

## Incidence, Risk Factors, Microbiological Profile, and Clinical Outcomes of Surgical Site Infections Following General Surgical Procedures: A Prospective Cohort Study.

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### Abstract

#### Background:

Surgical site infections (SSIs) remain an important cause of postoperative morbidity, prolonged hospitalization, repeated intervention, and antimicrobial use, particularly after emergency and contaminated operations.

#### Objectives:

To determine the 30-day cumulative incidence and pattern of SSI following general surgical procedures and to evaluate associated risk factors, microbiological profile, and short-term clinical outcomes.

#### Methods:

This prospective cohort study included 80 adults undergoing elective or emergency general surgical procedures at Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, from February 2025 to January 2026. Participants were followed for 30 postoperative days. SSI was classified as superficial incisional, deep incisional, or organ/space infection. Categorical variables were compared using the chi-square and Fisher's exact tests, while continuous variables were assessed using the independent-samples t test and Mann-Whitney U test, as appropriate. Unadjusted odds ratios with 95% confidence intervals were calculated, with  $p < 0.05$  considered statistically significant.

#### Results:

Fourteen of 80 participants developed SSI, giving a 30-day cumulative incidence of 17.5%. Superficial incisional SSI was most frequent (57.1%). SSI occurred more often after emergency surgery (31.3% vs 8.3%;  $p = 0.014$ ), operations lasting  $> 120$  minutes (33.3%;  $p = 0.024$ ), and contaminated/dirty procedures (40.0%;  $p = 0.005$ ). Thirteen infections were culture-positive, yielding 15 isolates; 66.7% were Gram-negative. *Escherichia coli* and *Staphylococcus aureus* were the leading isolates. SSI was associated with longer hospitalization, wound dehiscence, and higher 30-day readmission.

#### Conclusion:

The 30-day cumulative incidence of SSI was substantial and was concentrated among emergency, prolonged, and contaminated or dirty procedures. Culture-directed treatment and targeted perioperative prevention are important to reduce postoperative morbidity.

#### Recommendations:

Risk-stratified surveillance, appropriate antimicrobial prophylaxis, glycaemic optimization, and local antibiogram-guided management should be strengthened, particularly for high-risk procedures.

**Keywords:** Emergency Surgery; General Surgery; Microbiology; Risk Factors; Surgical Site Infection; Wound Infection

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### Introduction

Surgical site infection (SSI) is an infection involving the incision, deep soft tissues, or organ/space manipulated

during an operative procedure. It is among the most important healthcare-associated infections because it complicates recovery, increases antimicrobial exposure,

delays wound healing, and adds substantial clinical and economic burden. International prevention guidance emphasizes that a meaningful proportion of SSIs can be prevented through systematic perioperative measures, including appropriate antimicrobial prophylaxis, skin preparation, maintenance of physiological homeostasis, aseptic technique, and structured postoperative surveillance.<sup>1,2</sup> Despite advances in operative care and infection control, SSI remains a persistent problem across surgical disciplines.

The occurrence of SSI reflects interactions between patient susceptibility, wound contamination, operative factors, microbial exposure, and quality of perioperative care. Diabetes mellitus, obesity, smoking, higher American Society of Anesthesiologists (ASA) physical status, emergency surgery, contaminated wounds, prolonged operative duration, and use of drains have been repeatedly evaluated as potential risk determinants. Evidence-based recommendations therefore address risk reduction before incision as well as measures during and after surgery.<sup>3,4</sup> Recognition of modifiable factors is particularly relevant in general surgery, where emergency abdominal procedures and contaminated operative fields are frequent.

The global burden of SSI is unevenly distributed. A large international prospective cohort demonstrated substantially greater SSI rates and a higher proportion of resistant infections in lower-resource settings after gastrointestinal surgery.<sup>5</sup> The FALCON trial, conducted across seven low- and middle-income countries including India, reported an overall SSI rate of 22.0%, increasing to 30.0% in contaminated or dirty operations.<sup>6</sup> These observations illustrate that procedural contamination, emergency presentation, local antimicrobial resistance, and resource constraints influence postoperative infection risk. Indian studies also show considerable institutional variation in SSI rates, reflecting differences in case mix, surveillance intensity, operative complexity, and microbiological ecology.<sup>7-9</sup>

Microbiological surveillance is central to the management of established SSI. *Staphylococcus aureus* remains an important Gram-positive pathogen, whereas *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Acinetobacter* species, and other Gram-negative bacilli are frequently encountered after abdominal and contaminated surgery. The growing presence of methicillin-resistant *S. aureus* and resistant Enterobacterales further supports culture-directed therapy rather than indiscriminate escalation of broad-spectrum antibiotics. Local prospective data integrating incidence, risk profile, microbiology, and outcomes can therefore guide both preventive practice and empirical antimicrobial choices.

