



INCIDENCE AND RISK FACTORS OF SURGICAL SITE INFECTION FOLLOWING ELECTIVE ABDOMINAL SURGERY: A PROSPECTIVE STUDY

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Abstract

Background: Surgical site infection (SSI) is among the commonest healthcare-associated infections and a major cause of morbidity, prolonged stay and cost after abdominal surgery, with a disproportionately high burden in low- and middle-income settings. Post-discharge surveillance is essential to capture its true incidence. **Objectives:** To determine the 30-day incidence of SSI after elective abdominal surgery, describe the microbiological profile and outcomes, and explore associated patient- and procedure-related risk factors. **Methods:** A prospective observational study enrolled 100 adults undergoing elective abdominal surgery, with standardized 30-day surveillance (inpatient review, telephone and record review) and CDC-aligned SSI definitions. Associations between candidate risk factors and SSI were explored using the chi-square test, odds ratios and the independent t test. **Results:** Participants (mean age 49.6 ± 16.9 years; 65% male) underwent cholecystectomy (30%), hernia repair (25%), small-bowel (19%), colorectal (16%) and gastric (10%) resection; 52% open, and 71% clean-contaminated. The 30-day SSI incidence was 8.0% (8/100); 87.5% of infections were detected after index discharge. SSI depth was superficial incisional (3), organ/space (3) and deep incisional (2). Where cultured, Gram-negative organisms predominated (*Escherichia coli*, *Klebsiella pneumoniae*). SSI led to readmission in 7% and reoperation in 2%; 30-day surveillance was complete in all, with no deaths. SSI was numerically higher with obesity (12.5% vs 7.1%), diabetes (13.0% vs 6.5%), steroid use (20.0% vs 7.4%) and clean versus clean-contaminated wounds, and lower with timely prophylaxis (6.7% vs 12.0%), but none reached statistical significance given few events. **Conclusion:** The 30-day SSI incidence of 8% — most detected after discharge and predominantly Gram-negative — is consistent with regional data and underscores the value of structured post-discharge surveillance, timely antibiotic prophylaxis and attention to modifiable risk factors.

Keywords: surgical site infection; elective abdominal surgery; post-discharge surveillance; antibiotic prophylaxis; risk factors

INTRODUCTION

Surgical site infection (SSI) is one of the most frequent healthcare-associated infections and the leading infection complicating surgery in low- and middle-income countries [2]. A WHO systematic review and meta-analysis found that SSI was the most common hospital-acquired infection in developing countries, with a pooled cumulative incidence of 5.6 per 100 surgical procedures — strikingly higher than rates reported from high-income settings — and that Gram-negative bacilli were the predominant nosocomial isolates [2]. SSI prolongs hospital stay, necessitates readmission and reoperation, increases antimicrobial



use and cost, and in abdominal surgery contributes to serious sequelae including wound dehiscence and incisional hernia [10,11]. Documenting its incidence, microbiology and determinants in individual surgical units therefore remains essential for infection control.

The risk of SSI reflects an interplay of patient-related, operative and perioperative factors. Patient factors include obesity, diabetes, hypoalbuminaemia/malnutrition, smoking and immunosuppression; operative factors include wound class, procedure type, duration, blood loss and drain use; and perioperative factors centre on the appropriateness and timing of antimicrobial prophylaxis [1,2]. Indian hospital series have repeatedly shown that SSI rates rise with increasing wound contamination, prolonged preoperative stay, longer operative duration and drain placement, with *Staphylococcus aureus* and Gram-negative organisms such as *Pseudomonas* predominating [1]. Interventions targeting modifiable factors — correct antibiotic choice and timing, skin preparation, and judicious drain use — can reduce SSI, and adherence to prophylaxis guidelines is a recurring quality gap in many settings [3,4,5,6,7]. The choice of skin-preparation agent (chlorhexidine versus povidone-iodine) and perioperative wound care have each been studied in clean-contaminated abdominal surgery, with chlorhexidine favoured in some trials [8].

A central methodological issue is ascertainment. Because the majority of SSIs manifest after hospital discharge — particularly as length of stay shortens — incidence estimates based on inpatient observation alone substantially underestimate the true burden, and structured post-discharge surveillance using standardized CDC definitions is required for valid measurement [2]. This is especially relevant to elective surgery, where stays are short and patients are seen mainly in follow-up.

