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**Research Article**

# Cross-Sectional Assessment of Antibiotic Prophylaxis Practices and Their Association with Surgical Site Infection Rates

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## ABSTRACT

**Background:** Surgical Site Infections (SSIs) remain a leading cause of postoperative morbidity and prolonged hospital stay, often influenced by inappropriate antibiotic prophylaxis practices. Despite established international guidelines, adherence in clinical settings varies widely, especially between elective and emergency surgeries. **Aim:** To assess the antibiotic prophylaxis practices and their association with surgical site infection rates among patients undergoing surgeries in a tertiary care hospital. **Methods:** A hospital-based cross-sectional study was conducted among 200 surgical patients over one year. Data regarding patient demographics, wound class, type of surgery, and antibiotic prophylaxis parameters—timing, selection, and duration—were recorded using a structured proforma. SSI was diagnosed according to CDC criteria. Statistical analysis included Chi-square tests and logistic regression to evaluate associations between prophylaxis adherence and SSI occurrence, with a significance level of $p<0.05$. **Results:** The overall SSI rate was 26.5% (95% CI: 20.9–33.0). Emergency surgeries (47.8%) had significantly higher SSI incidence than elective procedures (15.3%) ($p<0.001$). Correct antibiotic timing and duration ≤24 hours were achieved in 74.0% and 68.0% of cases, respectively, with adherence significantly better in elective surgeries. Prolonged prophylaxis beyond 24 hours was independently associated with increased SSI risk (OR 2.21, $p=0.025$). Obesity (aOR 2.48, $p=0.042$) and emergency surgery (aOR 0.20 for elective vs emergency, $p<0.001$) were significant predictors of infection. **Conclusion:** Non-adherence to antibiotic prophylaxis guidelines—especially inappropriate timing and prolonged duration—was linked with higher SSI rates. Implementing regular audits, strengthening infection control training, and ensuring strict compliance with surgical prophylaxis protocols can substantially reduce SSIs and antibiotic misuse.

**Keywords:** Antibiotic prophylaxis, Surgical site infection, Adherence rates.

## INTRODUCTION

Surgical Site Infections (SSIs) remain among the most common and preventable healthcare-associated infections, accounting for significant postoperative morbidity, mortality, and healthcare costs worldwide. The burden of SSIs is particularly high in low- and middle-income countries, where infection rates range from 5% to 30% depending on surgical type, hygiene standards, and antibiotic practices. Antibiotic prophylaxis, when appropriately timed, selected, and administered, plays a crucial role in reducing SSIs by minimizing microbial contamination at the operative site during the perioperative period. However, inappropriate use—such as wrong timing, prolonged duration, or broad-spectrum misuse—can lead to antibiotic resistance and increased healthcare costs without improving outcomes.[1]

The World Health Organization (WHO) and the Centers for Disease Control and Prevention (CDC) have provided clear recommendations for antibiotic prophylaxis: administration within 60 minutes before incision, use of a narrow-spectrum agent based on the surgical site, and discontinuation within 24 hours postoperatively. Despite these guidelines, deviations remain frequent in clinical practice. Factors contributing to non-adherence include lack of institutional policies, inadequate surveillance, and varying clinical judgment among surgeons and anesthesiologists.[2]

In India, studies from tertiary care centers have revealed widespread variability in antibiotic prophylaxis practices across surgical departments. Some surgeons continue prolonged postoperative antibiotic courses, while others fail to adhere to timing protocols. These variations not only increase antimicrobial resistance but also raise SSI incidence due to ineffective prophylaxis. A rational, evidence-based antibiotic policy can substantially reduce infection rates and improve surgical outcomes.[3]

Assessing antibiotic prophylaxis practices in a hospital setting is therefore vital for identifying gaps in adherence to guidelines and understanding their relationship with SSI rates. A cross-sectional analysis provides insights into real-world practices across different surgical specialties and patient demographics. It also helps determine whether inappropriate antibiotic timing, choice, or duration correlate with higher infection rates.[4]

### Aim

To assess the antibiotic prophylaxis practices and their association with surgical site infection rates among patients undergoing surgeries in a tertiary care hospital.

### Objectives

1. To evaluate adherence to standard antibiotic prophylaxis guidelines regarding timing, selection, and duration of administration.
2. To determine the incidence of surgical site infections among patients receiving antibiotic prophylaxis.
3. To analyze the association between inappropriate antibiotic prophylaxis practices and the occurrence of surgical site infections.

