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An observational study on surgical site infections in the tertiary care centre of Jharkhand.

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Abstract

Background
Surgical site infections (SSIs) are one of the most common postoperative complications and a major contributor to increased morbidity, prolonged hospital stays, and healthcare costs, particularly in resource-constrained settings. Despite the implementation of preventive measures, SSIs remain prevalent in many Indian healthcare institutions, especially in tertiary care centres with high patient loads.
Aim: To determine the incidence, risk factors, microbial profile, and clinical outcomes associated with surgical site infections in patients undergoing surgery at a tertiary care centre in Jharkhand.

Methods
This prospective observational study included 100 patients undergoing various surgical procedures in the Department of Surgery at a tertiary care hospital in Jharkhand. Patients were followed for 30 days postoperatively for signs of SSIs. Data on demographics, comorbidities, surgical characteristics, and microbiological findings were collected. Statistical analysis was performed using SPSS version 23.0, with significance set at $p < 0.05$.

Results
Out of 100 participants, 18 (18%) developed SSIs. Superficial incisional infections were the most common (11%), followed by deep incisional (5%) and organ/space infections (2%). Significant risk factors associated with SSIs included diabetes mellitus (p = 0.002), surgery duration >2 hours (p = 0.001), and preoperative hospital stay >5 days (p = 0.003). The most frequently isolated pathogen was *Staphylococcus aureus* (53.3%), followed by *E. coli* (26.7%). Patients with SSIs had a significantly longer mean hospital stay (12.4 days) compared to those without SSIs (6.2 days).

Conclusion
Surgical site infections remain a significant concern in tertiary care centres, with identifiable and largely preventable risk factors. Effective perioperative management, strict aseptic protocols, and targeted antibiotic prophylaxis can help reduce the incidence of SSIs.

Recommendations
Implementation of standardized infection control practices, preoperative optimization of comorbidities, reduction of unnecessary hospital stays, and regular microbiological surveillance are essential strategies to mitigate the burden of SSIs in similar healthcare settings.

Keywords: *Surgical site infection, risk factors, tertiary care, Staphylococcus aureus, postoperative complications*
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Introduction

Surgical site infections (SSIs) remain one of the most common and significant healthcare-associated infections globally, posing a substantial burden on both patients and healthcare systems. Despite advancements in surgical techniques, sterilization protocols, and antimicrobial prophylaxis, the incidence of SSIs continues to be a critical concern, particularly in low- and middle-income countries like India. SSIs are defined as infections occurring at or near a surgical incision within 30 days of the procedure or within one year if an implant is placed, according to the Centers for Disease Control and Prevention (CDC) [1].

Globally, SSIs account for approximately 20% of all hospital-acquired infections, with higher rates observed in resource-limited settings [2]. In India, various studies have reported SSI rates ranging from 10% to 30%, depending on surgical type, patient comorbidities, and institutional infection control practices [3]. These

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infections not only delay postoperative recovery but also lead to increased morbidity, longer hospital stays, higher treatment costs, and, in severe cases, mortality [4]. Additionally, SSIs can result in psychological distress to patients and negatively impact the surgical team's performance indicators.

Multiple risk factors have been identified in the development of SSIs, including patient-related factors such as diabetes mellitus, obesity, malnutrition, and smoking; and procedure-related factors like prolonged surgery duration, emergency surgery, poor surgical technique, inadequate sterilization, and inappropriate use of prophylactic antibiotics [5]. The microbial spectrum of SSIs often includes *Staphylococcus aureus*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Klebsiella pneumoniae*, with increasing concern about antibiotic-resistant strains [6].

In recent years, emphasis has shifted toward adopting multimodal infection prevention strategies, including surveillance programs, surgical checklists, antibiotic stewardship, and better perioperative care practices [7]. However, data on SSIs from tertiary care centres in eastern India, particularly Jharkhand, are sparse. Given the socio-economic diversity, lack of uniform infection control protocols, and limited microbiological infrastructure in the region, it is imperative to study the local epidemiology of SSIs. To determine the incidence, risk factors, microbial profile, and clinical outcomes associated with surgical site infections in patients undergoing surgery at a tertiary care centre in Jharkhand.

Methodology

Study design

This research was conducted as a hospital-based **prospective observational study**.

Study setting

The study was conducted in the Department of Surgery at a tertiary care centre located in Jharkhand. The hospital caters to a large patient population and serves as a referral centre for surgical cases across the region.

