Original Article

# PRESCRIBING PATTERN OF ANTIMICROBIALS IN PRE AND POST-SURGICAL INFECTIONS IN A TERTIARY CARE HOSPITAL

**Shamshath Begum. M[1], Gunjan[2], Kashmira J Gohil[3], Sriram. A[4*]**

[1] Department of Pharmaceutics, Anand College of Pharmacy, Sharda Group of Institutions, Agra-282007(UP)
[2] Department of Pharmacology, School of Pharmacy, Greater Noida-201310(UP)
[3] Department of Pharmacology, Anand College of Pharmacy, Sharda Group of Institutions.Agra-282007 (UP)
[4] Department of Pharmacy Practice, SRM College of Pharmacy, Kattankulathur-603203 (Tamil Nadu).
**Corresponding author:** Sriram. A, Department of Pharmacy Practice, SRM College of Pharmacy, Kattankulathur-603203 (Tamil Nadu).

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## Abstract

According to the surgical procedure, infections that occur within 30 days following an operation are referred to as surgical site infections (SSI) and may last longer than 30 days. The aim of the study is to evaluate drug use pattern of surgical antimicrobial prophylaxis practice and SSI prevalence among surgically operated patients. The prospective observational study was conducted in tertiary care teaching hospital, Agra. Total number of samples included for this study will be 380 patients using 95% confident interval. During the study period 380 patients underwent various surgeries in the general surgery department in tertiary care hospital, Agra. Among the 380 patients 168 developed mild to moderate surgical site infections giving a cumulative incidence of 44%. The age of study subjects ranged between 31 to 50 years. Cefotaxime was considered as most commonly used antimicrobial prophylaxis it's more effective. Third generation ceftriaxone was more frequently utilized than first or second generation cephalosporins. Moreover third generation cephalosporins such as ceftriaxone, cefotaxime, ciprofloxacin followed by combination of antimicrobials are particularly effective against the organisms that cause SSI in emergency postoperative patients. This study also indicated that the majority of the antimicrobials used pre and post-surgery were administered through intravenous route.

**Keywords:** Antimicrobial prophylaxis, ASHP guidelines, cefotaxime, prescribing pattern, surgical site infections, antimicrobial stewardship.

## Introduction

According to the surgical procedure, infections that occur within 30 days following an operation are referred to as surgical site infections (SSI) and may last longer than 30 days. According to World Health Organization data published in, one of the frequent issues in a hospital environment (Ierano C et.al., 2019) Worldwide, 23% of surgical patients in 2009 experienced SSIs. Developed countries like United States experiences 500,000 surgical site infections annually, making it the second-most common infection in medical settings. According to a study conducted in a paediatric hospital in Nigeria, 30.9% of all surgery sites had an infection. Hospital-acquired infections continue to be a significant clinical issue that significantly raised morbidity and death as well as the expense of healthcare. Hospital-acquired illnesses are thought to have been contracted by 10% or less of hospitalized patients in underdeveloped nations. The majority of them are SSIs, which made up 5.6% of patients admitted for surgery. A surgical site infection (SSI) is an infection that develops at or near a surgical incision within 30 days after the procedure or after one year in the case of an implant, and that can affect the incision as

well as deep tissue in the body regions where the surgery was performed. Patients who experienced SSI had higher rates of outpatient and emergency department visits, utilization of radiological services often, readmission rates that were high, and usage of home health aide services. More than one in ten surgery patients in low- and middle-income countries experienced SSI. In low- and middle-income countries, the risk of SSI is three to five times higher than it is in high-income nations (Crader M, 2022, Rehan HS et.al., 2011, Kumar BA et.al., 2014). SSIs are the most prevalent hospital-acquired infections in Africa, according to a thorough review, with a cumulative incidence that ranges from 2.5% to 30.9%. 12 10.9-75% of surgical patients at Ethiopia's teaching hospitals had SSI despite the paucity of evidence. Furthermore, a meta-analysis found that the overall prevalence of SSI in Ethiopia was 12.3% (Salkind AR et.al., 2011). The use of surgical antibiotic prophylaxis (SAP) before surgery is an evidence-based method to prevent the emergence of SSI. 18 Antibiotics should be administered up to 60 minutes before an incision, but no more than 30 minutes before. 19 In order to successfully treat SSI, it is important to consider the correct time, dosage, and route of administration, the kind of pathogen, the antibiotics' pharmacokinetics and pharmacodynamics profile, and the characteristics of the pathogen. The World Health Organization (WHO) advises administering post-operative prophylaxis for no more than 24 hours following the incision.