The study was undertaken to generate institution-specific evidence among patients undergoing general surgical procedures at a tertiary teaching hospital in Andhra Pradesh. The objectives were to determine the 30-day cumulative incidence and clinical pattern of SSI; identify patient- and procedure-related factors associated with SSI; describe the microbiological profile of infected wounds; and compare short-term outcomes, including duration of hospitalization, wound dehiscence, reoperation, readmission, intensive care transfer, and mortality, between patients with and without SSI.

## Methodology

### Study design and setting

A prospective cohort study was conducted in the Department of General Surgery, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, from February 2025 to January 2026. Consecutive eligible adults undergoing elective or emergency general surgical procedures were enrolled and followed prospectively for 30 postoperative days to ascertain new-onset SSI and subsequent clinical outcomes. The institution is a teaching hospital providing general surgery alongside anaesthesiology, emergency medicine, general medicine, obstetrics and gynaecology, orthopaedics, paediatrics, radiology, urology, surgical gastroenterology, surgical oncology, and other specialty services.

### Study participants and eligibility

Adults undergoing elective or emergency general surgical procedures were eligible for inclusion. Patients with a pre-existing infection at the proposed operative site were considered ineligible. Eligible patients who declined consent were not enrolled and were therefore not classified as exclusions. Participants with incomplete 30-day postoperative follow-up were excluded from the final analytical cohort. During screening, 86 patients were assessed; two were ineligible because of pre-existing operative-site infection, leaving 84 eligible patients. Three declined consent, 81 were enrolled, and one had incomplete follow-up, resulting in 80 participants in the final analysis. Baseline information included age, sex, diabetes mellitus, body mass index, smoking status, ASA physical status, urgency of surgery, wound class, operative duration, and surgical drain placement.

### Sample size

Sample size was estimated for a single proportion using  $n = Z^2 p(1-p)/d^2$ . An anticipated SSI incidence of 17.0% was taken from a published Indian prospective study,<sup>7</sup> with  $Z = 1.96$  for a 95% confidence level and an absolute precision

(d) of 8.5%. The calculated minimum sample size was 75. After allowing approximately 5% for incomplete follow-up or non-evaluable data, the required sample increased to 79 and was rounded to a target of 80 participants.

### **Outcome definition and follow-up**

Participants were evaluated during hospitalization and followed for 30 days after surgery. SSI was categorized as superficial incisional, deep incisional, or organ/space infection using accepted surveillance concepts consistent with CDC and WHO guidance.<sup>1,2</sup> Clinical assessment included wound pain or tenderness, erythema, local warmth, purulent discharge, wound separation, fever, and evidence of deeper or organ/space infection. The date of diagnosis and whether infection was detected before or after discharge were recorded. Because participants were free of SSI at the operative site at baseline and new infections were ascertained prospectively, the primary frequency measure was 30-day cumulative incidence, calculated as the number of new SSI cases divided by the number of participants at risk and analysed. Percentages describing new SSI during follow-up therefore represent cumulative incidence proportions rather than prevalence. Short-term outcomes included length of hospital stay, wound dehiscence, reoperation, 30-day readmission, intensive care unit transfer, and 30-day mortality.

### **Microbiological assessment**

For patients meeting clinical criteria for SSI, wound specimens were obtained using aseptic technique before modification of antimicrobial therapy whenever feasible. Specimens were processed by standard bacteriological methods for culture and organism identification. The number of culture-positive and culture-negative infections, mono- and polymicrobial infections, Gram reaction, and individual bacterial isolates were documented. Methicillin resistance among *S. aureus* and extended-spectrum beta-lactamase production among Enterobacterales were noted when identified by the microbiology laboratory.

