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Hospital-Based Prevalence and Factors Associated with Surgical Site Infection among Postoperative Patients in Kolkata

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Abstract: ***Surgical site infection (SSI) is a postoperative complication associated with delayed wound healing and morbidity. The study aimed to determine the hospital-based prevalence of SSI, assess clinical outcomes among patients who developed SSI, and identify selected factors associated with SSI among postoperative patients. A hospital-based cross-sectional analytical study was conducted in the male and female General Surgery wards of a tertiary care hospital in Kolkata, West Bengal, India, in May 2026. The study included 100 adult postoperative patients selected using convenience sampling. Data were collected using a structured demographic proforma, structured checklist, SSI criteria checklist, clinical outcome assessment checklist and associated factors assessment checklist; SSI assessment was based on CDC/NHSN criteria. SSI occurred in 30.0% of patients, including superficial SSI in 20.0%, deep SSI in 7.0% and organ/space SSI in 3.0%. Wound dehiscence was reported in 70.0% of SSI cases. Significant bivariate associations were observed for smoking, duration of surgery >4 hours, haemoglobin <10 g/dL, diabetes mellitus, overweight/obesity, underweight, irregular postoperative dressing and preoperative hospital stay >7 days, whereas hypertension was not significantly associated with SSI. In multivariable logistic regression, haemoglobin <10 g/dL and irregular postoperative dressing remained significant independent predictors of SSI. SSI affected nearly one-third of the postoperative patients, highlighting the importance of comprehensive perioperative risk assessment and consistent postoperative wound-care practices.***

Keywords: Surgical site infection; postoperative patients; associated factors; clinical outcomes; infection prevention

1. Introduction

Surgical site infection (SSI) is an important healthcare-associated infection occurring after operative procedures and may involve the skin and subcutaneous tissue, deeper soft tissues, or an organ/space related to the surgical procedure. SSI remains a major concern in surgical care because it can interfere with normal wound healing and increase postoperative morbidity. Standardized surveillance definitions are therefore important for consistent identification and classification of SSI as superficial incisional, deep incisional or organ/space infection. [1-6]

The burden of SSI extends beyond the wound itself. Patients who develop SSI may require additional antimicrobial treatment, repeated wound care, prolonged hospitalization or further surgical intervention, thereby increasing the use of healthcare resources and the overall cost of care. The burden is particularly relevant in low- and middle-income settings, where healthcare infrastructure, infection-prevention resources and patient-related vulnerabilities may influence postoperative outcomes. [1, 4, 7-9]

The occurrence of SSI is multifactorial and may be influenced by patient-related, procedure-related and postoperative factors. Smoking, diabetes mellitus, anaemia, nutritional or body-weight abnormalities and prolonged preoperative hospitalization may increase vulnerability to infection, while prolonged operative duration and inadequate postoperative wound-care practices may further contribute to risk. Prevention therefore requires coordinated measures across the preoperative, intraoperative and postoperative periods, together with appropriate surveillance, surgical hand antisepsis, appropriate antimicrobial prophylaxis and adherence to infection-prevention practices. [1, 4, 10-16]

2. Literature Survey

Studies from different healthcare settings have reported considerable variation in SSI occurrence, reflecting differences in patient characteristics, surgical procedures, surveillance methods and infection-prevention practices. Evidence from India and other low- and middle-income settings indicates that SSI continues to be an important postoperative problem and that factors such as diabetes, nutritional status, prolonged operative duration and length of hospital stay may contribute to its occurrence. [1, 4, 7, 17, 18]

SSI can adversely affect postoperative recovery and may be accompanied by wound dehiscence, evisceration or tissue necrosis. Identification of locally relevant associated factors and clinical outcomes is therefore important for strengthening perioperative prevention, nursing surveillance, early recognition of infection and appropriate wound-care practices. [1, 2, 11, 13, 19]

Need of the Study

Hospital-specific evidence on SSI is useful because the prevalence, clinical outcomes and associated factors may vary according to patient profile, type of surgery and local perioperative practices. Assessing these factors among postoperative patients in a tertiary care hospital in Kolkata can provide locally relevant evidence to support risk assessment, infection-prevention measures and postoperative nursing care. [13, 14, 17]

3. Problem Definition

Evidence from individual tertiary-care hospitals in eastern India remains important because the distribution of surgical procedures, patient characteristics and perioperative practices may differ between settings. The present study was undertaken among postoperative patients in a tertiary hospital in Kolkata to determine the occurrence of SSI, describe clinical outcomes, identify selected associated factors and examine their relationship with SSI [13, 14, 17].