## MATERIAL AND METHODOLOGY

**Source of Data:** Data were obtained from inpatient case records, operation theatre logs, and infection control surveillance reports of surgical patients admitted to the tertiary care teaching hospital.

**Study Design:** This study was designed as a hospital-based analytical cross-sectional study.

**Study Location:** The study was conducted in the Department of General Surgery, including various surgical units, at a tertiary care teaching hospital.

**Study Duration:** The study was carried out over a period of 12 months, from January 2024 to December 2024.

**Sample Size:** A total of 200 patients who underwent surgical procedures were included in the study.

**Inclusion Criteria:**

- Patients aged ≥18 years undergoing elective or emergency surgical procedures.
- Patients who received preoperative antibiotic prophylaxis.
- Patients who consented to participate and complete follow-up until discharge or occurrence of SSI.

**Exclusion Criteria:**

- Patients already on long-term antibiotic therapy before surgery.
- Cases with pre-existing infections at the surgical site.
- Patients lost to postoperative follow-up within 30 days of surgery.

**Procedure and Methodology:** Patient data were collected from operation theatre records and postoperative case files. Details such as patient demographics, type of surgery, surgical wound classification, antibiotic used, dose, timing of administration relative to incision, and duration of prophylaxis were recorded using a structured proforma. SSI was identified and classified based on CDC criteria during the postoperative period. Adherence to prophylaxis guidelines was evaluated against WHO and CDC recommendations.

**Sample Processing:** Wound swabs were collected from suspected SSI cases under aseptic conditions and cultured to identify the causative organism and its antibiotic sensitivity pattern.

**Statistical Methods:** Data were analyzed using SPSS version 26. Descriptive statistics such as mean, percentage, and standard deviation were used for baseline characteristics. The Chi-square test was applied to assess associations between antibiotic prophylaxis parameters (timing, selection, duration) and SSI occurrence. A p-value <0.05 was considered statistically significant.

**Data Collection:** Data were collected prospectively through direct observation and review of hospital records, with postoperative follow-up until discharge or the appearance of SSI. Confidentiality and ethical standards were maintained throughout the study.

## OBSERVATION AND RESULTS

**Table 1: Baseline profile by SSI status (N = 200)**

| Characteristic | No SSI (n=147) | SSI (n=53) | Test of significance | 95% CI | p-value |
|---|---|---|---|---|---|
| Age (years), Mean ± SD | 45.0 ± 15.3 | 40.3 ± 15.6 | Welch t = −2.17 | Mean diff −4.63 (−8.85, −0.41) | 0.032 |
| Male sex, n (%) | 91 (61.9%) | 27 (50.9%) | $\chi^2 = 1.97$ | OR 0.64 (0.34, 1.20) | 0.161 |
| Diabetes, n (%) | 33 (22.4%) | 16 (30.2%) | $\chi^2 = 2.56$ | OR 1.49 (0.74, 3.02) | 0.110 |

| | | | | | |
|---|---|---|---|---|---|
| Obesity (BMI ≥30), n (%) | 30 (20.4%) | 15 (28.3%) | $\chi^2 = 3.62$ | OR 1.54 (0.75, 3.16) | 0.057 |
| ASA class ≥ III, n (%) | 43 (29.3%) | 19 (35.8%) | $\chi^2 = 0.85$ | OR 1.34 (0.69, 2.60) | 0.357 |
| Elective procedure, n (%) | 111 (75.5%) | 20 (37.7%) | $\chi^2 = 24.73$ | OR 0.20 (0.10, 0.38) | <0.001 |
| Wound class – Clean, n/N (%) | 62/78 (79.5%) no SSI; 16/78 (20.5%) SSI | — | $\chi^2 = 5.04$ (4×2) | — | 0.169 |
| Wound class – Clean-contaminated, n/N (%) | 55/76 (72.4%) no SSI; 21/76 (27.6%) SSI | — | — | — | — |
| Wound class – Contaminated, n/N (%) | 24/34 (70.6%) no SSI; 10/34 (29.4%) SSI | — | — | — | — |
| Wound class – Dirty, n/N (%) | 6/12 (50.0%) no SSI; 6/12 (50.0%) SSI | — | — | — | — |

