STM JOURNALS

International Journal of
Biomedical Innovations and Engineering

Volume 2, Issue 2, 2024
July–December
DOI (Journal): 10.37591/IJBIE

https://journals.stmjournals.com/ijbie

Review IJBIE

Evaluating the Use of Antibiotic Prophylaxis in Surgical Procedures: A Study Conducted at a Tertiary Care Teaching Hospital in Southern India

Abhishek[1], Shameem Abdurahiman T.[1,*], Vanishree[1], Kavya H.B.[2], Shivaraj D.R.[2]

Abstract

Background: *Prophylactic antibiotics can reduce the frequency of postoperative wound infections. Well-designed trials have demonstrated that the appropriate administration of prophylactic antibiotics in surgeries can reduce postoperative infections to about one-half of the incidence in untreated patients.* ***Objectives:*** *To examine surgeon's adherence to the hospital's antibiotic policy by comparing and assessing the usage of antibiotics as prophylactic before surgery.* ***Methods:*** *A prospective observational study was carried out among inpatients in the hospital regarding surgical procedures, prophylactic antibiotics, and timing of antibiotic administration. These data were compared against the hospital's antibiotic policy to verify adherence to the guidelines by the surgeons.* ***Results:*** *This study included 203 participants. During the trial, There was a noticeable deviation from the hospital's antibiotic policy which was mainly justified by the surgeons' execution of evidence-based medicine. 74% of samples (150) complied with the recommendations for prophylactic antibiotic selection, while 53 (26%) did not. 72% (147) received prophylactic antibiotics promptly by the guidelines. By integrating the aforementioned criteria, it was observed that 69% (140) of the samples indicated surgeon's adherence to the hospital antibiotic policy by administering prophylactic antibiotics during surgical procedures. With a 95% compliance rate, ceftriaxone was mostly used. The antibiotics with 100% noncompliance rates that are least commonly used are meropenem, cefoperazone, and amoxicillin.* ***Conclusion:*** *The study indicates that surgeon compliance with the hospital antibiotic policy fell short of guideline recommendations. It emphasizes the importance of implementing evidence-based practices and adhering to guidelines to promote the rational use of antibiotics in surgical prophylaxis.*

Keywords: Prophylactic antibiotic, hospital antibiotic guidelines, compliance, choice of antibiotic, and timing of antibiotic administration

***Author for Correspondence**
Shameem Abdurahiman T.
E-mail: shameemrahmankmr@gmail.com

[1]Pharm D. Intern, Sree Siddaganga College of Pharmacy, Tumakuru, Karnataka, India
[2]Assistant Professor, Sree Siddaganga College of Pharmacy, Tumakuru, Karnataka, India

Received Date: July 03, 2024
Accepted Date: July 29, 2024
Published Date: July 30, 2024

Citation: Abhishek, Shameem Abdurahiman T., Vanishree, Kavya H.B., Shivaraj D.R. Evaluating the Use of Antibiotic Prophylaxis in Surgical Procedures: A Study Conducted at a Tertiary Care Teaching Hospital in Southern India. International Journal of Biomedical Innovations and Engineering. 2024; 2(2): 7–17p.

INTRODUCTION

Antibiotics, potent medications for treating specific infections, can be lifesaving when employed correctly. They work by either halting bacterial reproduction or eradicating the bacteria entirely. In situations of bacterial overgrowth where the immune system struggles to clear them, antibiotics are invaluable [1]. However, antimicrobial resistance emerges when bacteria, fungi, and other microorganisms develop resistance to the drugs designed to combat them, allowing the microbes to persist and proliferate. Various forms of resistance exist, including natural, acquired, cross, and multidrug resistance [2]. Prophylactic antibiotics, when appropriately administered, can

lower the incidence of postoperative wound infections in specified procedures. Traditionally, accepted indications for prophylactic antibiotic use include clean-contaminated procedures and prosthesis insertion, but emerging criteria now consider wound contamination along with anesthetic risk and operation duration. The selection of a prophylactic antibiotic hinges on its effectiveness against encountered endogenous flora, its safety profile, and its cost, prioritized in that order [3]. Typically, potent antibiotics reserve for severe illnesses are not utilized for prophylaxis. Administered preoperatively at its maximum dose, a prophylactic antibiotic ensures adequate tissue concentration during and immediately after incision. Importantly, in the absence of infection, antibiotics should not be continued beyond the operative day [4].