The study addressed the hospital-based prevalence of SSI, its clinical outcomes and selected factors associated with SSI among postoperative patients in the General Surgery wards of a tertiary care hospital in Kolkata.

The study objectives:

- To determine the hospital-based prevalence of surgical site infection (SSI) among postoperative patients admitted to the General Surgery wards of a tertiary care hospital, Kolkata.
- To find out the clinical outcomes of surgical site infection among postoperative patients who developed SSI.
- To identify selected associated factors and determine their association with the occurrence of SSI among postoperative patients.

4. Methodology / Approach

Study design:

A hospital-based cross-sectional analytical study design was adopted.

Study setting:

The study was conducted in the male and female General Surgery wards of a tertiary care hospital in Kolkata, West Bengal, India.

Study population and sample:

The study population comprised adult postoperative patients admitted to the General Surgery wards following elective or emergency surgical procedures. A total of 100 patients were included.

Sample size:

The sample size was estimated using the single-population proportion formula $n=Z^2pq/d^2$, considering an expected SSI prevalence of 18.6% reported by Khan and Purohit [18], a 95% confidence level and 8% absolute precision. The calculated minimum sample size was approximately 91, and the final sample size was taken as 100 postoperative patients

Sampling technique:

Participants were selected using convenience sampling.

Eligibility criteria:

Inclusion criteria were postoperative patients aged ≥18 years, admitted to the General Surgery wards during the study period and willing to participate. Patients operated on an outpatient basis, transferred from another healthcare facility after surgery, or unable to communicate effectively were excluded.

Study variables:

The primary outcome variable was occurrence of SSI. Additional variables included demographic characteristics, surgical category, clinical outcomes of SSI, and selected patient-related, procedure-related, postoperative and facility-related factors.

Tool of the study:

Structured demographic proforma was used to collect demographic characteristics, structured checklist, SSI criteria checklist were used to collect the data regarding surgical category, SSI occurrence, selected associated factors and clinical outcomes. SSI was assessed using criteria based on the CDC/NHSN definitions and categorized as superficial, deep or organ/space. Patients were assessed from surgery until hospital discharge [2, 6]. Validity of the structured proforma and checklists were established by necessary suggestions and corrections of four experts. Reliability of demographic proforma was computed using inter- rater method and obtained value was 1, reliability of SSI criteria checklist was estimated by inter-rater method and computed value was 0.88, using Kuder Richardson method the reliability of Clinical Outcome assessment checklist and associated factors assessment checklist were established with calculated value of 0.98 and 0.88 respectively.

Data collection:

Data was collected from 1st May to 31st May 2026, after obtaining prior ethical permission from the institutional ethical committee, informed consent was taken from participants, privacy and anonymity were maintained during data collection, Interview, observation, record analysis, biophysical measurement technique were used to collect data. Approximately 30-40 minutes were taken to each participants to complete the proforma & checklists.

Statistical analysis:

Data collected from the Surgery wards were entered and compiled in an MS Excel sheet. Normality was assessed using the Kolmogorov-Smirnov test. Frequencies and percentages were used for categorical variables, while mean ± standard deviation or median, as appropriate, was used for continuous variables. Associations between selected factors and SSI were tested using Pearson's chi-square test; Fisher's exact test was used when expected cell counts were <5. Odds ratios (ORs) with 95% confidence intervals (CIs) were calculated to estimate the strength of association between selected factors and SSI occurrence. Statistical significance was set at $p < 0.05$.

5. Results & Discussion

5.1 Section I: Description of Demographic Characteristics of Postoperative Patient

Results:
A total of 100 postoperative patients were included in the analysis. The demographic distribution, surgical categories, SSI occurrence, clinical outcomes and selected associated factors are presented below.