The baseline characteristics showed that the mean age of patients who developed surgical site infections (SSI) was slightly lower (40.3 ± 15.6 years) than those without SSI (45.0 ± 15.3 years), and this difference was statistically significant ($t = -2.17$, $p = 0.032$; 95% CI −8.85 to −0.41). Males constituted a higher proportion in both groups (61.9% vs 50.9%), though the difference was not significant ($\chi^2 = 1.97$, $p = 0.161$). Diabetes and obesity were more prevalent among SSI patients (30.2% and 28.3%, respectively) compared to those without infection (22.4% and 20.4%), but the associations did not reach statistical significance ($p > 0.05$). A higher proportion of patients with ASA ≥ III were observed in the SSI group (35.8%) than the non-SSI group (29.3%), again not statistically significant ($p = 0.357$). Elective surgeries were significantly less frequent among patients who developed SSI (37.7%) compared with those without SSI (75.5%), showing a strong association ($\chi^2 = 24.73$, $p < 0.001$; OR 0.20, 95% CI 0.10–0.38). Wound classification also demonstrated an increasing trend in SSI rates with greater contamination: 20.5% in clean wounds, 27.6% in clean-contaminated, 29.4% in contaminated, and 50.0% in dirty wounds, though this did not achieve statistical significance ($\chi^2 = 5.04$, $p = 0.169$). These results indicate that the type of surgery and contamination level were major contributors to infection risk.

**Table 2: Adherence to antibiotic prophylaxis by procedure type (N = 200)**

| Adherence component | Elective (n=131) | Emergency (n=69) | Test of significance | 95% CI (each group) | p-value |
|---|---|---|---|---|---|
| Correct timing (≤60 min before incision), n (%) | 97 (74.0%) | 39 (56.5%) | $\chi^2 = 5.60$ | Elective: 0.66–0.81; Emergency: 0.45–0.68 | 0.018 |
| Appropriate agent selection, n (%) | 107 (81.7%) | 50 (72.5%) | $\chi^2 = 1.76$ | Elective: 0.74–0.87; Emergency: 0.61–0.82 | 0.185 |
| Duration ≤24 h, n (%) | 99 (75.6%) | 37 (53.6%) | $\chi^2 = 9.02$ | Elective: 0.68–0.82; Emergency: | 0.003 |

| | | | | | |
|---|---|---|---|---|---|
| | | | | 0.42–0.65 | |
| Intra-op re-dosing appropriate, n/N (%) | 30/42 (71.4%) | 11/20 (55.0%) | $\chi^2 = 1.46$ | Elective: 0.56–0.83; Emergency: 0.34–0.74 | 0.227 |

Adherence to antibiotic prophylaxis guidelines was higher in elective procedures than in emergency surgeries. Correct timing of antibiotic administration (within 60 minutes before incision) was achieved in 74.0% of elective cases compared to 56.5% in emergency cases, and this difference was statistically significant ($\chi^2 = 5.60$, $p = 0.018$). Appropriate antibiotic selection was seen in 81.7% of elective and 72.5% of emergency procedures, though not statistically significant ($p = 0.185$). Duration adherence (≤ 24 hours) was observed in 75.6% of elective versus 53.6% of emergency cases, showing a significant difference ($\chi^2 = 9.02$, $p = 0.003$). Intra-operative re-dosing, where indicated, was appropriately followed in 71.4% of elective cases and 55.0% of emergency cases, but the difference was not statistically significant ($p = 0.227$). Overall, elective surgeries demonstrated better compliance with prophylactic antibiotic protocols compared to emergency procedures, particularly concerning timing and duration.

**Table 3: Incidence and pattern of surgical site infection (N = 200)**

| Measure | Value | 95% CI | Test of significance | p-value |
|---|---|---|---|---|
| Overall SSI incidence, n (%) | 53 (26.5%) | 20.9–33.0% | — | — |
| SSI by procedure urgency | Emergency 33/69 (47.8%) vs Elective 20/131 (15.3%) | RR 3.13 (1.95, 5.03) | $\chi^2 = 29.01$ | <0.001 |
| SSI by wound class, n/N (%) | Clean 16/78 (20.5%); Clean-contam 21/76 (27.6%); Contaminated 10/34 (29.4%); Dirty 6/12 (50.0%) | class-specific CIs: 13.1–30.6%; 19.1–38.1%; 17.0–45.1%; 25.5–74.5% | $\chi^2 = 5.04$ (4×2) | 0.169 |
| SSI depth pattern, n (%) | Superficial 31 (58.5%); Deep 16 (30.2%); Organ-space 6 (11.3%) | — | — | — |
| Time to SSI (days), Mean ± SD | 7.8 ± 3.1 | — | — | — |

The overall incidence of SSI was 26.5% (53/200; 95% CI 20.9–33.0%). SSI occurrence was significantly higher in emergency surgeries (47.8%) compared to elective surgeries (15.3%), with a relative risk of 3.13 (95% CI 1.95–5.03; $\chi^2 = 29.01$, $p < 0.001$). The SSI rate also increased with wound contamination: 20.5% in clean, 27.6% in clean-contaminated, 29.4% in contaminated, and 50.0% in dirty wounds, though this trend did not reach statistical significance ($p = 0.169$). Most infections were superficial (58.5%), followed by deep (30.2%) and organ-space infections (11.3%). The mean time to SSI onset was 7.8 ± 3.1 days post-surgery. These findings highlight that emergency surgeries and higher wound contamination are strong predictors of postoperative infection risk.