Antibiotics given prior to the contamination of sterile tissues or fluids are categorized as prophylactic [5]. Their aim is to avert the onset of surgical site infections (SSIs). Hospital Antibiotic Guidelines are enforced to oversee antibiotic usage in patients, aiming to prevent the emergence of resistance strains and reduce the frequency of hospital-acquired infections [6]. It consists of various sections which include General Principles of Antimicrobial Therapy which are composed of diagnosis, bacteriology, choice of antibiotic(s), the site of infection, the known or probable sensitivity of the likely pathogen(s), toxicity, cost, dose, route of administration and antibiotic combinations [7]. Prophylactic antibiotics for surgery will be covered in detail in a section, along with suggestions for surgeons and information on the dosage, frequency, method of administration, and ideal time to administer prophylactic antibiotics for various diseases [8]. This helps clinicians to administer antibiotics systematically and specifically [9].

METHODS

This prospective observational study enrolled a total of 203 patients from the hospital's inpatient department.

Materials Used

- Patient case sheets
- Data collection forms
- Informed consent forms
- Hospital antibiotic guidelines

Study Criteria

- ***Inclusion Criteria:*** Surgeries concerning orthopedics, neurosurgery, otorhinolaryngology, gastroenterology, accident & emergency, and cardiology, and Individuals of both genders, aged over 18 to 60 years were included in the study [10].
- ***Exclusion criteria:*** Surgeries concerning oncology, dental, dermatology, obstetrics & gynecology, urology, nephrology, ophthalmology, respiratory, and pediatrics, and the procedures performed in the departments that are not included in the guidelines were not considered [11].

Data Collection Method

Data collection forms were utilized to gather information on prophylactic antimicrobial agents prescribed to the study population, detailing the surgical procedure, prophylactic antibiotics, and the timing of antibiotic administration [12]. After these data were compared with the hospital antibiotic policy to check the surgeon's compliance with the guidelines.

Study Procedure

Phase 1

- Choosing the area of research
- Designing the study [13]

Phase 2

- Studying and understanding the hospital antibiotic guidelines
- Collecting the data
- Analyze the gathered data [14]

Phase 3

- Concluding the research report
- Presenting the result [15]

Statistical Analysis

The data was collected, compiled in MS EXCEL, and analyzed choice and timing of prophylactic antibiotics for compliance with the guidelines [16]. Graphical representations such as bar graphs and tables have been used for visual interpretation of the analyzed data [17].

Results

According to this study, out of the 203 samples that were collected,

1. Out of the total, 150 cases (74%) followed the recommended guidelines for selecting prophylactic antibiotics, while 53 cases (26%) did not [18].
2. 147 samples (72%) received prophylactic antibiotics in a timely manner in accordance with the guidelines, while 57 samples (28%) did not as seen in Table 1 [19].

After applying these criteria, it was found that surgeons used prophylactic antibiotics in 140 cases (69%) during surgery, while 63 cases (31%) did not. This pattern aligns with the hospital's antibiotic policy, as shown in Table 2. [20].

The most commonly used antibiotic is inj. ceftriaxone, which has a 95% compliance rate [21]. The least commonly used antibiotics are inj. meropenem, inj. cefoperazone with sulbactam, inj. cefoperazone with tazobactam, and inj. amoxicillin with clavulanic acid, all of which have 100% noncompliance rates as seen in Table 3 [22].

Prophylactic Antibiotics Selection: Choosing prophylactic antibiotics involves selecting the appropriate antibiotic to prevent infections, particularly in surgical or high-risk scenarios. The decision depends on factors like the type of surgery, the patient's health, and the potential bacteria that could cause an infection. The goal is to minimize the risk of post-procedural infections while avoiding unnecessary antibiotic use, which can lead to resistance. Effective prophylaxis requires understanding the local microbial resistance patterns and ensuring the antibiotic is administered at the correct timing and dosage to maximize efficacy and minimize side effects.

Table 1. Department-wise compliance of antibiotic selection.

Variables	Guideline Compliance (N, %)	Guideline Non-Compliance (N, %)
Cardiology	2(100)	0
Otorhinolaryngology	11(100)	0
Neurosurgery	13(100)	0
GE	54(54)	46(46)
Orthopedics	70(91)	7(9)

Timing Compliance: Total compliance refers to the adherence to the prescribed timing for antibiotic administration across all departments within a hospital. This involves each department following the established schedules for administering antibiotics precisely as directed. Ensuring total compliance with these timing guidelines is vital for maintaining the effectiveness of treatment and achieving optimal patient outcomes. Consistent adherence to the timing protocol helps in maintaining proper drug levels,

preventing infections, and avoiding potential complications. Achieving department-wise compliance requires diligent coordination and commitment from all units within the hospital to support effective antimicrobial management.

