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Surgical Site Infections Following Elective and Emergency Abdominal Surgeries in a Teaching Hospital: A Prospective Observational Cohort Study.

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Abstract
Background:
Surgical site infection remains one of the most frequent healthcare-associated complications after abdominal operations and contributes to delayed recovery, additional procedures, prolonged hospitalization, and increased treatment costs. To determine the incidence, clinical pattern, microbiological profile, and risk factors of surgical site infection following elective and emergency abdominal surgeries in a teaching hospital.

Methods:
This hospital-based prospective observational cohort study enrolled 100 consecutive patients undergoing open abdominal surgery and followed them during the postoperative surveillance period. Demographic characteristics, comorbidities, operative variables, wound class, microbiological findings, and postoperative outcomes were recorded. Surgical site infection was identified clinically and microbiologically using standard surveillance criteria. Data were summarized descriptively, and associations between categorical variables and SSI were assessed using the chi-square test, with $p < 0.05$ considered significant.

Results:
Among 100 patients, the overall incidence of surgical site infection was 18.0%. Infection occurred more often after emergency than elective surgery [26.0% versus 10.0%] and increased across wound classes from clean-contaminated to dirty wounds. Perforation peritonitis had the highest procedure-specific infection rate. Diabetes mellitus, anemia, hypoalbuminemia, prolonged operative duration, contaminated or dirty wounds, and drain placement were significantly associated with infection. Most infections were superficial incisional, and Escherichia coli was the most common isolate. Patients with infection had substantially longer postoperative hospital stay and a greater need for secondary suturing and re-intervention.

Conclusion:
Surgical site infection imposed considerable postoperative morbidity in abdominal surgery, particularly in emergency and contaminated procedures. Recognition of modifiable perioperative and patient-related risk factors is essential for targeted prevention and improved surgical outcomes.

Recommendations:
Routine surveillance, strict perioperative infection-control practices, optimization of anemia and nutritional status, appropriate antimicrobial prophylaxis, and focused monitoring of high-risk abdominal procedures should be strengthened in comparable teaching hospitals.

Keywords: *Surgical site infection; abdominal surgery; elective surgery; emergency surgery; risk factors; postoperative wound infection; teaching hospital.*
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Introduction

Surgical site infection [SSI] continues to represent a major postoperative complication across surgical specialties and remains an important indicator of quality of perioperative care. Contemporary prevention frameworks from the Centers for Disease Control and Prevention and the World Health Organization emphasize that many SSIs are potentially preventable through coordinated preoperative, intraoperative, and postoperative measures [1-3]. A recent clinical review further highlighted that appropriate antimicrobial prophylaxis, glycemic control, skin preparation, maintenance of normothermia, and careful wound surveillance remain central to prevention strategies in modern surgical practice [4]. Despite these advances, SSI still contributes substantially to patient discomfort, delayed recovery, readmissions, repeated interventions, and increased hospital expenditure.

Abdominal surgery carries a particularly high burden of SSI because many procedures involve entry into the gastrointestinal tract, contamination by endogenous flora, emergency presentations, tissue edema, bowel perforation, and physiologic derangement. Earlier and more recent studies have shown that the risk is strongly influenced by wound contamination, operative duration, nutritional status, diabetes, anemia, smoking, drain usage, and the emergency nature of the procedure [5-10]. Indian and other low- and middle-income settings continue to report clinically meaningful SSI rates after abdominal operations, underscoring the need for sustained surveillance and context-specific prevention efforts.

The epidemiologic pattern of SSI after abdominal operations is also important from the standpoint of surgical planning and resource allocation. Superficial infections may delay discharge and increase dressing requirements, while deep or organ/space infections can lead to sepsis, re-exploration, intensive care requirements, and mortality. Microbiological patterns likewise vary according to wound class and procedure type; organisms such as Escherichia coli, Klebsiella species, and Staphylococcus aureus are commonly reported, especially in contaminated and dirty abdominal procedures [5,8]. Identifying local microbial trends and risk factors, therefore, supports both empiric therapeutic decisions and targeted preventive bundles.

Against this background, prospective institutional data are valuable for understanding the magnitude and determinants of SSI in real-world surgical practice. The present study was undertaken to evaluate SSI following elective and emergency abdominal surgeries. The objectives of the study were to determine the incidence of SSI, describe its clinical and microbiological profile, compare infection rates across operative categories and wound classes, identify associated risk factors, and assess short-term postoperative outcomes among affected patients.

Methodology

Study design.