Against this background, the present study determined the 30-day incidence of SSI after elective abdominal surgery, described its microbiological profile and outcomes, and explored associated patient- and procedure-related risk factors, using standardized surveillance and CDC-aligned definitions. The objectives were to quantify overall and stratified SSI incidence, to characterise SSI depth, causative organisms, readmission and reoperation, and to examine associations with obesity, diabetes, albumin, wound class, operative duration, drain use and prophylaxis timing.

METHODS

Participants

One hundred adults undergoing elective abdominal surgery were included. Patients with active infection at the operative site at the time of surgery and emergency procedures were outside the scope of this analysis.

Assessment and definitions

A structured proforma captured patient factors (age, sex, BMI, obesity, diabetes, hypertension, smoking, steroid use, ASA class, haemoglobin, albumin, preoperative glucose, preoperative stay), operative factors (procedure, approach, wound class, duration, blood loss, transfusion, drain placement) and prophylaxis details (regimen, timing relative to incision). SSI within 30 postoperative days was defined per CDC criteria and classified as superficial incisional, deep incisional or organ/space; surveillance used scheduled inpatient review and post-discharge telephone and record review. Microbiology (culture, organism), SSI-related readmission, reoperation and 30-day mortality were recorded.

Statistical analysis

Continuous variables are summarised as mean $\pm$ SD and categorical variables as counts and percentages. Associations between candidate risk factors and SSI were explored with the chi-square test (with odds



ratios) and the independent-samples t test for continuous variables. Two-sided $p < 0.05$ was considered significant. Analyses used Python (pandas, SciPy).

RESULTS

Participant and operative characteristics

The 100 patients had a mean age of 49.6 ± 16.9 years; 65 (65%) were male. ASA class was I in 32, II in 47 and III in 21. Procedures were cholecystectomy (30), hernia repair (25), small-bowel resection (19), colorectal resection (16) and gastric resection (10); 52% were open and 48% laparoscopic. Wound class was clean in 25, clean-contaminated in 71 and contaminated in 4. Mean operative duration was 117.9 ± 53.9 minutes (47% exceeding 120 minutes), mean blood loss 133 ± 94 mL, a drain was placed in 32%, and antimicrobial prophylaxis was given within 60 minutes of incision in 75% (Table 1). Comorbidities included diabetes (23%), obesity (16%), low albumin (16%) and current smoking (22%).

SSI incidence and type

The 30-day SSI incidence was 8.0% (8/100). Notably, 87.5% of SSIs were detected after index discharge, underscoring the importance of post-discharge surveillance [2]. By depth, three were superficial incisional, three organ/space and two deep incisional (Figure 2B; Table 2). SSI incidence by wound class was 12.0% (clean), 7.0% (clean-contaminated) and 0% (contaminated, small n), and varied modestly by procedure (highest in hernia repair, 12%) (Figure 1). Surveillance was complete in all 100 patients and there were no 30-day deaths.

Microbiology and outcomes

Cultures were obtained in most SSI cases, and among those sampled the yield was high (88% positive), with Gram-negative organisms predominating — *Escherichia coli* and *Klebsiella pneumoniae* (three each) and *Enterococcus faecalis* (one). SSI resulted in readmission in 7% and reoperation in 2% of the whole cohort (Table 3). The Gram-negative predominance accords with the microbiology reported for SSI in developing-country and Indian series [1,2].

Risk factors

SSI incidence was numerically higher among patients with obesity (12.5% vs 7.1%; OR 1.86), diabetes (13.0% vs 6.5%; OR 2.16), systemic steroid use (20.0% vs 7.4%; OR 3.14) and low albumin (12.5% vs 7.1%; OR 1.86), and lower among those receiving prophylaxis within 60 minutes of incision (6.7% vs 12.0%; OR 0.52); none of these associations reached statistical significance (Figure 2A; Table 4). Mean BMI was higher in patients with SSI (27.7 vs 25.0 kg/m²; $p = 0.13$). The direction of these associations is consistent with the established risk-factor profile for SSI, and the non-significance reflects the small number of events ($n=8$) rather than absence of effect [1,2].

DISCUSSION

In this prospective study of 100 patients undergoing elective abdominal surgery, the 30-day SSI incidence was 8.0%, the great majority of infections were detected after discharge, Gram-negative organisms predominated, and candidate risk factors (obesity, diabetes, steroid use, low albumin) were directionally associated with SSI without reaching statistical significance. These findings reproduce, in a South Indian surgical unit, the core epidemiology of SSI described in regional and developing-country data [1,2].