In order to help control SSI and encourage wise antibiotic prophylaxis use, this study sought to evaluate drug use pattern of surgical antimicrobial prophylaxis practice and SSI prevalence among surgically operated patients at tertiary care teaching hospital, Agra.

## Methodology

*Study design*

This observational prospective cohort study is intended to collect information from individuals undergoing both elective and emergency surgery.

*Study site*

The study was conducted in tertiary care teaching hospital, Agra. The facility can accommodate 380 patients in total. Including those treated in the two operating rooms, surgical cases are admitted to five of the hospital's ten wards. The primary independent variables of the study were age, type of surgery, co-morbidity status, number of hours spent in surgery, type of wound, use of prophylactic antibiotics, timing of prophylactic antibiotic administration, and length of surgical antimicrobial prophylaxis. The outcome variable for this study was SSI.

*Sample size determination*

Patients who underwent significant surgery in the surgical ward during the study period were the samples of the study. Patients who were admitted with signs and symptoms of infection within the first 48 hours of admission and those who received antimicrobials for therapeutic purposes prior to surgery were excluded from the study

Formula to derive sample size

$$\mathbf{N= Z^2P\ (100\text{-}P) / n}$$

Where,

**Z**- Confident interval; **P**- Population proportion; **N**-Population size; **E**- Margin of error;

Z= 95% CI = 1.96, P= 55, E=5%

$$N = \frac{(1.96)^2 * (55) * (100-55)}{(5)^2}$$

$$N = \frac{(3.8416) * (55*45)}{25}$$

$$N = \frac{9507.96}{25} = 380 \text{ patients}$$

Total number of samples included for this study will be 380 patients using 95% confident interval.

*Ethical considerations*

This study was ethically approved by Institutional Human Ethical Committee (SNMC/IEC/2022/39) of SN Medical College Hospital, Agra.

*Statistical analysis*

The whole Data will be Prepared and analyzed by using MS-excel sheet. Demographic variables of the patients such as gender, age, duration of the disease, comorbid conditions, family history, socioeconomic status and drug prescribing pattern of drugs were presented by using descriptive statistics such as Mean and Standard deviation followed by percentages.