Participants

A total of **100 patients** who underwent major surgical procedures during the study period were enrolled. These patients were observed postoperatively for the development of surgical site infections.

Inclusion criteria

- Patients of either sex aged ≥18 years.
- Patients undergoing clean or clean-contaminated surgical procedures.
- Patients willing to give informed consent and participate in postoperative follow-up.

Exclusion criteria

- Patients with pre-existing infections or sepsis.
- Patients undergoing contaminated or dirty surgeries (emergency bowel perforation, gangrene, etc.).
- Immunocompromised patients (e.g., those with HIV, chemotherapy recipients).
- Patients unwilling or lost to follow-up.

Bias

To minimize **selection bias**, consecutive eligible patients were included during the study period. **Observer bias** was reduced by standardizing the diagnostic criteria for SSIs based on CDC guidelines and ensuring that data collection was performed by trained personnel using a uniform protocol.

Data collection

Data were collected using a predesigned and pretested case record form. The information gathered included demographic details, type and duration of surgery, comorbid conditions (e.g., diabetes), use of antibiotics, duration of hospital stay, and postoperative wound assessment. Postoperative wound status was monitored on the 3rd, 7th, and 30th day or until complete healing.

Procedure

Patients were followed up from the time of surgery until the 30th postoperative day. Surgical sites were examined clinically for signs of infection such as redness, swelling, warmth, discharge, and pain. Laboratory confirmation was done using culture and sensitivity tests for suspected infections. All infections were classified according to CDC definitions into superficial incisional, deep incisional, and organ/space SSIs.

Statistical analysis

All collected data were entered into Microsoft Excel and then analyzed using IBM SPSS version 23.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were presented as frequencies and percentages, and continuous variables as mean ± standard deviation. Chi-square test and Student's t-test were used for univariate analysis. A p-value of <0.05 was considered statistically significant.

Results

A total of 100 patients undergoing surgical procedures were enrolled. The mean age was **44.6 ± 13.2 years**, with a male-to-female ratio of **1.2:1**. The most common age group was 41–60 years (42%).

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Table 1: Demographic profile of the participants (n = 100)

Variable	Frequency (n)	Percentage (%)
Age Group (years)		
18–30	18	18%
31–40	22	22%
41–60	42	42%
>60	18	18%
Gender		
Male	55	55%
Female	45	45%

The majority of surgical patients were middle-aged adults, with a slightly higher male predominance.

Incidence of Surgical Site Infections (SSIs)

Out of 100 patients, 18 (18%) developed SSIs. Of these, 11 (61.1%) were superficial incisional, 5 (27.8%) deep incisional, and 2 (11.1%) organ/space infections.

Table 2: Incidence and type of SSIs

Type of SSI	Number of Cases (n)	Percentage (%)
Superficial Incisional	11	11%
Deep Incisional	5	5%
Organ/Space	2	2%
Total	**18**	**18%**

Superficial incisional infections were the most common subtype, accounting for more than half of all infections.

Risk factors associated with SSIs

Significant associations were found between SSIs and the presence of diabetes mellitus, duration of surgery >2 hours, and preoperative hospital stay >5 days.

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Table 3: Risk factors associated with SSIs

Risk Factor	SSI Present (n=18)	SSI Absent (n=82)	p-value
Diabetes Mellitus	9 (50%)	12 (14.6%)	0.002**
Smoking	7 (38.8%)	18 (21.9%)	0.09
Duration of surgery >2 hrs	13 (72.2%)	24 (29.3%)	0.001**
Preoperative stay >5 days	12 (66.7%)	22 (26.8%)	0.003**
Emergency surgery	5 (27.7%)	10 (12.2%)	0.08

Note: *p-value <0.05 is considered statistically significant*

Explanation: Diabetes, longer surgeries, and prolonged hospital stays were statistically significant predictors for developing SSIs.

Microbial profile of SSIs

Among the 18 patients with SSIs, wound swab cultures revealed bacterial growth in 15 cases. The most common organism isolated was *Staphylococcus aureus* (53.3%), followed by *E. coli* (26.7%).

Table 4: Microbial profile in SSI Cases (n = 15 positive cultures)

Microorganism	Frequency (n)	Percentage (%)
Staphylococcus aureus	8	53.3%
Escherichia coli	4	26.7%
Pseudomonas aeruginosa	2	13.3%
Klebsiella pneumoniae	1	6.7%

Gram-positive organisms, particularly *S. aureus*, were the predominant pathogens, underscoring the need for proper aseptic technique and antibiotic prophylaxis.