### **Bias**

Potential selection bias was reduced by consecutive recruitment of eligible surgical patients during the study period. Information bias was limited by using predefined SSI criteria and a uniform data-collection approach for baseline, operative, microbiological, and outcome variables. Follow-up bias was addressed through 30-day surveillance that included post-discharge assessment. Wound specimens were collected using aseptic technique and, whenever feasible, before antimicrobial modification to reduce microbiological misclassification. Because the number of SSI events was small, adjusted modelling was not performed; consequently, residual confounding was considered when interpreting associations.

### **Statistical analysis**

Data were summarized as frequencies and percentages for categorical variables and as mean with standard deviation or median with interquartile range for continuous variables, according to distribution. The 30-day cumulative incidence of SSI was calculated as the number of participants who developed a new SSI divided by the 80 participants analysed. The chi-square test and Fisher's exact test were used for categorical comparisons, depending on expected cell counts. The independent-samples t test and Mann-Whitney U test were used for continuous-variable comparisons according to distribution. Unadjusted odds ratios with 95% confidence intervals were calculated for potential risk factors. A two-sided p-value < 0.05 was considered statistically significant. Because only 14 SSI events occurred, multivariable modelling was not undertaken to avoid unstable and overfitted estimates.

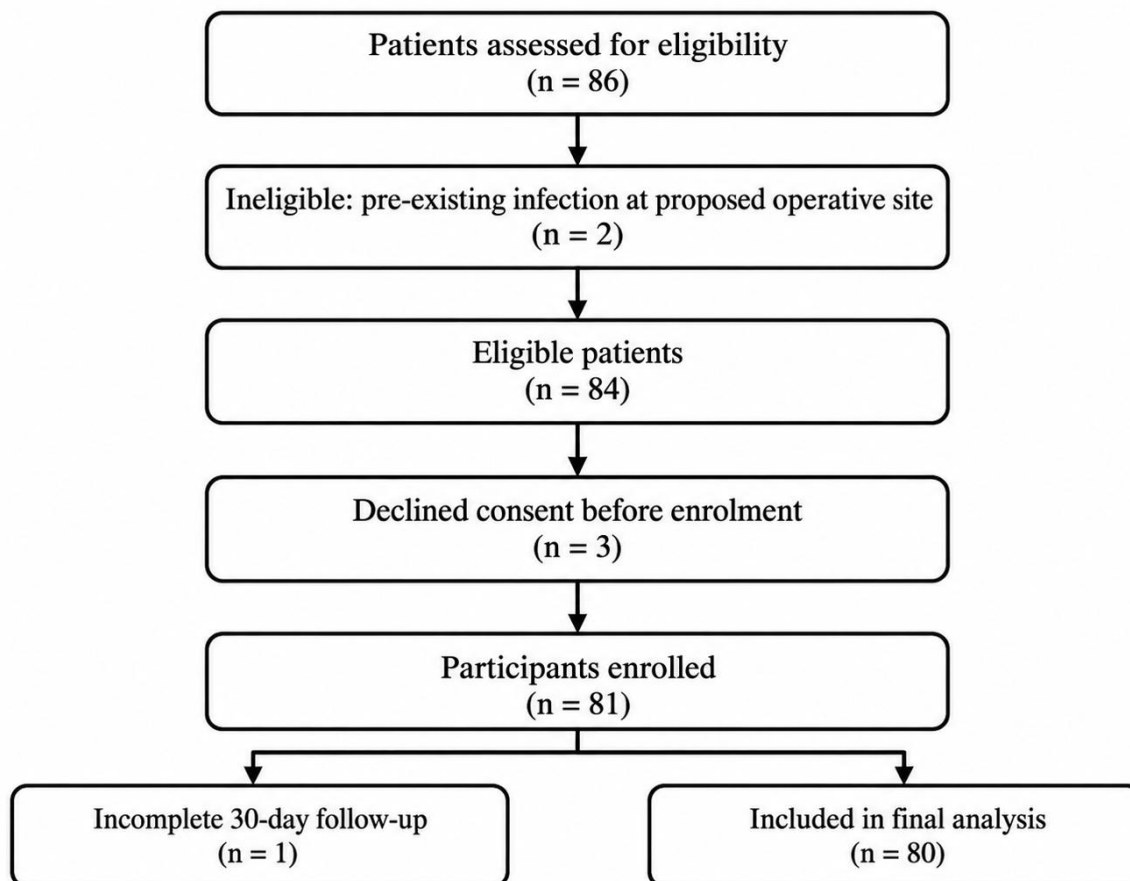
### **Ethical considerations**

The study protocol was approved by the Institutional Ethics Committee of Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India, before commencement of participant enrolment. Written informed consent was obtained from each enrolled participant. Patient identifiers were removed from the analytical dataset, confidentiality was maintained, and clinical management was not altered by study participation.