Table 2. Department-wise compliance of timing of antibiotic administration.

Variables	Guideline compliance (N, %)	Guideline non-compliance (N, %)
Cardiology	2(100)	0
Otorhinolaryngology	10(91)	1(9)
Neurosurgery	12(92)	1(8)
GE	47(47)	53(53)
Orthopedics	75(97)	2(3)

Table 3. Department-wise compliance of hospital antibiotic policy.

Variables	Guideline Compliance (N, %)	Guideline Non-Compliance (N, %)
Cardiology	2(100)	0
Otorhinolaryngology	10(91)	1(9)
Neurosurgery	12(92)	1(8)
GE	47(47)	53(53)
Orthopedics	69(90)	8(10)

Total Compliance

Total compliance involves the adherence to hospital antibiotic policies across all departments. This means each department within the hospital follows the established guidelines and protocols for antibiotic use consistently. Ensuring total compliance is crucial for effective infection control and optimizing patient outcomes. It requires coordination and commitment from all departments to adhere to prescribed practices, which helps in preventing antibiotic resistance and enhancing the overall effectiveness of the hospital's antimicrobial stewardship efforts**.**

Antibiotics Usage In Various Departments

"Antibiotic usage across different departments refers to how antibiotics are prescribed and administered in various clinical areas of a hospital. Each department, such as surgery, internal medicine, or pediatrics, has specific guidelines and practices for using antibiotics based on the types of infections commonly encountered and the patient populations served. Effective antibiotic usage in these departments involves selecting the appropriate antibiotics, dosages, and treatment durations tailored to each department's needs, while also adhering to broader antimicrobial stewardship policies to prevent resistance and ensure optimal patient care

Department of Cardiology

The CABG procedure was carried out in this department, during which inj. cefoperazone with sulbactam was administered [23]. The 2 samples taken from this department were 100% compliant with the antibiotic selection, timing, and guideline [24].

Department of Neurosurgery

Craniotomy and Cranioplasty, clean contaminant surgeries (procedures that brain air sinus, mastoid air cells, nasal or oral cavity), and depressed skull fracture were performed in the neurosurgery department [25]. Different antibiotics are recommended during neurosurgical procedures, and the prophylactic antibiotic is chosen by utilizing EBM [26].

Inj. ceftriaxone (n=12, 92%) and inj. cefuroxime (n=1, 8%) were the most frequently given antibiotics in this division [27]. The antibiotics administered in this department fully adhere to the prescribed

standards. Out of 13 samples, 92% (n=12) were found to be in compliance with the timing of antibiotic administration, whereas 8% (n=1) were found to be out of compliance [28].

In the neurosurgical department, guidelines compliance followed the same pattern as timing.

Department of Otorhinolaryngology

One of the operations performed at this department's Otitis Media unit included the collection of 11 (5.4%) samples, of which inj. ceftriaxone (n=7) and inj. cefuroxime (n=4) was administered to 64% and 36% of participants, respectively [29]. In this department, the choice of antibiotic was 100% in compliance with the hospital antibiotic policy [30]. The timing of antibiotic administration was not properly followed by this department as per the recommendations. 91% compliance was seen in the timing where (n=10) & Guidelines compliance was observed with 91% samples(n=10) and 9% non-compliance (n=1) as seen in Figure 1 [31].