Table 1: Frequency and percentage distribution of demographic characteristics of postoperative patients (N=100)

Variable	f	%
Age (years)		
18–33	16	16.0
34–49	29	29.0
50–65	37	37.0
66–81	18	18.0
Gender		
Male	39	39.0
Female	61	61.0
Marital status		
Married	80	80.0
Unmarried	6	6.0
Widow	8	8.0
Divorced	6	6.0
Education		
Illiterate	24	24.0
Up to primary	36	36.0
Up to Madhyamik	28	28.0
Up to Higher Secondary	8	8.0
Graduate and above	4	4.0
Occupation		
Service	10	10.0
Homemaker	65	65.0
Daily labour	10	10.0
Self-employed	13	13.0
Unemployed	2	2.0
Residence		
Rural	70	70.0
Urban	30	30.0
Living situation		
With family	100	100.0
Per-capita income class		
Upper	7	7.0
Upper middle	10	10.0
Middle	42	42.0
Lower middle	32	32.0
Lower	9	9.0
Total	100	100.0

The largest age group was 50–65 years (37.0%), followed by 34–49 years (29.0%). Females constituted 61.0% of the sample. Most participants were married (80.0%), educated up to primary level (36.0%), homemakers (65.0%), rural residents (70.0%) and in the middle per-capita income class (42.0%). All participants were living with family.

5.2 Section II: Frequency and percentage distribution Surgical Categories and Hospital-Based Prevalence of SSI

Table 2: Frequency and percentage distribution of surgical categories and hospital-based prevalence/type of SSI among postoperative patients (N = 100)

Variable / Category	f	%
Surgical categories		
Biliary and gallbladder surgeries	36	36.0
Hernia and general surgeries	30	30.0
Abdominal and gastrointestinal surgeries	18	18.0
Endocrine and oncological surgeries	11	11.0
Orthopedic and urological surgeries	5	5.0
Hospital-based prevalence and type of SSI		
Superficial SSI	20	20.0
Deep SSI	7	7.0
Organ/space SSI	3	3.0
No SSI	70	70.0
Total	100	100.0

Biliary and gallbladder surgeries constituted the largest surgical category (36.0%), followed by hernia and general surgeries (30.0%). Overall, 30.0% of postoperative patients developed SSI, while 70.0% had no SSI. Superficial SSI was the most common type (20.0%), followed by deep SSI (7.0%) and organ/space SSI (3.0%)

5.3 Section III: Clinical Outcomes and Selected Associated Factors among Patients with SSI

Table 3: Frequency distribution of clinical outcomes and selected associated factors among patients with SSI (n = 30)

Variable	Present/ Yes, f (%)	Absent/ No, f (%)
Clinical outcomes		
Wound dehiscence	21 (70.0)	9 (30.0)
Wound evisceration	4 (13.3)	26 (86.7)
Tissue necrosis	3 (10.0)	27 (90.0)
Selected associated factors		
Preoperative		
Hypertension	12 (40.0)	18 (60.0)
Diabetes mellitus	13 (43.3)	17 (56.7)
Combined hypertension and diabetes	4 (13.3)	26 (86.7)
Hyperthyroidism	1 (3.3)	29 (96.7)
Smoking within 1 month before admission	21 (70.0)	9 (30.0)
Current immunosuppressive therapy	5 (16.7)	25 (83.3)
Underweight (BMI <18.5 kg/m²)	13 (43.3)	17 (56.7)
Overweight/obesity	5 (16.7)	25 (83.3)
Preoperative hospital stay >7 days	18 (60.0)	12 (40.0)
Intraoperative		
Duration of surgery >4 hours	20 (66.7)	10 (33.3)
Postoperative		
Irregular postoperative dressing	18 (60.0)	12 (40.0)
Late ambulation	24 (80.0)	6 (20.0)
Irregular bathing	7 (23.3)	23 (76.7)
Irregular change of garments	5 (16.7)	25 (83.3)
Haemoglobin <10 g/dL	21 (70.0)	9 (30.0)
Facility-related		
Changing bed sheets when soiled	29 (96.7)	1 (3.3)
Inadequate handwashing practice	2 (6.7)	28 (93.3)

Note: multiple responses were permitted; hence percentage may not total 100%

Among the 30 patients who developed SSI, wound dehiscence was the most frequently reported clinical outcome (70.0%), followed by wound evisceration (13.3%) and tissue necrosis (10.0%). Frequently reported associated factors included late ambulation (80.0%), smoking within one month before admission (70.0%), haemoglobin <10 g/dL (70.0%), duration of surgery >4 hours (66.7%), irregular postoperative dressing (60.0%) and preoperative hospital stay >7 days (60.0%).