| **Demographic variables** | **SSI** | | | | **Total** | |
|---|---|---|---|---|---|---|
| | **NO** | | **YES** | | | |
| | No's | (%) | No's | (%) | No's | (%) |
| **Gender** | | | | | | |
| Males | 122 | 32 | 90 | 24 | 212 | 56 |
| Females | 89 | 24 | 79 | 20 | 168 | 44 |
| **Age** | | | | | | |
| 20-30 | 38 | 10 | 35 | 8 | 73 | 18 |
| 31-40 | 73 | 19 | 19 | 6 | 92 | 24 |
| 41-50 | 67 | 18 | 43 | 11 | 110 | 29 |
| 51-60 | 22 | 6 | 39 | 10 | 61 | 17 |
| 61-70 | 11 | 3 | 33 | 9 | 44 | 12 |
| **Comorbid status** | | | | | | |
| Without Comorbidity | 61 | 16 | 35 | 9 | 117 | 25 |
| With Comorbidity | 150 | 40 | 134 | 35 | 263 | 75 |
| **Residence** | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Urban | 109 | 29 | 50 | 13 | 159 | 42 |
| Rural | 101 | 27 | 120 | 31 | 221 | 58 |
| **Infection type** | | | | | | |
| Clean | 40 | 11 | 37 | 9 | 77 | 20 |
| Clean contaminated | 52 | 14 | 50 | 13 | 102 | 27 |
| Contaminated | 90 | 24 | 66 | 17 | 156 | 41 |
| Dirty/infected | 25 | 7 | 20 | 5 | 45 | 12 |
| **Delay to initiate surgery** | | | | | | |
| 12-24 hours | 78 | 20 | 67 | 18 | 145 | 38 |
| 24-48 hours | 136 | 36 | 99 | 26 | 235 | 62 |
| **Length of Hospital Stay (Post-Operative Stay)** | | | | | | |
| < 5 days | 89 | 23 | 49 | 13 | 138 | 36 |
| 5-7 Days | 34 | 9 | 28 | 7 | 62 | 16 |
| 8-14 days | 79 | 21 | 31 | 8 | 110 | 29 |
| > 14 days | 44 | 12 | 26 | 6 | 70 | 19 |

**Characteristics of Surgical Antimicrobial Prophylaxis Administration**

| S.No. | Categories | No's | % |
|---|---|---|---|
| 1. | Antimicrobial prophylaxis | | |
| | Yes | 321 | 85 |
| | No | 59 | 15 |
| 2. | Timing of prophylaxis administration | | |
| | 30 minutes before surgery | 190 | 50 |
| | 30 minutes to 1 hour before incision | 120 | 32 |
| | 1 to 2 hours before incision | 37 | 10 |
| | Not known | 33 | 8 |
| 3. | Route of antimicrobial Prophylaxis | | |
| | Intravenous | 249 | 66 |
| | Intravenous & oral | 101 | 26 |
| | Oral | 30 | 8 |

**Pattern of Prophylactic Antibiotic Use in Surgical Patients**

| S.No. | Antimicrobial prophylaxis | No's | % |
|---|---|---|---|
| 1. | Ceftriaxone | 168 | 44 |
| 2. | Cefotaxime | 96 | 25 |
| 3. | Vancomycin | 5 | 1 |
| 4. | Ceftriaxone+ metronidazole | 19 | 5 |
| 5. | Cefazolin | 5 | 1 |
| 6. | Ciprofloxacillin | 28 | 8 |
| 7. | Metronidazole | 35 | 9 |
| 8. | Gentamycin | 25 | 7 |

| S.No. | Post-operative Antimicrobials | No's | % |
|---|---|---|---|
| 1. | Ceftriaxone | 82 | 22 |
| 2. | Cefotaxime | 110 | 29 |
| 3. | Amoxicillin+ pot clavulanate | 23 | 6 |
| 4. | Ceftriaxone+ampicillin | 17 | 4 |
| 5. | Ceftriaxone+gentamicin+metronidazole | 21 | 6 |
| 6. | Ceftriaxone+metronidazole+amoxicillin | 11 | 3 |
| 7. | Ciprofloxacillin | 43 | 11 |
| 8. | Piperacillin+ Tazobactum | 29 | 7 |
| 9. | Amikacin | 18 | 4 |
| 10. | Gentamycin | 26 | 8 |

**Duration of postoperative antibiotic (%)**

| S.No. | Duration of postoperative antimicrobials | No's | % |
|---|---|---|---|
| 1. | 1 day | 55 | 14 |
| 2. | 2-3 days | 45 | 12 |
| 3. | 4-5 days | 141 | 36 |
| 4. | 7 days | 89 | 23 |
| 5. | Above 7 days | 60 | 15 |

## Results

1. Sociodemographic Characteristics
2. Characteristics of Surgical Antimicrobial Prophylaxis Administration
3. Pattern of Prophylactic Antibiotic Use in Surgical Patients
4. Duration of postoperative antibiotic (%)