Length of hospital stay and outcome

Patients with SSIs had a significantly longer mean hospital stay (12.4 ± 3.8 days) compared to those without SSIs (6.2 ± 2.1 days, $p < 0.001$). Two patients required readmission for wound debridement.

Discussion

In this prospective observational study of 100 patients undergoing surgical procedures at a tertiary care centre in Jharkhand, the incidence of surgical site infections (SSIs) was found to be **18%**, which is consistent with national estimates reported in similar healthcare settings. The majority of infections were superficial incisional (11%), followed by deep incisional (5%) and organ/space infections (2%). This highlights that while superficial infections are more common, a significant number of patients may develop deeper or more severe infections if not managed early.

Demographically, the most affected age group was 41–60 years, and the male-to-female ratio was 1.2:1. However, no statistically significant gender-based difference in infection rate was observed. The study identified diabetes mellitus, longer duration of surgery (>2 hours), and prolonged preoperative hospital stay (>5 days) as significant risk factors for SSIs (p-values <0.05). This underlines the importance of optimizing preoperative care and controlling modifiable comorbidities to reduce infection risk.

Microbiological analysis revealed that Staphylococcus aureus was the most frequently isolated pathogen (53.3%) from infected wound cultures, followed by E. coli and Pseudomonas aeruginosa. This microbial distribution suggests the predominance of gram-positive organisms, although gram-negative organisms were also notable contributors, possibly due to cross-contamination or inadequate hygiene practices.

Patients who developed SSIs had a markedly longer hospital stay (average of 12.4 days) compared to those without infections (6.2 days), indicating that SSIs significantly increase morbidity, healthcare costs, and bed occupancy. Additionally, two patients required readmission for surgical wound complications, emphasizing the potential severity of untreated infections.

Surgical site infections (SSIs) continue to be a significant concern across tertiary care hospitals in India, with varying incidence rates and associated risk factors. A two-year retrospective study involving 245 patients identified an overall SSI incidence of 11.4%, with elderly patients and those with malignancies at significantly higher risk. Emergency surgeries, increased surgical duration, and contaminated wounds also showed higher infection rates, with the predominant pathogens being *Staphylococcus*, *Streptococcus*, *E. coli*, and *Klebsiella* [8]. Similarly, an observational study from Bihar reported a remarkably high SSI rate of 38.2%, particularly among patients in their 50s, and emphasized the need for more rigorous infection surveillance and antibiotic regulation due to the observed resistance among Gram-negative bacteria [9].

A cross-sectional study from GSVM Medical College found *Klebsiella*, *E. coli*, and *Staphylococcus aureus* as dominant pathogens, with older age and diabetes being key risk factors. The isolates displayed resistance to multiple antibiotics such as ampicillin and ceftriaxone but remained sensitive to imipenem and meropenem [10]. Another study from Uttar Pradesh recorded an 8.6% infection rate and found that emergency surgeries and comorbidities like diabetes significantly increased the odds of SSIs, particularly superficial infections [11].

A 2025 prospective study of 800 patients found a 15% SSI incidence, where *E. coli* was the most common isolate, and deep SSIs were most prevalent. Key contributing factors included age, emergency procedures, and comorbid conditions [12]. In Chennai, a study involving 100 patients undergoing laparotomy reported superficial infections in 60% and organ-space infections in 10%. Prolonged surgical duration, diabetes, and poor antibiotic prophylaxis were identified as significant risk factors [13]. Another large-scale study analyzed 2382 clean and clean-contaminated surgeries over a year and found a 2.05% SSI rate, with a substantial number of cases diagnosed post-discharge. *E. coli*, *Staph aureus*, and Coagulase-negative *Staphylococcus* were leading causative organisms [14]. Additionally, a 5-year study from Barabanki observed a 14.29% SSI incidence in elective laparotomies, with preoperative serum protein levels and longer hospital stays as statistically significant risk factors, again with *E. coli* being the most frequently isolated pathogen [15].

Conclusion

In conclusion, the results demonstrate that surgical site infections remain a significant postoperative complication. Effective preoperative screening, stringent intraoperative aseptic techniques, postoperative wound monitoring, and antibiotic stewardship are essential to reducing the burden of SSIs in tertiary care centres.

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