current study analysis records, which has been the same with earlier studies by Samreen et al. (2019) and Patel et al. (2017), in which they indicated that surgical admissions were predominant in this group. This may be a pointer of higher surgical cases and higher health-seeking behaviour among men.

Antibiotic combination therapy was more common (56.41%), and only 33.84% were used as monotherapies. The pattern is similar to Ghana and Bangladesh, where empirical and combination antibiotics were common among inpatients (Agyare et al. 2024; Rashid et al. 2022). The non-culture-directed administration of combinations increases the risk of toxicity and resistance, implying that superior diagnostic support and protocol adherence are necessary.

Of the 24 samples under test in terms of culture sensitivity, only 20 samples had positive growth. The dominant samples of pus (57.14%), urine, and blood reflect profiles of surgical infections. In Uganda, George et al. (2018) also found that the under-use of diagnostics in the post-surgical cases increases the burden of resistant infection. Probably, however, avoidance of testing in elective surgeries was clinically justified in some circumstances.

Surgical conditions normally treated were cholecystitis, pancreatitis, hernia, and fissure-in-ano, and were accompanied by typical surgical presentations. Extensive empiric antibiotic coverage of infection (such as cellulitis and abscess) requires qualified stewardship of antibiotics to encourage prudent and good use.

The two most dispensed classes of antibiotics were cephalosporins (23.55% second-generation and 18.91% third-generation). The same has been noted by Patel et al. (2017) and Rashid et al. (2022), as they indicate that cephalosporins have been overused in surgery. WHO Watch group drugs are only applicable in cases of pathogen resistance, as unsuitable action could result in unnecessary selective pressure (World Health Organization 2021).

Fixed-dose combinations (54%), with the majority of those being cefoperazone + sulbactam and cefuroxime + sulbactam, were high. Some of these combinations, e.g., ceftriaxone + sulbactam and cefoperazone + sulbactam, are not in WHO guidelines or the Essential Medicines List, but they are widely used (Rashid et al. 2022; World Health Organization 2021). Their approval as being popular in the absence of regulation creates a loophole in the prescription, resistance, effectiveness, and cost-effectiveness issues.

Prescription of drugs on a patient-to-patient basis (1.66 on average) was within recommended WHO guidelines. However, the fact that 62.5% of antibiotics are included in the NLEM 2015 and 70.83 in the WHO EML 2021 suggests that the policies should be tightened, and prescribers should raise awareness.

AWaRe prescribed antibiotics indicated that Watch group antibiotics were overused (45.83%), whereas Access (33.3) and Reserve (8.33) were underused. As per the WHO guidelines, to curtail the risk of resistance, at least 60 percent of all prescriptions should be composed of Access antibiotics (World Health Organization 2021). The lack of responsible prescribing is implied by the continued use of Watch antibiotics in the empirical treatment, as seen in LMICs like Ghana and Bangladesh (Agyare et al. 2024; Rashid et al. 2022).

Cephalosporins (J01D) use represented over fifty percent of the total number of antibiotics (53.64), followed by macrolides and quinolones. Similar excessive use of broad-spectrum agents has been observed in Mexico and Ghana, which have been commonly associated with limitations in diagnosis and low adherence to recommendations (Agyare et al. 2024; Zumaya-Estrada et al. 2025).

Complete compliance with institutional antibiotic policy was 75% in our study, indicating that stewardship efforts have some success. There is, however, 25% non-compliance, which emphasizes the need to continue training and audit systems. According to international evidence, compliance with the policy can be enhanced with the help of electronic audit tools, feedback, and standardized checklists (Fridkin et al. 2014).

Empirical literature shows that fixed-dose combinations have a higher likelihood of resistance in MRSA, Pseudomonas aeruginosa, and ESBL-producing Enterobacteriaceae, although pathogen-specific data were not examined in this study in any detail (George et al. 2018; Sweileh et al. 2012). This trend can cause negative resistance, unless managed.

Tigecycline and linezolid, as reserve group medications, were used very infrequently (8.33%), which is consistent with the advice that they should be reserved to treat known infections with multiple-drug resistance. Still, the restricted use should be closely observed to avoid unintentional abuse.

CONCLUSION

A tertiary care teaching hospital study of this nature assessed antibiotic usage and institutional policies adherence in the general surgery unit. Combination therapy was prevalent in the 390 patient records with males domineering and the majority of the patients aged between 41 and 55 years. Usage of Cefuroxime + Sulbactam was the highest and cephalosporins were top in their type. Even though 75 percent of all prescriptions were adherent to the hospital policy, a lot of them belonged to the WHO Watch group rather than the desirable Access group. The restrictions in culture and sensitivity testing are probably as a result of elective surgeries. Results identify the necessity to conduct regular audits, enhanced diagnostics, and prescriber education to fall into line with WHO AWaRe and essential medicines recommendations, which enhance outcomes and facilitate antimicrobial stewardship.

ABBREVIATIONS

(**ADRs**) Adverse Drug Reactions, (**AMDs**) Antimicrobial Drugs, (**AMR**) Antimicrobial Resistance, **(AMS)** Antimicrobial Stewardship, (**AMSP**) Antimicrobial Stewardship Programme, (**ARBs**) Antibiotic Resistance Breakers, **(ATC/DDD)**Anatomical Therapeutic Chemical / Defined Daily Dose, (**AWaRe**)Access, Watch, Reserve, **(CDCP)** Centres for Disease Control and Prevention, (**CMB**) Cell Membrane Biosynthesis, (**CMS**) Centres for Medicare and Medicaid Services, (**DHPS**)– Dihydropteroate Synthesis, (**FAS**) Fatty Acid Synthesis, (**FDCs**)Fixed Dose Combinations, **(GAP-AMR)** Global Action Plan on Antimicrobial Resistance, **(GLASS)** Global Antimicrobial

Resistance and Use Surveillance System, **(ICU)** Intensive Care Unit, **(IPC)** Infection Prevention and Control, **(MDROs)** Multidrug-Resistant Organisms, **(MLS)** Macrolide, Lincosamides, Streptogramins, **(MOA)** Mechanism of Action, **(MRSA)** Methicillin-Resistant *Staphylococcus aureus*, **(MSSA)** Methicillin-Susceptible *Staphylococcus aureus*, **(NLEM)** National List of Essential Medicines, **(P/S/T)** Primary / Secondary / Tertiary, **(PBP)** Penicillin Binding Proteins, **(PCP)** Primary Care Physicians, **(RTI)** Respiratory Tract Infections, **(SHEA)** Society for Healthcare Epidemiology of America, **(URTI)** Upper Respiratory Tract Infections, **(WHO-EML)** World Health Organization – Essential Medicines List

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