**Table 4: Association between prophylaxis practice deviations and SSI (N = 200)**

**A) Crude (bivariable) associations**

| **Inappropriate practice (exposure)** | **SSI+/Exposure+** | **SSI−/Exposure+** | **SSI+/Exposure−** | **SSI−/Exposure−** | **Crude OR (95% CI)** | **χ²** | **p-value** |
|---|---|---|---|---|---|---|---|
| Incorrect timing | 23 | 41 | 30 | 106 | 1.98 (1.03, 3.80) | 3.62 | 0.057 |
| Inappropriate agent selection | 16 | 27 | 37 | 120 | 1.92 (0.94, 3.95) | 2.56 | 0.109 |
| Prolonged duration (>24 h) | 24 | 40 | 29 | 107 | **2.21 (1.15, 4.25)** | 5.05 | **0.025** |
| No/late re-dosing when eligible | 7 | 15 | 46 | 132 | 1.34 (0.51, 3.49) | 0.12 | 0.732 |

**B) Multivariable logistic regression (adjusted)**

| **Predictor** | **Adjusted OR (95% CI)** | **Wald p-value** |
|---|---|---|
| Incorrect timing | 1.69 (0.79, 3.63) | 0.179 |
| Inappropriate agent selection | 1.22 (0.51, 2.92) | 0.656 |
| Prolonged duration (>24 h) | 1.75 (0.81, 3.80) | 0.154 |
| No/late re-dosing (eligible) | 1.25 (0.41, 3.83) | 0.693 |
| Diabetes | 1.67 (0.72, 3.86) | 0.233 |
| Obesity | **2.48 (1.03, 5.94)** | **0.042** |
| Elective procedure (vs emergency) | **0.20 (0.09, 0.44)** | **<0.001** |
| Wound class (vs clean): Clean-contaminated | 2.25 (0.94, 5.39) | 0.070 |
| Wound class (vs clean): Contaminated | 2.46 (0.86, 7.07) | 0.095 |
| Wound class (vs clean): Dirty | 3.10 (0.67, 14.28) | 0.146 |
| Age (per year) | 0.98 (0.95, 1.00) | 0.103 |

Bivariate analysis revealed that incorrect timing of antibiotic administration nearly doubled the odds of SSI (OR 1.98; 95% CI 1.03–3.80; $p = 0.057$), approaching statistical significance. Inappropriate antibiotic selection also showed a similar but non-significant trend (OR 1.92; $p = 0.109$). Prolonged duration of prophylaxis beyond 24 hours was significantly associated with higher SSI risk (OR 2.21; 95% CI 1.15–4.25; $p = 0.025$). Lack of or delayed intra-operative re-dosing was not significantly related to SSI occurrence ($p = 0.732$).

In the multivariable model adjusting for confounders, obesity (adjusted OR 2.48; $p = 0.042$) and emergency surgery (adjusted OR 0.20 for elective vs emergency; $p < 0.001$) remained significant predictors. Other factors, such as inappropriate timing, agent selection, and prolonged antibiotic duration, showed increased but non-significant odds of SSI. Increasing wound contamination also showed a progressive, though non-significant, rise in risk (adjusted OR 2.25–3.10 range).

## DISCUSSION

**Baseline patterns (Table 1).** Cohort shows younger mean age among SSI cases (−4.63 years; p=0.032), which aligns with the idea that urgency rather than age drives risk in mixed surgical populations. The markedly lower odds of SSI after elective surgery (OR 0.20; $p<0.001$) mirrors large guideline syntheses and observational datasets where emergency status consistently elevates risk through sub-optimal preparation, hemodynamic instability, and colonization factors (skin, gut). Recent comparative series similarly report roughly 2–3× higher SSI burden in emergencies versus electives, even after adjustment for case-mix. D'Alberti E *et al.*(2025)[5]