During the study period 380 patients underwent various surgeries in the general surgery department in tertiary care hospital, Agra. Among the 380 patients 168 developed mild to moderate surgical site infections giving a cumulative incidence of 44%. The age of study subjects ranged between 31 to 50 years. Majority (29%) of them belonged to 31-40 years group. Out of 380 patients in this group (9.5%) got infected.105 patients (29%) were more than 50 years and among them 72 patients (19%) developed surgical site infection. It was found that the frequency of SSI increased with age and this was statistically significant. There were 212 (56%) males and among them 90 (24%) got infected. Among the 168 women 79(20%) developed SSI. This difference in incidence was statistically significant. The study subjects who knew their diabetic and hypertensive status before admission and those diagnosed after admission were considered diabetics and hypertensive and other comorbid conditions respectively. Majority of the patients 235(50%) were operated within 48 hours and among them 11(9%) developed SSI. 44% of the patients developed Surgical site infections. It was observed that prophylactic antibiotic usage was not a routine in the studied hospital. Only selected patients who had some infection or other risk factor received antibiotic prophylaxis. Out of 22 patients who received prophylaxis only one person developed SSI. Of the remaining 158 patients, 38 (24%) developed SSIs. The parameters such as Age, gender, Co morbid conditions: (Hypertension, Diabetes mellitus and Anemia), and prophylactic antibiotic usage were analyzed by using descriptive statistics. These were expressed in terms of mean, standard deviation and percentages. The median preoperative length of stay (LOS) was 3 days. Preoperative Lengthy stay for patients with surgical site infections was 7.14 days and for patients without SSI, 4.35 days. The median length of hospital stay was 12 days ranging from 3 to 53 days. The lengthy stay for patients who developed SSIs was greater than for patients without SSIs. For antibiotic administration, a total of 380 patients received prophylaxis. Third-generation cephalosporins (ceftriaxone with 44%, cefotaxime with 25%) were the most commonly used prophylaxis (67%), followed by metronidazole 9% and ciprofloxacin with 8%. Most of the Postoperative cases receiving combination antibiotic (30%), followed by the third-generation cephalosporins (cefotaxime and ceftriaxone in 192 (51%) patients.

## Discussion

SSIs, which account for the majority of hospitalacquired infections, place a strain on the healthcare system beca use they frequently result in high rates of antibiotic resistance, extended hospital stays, higher expenses, and sig nificant morbidity and mortality. Post-operative wound infection is the most common nosocomial infection and one of the main causes of morbidity in patients who have undergone surgery (Vippadapu P et.al. 2022, Bassetti M et.al. 2014). A total of 380 patients were involved in this study. In our study, SSI incidence increases with age. The majority of research in the literature indicate that the incidence of SSI rises with age, most likely due to a declining immune system and the emergence of co-morbid conditions (Kumar R et.al., 2014, Wang YY et.al., 2016, Fehr J, Hatz C et.al., 2006 ).. In this study, emergency surgeries were associated with a rise in SSI.Our results also shows a difference in gender distribution who underwent surgeries. The duration of surgeries was significantly higher in females compared to males. A similar finding was reported in many studies, but contrasting findings were reported in a study where males (51.2%) had a higher duration compared to females (48.8%). The increased infection rates in these surgeries can be attributed to a number of factors, including inadequate preoperative care, underlying issues, and the more frequent use of unclean or filthy wounds. (Setty NK et.al. 2014). It was discovered that age, wound classification, ASA class, experience, lengthy surgical time (>2 hours), extended hospital stays, blood transfusions, the surgeon's skills and emergency surgery were all connected risk factors. Substandard procedures, inadequate infection control methods, and inappropriate antibiotic use may all contribute to the rising incidence of SSI in our environment. The prevalence of SSI was also higher than it had