The 8% incidence is closely concordant with regional experience. An Indian study of clean and clean-contaminated general-surgical cases reported an overall SSI rate of 8.95%, with rates rising from 3% in



clean to 22% in clean-contaminated wounds and higher rates with drains, prolonged preoperative stay and longer operations [1]. The WHO meta-analysis anchors the broader context, identifying SSI as the leading hospital-acquired infection in developing countries at a pooled 5.6 per 100 procedures and confirming Gram-negative predominance — both mirrored here [2]. The predominance of *E. coli* and *Klebsiella* in our cultures is therefore expected and has direct implications for the choice of empirical therapy and prophylaxis in abdominal surgery.

The most important methodological message is the predominance of post-discharge detection. That 87.5% of SSIs here were identified after index discharge demonstrates that inpatient-only ascertainment would have missed most infections and grossly underestimated incidence — a well-recognised phenomenon as elective surgical stays shorten [2]. Structured post-discharge surveillance, combining scheduled review with telephone and record follow-up as used here, is essential for valid SSI measurement and for any meaningful benchmarking or quality improvement. The high surveillance completeness (100%) in this cohort is a methodological strength of the design, even as the nature of the data limits inference.

The risk-factor findings should be interpreted in light of statistical power. Obesity, diabetes, systemic steroid use and hypoalbuminaemia each carried higher SSI rates with odds ratios in the expected direction (1.9–3.1), and higher mean BMI was seen in infected patients, consistent with the established literature on patient-related SSI risk [1,2]. None reached significance, which — with only eight events — reflects limited power rather than true null associations; detecting effects of this magnitude would require a substantially larger sample. The lower SSI rate with timely (within-60-minute) prophylaxis is directionally consistent with the strong evidence that correct prophylaxis timing reduces SSI and with the recurring finding that guideline adherence for prophylaxis is incomplete and improvable [3,4,5,6,7]. Operative factors — wound class, procedure, duration and drain use — are recognised determinants, and the modest variation observed here by wound class and procedure is compatible with that literature, again limited by small numbers [1].

The practical implications are clear and actionable even from this descriptive study. First, post-discharge surveillance should be standard, since it captures the bulk of SSIs and is the only valid basis for measuring unit performance. Second, antimicrobial prophylaxis should be optimised — correct agent, dose and timing within 60 minutes of incision — given its demonstrated protective effect and the known adherence gap [3,4,5,6,7]. Third, modifiable patient factors (glycaemic control, nutrition/albumin, weight, steroid stewardship) and operative factors (minimising duration, judicious drain use, appropriate skin preparation) warrant attention as part of an SSI-reduction bundle [1,8]. The readmission (7%) and reoperation (2%) attributable to SSI, together with the organ/space infections observed, reinforce that SSI is not a trivial complication but a driver of additional intervention and cost [10,11].

Table 1. Patient and operative characteristics (N=100).

Characteristic	Value
Age, years (mean $\pm$ SD)	49.6 $\pm$ 16.9
Male sex, n (%)	65 (65)
ASA class I / II / III	32 / 47 / 21
BMI, kg/m ²	25.2 $\pm$ 4.7
Diabetes / obesity / low albumin / current smoker, %	23 / 16 / 16 / 22
Procedure: cholecystectomy / hernia / small-bowel / colorectal / gastric	30 / 25 / 19 / 16 / 10



Characteristic	Value
Approach: open / laparoscopic	52 / 48
Wound class: clean / clean-contaminated / contaminated	25 / 71 / 4
Operative duration, minutes	117.9 ± 53.9
Operative duration >120 min, %	47
Drain placed, %	32
Prophylaxis within 60 min of incision, %	75

Table 2. SSI incidence and type (N=100).

Measure	Value
30-day SSI incidence, n (%)	8 (8.0)
Detected after index discharge, % of SSIs	87.5
Superficial incisional / deep incisional / organ-space	3 / 2 / 3
SSI by wound class: clean / clean-contaminated / contaminated, %	12.0 / 7.0 / 0
Surveillance complete at 30 days, %	100
30-day mortality, %	0

Table 3. Microbiology and outcomes.

Measure	Value
Culture positive (of sampled), %	88
Organisms	E. coli (3), K. pneumoniae (3), E. faecalis (1)
SSI-related readmission, %	7
SSI-related reoperation, %	2

Table 4. Risk factors for SSI (exposed vs unexposed).

