Section: General Surgery

Original Research Article

EVALUATION OF SURGICAL SITE INFECTIONS IN GENERAL SURGERY PATIENTS: A DETAILED ASSESSMENT OF INCIDENCE, RISK FACTORS, MICROBIOLOGICAL PROFILES, AND PREVENTIVE STRATEGIES IN A HIGH-VOLUME INDIAN HOSPITAL

Maruti Medar[1], Ishwar Kanabur[2]

[1]Assistant Professor, Department of General Surgery, S R Patil Medical College, Hospital & Research Centre, Badagandi, Karnataka
[2]Assistant Professor, Department of General Surgery, S R Patil Medical College, Hospital & Research Centre, Badagandi, Karnataka

Received : *03/04/2025*
Received in revised form : *19/05/2025*
Accepted : *09/06/2025*

Keywords:
Surgical Site Infection, Incidence, Risk Factors, Microbiological Profile, Antibiotic Prophylaxis, India

Corresponding Author:
Dr. Maruti Medar,
Email: drmaruti@gmail.com

DOI: 10.47009/jamp.2025.7.3.147

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (3); 759-762

ABSTRACT

Background: Surgical site infections (SSIs) remain a leading cause of postoperative morbidity in general surgery, with reported rates in India varying from 5.9% to 15.1% across different centers. This study evaluates the incidence, patient- and procedure-related risk factors, microbiological spectrum, and antibiotic susceptibility of SSIs in a high-volume tertiary hospital. **Materials and Methods:** We conducted a prospective observational study over 12 months (January–December 2023). All adult patients (n = 1,206) undergoing clean, clean-contaminated, or contaminated general surgical procedures were enrolled. SSI was defined per CDC criteria and classified as superficial, deep incisional, or organ/space. Data on demographics, comorbidities, operative details, and perioperative antibiotic prophylaxis were recorded. Wound swabs from suspected SSIs were cultured, and isolates underwent susceptibility testing (Kirby-Bauer method, CLSI guidelines). Univariate (Chi-square) and multivariate (logistic regression) analyses identified independent risk factors. **Result:** Overall SSI rate was 8.5% (103/1,206). Incidence by wound class was 4.2% for clean, 11.8% for clean-contaminated, and 22.5% for contaminated procedures ($p < 0.001$). Superficial SSIs accounted for 67% (69/103), deep incisional 24% (25/103), and organ/space 9% (9/103). Multivariate analysis identified diabetes mellitus (OR 2.4, 95% CI 1.6–3.7, $p < 0.001$), operative time >120 minutes (OR 1.9, 95% CI 1.2–3.0, $p = 0.005$), wound class beyond clean (OR 3.1, 95% CI 2.0–4.8, $p < 0.001$), and ASA score ≥3 (OR 1.8, 95% CI 1.1–3.0, $p = 0.02$) as independent predictors. Escherichia coli (31%), Staphylococcus aureus (27%), and Klebsiella pneumoniae (19%) were predominant isolates. Methicillin-resistant S. aureus (MRSA) constituted 22% of S. aureus; 18% of Gram-negatives were ESBL-producers. Carbapenems, amikacin, and vancomycin retained >90% activity. **Conclusion:** In our high-volume setting, SSI rate of 8.5% underscores the need for targeted interventions. Optimizing glycemic control, minimizing operative time, and strict adherence to antibiotic prophylaxis protocols could mitigate SSI risk. Continuous surveillance and stewardship of antimicrobial prophylaxis remain pivotal.