## Results

### Participant flow and baseline characteristics

**Figure 1. Participant flow through screening, enrolment, follow-up, and analysis**



During the study period, 86 patients were assessed for eligibility. Two were ineligible because of a pre-existing infection at the proposed operative site. Of the 84 eligible patients, three declined consent before enrolment. Eighty-

one participants were enrolled; one subsequently had incomplete 30-day postoperative follow-up. Therefore, 80 participants completed follow-up and were included in the final analysis (Figure 1).

**Table 1. Baseline clinical and operative characteristics of the study population**

| Characteristic                  | Value           |
|---------------------------------|-----------------|
| Total participants              | 80              |
| Age, years, mean $\pm$ SD       | 47.8 $\pm$ 15.6 |
| Male                            | 49 (61.3%)      |
| Female                          | 31 (38.8%)      |
| Diabetes mellitus               | 22 (27.5%)      |
| BMI $\geq$ 30 kg/m <sup>2</sup> | 20 (25.0%)      |
| Current smoking                 | 24 (30.0%)      |
| Elective surgery                | 48 (60.0%)      |
| Emergency surgery               | 32 (40.0%)      |
| ASA physical status I           | 31 (38.8%)      |
| ASA physical status II          | 37 (46.3%)      |
| ASA physical status III         | 12 (15.0%)      |
| Clean wound                     | 18 (22.5%)      |
| Clean-contaminated wound        | 42 (52.5%)      |
| Contaminated wound              | 14 (17.5%)      |
| Dirty wound                     | 6 (7.5%)        |
| Operative duration >120 min     | 24 (30.0%)      |
| Surgical drain placement        | 26 (32.5%)      |

Among the 80 analysed participants, the mean age was 47.8  $\pm$  15.6 years and 49 (61.3%) were male. Diabetes mellitus was present in 22 (27.5%), obesity in 20 (25.0%), and current smoking in 24 (30.0%). Forty-eight procedures

(60.0%) were elective, and 32 (40.0%) were emergency surgeries. Clean-contaminated operations constituted the largest wound category (42/80, 52.5%) (Table 1).

### 30-day cumulative incidence and pattern of surgical site infection

**Table 2. 30-day cumulative incidence and characteristics of surgical site infections**

| SSI characteristic                        | Value         |
|-------------------------------------------|---------------|
| Overall SSI                               | 14/80 (17.5%) |
| No SSI                                    | 66/80 (82.5%) |
| Superficial incisional SSI                | 8/14 (57.1%)  |
| Deep incisional SSI                       | 4/14 (28.6%)  |
| Organ/space SSI                           | 2/14 (14.3%)  |
| SSI following elective surgery            | 4/48 (8.3%)   |
| SSI following emergency surgery           | 10/32 (31.3%) |
| SSI in clean/clean-contaminated wounds    | 6/60 (10.0%)  |
| SSI in contaminated/dirty wounds          | 8/20 (40.0%)  |
| SSI detected during hospital stay         | 10/14 (71.4%) |
| SSI detected after discharge              | 4/14 (28.6%)  |
| Time to SSI diagnosis, days, median (IQR) | 6 (4-9)       |

During 30-day follow-up, 14 of 80 participants developed a new SSI, corresponding to a cumulative incidence of 17.5%. Superficial incisional SSI was the most frequent category (8/14, 57.1%), followed by deep incisional SSI (4/14, 28.6%) and organ/space SSI (2/14, 14.3%). Ten infections (71.4%) were detected during the index admission and four

(28.6%) after discharge; the median time to diagnosis was 6 days (IQR 4–9). The cumulative incidence was 31.3% after emergency procedures compared with 8.3% after elective procedures and 40.0% in contaminated/dirty wounds compared with 10.0% in clean/clean-contaminated wounds (Table 2).