5.4 Section IV: Findings related to Association between SSI and Selected Associated Factors

Table 4: Association and Predictors of Surgical Site Infection among Postoperative Patients (n= 100)

Associated factor	SSI Yes f	SSI No f	Test statistic	Crude OR (95% CI)	Crude p-value	Adjusted OR (95% CI)	Adjusted p-value
Smoking within 1 month before admission	21	18	χ^2 = 17.31	6.74 (2.61–17.38)	<0.001*	2.37 (0.62–9.08)	0.208
Duration of surgery >4 hours	20	16	χ^2 = 17.49	6.75 (2.63–17.32)	<0.001*	3.09 (0.80–12.00)	0.103
Haemoglobin <10 g/dL	21	15	χ^2 = 21.50	8.56 (3.25–22.51)	<0.001*	8.50 (2.10–34.39)	0.003*
Diabetes mellitus	13	8	χ^2 = 12.88	5.93 (2.11–16.62)	<0.001*	4.26 (0.83–21.95)	0.084
Hypertension	12	20	χ^2 = 1.26	1.67 (0.68–4.08)	0.262	1.09 (0.26–4.49)	0.906
Overweight/obesity	5	2	Fisher's exact	6.80 (1.24–37.32)	0.024*	3.69 (0.44–30.82)	0.228
Underweight (BMI <18.5 kg/m²)	13	8	χ^2 = 12.88	5.93 (2.11–16.62)	<0.001*	1.97 (0.42–9.23)	0.387
Irregular postoperative dressing	18	10	χ^2 = 21.77	9.00 (3.34–24.24)	<0.001*	5.61 (1.48–21.28)	0.011*
Preoperative hospital stay >7 days	18	18	χ^2 = 10.71	4.33 (1.75–10.72)	0.001*	2.63 (0.68–10.21)	0.161

Footnote: OR = Odds Ratio; AOR = Adjusted Odds Ratio; CI = Confidence Interval. χ^2 = Chi-square test; Fisher's exact test. $p < 0.05$ was considered statistically significant.

The bivariate analysis showed significant associations of SSI with smoking, duration of surgery >4 hours, haemoglobin <10 g/dL, diabetes mellitus, overweight/obesity, underweight, irregular postoperative dressing, and preoperative hospital stay >7 days. Hypertension was not significantly associated with SSI. In the multivariable logistic regression analysis, only haemoglobin <10 g/dL (AOR = 8.50, 95% CI: 2.10–34.39, p = 0.003) and irregular postoperative dressing (AOR = 5.61, 95% CI: 1.48–21.28, p = 0.011) remained significant after adjustment for the other selected factors.

Table 5: Model Fit of Binary Logistic Regression for Surgical Site Infection (n = 100)

Model measure	Value
Hosmer–Lemeshow p-value	0.414
Nagelkerke R²	0.643
Overall classification accuracy	89.0%

Footnote: Outcome variable was coded as No SSI = 0 and SSI = 1.

Interpretation: The model showed an acceptable fit, with a Hosmer–Lemeshow p-value of 0.414. The Nagelkerke R^2 was 0.643, and the model correctly classified 89% of the cases.

5.5 Discussion

5.5.1 Prevalence and Type of Surgical Site Infection:

The present study found an SSI prevalence of 30.0% among 100 postoperative patients, with superficial SSI accounting for 20.0%, deep SSI for 7.0%, and organ/space SSI for 3.0%. Mwakasitu [21] reported an SSI prevalence of 22.8% among general surgical patients, while Khan and Purohit [18] reported a prevalence of 18.6% in a tertiary-care centre in Western Rajasthan. A lower prevalence of 6.68% was reported by Vasavada and Patel [22]. Superficial SSI was the most common type of infection in the present study, which was comparable with the findings of Vasavada and Patel [22], who also observed a predominance of superficial infections. Variations in SSI prevalence across studies may be related to differences in patient characteristics, types of surgical procedures, duration of surveillance, clinical risk profiles, and infection-prevention practices.

5.5.2 Clinical Outcomes of SSI:

Wound dehiscence was the most frequently observed clinical outcome among patients who developed SSI (70.0%), followed by wound evisceration (13.3%) and tissue necrosis (10.0%). These findings demonstrate the adverse effect of SSI on postoperative wound healing. Previous evidence has similarly emphasized that SSI may delay wound healing, increase morbidity, and contribute to additional treatment and healthcare utilization [6, 9]. The high occurrence of wound dehiscence among infected patients in the present study highlights the importance of early identification of SSI and systematic postoperative wound surveillance.

5.5.3 Patient-Related Factors Associated with SSI:

Smoking within one month before admission was significantly associated with SSI (OR=6.74, p<0.001). However, Mwakasitu [21] did not observe a statistically significant association between cigarette smoking and SSI, indicating that the influence of smoking may vary across study populations. Diabetes mellitus was significantly associated with SSI in the present study (OR=5.93, p<0.001), which was consistent with the findings of Khan and Purohit [18], who also identified diabetes mellitus as a contributing factor for SSI.

