ORIGINAL ARTICLE

Surgical Antimicrobial Prophylaxis Appropriateness and Its Impact on Surgical Site Infection Rate

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Abstract

Objectives: Surgical antimicrobial prophylaxis (SAP) is a critical component of postoperative infection prevention, but its misuse is a widespread global issue. This study aims to assess SAP utilization patterns and appropriateness of SAP in terms of choice, timing of administration, and duration of SAP, and to evaluate possible correlation of SAP compliance with reduction in surgical site infection (SSI) rates.

Methods: A facility-based prospective cross-sectional study was conducted over a period of 6 months to evaluate the prescribing patterns of SAP and the incidence of SSIs. Prophylactic antimicrobial use was considered appropriate when the correct antimicrobial was administered for the appropriate indication, at the correct time, and for the recommended duration, in alignment with institutional protocols.

Results: The findings suggest a general improvement in SAP adherence over the 6-month period, with a peak of 83% in May-24 coinciding with the lowest recorded SSI rate (0.64%). Conversely, the highest SSI rate (5.14%) in Jan-24 corresponded with the lowest adherence (60%), reinforcing the association between proper SAP compliance and reduced infection rates. SAP adherence improvement correlates with reduced SSI rates, but there is still a need to reduce prolonged SAP use.

Conclusion: The relationship between SAP adherence and SSI rates underscores the importance of evidence-based antimicrobial stewardship. Strengthening compliance with established protocols and aligning SAP practices with international guidelines will be critical in sustaining low SSI rates while minimizing antibiotic resistance risks. Further, assessing SAP using days of therapy/100 patient-days (DOT/100 PD) data could provide valuable insights into adherence trends and potential areas for improvement.

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Introduction

Evaluating the appropriateness of surgical antimicrobial prophylaxis (SAP) is crucial, especially in contexts like India, where antibiotic resistance is a growing concern. Ensuring the correct choice, timing, and duration of antibiotics in alignment with current guidelines not only optimizes patient outcomes but also plays a significant role in antimicrobial stewardship. The Indian Council of Medical Research (ICMR) and World Health Organization (WHO) guidelines for SAP[1,2] provide comprehensive recommendations on various aspects of SAP, including selection of appropriate prophylactic antibiotics for different surgical procedures, optimal timing for administering prophylactic antibiotics, recommended routes of administration and dosage guidelines, duration of prophylaxis (emphasizing that it should not exceed 24 hours postoperatively), and guidance on redosing for prolonged surgeries.

The selected antibiotic should cover the most likely pathogens for the specific procedure, following evidence-based guidelines. The first dose should be given within 60 minutes before incision (or 120 minutes for drugs like vancomycin or fluoroquinolones that require longer infusion times). SAP should typically not exceed 24 hours postoperatively, as prolonged use does not provide additional benefit but increases the risk of antibiotic resistance, *Clostridioides difficile* infections, and other complications.[3]

Surgical antimicrobial prophylaxis is a critical component of postoperative infection prevention, but its misuse is a widespread global issue. Irrational use of prophylactic antibiotics is associated with increased medical care costs, prolonged hospitalization, superinfection, the emergence of antimicrobial-resistant strains of hospital pathogens that challenge the patient care process, and adverse drug reactions.[4] From an estimated 30–50% of the antimicrobials used for surgical prophylaxis in hospitals, 30–90% were inappropriate.[5] This highlights a significant gap in adherence to established guidelines, despite strong evidence discouraging prolonged SAP use.

This study aims (1) to assess SAP utilization patterns and appropriateness of SAP in terms of choice, timing of administration, and duration of SAP; and (2) to evaluate possible correlation of SAP compliance with reduction in surgical site infection (SSI) rates.

Methods

A facility-based prospective cross-sectional study was conducted over a 6-month period to evaluate the prescribing patterns of SAP and the rate of SSIs. Data were collected using a structured extraction form, capturing patient demographics, diagnosis, type of surgical procedure, and details of SAP administration including indication, choice of antimicrobial, timing of the first dose, and duration of use. SAP was deemed appropriate when the selected antimicrobial matched the correct indication, was administered at the appropriate time, and maintained for the recommended duration, in accordance with institutional guidelines. Institutional protocols were framed as per recommendations of ICMR Guidelines (India, 2023) and WHO Consensus on SAP (2016).[1,2] SAP adherence rate was calculated using the formula:

$$\text{SAP adherence rate (\%)} = \frac{\text{No. of patients who received appropriate SAP}}{\text{Number of surgeries for which data was captured}} \times 100$$