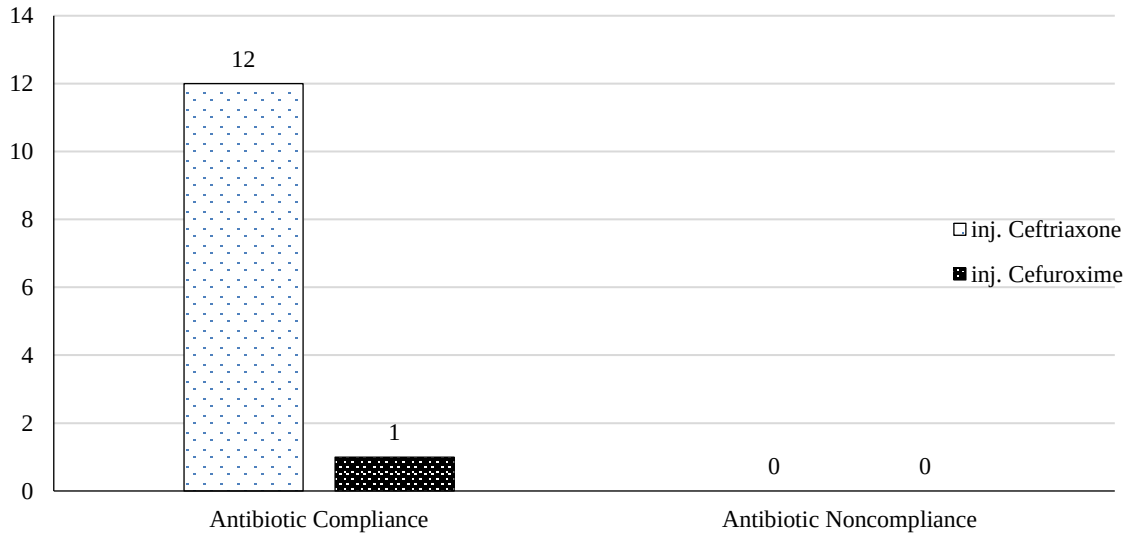

Figure 1. Antibiotic compliance in Neurosurgery.

Department of Gastroenterology

The following procedures were performed at the GE department: Appendectomy, Colorectal surgery (fistulectomy), Biliary tract surgeries (lap cholecystectomy), and Inguinal hernia repair [32]. Here, samples for the aforementioned procedures were taken (n=18, 18%), (n=1, 1%), (n=26, 26%), and (n=55, 55%) accordingly. In the GE department, inj. ceftriaxone (43%), inj. Cefoperazone with sulbactam (53%), inj. Cefoperazone with tazobactam (1%), inj. meropenem (1%), inj. amoxicillin with clavulanic acid (1%), and inj. cefuroxime (1%), are the most commonly prescribed antibiotics [33]. Among the 100 samples collected, the choice of prophylactic antibiotic showed (n=54) 54% compliance and (n=46) 46% non-compliance. In analyzing the timing of administration in the GE department, 87% (n=87) were compliant and 19% (n=19) were not. Out of 100 samples, 47% (n=47%) adhered to the hospital antibiotic guidelines, whereas 53% (n=53) did not [34].

Department of Orthopedics

There are 4 significant surgeries in this department. They are joint replacement, open reduction of fracture/internal fixation, closed fracture, and soft tissue surgeries. (n=32, 41%), (n=26, 34%), (n=17, 22%), and (n=2, 3%) samples are taken from each surgery, correspondingly. Inj. ceftriaxone (n = 19), inj. cefuroxime (n = 52), inj. cefoperazone with sulbactam (n = 5), and inj. piperacillin with tazobactam (n = 1) were prescribed among the 77 samples taken. Several prophylactic antibiotics were provided in the orthopedic division. Surgeons do prescribe an antibiotic of their choice by keeping EBM in mind. For instance, the preferred antibiotic in procedures like ORIF (open reduction and internal fixation) is

ceftriaxone (3rd gen cephalosporin), however, the surgeon prefers cefuroxime, a 2nd gen cephalosporin since it has a larger volume of distribution, or spreads more effectively, than ceftriaxone [35].

Ninety-one percent (n=70) of the 77 samples were found to be in accordance with the guideline in the antibiotic selection, whereas seven samples (9%) were not as seen in Figure 2.