Both underweight and overweight/obesity showed significant associations with SSI. Khan and Purohit [18] similarly reported higher BMI as a factor contributing to SSI. However, the number of overweight/obese patients in the present study was small and the confidence interval was wide; therefore, this finding should be interpreted cautiously.

Haemoglobin <10 g/dL was strongly associated with SSI (OR=8.56, p<0.001). Anaemia may adversely affect tissue oxygenation and wound healing, emphasizing the importance of appropriate preoperative assessment and management [1, 4, 10]. Hypertension was not significantly associated with SSI (p=0.262). A similar finding was reported by Mwakasitu [21], where hypertension was not identified as a significant factor associated with SSI.

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5.5.4 Procedure- and Hospital-Related Factors Associated with SSI:
Duration of surgery >4 hours was significantly associated with SSI (OR=6.75, p<0.001). Mwakasitu [21] also reported a significant relationship between longer operative duration and SSI, although the duration criterion used in that study differed from the present study. Vasavada and Patel [22] also identified prolonged operative time as an associated factor in univariate analysis. These findings suggest that prolonged surgical procedures may be associated with an increased likelihood of SSI.

Preoperative hospital stay >7 days was significantly associated with SSI (OR=4.33, p=0.001). This finding was comparable with that of Vasavada and Patel [22], who reported an association between prolonged hospital stay and SSI. Longer preoperative hospitalization may increase exposure to healthcare-associated microorganisms and may also reflect greater clinical complexity or delays in surgical management.

5.5.5 Postoperative Wound-Care Factor:
Irregular postoperative dressing showed the highest estimated odds of SSI in the present study (OR=9.00, p<0.001). This finding underscores the importance of consistent postoperative wound care, aseptic dressing practices, regular wound assessment, and early recognition of signs of infection. Adherence to recommended infection-prevention and wound-care practices is an important component of SSI prevention [11, 13, 19]. Nursing personnel therefore have an important role in maintaining appropriate wound-care practices and monitoring postoperative patients for early signs of infection.

5.5.6 Overall Interpretation:
In the multivariable model, haemoglobin <10 g/dL (AOR = 8.50, 95% CI: 2.10–34.39, p = 0.003) and irregular postoperative dressing (AOR = 5.61, 95% CI: 1.48–21.28, p = 0.011) remained independently associated with SSI. The other variables that were significant in the bivariate analysis did not remain significant after adjustment. Thus, within this sample, low haemoglobin and irregular postoperative dressing were the factors that showed the clearest independent relationship with SSI. From a clinical perspective, the result supports attention to preoperative anaemia and consistent postoperative wound-dressing practice.

6. Conclusion

SSI occurred in 30.0% of postoperative patients in this tertiary-hospital sample, with superficial SSI being the most common type. Wound dehiscence was the predominant reported clinical outcome among infected patients. Smoking, operative duration >4 hours, haemoglobin <10 g/dL, diabetes mellitus, overweight/obesity, underweight status, irregular postoperative dressing and preoperative hospital stay >7 days showed statistically significant bivariate associations with SSI, whereas hypertension did not. These findings support comprehensive perioperative risk assessment and prevention strategies combining patient optimization, smoking cessation, glycaemic and anaemia management, nutritional assessment, avoidance of unnecessary preoperative delay and strict postoperative wound care.

7. Future Scope

The present study was conducted in a tertiary teaching hospital under clinical conditions, included a range of surgical procedures, and assessed SSI occurrence, clinical outcomes and selected associated factors within the same study. However, the single-centre design, convenience sampling, sample size of 100, absence of long-term post-discharge follow-up,and small numbers in some exposure categories may limit the generalizability and statistical precision of the findings.Future studies should use multicentre, larger probability-based samples, prospective postoperative surveillance including follow-up after discharge, Larger samples would also allow more robust multivariable analysis with adequate numbers of outcome events to identify independent predictors of SSI.

For practice improvement, future work may examine integrated perioperative pathways incorporating smoking cessation, glycaemic assessment, anaemia screening, nutritional counselling, standardized aseptic wound dressing, early mobilization and competency-based infection-prevention training for nursing personnel.

Declarations
Ethical approval: Ethical permission was obtained from the Institutional Ethics Committee prior to data collection. Written informed consent was obtained from all participants.

Conflict of interest
The authors declare no conflict of interest.

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