An internal benchmark rate of 4% for SSI was set based on SSI rates observed in the hospital in the previous years, taking recommendations from standard literature references. SSI rate was calculated using the formula:

$$\text{SSI rate } (\%) = \frac{\text{No. of SSI}}{\text{No. of surgeries done}} \times 100$$

Results

The SAP adherence rate shows a steady increase from 60% in Jan-24 to 83% in May-24, with a slight decline to 82% in Jun-24, as shown in Figure 1. The lowest SSI rate (0.64%)

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in May-24 correlates with the highest SAP adherence (83%) in that month. The highest SSI rate (5.14%) in Jan-24 aligns with low adherence (60%). However, excessive SAP duration remains high (~68–80%) across months, as shown in Table 1.

The SSI rate crossed the internal benchmark (4%) in January (5.14%) and March (4.3%) but remained well below the benchmark in February (1.5%), April (1.91%), May (0.64%), and June (2.4%). Trend analysis (R^2 = 0.337) suggests a weak correlation between time and the downward trend in SSI rates, as shown in Figure 2.

While there is a moderate negative correlation (correlation coefficient −0.54) between SAP adherence rate and SSI rate, the relationship is not statistically significant (p-value = 0.267), as shown in Table 2. Prolonged SAP duration does not show a strong association with SSI reduction, reinforcing guidelines that extended SAP does not prevent SSIs.