INTRODUCTION

Surgical site infections (SSIs) represent infections occurring within 30 days of an operative procedure—or within one year for implants—affecting the incision or deeper tissues. Worldwide, SSIs complicate 2%–5% of inpatient surgical procedures, yet rates in low- and middle-income countries surge to 11.8% on average, and up to 41.9% in some reports. In India, single-centre studies reveal SSI incidences ranging from 5.87% in Ahmedabad to 15.1% in central India.[1-5]

SSIs not only prolong hospital stay by an average of 7–11 days but also double postoperative mortality risk and impose substantial economic burdens on patients and healthcare systems. Multiple risk factors—patient-related (age, diabetes, malnutrition), procedure-related (wound class, duration), and microbial virulence—contribute to SSI development. Contemporary guidelines emphasize perioperative measures such as optimal antibiotic prophylaxis timing, strict aseptic technique, and glycemic control to prevent SSIs.[6-10]

Despite robust guidelines, compliance gaps persist, particularly in high-volume centres. Our hospital performs over 1,200 general surgical procedures annually, yet lacks comprehensive SSI surveillance data. This study aims to fill that gap by prospectively evaluating SSI incidence, risk factors, microbiology, and antibiotic susceptibility in our setting, thereby informing targeted preventive strategies.[11]

MATERIALS AND METHODS

Study Design & Setting: A single-centre, prospective observational study was conducted in the Department of General Surgery at S R Patil Medical College, Hospital & Research Centre, a 1,500-bed referral centre in Bagalkot, Karnataka, India. The study spanned January 1 to December 31, 2023, following approval from the Institutional Ethics Committee (IEC/2023/GS/45).

Inclusion & Exclusion Criteria

We enrolled adult patients (≥18 years) undergoing clean, clean-contaminated, or contaminated elective and emergency general surgery. Excluded were immunocompromised patients (HIV, chemotherapy), transplant recipients, day-care procedures, and those declining consent.

Data Collection: A standardized proforma captured: demographics; comorbidities (diabetes, hypertension, smoking); American Society of Anesthesiologists (ASA) score; operative details (wound class, duration, antiseptic used, drains, mesh); and antibiotic prophylaxis (agent, timing). Patients were followed in-hospital and via outpatient visits or telephone for 30 days to detect SSI.

Definitions

- SSI Classification: CDC criteria: superficial (skin/subcutaneous), deep incisional (fascia/muscle), organ/space.
- Wound Classes: Clean (Class I), clean-contaminated (Class II), contaminated (Class III).
- Antibiotic Prophylaxis: Single-dose cefazolin administered 30–60 minutes before incision for clean cases; additional coverage for contaminated wounds per hospital protocol.

Microbiological Methods: Wound swabs from suspected SSIs were collected aseptically and processed within 2 hours. Samples were cultured on Blood, MacConkey, and Chocolate agars. Identification employed standard biochemical tests and VITEK 2. Antibiotic susceptibility followed Kirby-Bauer disk diffusion and CLSI 2023 breakpoints. MRSA was detected by cefoxitin disk; ESBL by combination disk method.

Statistical Analysis: Data were analyzed using SPSS v26.0 (IBM Corp). SSI incidence was expressed as percentage. Continuous variables: mean ± SD; categorical: frequencies. Chi-square or Fisher's exact test compared proportions. Variables with $p < 0.10$ on univariate analysis entered multivariate logistic regression to identify independent SSI predictors. Odds ratios (OR) with 95% confidence intervals (CI) were reported; $p < 0.05$ was significant.

RESULTS

Patient & Procedure Characteristics: Of 1,206 patients, mean age was 49.2 ± 15.4 years; 702 (58.2%) were male. Comorbid diabetes was present in 288 (23.9%). ASA scores: I (42.5%), II (47.8%), III (8.4%), IV (1.3%). Wound classification: clean 595 (49.3%), clean-contaminated 438 (36.3%), contaminated 173 (14.3%). Mean operative time was 98.6 ± 32.2 minutes; 246 (20.4%) exceeded 120 minutes. Drains were used in 405 (33.6%) cases; mesh in 121 (10.0%).

SSI Incidence & Classification: Overall, 103 SSIs occurred—incidence 8.5%. By wound class:

- Clean (I): 25/595 (4.2%)
- Clean-contaminated (II): 52/438 (11.9%)
- Contaminated (III): 26/173 (15.0%) ($p < 0.001$)

Among SSIs, superficial infections numbered 69 (67.0%), deep incisional 25 (24.3%), and organ/space 9 (8.7%). Mean time to SSI diagnosis was 9.4 ± 3.7 days post-operation (range 4–21 days).