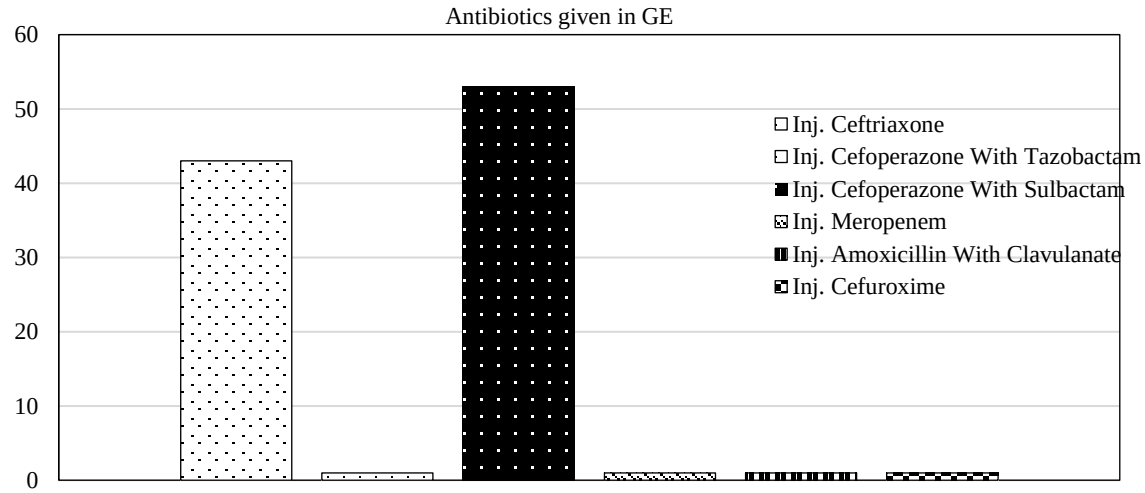

Figure 2. Antibiotics used in GE.

97% (n=75) of the samples in this department adhered to the timing of administration, while 3% (n=2) of the samples were non-adherent. It was discovered that 90% (n=69) of the samples analyzed at the orthopedics department complied with guidelines, whereas 10% (n=8) did not.

Highlights of Result

Using data collection forms and in-person interviews with the patients and surgeons, this study was carried out over the course of 6 months in 5 departments of a tertiary care teaching hospital. The results were produced using a variety of statistical analyses as seen in Figure 3.

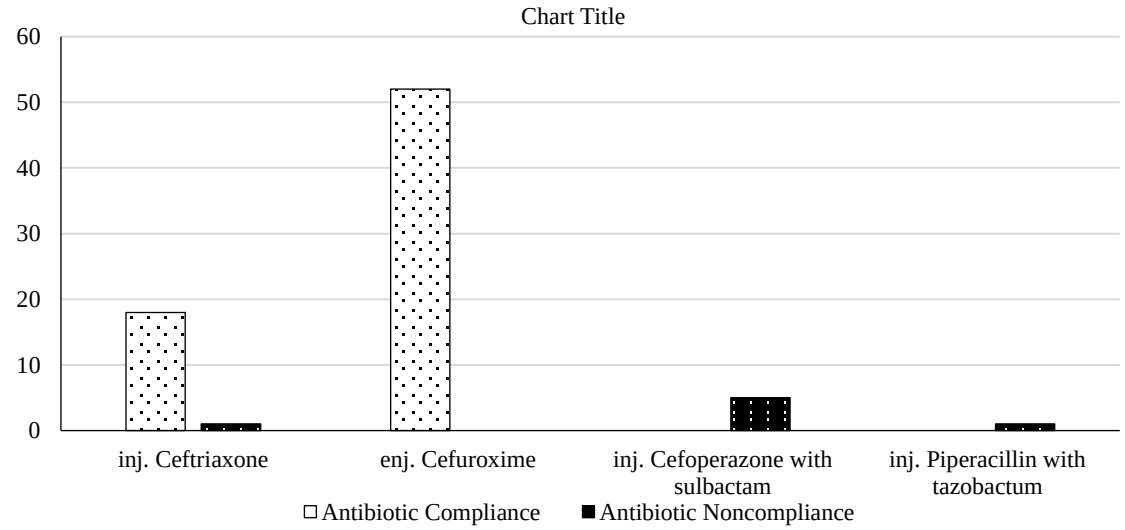

Figure 3. Antibiotic compliance in Orthopedics.

During the trial, a deviation from the hospital's antibiotic standards was noted. The use of methodologies like Evidence-Based Medicine by the surgeons mostly served to justify these few deviations.

DISCUSSION

It is important to strictly monitor compliance with the guidelines for using the proper antibiotic prophylaxis during surgical procedures. Seventy-four percent of the patients included in the study adhere to the guidelines for selecting the appropriate antimicrobial agent.

The timing of medication administration, the blood supply to the tissue, and the suitability of the antimicrobial spectrum were thought to be the three most important factors. A delay in giving antibiotics can raise the risk of SSIs. In our study, 72% of patients received the antibiotic on time before surgery.

The relationship between the administration of the correct choice of prophylactic antibiotic and the timely administration is a major problem in several instances. The study is conducted with 203 participants (Male:120, and Female:83) of the age group of 18-60years, 140 patients were compliant with guidelines (Male:78, and Female:62). Our analysis demonstrates that 69% of surgical procedures fully adhere to the guidelines.