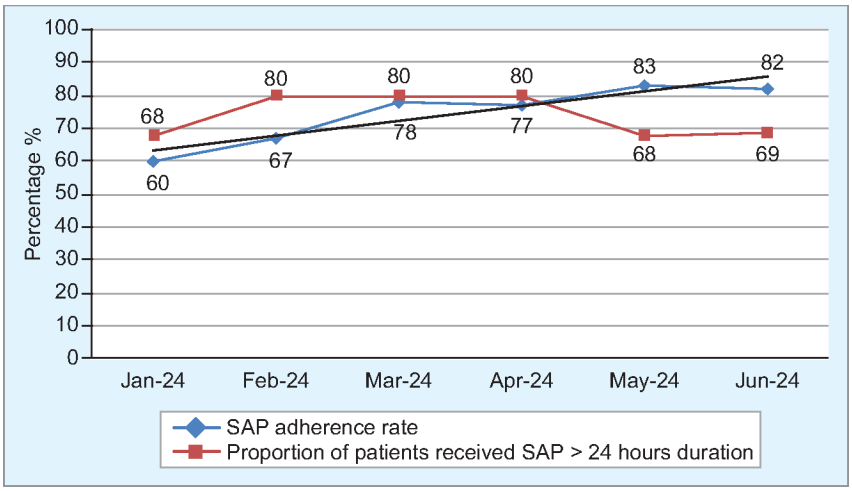

Fig. 1: SAP adherence trends

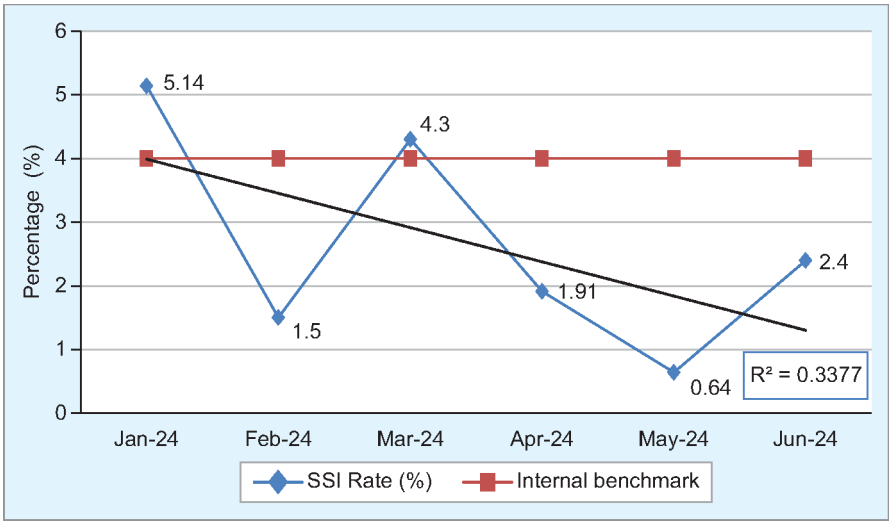

Fig. 2: SSI rate trend analysis

Discussion

The SSI rate shows significant fluctuation over the 6-month period. The overall trend shows a gradual decline over time despite the fluctuations. A comprehensive meta-analysis involving 4,88,594 general surgery patients estimated a global 30-day cumulative SSI incidence of 11%, highlighting a significant worldwide burden.[6] In India, a 2023 study across rural and semi-urban hospitals documented an SSI rate of 7.0%.[7] This rate is comparable to or slightly higher than the internal benchmark set in our institute as well as the findings in our study. The SSI rate exceeded the 4% benchmark in January and March. The R^2 value of 0.337 indicates a moderate correlation between time and SSI rate trends. This suggests that while there is some improvement over time, other factors may also be influencing SSI rates which are not taken into account in this study.

A study in Japanese hospitals found that the overall appropriateness of SAP was only 33.9%.[8] In our study, higher SAP adherence coincided with lower SSI rates in May, and prolongation of SAP did not correlate with better SSI prevention, emphasizing that prolonged SAP use does not reduce SSI rates but increases antimicrobial resistance risks.[3] It was also observed that, as SAP adherence improved, the proportion of patients receiving SAP for >24 hours decreased after April. The decline in May to June suggests a potential shift toward better compliance with recommended SAP duration, while reducing unnecessary prolonged antibiotic exposure. A study in Indian hospitals[7] found that prolonged SAP use (>24 hours) was common (~75%), but hospitals with strict adherence to SAP guidelines had lower SSI rates (~4.2%).

Despite high adherence in our study, a significant proportion of patients (69–80%) received SAP beyond 24 hours. Extending SAP beyond 24 hours does not correlate with lower SSI rates, supporting ICMR and WHO recommendations to limit SAP to ≤24 hours. This study underscores that although SAP plays a vital role in preventing SSIs, its effectiveness depends on the appropriate selection, timing, and duration

Table 1: SAP adherence indicators

SAP adherence indicators	*Jan-24*	*Feb-24*	*Mar-24*	*Apr-24*	*May-24*	*Jun-24*
No. of surgeries performed	214	264	229	261	310	250
No. of patients received SAP	186	196	169	211	198	166
SAP adherence rate	60%	67%	78%	77%	83%	82%
No. of patients received SAP >24 hours duration	127	157	136	169	134	115
Proportion of patients received SAP >24 hours duration	68%	80%	80%	80%	68%	69%
Number of SSI in a month	11	4	10	5	2	6
SSI rate (%)	5.14	1.5	4.3	1.91	0.64	2.4

Table 2: Tabulated summary of the correlation analysis

Comparison	*Correlation coefficient*	*Strength and direction*	*p-value*	*Statistical significance*
SAP adherence rate vs SSI rate	–0.54	Moderate negative	0.267	Not significant
SAP duration >24 hours vs SSI rate	–0.056	Very weak negative	0.917	Not significant

of antibiotic use. Departures from established guidelines such as unnecessarily prolonged administration or the use of broad-spectrum agents without clear indication can disrupt the natural microbial balance and contribute to antimicrobial resistance, posing risks to both patient safety and public health.[9] Adherence to guidelines enables healthcare providers to combat antibiotic resistance while minimizing the risk of antibiotic related adverse events and complications.[10]

Further, assessing SAP using days of therapy/100 patient-days (DOT/100 PD) data could provide valuable insights into adherence trends and potential areas for improvement.

Conclusion

The findings from this study highlight the fluctuating yet gradually declining trend in SSI rates over 6 months. While the observed rates are generally in line with national and global data, the occasional deviations from the internal benchmark suggest the need for continuous monitoring and targeted interventions. The relationship between SAP adherence and SSI rates underscores the importance of evidence-based antimicrobial stewardship. Consistent with global research, our study reaffirms that prolonging SAP beyond 24 hours does not reduce SSI incidence but increases the risk of antimicrobial resistance. Strengthening compliance with established protocols and aligning SAP practices with international guidelines will be critical in sustaining low SSI rates while minimizing antibiotic resistance risks.

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Author Contribution

Conception of the study, analysis of the records, and writing the manuscript are solely done by the first and corresponding author.

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