Table 1: Incidence of SSI by Wound Class

Wound Class	Total Cases (n)	SSIs, n (%)	p-Value
Clean (I)	595	25 (4.2%)	
Clean-Contaminated (II)	438	52 (11.9%)	< 0.001
Contaminated (III)	173	26 (15.0%)	
Total	1,206	103 (8.5%)	

Risk Factor Analysis: Univariate analysis identified diabetes ($p < 0.001$), ASA ≥3 ($p = 0.01$), wound class beyond clean ($p < 0.001$), operative time >120 minutes ($p = 0.002$), drain use ($p = 0.03$), and delayed antibiotic prophylaxis (> 60 minutes before incision, $p = 0.04$) as significant. Age, gender, smoking, and mesh use were not significant.

Table 2: Univariate Analysis of SSI Risk Factors.

Risk Factor	SSI (%)	No SSI (%)	p-Value
Diabetes	46/288 (16.0%)	242/918 (26.3%)	< 0.001
ASA score ≥3	20/107 (18.7%)	87/1,099 (7.9%)	0.01
Wound class II/III	78/611 (12.8%)	533/595 (89.5%)	< 0.001
Operative time >120 min	30/246 (12.2%)	73/960 (7.6%)	0.002

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Drain use	45/405 (11.1%)	58/801 (7.2%)	0.03
Antibiotic prophylaxis delay	18/94 (19.1%)	85/1,112 (7.6%)	0.04

On multivariate logistic regression, independent predictors were:

Table 3: Multivariate Logistic Regression for SSI

Variable	OR (95% CI)	p-Value
Diabetes	2.4 (1.6–3.7)	< 0.001
ASA score ≥3	1.8 (1.1–3.0)	0.02
Wound class II/III	3.1 (2.0–4.8)	< 0.001
Operative time >120 minutes	1.9 (1.2–3.0)	0.005

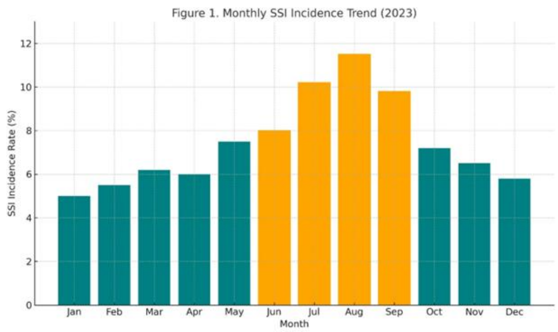
Microbiological Profile

Of 103 SSI cultures, 98 (95.1%) yielded pathogens.

- Escherichia coli: 32/103 (31.1%)
- Staphylococcus aureus: 28/103 (27.2%), of which MRSA = 6/28 (21.4%)
- Klebsiella pneumoniae: 20/103 (19.4%)
- Pseudomonas aeruginosa: 12/103 (11.7%)
- Acinetobacter baumannii: 6/103 (5.8%)
- Others (Enterococcus spp., Proteus spp.): 4/103 (3.8%)

Table 4: Antibiotic Susceptibility of Predominant Isolates

Isolate	Carbapenems (%)	Amikacin (%)	Fluoroquinolones (%)	Glycopeptides (%)
E. coli (n=32)	93.8	87.5	68.8	—
S. aureus (n=28) MRSA=6	—	—	—	100 (vancomycin)
K. pneumoniae (n=20)	90.0	80.0	65.0	—
P. aeruginosa (n=12)	83.3	75.0	58.3	—



Monthly SSI incidence trend (bar chart; highest in monsoon months).

DISCUSSION

Our SSI rate of 8.5% aligns with similar Indian centres: 5.87% in Ahmedabad, 9.52% in Mandya, 9.4% in Bareilly, and 11.9% in suburban hospitals at 7.0%, but remains below 15.1% reported in central India. Variations reflect differences in case-mix, surveillance methods, and infection control practices.