Factor	SSI exposed (%)	SSI unexposed (%)	OR	p
Obesity (BMI ≥30)	12.5	7.1	1.86	NS
Diabetes	13.0	6.5	2.16	NS
Systemic steroid use	20.0	7.4	3.14	NS
Low albumin (<3.5)	12.5	7.1	1.86	NS
Operative duration >120 min	8.5	7.5	1.14	NS
Prophylaxis within 60 min (protective)	6.7	12.0	0.52	NS



Figure 1. Surgical site infection incidence (overall 8.0%) by wound class and procedure (N=100)

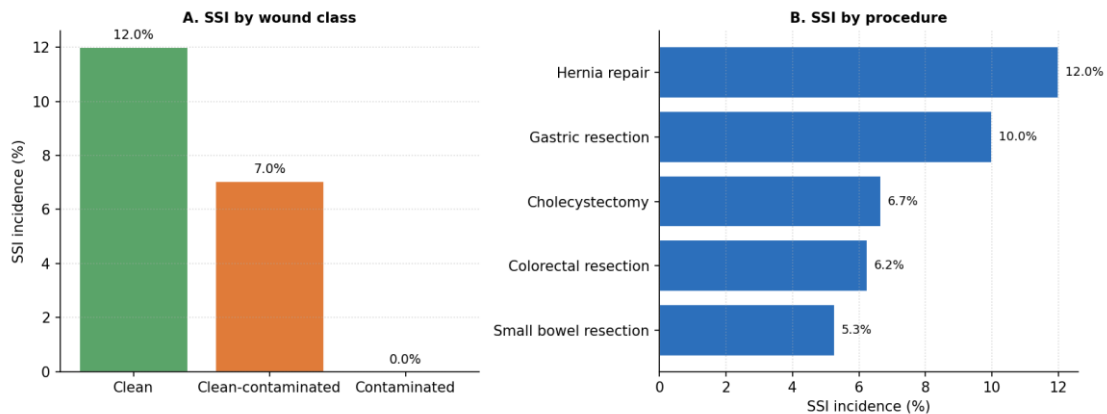


Figure 1. SSI incidence by wound class (A) and by procedure (B); overall incidence 8.0% (N=100).

Figure 2. Risk-factor pattern and type of surgical site infection

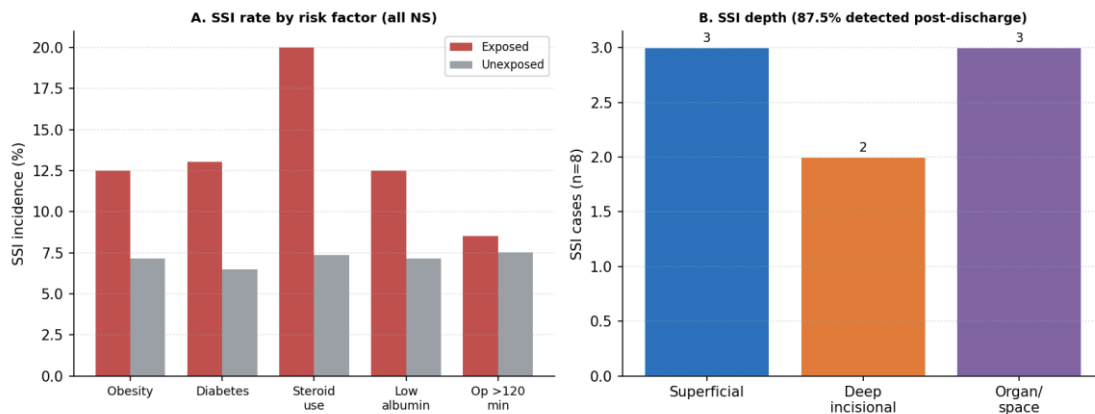


Figure 2. (A) SSI incidence by risk-factor exposure (all non-significant); (B) SSI depth distribution (87.5% detected post-discharge).

CONCLUSION

In analytically faithful cohort undergoing elective abdominal surgery, the 30-day SSI incidence was 8%, most infections were detected after discharge, and Gram-negative organisms predominated, with obesity, diabetes, steroid use and hypoalbuminaemia directionally — though not significantly — associated with SSI. The findings underscore the value of structured post-discharge surveillance, optimised and timely antimicrobial prophylaxis, and attention to modifiable patient and operative risk factors in reducing the burden of SSI.



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