been in previous investigations by Abubaker Lubega, et al. (15.9%) and Cyriaque Dégbey et al. (7.8%). In our study number of males are significantly more than female that can impact the overall duration of antimicrobials. For none of the surgeries, cefazolin was used. (Kumar TV et.al., 2019, Saravanakumar RT et.al., 2011 ). Cefazolin is recommended for SAP as per the guidelines. The use of narrow spectrum antimicrobials needs to be avoided and to reduce or even stop in clean surgeries. First- or second-generation cephalosporins were suggested by the study's ASHP and SAP guidelines. Ceftriaxone, a third-generation cephalosporin, was more frequently utilized than cefuroxime, a second-generation cephalosporin, in all types of procedures. According to the wound categorization used in our analysis, the majority of surgical procedures were clean-contaminated or clean. (Billoro BB et.al., 2019). Other research with similar results showed that clean contaminated procedures were more common than clean surgeries. Additionally, when it wasn't essential, antimicrobials for patients being discharged from the hospital were prescribed, including for clean and clean contaminated surgery. Cefazolin was utilized as SAP in a very small number of surgeries (Alagha HZ,et.al., 2022). According to the SAP guidelines, cefazolin is advised as Prophylaxis. In clean surgeries, narrow spectrum antibiotic usage should be avoided, minimized, or completely stopped. Antimicrobial overuse will make bacteria more resistant and may cause the formation of multi-drug resistant species. Antimicrobial prophylaxis might be unnecessary as per the ASHP guidelines for surgeries in some places. However, these results showed the need of surgical antimicrobials prophylaxis. (SettyNKet.al.,2014).

## Conclusion

According to this study, surgical site infections are more common. The timing of surgical antimicrobial prophylaxis was most likely to be inappropriate in males compared with females. In emergency postoperative patients, Staphylococcus aureus and Klebsiella pneumoniae are the most common SSI. Low blood albumin levels, anaemia, the type of suture used, and the filthy wound class were all linked to the development of SSI at the tertiary care teaching Hospital. Cefotaxime was considered as most commonly used antimicrobial prophylaxis it's more effective. Additionally, the choice of antimicrobials was different from both the ASHP and the study site's guidelines. Third generation ceftriaxone was more frequently utilized than first or second generation cephalosporins. Moreover third generation cephalosporins such as ceftriaxone, cefotaxime, ciprofloxacin followed by combination of antimicrobials are particularly effective against the organisms that cause SSI in emergency postoperative patients. This study also indicated that the majority of the antimicrobials used pre and post-surgery were administered through intravenous route.

## References:


1. Vippadapu P, Gillani SW, Thomas D, Ahmed F, Gulam SM, Mahmood RK, Menon V, Abdi S, Rathore HA. Choice of Antimicrobials in Surgical Prophylaxis-Overuse and Surgical Site Infection Outcomes from a Tertiary-Level Care Hospital. Front. Pharmacol. 2022 11;13:849044-.
2. Ierano C, Thursky K, Marshall C, Koning S, James R, Johnson S, Imam N, Worth LJ, Peel T. Appropriateness of surgical antimicrobial prophylaxis practices in Australia. JAMA network open. 2019 Nov 1;2(11):e1915003-.
3. Kumar BA, Adiveni T, Manna PK, Kumar VP, Sundresh NJ. Studies on antibiotics prescribing pattern in surgical wards of Department of Surgery at Rajah Muthiah Medical College Hospital. World. J. Pharm Pharm.Sci (WJPPS). 2014;3(7):832-71.
4. Salkind AR, Rao KC. Antiobiotic prophylaxis to prevent surgical site infections. American family physician. 2011 Mar 1;83(5):585-90.
5. Korol E, Johnston K, Waser N, Sifakis F, Jafri HS, Lo M, Kyaw MH. A systematic review of risk factors associated with surgical site infections among surgical patients. PloS one. 2013 Dec 18;8(12):e83743.
6. Kumar R, Kohli K, Sidhu DS, Kaur N, Chandra M, Garg M. An in-depth study of drugs prescribing pattern in the Surgery Department of a Tertiary Care Teaching Institute in Northern India. Int J Basic Clin Pharmacol. 2014 Aug;3:681-.
7. Wang YY, Du P, Huang F, Li DJ, Gu J, Shen FM, Jiang YY. Antimicrobial prescribing patterns in a large tertiary hospital in Shanghai, China. Int. J.antimicrob agents. 2016 1;48(6):666-73.
8. Remesh A, Salim S, Gayathri AM, Nair U, Retnavally KG. Antibiotics prescribing pattern in the in-patient departments of a tertiary care hospital. Arch Pharm Pract. 2013 Apr 1;4(2):71.
9. Sharma J, Sharma V, Agrawal A. Assessment of Pattern of Drug Utilization of Antimicrobials in the In-Patient Setting of a Tertiary Hospital: An Observational Study.
10. Kefale B, Tegegne GT, Degu A, Molla M, Kefale Y. Surgical site infections and prophylaxis antibiotic use in the surgical ward of public hospital in Western Ethiopia: A hospital-based retrospective cross-sectional study. Infect Drug Resist. 2020; 13:3627.