### Risk factors associated with surgical site infection

**Table 3. Risk factors associated with surgical site infection**

| Risk factor                     | SSI, n/N (%)  | Odds ratio (95% CI) | p-value |
|---------------------------------|---------------|---------------------|---------|
| Emergency surgery               | 10/32 (31.3%) | 5.00 (1.41-17.76)   | 0.014   |
| Diabetes mellitus               | 7/22 (31.8%)  | 3.40 (1.03-11.24)   | 0.051   |
| BMI $\geq 30$ kg/m <sup>2</sup> | 6/20 (30.0%)  | 2.79 (0.83-9.36)    | 0.102   |
| Current smoking                 | 7/24 (29.2%)  | 2.88 (0.88-9.42)    | 0.107   |
| Operative duration >120 min     | 8/24 (33.3%)  | 4.17 (1.26-13.82)   | 0.024   |
| Contaminated/dirty wound        | 8/20 (40.0%)  | 6.00 (1.75-20.52)   | 0.005   |
| Surgical drain placement        | 8/26 (30.8%)  | 3.56 (1.08-11.68)   | 0.056   |

Emergency surgery was significantly associated with SSI: 10 of 32 emergency procedures (31.3%) developed SSI compared with 4 of 48 elective procedures (8.3%), corresponding to an unadjusted odds ratio (OR) of 5.00

(95% CI 1.41–17.76;  $p=0.014$ ). Operative duration >120 minutes was associated with higher odds of SSI (OR 4.17, 95% CI 1.26–13.82;  $p=0.024$ ), while contaminated/dirty wound class showed the strongest association (OR 6.00,

95% CI 1.75–20.52;  $p=0.005$ ). Diabetes mellitus, obesity, current smoking, and drain placement showed higher SSI

frequencies but did not meet the prespecified statistical-significance threshold (Table 3).

## Microbiological profile and clinical outcomes

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**Table 4. Microbiological profile and clinical outcomes of patients with surgical site infection**

| Parameter                          | Value                                      |
|------------------------------------|--------------------------------------------|
| <b>Microbiological findings</b>    |                                            |
| Culture-positive SSI               | 13/14 (92.9%)                              |
| Culture-negative SSI               | 1/14 (7.1%)                                |
| Total bacterial isolates           | 15                                         |
| <i>Escherichia coli</i>            | 4 (26.7%)                                  |
| <i>Staphylococcus aureus</i>       | 4 (26.7%)                                  |
| <i>Klebsiella pneumoniae</i>       | 2 (13.3%)                                  |
| <i>Pseudomonas aeruginosa</i>      | 2 (13.3%)                                  |
| <i>Enterococcus</i> spp.           | 1 (6.7%)                                   |
| <i>Acinetobacter</i> spp.          | 1 (6.7%)                                   |
| <i>Proteus</i> spp.                | 1 (6.7%)                                   |
| Gram-negative isolates             | 10 (66.7%)                                 |
| Gram-positive isolates             | 5 (33.3%)                                  |
| <b>Clinical outcomes</b>           |                                            |
|                                    | <b>SSI (n=14) vs No SSI (n=66)</b>         |
| Hospital stay, days, mean $\pm$ SD | 14.6 $\pm$ 6.2 vs 6.7 $\pm$ 2.8; $p<0.001$ |
| Wound dehiscence                   | 4 (28.6%) vs 1 (1.5%); $p=0.003$           |
| Reoperation                        | 2 (14.3%) vs 1 (1.5%); $p=0.078$           |
| 30-day readmission                 | 3 (21.4%) vs 2 (3.0%); $p=0.035$           |
| ICU transfer                       | 2 (14.3%) vs 2 (3.0%); $p=0.139$           |
| 30-day mortality                   | 1 (7.1%) vs 0; $p=0.175$                   |

Wound specimens were obtained from all 14 participants with SSI. Bacterial growth was demonstrated in 13 cases (92.9%); one specimen was culture-negative. Eleven infections were monomicrobial, and two were polymicrobial, yielding 15 bacterial isolates. Gram-negative organisms accounted for 10 isolates (66.7%) and Gram-positive organisms for five (33.3%). *Escherichia coli* and *Staphylococcus aureus* were the leading isolates, each accounting for 26.7%. Two of four *S. aureus* isolates were methicillin-resistant, and three Enterobacterales isolates

were reported as extended-spectrum beta-lactamase producers. Participants with SSI had longer hospitalization than those without SSI (14.6  $\pm$  6.2 vs 6.7  $\pm$  2.8 days;  $p<0.001$ ), with significantly greater wound dehiscence and 30-day readmission (Table 4).