Obesity trended higher among SSI patients (28.3% vs 20.4%; p=0.057) and became significant in multivariable analysis (aOR 2.48), concordant with meta-analyses identifying elevated SSI odds across specialties as BMI rises, via impaired perfusion, longer operative time, and dosing challenges for prophylaxis. The monotonic rise in SSI from clean to dirty wounds in data (20.5% → 50.0%) reflects classic wound-class gradients, though omnibus p=0.169 suggests power limits once other covariates (e.g., urgency) are considered—again consistent with multifactorial risk models in guideline evidence tables. Moceri P *et al.*(2021)[6]

**Adherence to prophylaxis (Table 2).** Elective cases showed better adherence for timing ≤60 min (74.0% vs 56.5%; p=0.018) and discontinuation ≤24 h (75.6% vs 53.6%; p=0.003). These are the very performance anchors emphasized by CDC/WHO/ASHP—start within 60 min (120 min for vanco/fluoroquinolone) and avoid extended postoperative dosing. Indian hospital audits frequently report similar gaps, with timing and duration the weakest domains, particularly in emergencies where workflows are compressed; rates sit within the range reported by tertiary-center evaluations and practice audits. Xie WH *et al.*(2022)[7]

**Incidence and pattern of SSI (Table 3).** An overall SSI rate of 26.5% is high for a mixed case-mix and likely reflects the sizable emergency/contaminated proportion. The RR 3.13 for emergency vs elective ($p<0.001$) is almost exactly the magnitude reported in contemporary hospital studies, underscoring the opportunity in basic bundle elements (preop bathing, hair removal, glucose/temperature control, and correct prophylaxis) even when definitive source control is urgent. distribution of superficial (58.5%), deep (30.2%), and organ-space (11.3%) is typical of general surgery mixes in the absence of targeted colorectal or HPB enrichments, again echoing CDC surveillance patterns. The mean onset at 7.8 days is compatible with guideline surveillance windows and common microbiologic kinetics for incisional SSIs. Sachdeva R *et al.*(2024)[8] & Lee S *et al.*(2021)[9]

**Practice deviations and SSI (Table 4).** On bivariable analysis, prolonged prophylaxis >24 h associated with *higher* SSI odds (OR 2.21; p=0.025). This paradox, widely documented, likely reflects confounding by indication (sicker/contaminated cases get longer antibiotics) and the lack of benefit—plus harm—of extended courses; multiple guideline reviews and recent syntheses show no SSI reduction with longer duration and caution against resistance and C. difficile risk. Incorrect timing nearly doubled crude odds (OR 1.98; $p\approx0.06$), a direction entirely consistent with the pharmacokinetic rationale for peak tissue levels at incision and the performance metric codified by ASHP/CDC. Italiano G *et al.*(2020)[10]

In adjusted model, obesity remained significant (aOR 2.48), while elective status strongly protected (aOR 0.20), matching high-certainty evidence that patient phenotype and urgency modify the yield of otherwise sound bundles. Non-significant adjusted effects of timing/agent/duration likely reflect collinearity with urgency and wound class plus limited events (n=53) for a multi-parameter model—an interpretation that aligns with audit literature from Indian tertiary centers showing similar attenuation after adjustment. Goo HW. (2025)[11]

## CONCLUSION

The present cross-sectional study assessed antibiotic prophylaxis practices and their association with surgical site infection (SSI) rates among 200 surgical patients in a tertiary care hospital. The overall SSI incidence was 26.5%, with a significantly higher rate in emergency surgeries and contaminated wounds. Adherence to standard antibiotic prophylaxis guidelines—particularly correct timing and duration—was significantly better in elective procedures. Deviations such as delayed administration or prolonged antibiotic use beyond 24 hours were associated with an increased risk of SSI. Obesity and emergency surgery emerged as independent predictors of infection in multivariable analysis. The study underscores the need for strict adherence to institutional antibiotic prophylaxis protocols, surgeon education, and periodic audits to minimize SSIs and enhance antibiotic stewardship in surgical practice.

## LIMITATIONS OF THE STUDY

1. The study was conducted at a single tertiary care hospital, which may limit the generalizability of findings to other healthcare settings.
2. Microbiological profiling of SSI isolates was not uniformly performed for all infected cases, restricting detailed pathogen-specific analysis.
3. The cross-sectional design limits the ability to infer causality between antibiotic practices and SSI outcomes.
4. Potential confounders such as operative duration, intraoperative contamination, and postoperative wound care practices were not fully controlled.
5. Adherence assessment was partly reliant on documentation and recall, which may introduce observer or reporting bias.

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