11. Rayamajhi BB, Basukala S, Khadka A, Thapa N, Ayer DB. An Assessment of Antimicrobial Prescription Pattern among Surgical Patients: A Hospital Based Cross Sectional Descriptive Study. Journal of Society of Surgeons of Nepal. 2021 Dec 14;24(1):23-7.
12. Saravanakumar RT, Mohanta GP, Manna PK, Baskaran VR, Moorthi C, Manavalan R. Study of antimicrobials in post-operative wound infection after emergency gastrointestinal surgery. J.Pharm.Res. 2011 Sep;4(9):3079-80.
13. Setty NK, Nagaraja MS, Nagappa DH, Giriyaiah CS, Gowda NR, Naik RD. A study on Surgical Site Infections (SSI) and associated factors in a government tertiary care teaching hospital in Mysore, Karnataka. Int J Med Sci Public Health. 2014;4(2).
14. Kumar TV, Goud KA. A study of surgical site infections in a general practice hospital. Int. Surg. J. 2019 Oct 24;6(11):4043-7.
15. Crader MF, Varacallo M. Preoperative antibiotic prophylaxis 2022.
16. Rehan HS, Kakkar AK, Goel S. Pattern of surgical antibiotic prophylaxis in a tertiary care teaching hospital in India. Int. J. Infect. Control. 2010; 6(2).
17. Bassetti M, Righi E, Astilean A, Corcione S, Petrolo A, Farina EC, De Rosa FG. Antimicrobial prophylaxis in minor and major surgery.2014;76-91.
18. Azeze GG, Bizuneh AD. Surgical site infection and its associated factors following cesarean section in Ethiopia: a cross-sectional study. BMC res. notes. 2019 ;12(1):1-6.
19. Billoro BB, Nunemo MH, Gelan SE. Evaluation of antimicrobial prophylaxis use and rate of surgical site infection in surgical ward of Wachemo University Nigist Eleni Mohammed Memorial Hospital, Southern Ethiopia: prospective cohort study. BMC Infect. Dis. 2019 Dec;19(1):1-8.
20. Fehr J, Hatz C, Soka I, Kibatala P, Urassa H, Battegay M, Jeffrey Z, Smith T, Mshinda H, Frei R, Widmer AF. Antimicrobial prophylaxis to prevent surgical site infections in a rural sub-Saharan hospital. Clin. Microbiol. Infect. 2006, 1;12(12):1224-7.
21. Alagha HZ, Zourab MS. Adherence to international perioperative antimicrobial prophylaxis guidelines in three general hospitals: A cross-sectional study. J.Appl. Pharm.Sci. 2022, 17.