Overall, the 30-day cumulative incidence of SSI was 17.5%. Emergency surgery, operative duration >120 minutes, and contaminated/dirty wound classification were the principal statistically significant factors associated with SSI. Gram-negative organisms predominated among cultured isolates,

and SSI was associated with clinically important postoperative morbidity, particularly prolonged hospitalization, wound dehiscence, and readmission.

## Discussion

The prospective cohort comprised 80 adults with a mean age of  $47.8 \pm 15.6$  years; 61.3% were male, 60.0% underwent elective surgery, and 40.0% underwent emergency surgery (Table 1). Participant progression from screening to final analysis is shown in Figure 1. During 30-day follow-up, 14 participants developed SSI, giving a cumulative incidence of 17.5%; superficial incisional infection was the predominant SSI type (Table 2). The principal factors associated with SSI were emergency surgery, operative duration >120 minutes, and contaminated/dirty wound class (Table 3). Gram-negative organisms predominated, and SSI was accompanied by longer hospitalization, greater wound dehiscence, and increased 30-day readmission (Table 4). These findings directly address the study objectives by linking the observed infection burden with procedure-related risk, microbiological pattern, and early postoperative outcomes.

The 17.5% cumulative incidence is comparable with the 17% rate reported by Jatoliya et al. in elective and emergency abdominal surgery in India and lies within the broad range reported across Indian surgical settings<sup>7</sup>. Meena et al. likewise emphasized that SSI remains frequent after abdominal operations and is closely related to established perioperative risk indices<sup>8</sup>. Differences between institutions are expected because surveillance duration, emergency case load, operative spectrum, wound class, antimicrobial practices, and post-discharge ascertainment can materially influence measured incidence. In the current cohort, the inclusion of 30-day post-discharge surveillance likely improved detection beyond infections identified during the index admission alone (Table 2).

Emergency surgery was associated with a five-fold increase in the odds of SSI (Table 3). This finding is clinically plausible because emergency operations often allow less time for physiological optimization and frequently involve inflamed, obstructed, perforated, or contaminated pathology. Similar observations have been reported in prospective abdominal-surgery studies<sup>7,10</sup>. Contaminated/dirty wounds showed the strongest association in the cohort, with a six-fold increase in unadjusted odds of SSI. Aga et al. also identified dirty wound classification as an important predictor of SSI after abdominal surgery<sup>11</sup>. Together, these results support wound class and operative urgency as practical markers for intensified perioperative infection-prevention surveillance. Operative duration exceeding 120 minutes was another significant factor (Table 3). Longer procedures increase

tissue exposure, opportunities for bacterial inoculation, blood loss, tissue manipulation, and the likelihood of technically complex operative conditions. Indian surveillance work from Ujjain similarly identified operative duration as a recurring risk factor for SSI.<sup>12</sup> Diabetes, obesity, smoking, and drain placement were associated with numerically higher SSI frequencies but did not reach statistical significance in this cohort. Given only 14 SSI events, these non-significant findings should be interpreted as imprecise rather than as evidence of no association.

Microbiological analysis demonstrated a predominance of Gram-negative organisms, which accounted for two-thirds of isolates (Table 4). *Escherichia coli* and *Staphylococcus aureus* were the leading pathogens. This pattern is consistent with a mixed general-surgical population containing abdominal, emergency, and contaminated procedures. Shah et al. reported a predominance of Gram-negative bacilli in a large prospective Indian SSI surveillance study, with *E. coli*, *Klebsiella*, *Pseudomonas*, and *Acinetobacter* among major isolates<sup>13</sup>. Other Indian work has also demonstrated substantial contributions from *S. aureus* and *E. coli*<sup>7</sup>. The presence of MRSA and ESBL-producing Enterobacterales in the present cohort further supports early specimen collection and culture-directed antimicrobial treatment.

The higher SSI frequencies observed among participants with diabetes, obesity, smoking, and drain placement remain clinically relevant despite the lack of statistical significance in this small cohort. A 2024 systematic review and meta-analysis demonstrated significant associations between comorbidities, including diabetes and obesity, and SSI in emergency surgical populations<sup>14</sup>. This broader evidence supports continued attention to modifiable patient-level risk while recognizing that the present study was not sufficiently powered for stable adjusted estimates.