This was a hospital-based prospective observational cohort study conducted over a one-year period from January 2025 to December 2025. The design was selected to document the occurrence of surgical site infection after abdominal surgery under routine institutional practice and to evaluate associated perioperative factors and short-term postoperative outcomes.

Study setting.

The study was conducted in the Department of General Surgery, Government Medical College and General Hospital, Bhadradri Kothagudem, Telangana, India. The institution is a teaching hospital providing elective and emergency general surgical services to patients from Bhadradri Kothagudem and adjoining areas. Patient recruitment and follow-up were carried out through the surgical outpatient admission area, emergency surgical unit, operation theatres, postoperative surgical wards, and intensive care area when required. Microbiological evaluation of suspected SSI samples was performed through the institutional microbiology laboratory according to routine hospital protocol.

Study population.

The source population comprised patients undergoing elective or emergency open abdominal surgery in the Department of General Surgery during the study period. A total of 100 patients were included in the analyzed cohort, with 50 elective and 50 emergency abdominal procedures.

Eligibility criteria.

Inclusion criteria were patients aged 18 years and above, of either sex, who underwent elective or emergency open abdominal surgery and provided informed consent for participation and postoperative wound assessment. Exclusion criteria were non-abdominal procedures, incomplete perioperative records, refusal to participate, loss to postoperative wound assessment before SSI surveillance, and cases in which adequate clinical or microbiological documentation was unavailable.

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Participant selection.

Consecutive eligible patients were screened and enrolled during the study period until the required sample size was achieved. This approach was used to reduce investigator-driven selection and to reflect routine elective and emergency abdominal surgical practice in the hospital.

Study size:

The sample size was calculated using the formula:

$n = Z^2p(1 - p) / d^2$

where **n** represents the required sample size, **Z** is the standard normal deviate at a 95% confidence level, taken as 1.96, **p** is the anticipated proportion of surgical site infection based on previous abdominal surgery studies, and **d** is the allowable absolute precision.

Assuming an expected surgical site infection proportion of 15% from previously published abdominal surgery studies [11–14], a 95% confidence level, and 7% absolute precision, the minimum required sample size was approximately 100 patients. Therefore, 100 patients were enrolled and included in the final analysis.

Bias.

Potential selection bias was minimized by consecutive recruitment of eligible patients. Information bias was reduced by using a structured case record form, standard SSI surveillance definitions, and documentation of operative variables from hospital records and operative notes. Misclassification bias was minimized by combining clinical wound assessment with microbiological evaluation whenever infection was suspected. Loss-to-follow-up bias was limited by including only patients who completed postoperative wound assessment.

Data collection.

A structured case record form was used to collect demographic data, clinical history, comorbid illnesses, smoking or tobacco exposure, nutritional and hematological status, type of surgery, urgency of procedure, wound class, operative duration, drain usage, and postoperative course. Preoperative variables included diabetes mellitus, hypertension, anemia, obesity, and hypoalbuminemia as recorded in the hospital records and perioperative evaluation sheets. Operative details were documented immediately after surgery by the treating surgical team.

Outcome assessment.

The primary outcome was the development of surgical site infection during postoperative follow-up. Wounds were examined clinically during hospital stay and at standard postoperative review until completion of surveillance. SSI was categorized as superficial incisional, deep incisional, or organ/space infection using standard surveillance principles consistent with accepted guideline-based definitions [1-4]. Clinical features such as erythema, tenderness, wound discharge, fever, gaping, and need for secondary procedures were recorded. Secondary outcomes included duration of postoperative hospital stay, requirement for secondary suturing, re-intervention or re-exploration, intensive care admission, and mortality.

Microbiological evaluation.

Whenever SSI was suspected clinically, wound swabs or appropriate samples were sent for microbiological culture and sensitivity testing according to the institutional laboratory protocol. Organisms isolated were documented and correlated with the clinical pattern of infection. Culture positivity and the distribution of common isolates were included in the final analysis.

Statistical analysis.

Data were entered in Microsoft Excel and analyzed using standard statistical software. Continuous variables were summarized as mean ± standard deviation, while categorical variables were expressed as frequency and percentage. The chi-square test was used as the single inferential test to assess associations between selected categorical variables and surgical site infection. A two-sided p-value of less than 0.05 was considered statistically significant.

Ethical considerations.

Institutional scientific and ethical approval was obtained from the Institutional Ethics Committee, Government Medical College and General Hospital, Bhadradri Kothagudem, Telangana, India, before commencement of the study. Written informed consent was obtained from each participant before enrolment. Participation was voluntary and did not alter the standard surgical treatment received by the patient. Confidentiality and anonymity were ensured by assigning study codes, removing personal identifiers from the analysis file, storing data securely, and reporting results only in aggregate form.