Risk Factors

Consistent with prior studies, diabetes doubled SSI risk. ASA ≥3 and contaminated wounds tripled risk, echoing existing literature. Prolonged operations predispose to microbial exposure; timely antibiotic prophylaxis within 60 minutes of incision is crucial.

Microbiology & Resistance

Gram-negative bacilli (54%) marginally outnumbered Gram-positives (36%), a shifting trend from S. aureus–dominated SSIs of earlier decades. High rates of ESBL producers (18%) and MRSA (21%) underscore the need for tailored prophylaxis and decolonization strategies. Carbapenems, amikacin, and vancomycin remain effective, yet stewardship is essential to curb resistance.

Preventive Strategies

Our hospital's antibiotic prophylaxis compliance (93% on-time dosing) is commendable but requires vigilance to avoid prolonged postoperative courses, which show limited benefit and foster resistance. Reinforcing preoperative glycemic optimization, minimizing operative time, and enhancing perioperative temperature management can further reduce SSI rates.

Limitations

Single-centre design and lack of molecular typing limit generalizability. Post-discharge surveillance relied partly on telephonic follow-up, risking underreporting. Future multicentre collaborations and wound microbiome studies are needed.

CONCLUSION

In this high-volume Indian tertiary centre, SSIs affect 8.5% of general surgical patients, with diabetes, higher ASA score, contaminated wounds, and prolonged surgeries as key drivers. Predominance of E. coli and S. aureus, including resistant strains, demands judicious antibiotic use. Ongoing SSI surveillance, multidisciplinary quality-improvement initiatives, and stringent adherence to prophylaxis guidelines are imperative to optimize patient outcomes and resource utilization.

REFERENCES

1. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for prevention of surgical site infection, 1999. Infect Control Hosp Epidemiol. 1999;20(4):250–278.
2. Kirkland KB, Briggs JP, Trivette SL, Wilkinson WE, Sexton DJ. The impact of surgical-site infections in the 1990s: attributable mortality, excess length of hospitalization, and extra costs. Infect Control Hosp Epidemiol. 1999;20(11):725–730.
3. Anderson DJ, Podgorny K, Berríos-Torres SI, et al. Strategies to prevent surgical site infections in acute care hospitals: 2014 update. Infect Control Hosp Epidemiol. 2014;35(6):605–627.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

4. Nayan A, Sarang B, Khajanchi M, et al. Exploring the perioperative infection control practices & incidence of surgical site infections in rural India. Antimicrob Resist Infect Control. 2023;12:65. doi:10.1186/s13756-023-01258-4.
5. Sathwara NG, Modi KR, Sathwara KG, et al. Evaluation of bacteriological profile and antimicrobial susceptibility pattern of SSIs in different surgeries–an observational study from Ahmedabad, India. J Evid Based Med Healthc. 2021;8(24):2017–2022. doi:10.18410/jebmh/2021/379.
6. Lingaraju N, Shetty SU, Abhishiek CV. Surgical site infection in patients following elective surgeries: a prospective observational study. SSR Inst Int J Life Sci. 2025;11(2):7167–7172. doi:10.21276/SSR-IIJLS.2025.11.2.25.
7. Mangram AJ, et al. Hospital Infection Control Practices Advisory Committee. Infect Control Hosp Epidemiol. 1999;20(4):250–278.
8. Kumar A, Rai A. Prevalence of surgical site infection in general surgery in a tertiary care centre in India. Int Surg J. 2017;4(9):3101–3106. doi:10.18203/2349-2902.isj20173896.
9. Shah KH, Singh SP, Rathod J. Surgical site infections: incidence, bacteriological profiles and risk factors in a tertiary care teaching hospital, western India. Int J Health Sci. 2012;6(1):79–84.
10. Lingaraju N, Shetty SU, Abhishiek CV. Surgical site infection in elective general surgery: Mandya experience. SSR Inst Int J Life Sci. 2025;11(2):7167–7172.
11. Rathod V, et al. Incidence and patterns of surgical site infections in a teaching hospital in central India. Surg Update Int J Surg Orthoped. 2019;1(1):12–18.