The antibiotic guideline is a hospital-specific document tailored to its patient demographic and prevalent diseases in the area, aimed at promoting the rational, judicious, and efficacious utilization of antibiotics. These guidelines are put into practice to make sure that the administration of antibiotics to patients is regulated in order to avoid the development of resistant strains of bacteria and to reduce the occurrence of nosocomial infections

Concern over the potentially harmful consequences that using and discarding medications could have on both human and ecological health has risen over the past ten years. A key issue associated with antibiotic usage is the emergence and proliferation of antibiotic-resistant bacteria. Antibiotic prophylaxis in surgery involves administering antimicrobial agents to surgical patients aiming to decrease postoperative wound infections and other infectious complications.

The decision to use antibiotic prophylaxis is based on the relative risks (toxic or allergic reactions, emergence of resistant bacterial strains, and superinfection) and benefits (decreased infection rate). Currently available drugs administered as a single dose pose a sufficiently small risk such that when appropriate, antibiotic prophylaxis is clearly justified. The classic indications for antibiotic prophylaxis are clean-contaminated operations (see below) or those involving the insertion of a prosthesis. Less-established indications include clean operations in patients with impaired host defenses, or operations in patients for whom postoperative infection would be catastrophic as is often the case in cardiac, neurological, or ophthalmologic surgery as seen in Table 4.

Table 4. Classification of surgical wounds

Classification of surgical wound	Criteria
Clean	Operative wounds devoid of inflammation and not involving the respiratory, gastrointestinal, genital or urinary tracts (and maintaining aseptic technique) are classified as uninfected. Clean wounds are usually closed directly, and if needed, a closed drainage system is used. Additionally, operative incisional wounds resulting from non-penetrating (blunt) trauma fall into this category if they meet the specified criteria.
Clean-contaminated	Operative wounds involving entry into the respiratory, GI, genital or urinary tracts are considered under controlled conditions and without significant contamination. This category includes procedures involving the biliary tract, appendix, vagina, and oropharynx, as long as there is no sign of infection or major technical breach.
Contaminated	Significant breaches in sterile technique such as open

	cardiac massage, substantial spillage from GIT, or encountering acute, non-purulent inflammation during incision classify a wound in this category. Additionally, open, recent, or accidental wound fall under this classification.
Dirty (or infected)	This category includes cases with existing infections, perforated organs, and old traumatic wounds containing dead tissue. This definition implies that the microorganisms responsible for postoperative infections were present prior to the surgery, in such instance, antibiotic treatment is necessary in addition to prophylaxis.

Prophylactic antibiotics for surgery will be covered in detail in a section, along with suggestions for surgeons and information on the dosage, frequency, method of administration, and ideal time to administer prophylactic antibiotics for various diseases. This helps clinicians to administer antibiotics systematically and specifically.

CONCLUSION

The study results reveal that adherence among surgeons to the hospital's antibiotic policy did not meet the recommended guidelines. This shortfall underscores the need for integrating evidence-based guidelines into clinical practice to improve antimicrobial surgical prophylaxis. Implementing such guidelines is crucial for ensuring that antibiotics are used appropriately, thereby minimizing the risk of infections and combating antibiotic resistance. The findings highlight that while guidelines exist, consistent application in practice is lacking. It is essential to enforce these evidence-based recommendations rigorously to enhance the effectiveness of prophylactic antibiotics and ensure that they are administered only when necessary and in the correct manner. Additionally, establishing a system for ongoing monitoring and evaluation of compliance is vital. This regular oversight helps identify areas where adherence may be slipping and provides opportunities for corrective actions. By maintaining strict adherence to established guidelines and continually monitoring their application, hospitals can improve patient outcomes, reduce the incidence of postoperative infections, and contribute to the broader goal of antimicrobial stewardship.

Acknowledgement

We extend our sincere gratitude to Dr. S. Paramesh, our director of SMCRI; Dr. Suresh V. Kulkarni, our principal; Dr. P. Ashok Kumar, Head of the Department of Pharmacy Practice; and Dr. Kavya. H. B, our guide of Sree Siddaganga College of Pharmacy, Tumkur, for the suggestions and guidance. We express our gratitude to Siddaganga Medical College and Research Institute for supporting us in conducting this study. Our sincere appreciation is extended to the SMCRI staff members who assisted and allowed us to collect and compile data.

Conflict of Interest

No conflict of interest in this work.

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