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Results

Participant flow.

During the study period, 100 consecutive patients undergoing abdominal surgery were screened for eligibility. All 100 patients fulfilled the eligibility criteria, provided consent, completed postoperative wound assessment, and were included in the final analysis. No patient was excluded after screening, and no patient was lost before SSI outcome assessment.

Elective and emergency procedures contributed equally, with 50 cases each. The mean age of the study population was 44.8 ± 15.2 years, and the largest proportion of patients belonged to the 41-50 years age group [26.0%]. Men constituted 58.0% of the cohort. Diabetes mellitus, hypertension, anemia, obesity, and hypoalbuminemia were noted in 24.0%, 19.0%, 28.0%, 16.0%, and 22.0% of patients, respectively. The baseline demographic and clinical characteristics of the study population are shown in Table 1.

Table 1. Baseline demographic and clinical characteristics of the study population [n = 100]

Variable	Category	n	%
Age group [years]	18-30	18	18.0
	31-40	24	24.0
	41-50	26	26.0
	51-60	18	18.0
	>60	14	14.0
Sex	Male	58	58.0
	Female	42	42.0
Type of surgery	Elective	50	50.0
	Emergency	50	50.0
Diabetes mellitus	Present	24	24.0
Hypertension	Present	19	19.0
Anemia	Present	28	28.0
Obesity	Present	16	16.0
Hypoalbuminemia	Present	22	22.0
Smoking/tobacco use	Present	27	27.0
Duration of surgery	≤2 hours	56	56.0
	>2 hours	44	44.0
Wound class	Clean-contaminated	52	52.0
	Contaminated	30	30.0
	Dirty	18	18.0

The overall incidence of surgical site infection [SSI] was 18.0% [18/100]. SSI was more frequent after emergency surgeries than after elective surgeries [26.0% versus 10.0%]. A progressive increase in infection rate was observed from clean-contaminated wounds to dirty wounds, and perforation peritonitis showed the highest procedure-specific SSI rate. The distribution of SSI according to operative category and procedure type is summarized in Table 2.

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Table 2. Distribution of surgical site infection by operative category and procedure

Variable	Total cases	SSI cases	SSI rate [%]
Overall	100	18	18.0
Elective surgery	50	5	10.0
Emergency surgery	50	13	26.0
Clean-contaminated wounds	52	5	9.6
Contaminated wounds	30	6	20.0
Dirty wounds	18	7	38.9
Appendectomy	18	2	11.1
Cholecystectomy	16	1	6.3
Hernia repair	14	0	0.0
Surgery for perforated peritonitis	20	7	35.0
Surgery for intestinal obstruction	12	3	25.0
Colorectal surgery	10	3	30.0
Exploratory laparotomy for abdominal trauma	10	2	20.0

When patients with SSI were compared with those without SSI, several factors were more frequently observed in the infected group. Diabetes mellitus, anemia, hypoalbuminemia, emergency surgery, operative duration greater than two hours, contaminated or dirty wounds, and surgical drain use showed statistically significant associations with SSI, whereas obesity showed an increasing trend without statistical significance. The comparative distribution of these factors is presented in Table 3.

Table 3. Comparison of risk factors between patients with and without surgical site infection

Variable	SSI present [n = 18]	SSI absent [n = 82]	p value
Diabetes mellitus	9 [50.0%]	15 [18.3%]	0.006
Anemia	10 [55.6%]	18 [22.0%]	0.005
Hypoalbuminemia	8 [44.4%]	14 [17.1%]	0.010
Obesity	5 [27.8%]	11 [13.4%]	0.140
Emergency surgery	13 [72.2%]	37 [45.1%]	0.030
Duration >2 hours	12 [66.7%]	32 [39.0%]	0.031
Contaminated/dirty wound	13 [72.2%]	35 [42.7%]	0.022
Surgical drain used	11 [61.1%]	24 [29.3%]	0.012

Of the 18 SSI cases, 11 [61.1%] were superficial incisional infections, 5 [27.8%] were deep incisional infections, and 2 [11.1%] were organ/space infections. Culture positivity was obtained in 16 patients [88.9%], and Escherichia coli was the most frequently isolated organism, followed by Staphylococcus aureus and Klebsiella spp. Patients who developed SSI had a longer postoperative hospital stay than those without infection [12.8 ± 4.6 days versus 7.1 ± 2.8 days]. Secondary suturing, re-intervention, ICU admission, and mortality were observed more often among infected patients. These infection patterns, microbiological findings, and postoperative outcomes are shown in Table 4.