SSI substantially worsened short-term recovery (Table 4). Mean hospital stay was more than twice as long among infected participants, while wound dehiscence and 30-day readmission were significantly more frequent. International prospective evidence likewise links SSI with greater postoperative intervention, prolonged hospitalization, and adverse outcomes<sup>5</sup>. The clinical implication is that preventing SSI has consequences beyond wound healing alone, including bed utilization, repeat care, antimicrobial exposure, and early readmission. The prevention-oriented actions arising from these findings are presented separately in the Recommendations section.

## Generalizability

The findings are most applicable to adult patients undergoing a mixed spectrum of elective and emergency general surgical procedures in tertiary teaching hospitals with comparable case profiles and microbiological

environments. Inclusion of different wound classes and systematic 30-day follow-up strengthens clinical relevance beyond a single procedure group. However, institutional antimicrobial policies, operative volumes, referral patterns, resistance profiles, and infection-control resources vary substantially; therefore, the exact cumulative incidence and organism distribution should not be extrapolated directly to all hospitals or regions.

### Conclusion

The 30-day cumulative incidence of surgical site infection was 17.5% among adults undergoing general surgical procedures in this prospective cohort. Emergency surgery, operative duration exceeding 120 minutes, and contaminated/dirty wound classification were significantly associated with infection. Gram-negative bacteria predominated, while *Escherichia coli* and *Staphylococcus aureus* were the most frequent isolates. SSI was accompanied by markedly prolonged hospitalization and higher frequencies of wound dehiscence and 30-day readmission. These findings support systematic perioperative risk assessment, evidence-based infection-prevention practices, structured postoperative surveillance, and early microbiological sampling of suspected infection. Institution-specific surveillance and antimicrobial susceptibility data should guide empirical treatment and stewardship strategies while definitive culture results are awaited.

### Limitations

This single-centre study included a relatively small cohort with only 14 SSI events, limiting precision for less frequent risk factors and preventing reliable multivariable modelling. The inclusion of heterogeneous general surgical procedures also restricted procedure-specific estimates. Microbiological evaluation relied on routine bacterial culture without molecular characterization of resistance mechanisms. Follow-up ended at 30 postoperative days, so infections or wound-related outcomes occurring beyond this surveillance period were not captured.

### Recommendations

A coordinated prevention pathway should combine evidence-based antimicrobial prophylaxis, intraoperative infection-control measures, postoperative surveillance, and antimicrobial stewardship. Hospitals should maintain prospective SSI surveillance with 30-day follow-up and regular feedback to surgical teams. Patients undergoing emergency, prolonged, contaminated, or dirty procedures should receive intensified perioperative risk-reduction measures. Antimicrobial prophylaxis should be timed appropriately and selected according to procedure type,

institutional policy, and local resistance patterns. Glycaemic optimization, smoking cessation, nutritional optimization, aseptic technique, and standardized wound care should form a prevention bundle. Suspected SSI should undergo prompt microbiological sampling before antibiotic escalation whenever clinically feasible. Periodic antibiogram review and multidisciplinary antimicrobial stewardship should guide empirical therapy, reduce unnecessary broad-spectrum exposure, and address resistant Gram-negative organisms and MRSA.

### Conflict of interest

The authors declare no conflict of interest related to this study.

### Author biography

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### Author contributions

V.S.: Conceptualization, methodology, investigation, data curation, writing—original draft, and project administration. K.C.B.: Methodology, validation, formal analysis, interpretation, and writing—review and editing. Both authors reviewed the final manuscript, approved the submitted version, and accept accountability for the work.

### Data availability

The de-identified dataset is not publicly posted because it contains clinical participant information. Data can be made available by the corresponding author on reasonable request, subject to institutional and ethical requirements.

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facilitating patient evaluation and data collection. The authors also thank all study participants for their cooperation during hospitalization and postoperative follow-up.

### Abbreviations

ASA – American Society of Anesthesiologists; BMI – Body mass index; CDC – Centers for Disease Control and Prevention; CI – Confidence interval; ESBL – Extended-spectrum beta-lactamase; ICU – Intensive care unit; IQR – Interquartile range; MRSA – Methicillin-resistant *Staphylococcus aureus*; OR – Odds ratio; SD – Standard deviation; SSI – Surgical site infection; WHO – World Health Organization.

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