Table 4. Pattern of surgical site infection, microbiological profile, and outcomes

Parameter	Category	n / value	%
Type of SSI [n = 18]	Superficial incisional	11	61.1
	Deep incisional	5	27.8
	Organ/space	2	11.1
Culture result [n = 18]	Growth obtained	16	88.9
	No growth	2	11.1
Isolated organism [n = 16]	Escherichia coli	5	31.3
	Staphylococcus aureus	4	25.0
	Klebsiella spp.	3	18.8

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Parameter	Category	n / value	%
	Pseudomonas aeruginosa	2	12.5
	Enterococcus spp.	1	6.3
	Polymicrobial growth	1	6.3
Mean postoperative hospital stay	SSI present	12.8 ± 4.6 days	
	SSI absent	7.1 ± 2.8 days	
Secondary suturing required	SSI present	5	27.8
	SSI absent	0	0.0
Re-intervention/re-exploration	SSI present	2	11.1
	SSI absent	0	0.0
ICU admission	SSI present	3	16.7
	SSI absent	4	4.9
Mortality	SSI present	1	5.6
	SSI absent	0	0.0

Overall, the findings of the present study showed that SSI remained a frequent postoperative complication after abdominal surgery, with a distinctly greater burden among emergency procedures and contaminated operations. Infection was associated with clinically important morbidity, reflected by prolonged hospital stay and increased need for wound-related secondary procedures.

Discussion

The present prospective observational study demonstrated an overall SSI incidence of 18.0% following abdominal surgery, indicating that postoperative wound infection remains an important source of morbidity in a teaching hospital setting. This rate lies within the broad range reported in abdominal surgery cohorts and is comparable to several prospective studies from similar settings [11-14]. The burden observed in the present series reinforces the continuing relevance of institutional SSI surveillance and the practical value of guideline-driven preventive strategies in general surgical units.

A key finding of this study was the distinctly higher infection rate after emergency procedures than after elective operations. Emergency surgery often limits optimal preoperative optimization, bowel preparation, where indicated, and careful control of contamination, which explains its repeated association with SSI in prior studies [6-14]. The progressive increase in infection frequency from clean-contaminated to dirty wounds in the present study is also biologically plausible and strongly supported by systematic reviews and cohort data identifying wound contamination and longer operative duration as consistent predictors of SSI after abdominal surgery [9,10]. The particularly high rate observed in perforation peritonitis further reflects the heavy bacterial load and tissue inflammation typical of this subgroup.

Among patient-related variables, diabetes mellitus, anemia, and hypoalbuminemia were significantly associated with SSI in the present analysis. These findings are in agreement with previous literature showing that hyperglycemia, impaired nutritional reserve, reduced tissue oxygenation, and poor wound healing contribute substantially to postoperative infection risk [5,9]. Drain placement was also more frequent among infected patients, which has been noted in earlier abdominal surgery studies and may reflect both higher operative complexity and an added route for bacterial colonization in selected cases [9,12,14]. Although obesity showed an upward trend without statistical significance in this dataset, the direction of association remained consistent with existing evidence [9,10,13].

Most infections in the present study were superficial incisional, whereas deep and organ/space infections accounted for a smaller but clinically important proportion. This pattern resembles other abdominal surgery reports in which superficial SSI predominates numerically, but deeper infections contribute disproportionately to re-intervention, ICU requirement, and mortality [11,14]. Escherichia coli was the most common isolate, followed by Staphylococcus aureus and Klebsiella spp., a microbiological pattern expected in abdominal procedures involving enteric contamination and also described in earlier cohorts [11,14]. The significantly prolonged postoperative hospital stay among infected patients in the present study underscores the economic and clinical consequences of SSI and mirrors the increased resource utilization described in prior research [14].

Generalizability: Although this was a single-center study, the case mix included both elective and emergency abdominal procedures across a range of wound classes, comorbid states, and operative durations. The observed associations are therefore likely to be relevant to comparable tertiary teaching hospitals and government surgical units

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managing open abdominal surgery in resource-constrained settings. Nevertheless, direct extrapolation to highly specialized centers, laparoscopic-dominant practices, or settings with different antimicrobial ecology should be undertaken cautiously.

Conclusion

This study demonstrated that surgical site infection remains a substantial postoperative problem following abdominal surgery, with an overall incidence of 18.0% and a markedly greater burden in emergency and contaminated procedures. Diabetes mellitus, anemia, hypoalbuminemia, prolonged operative duration, wound contamination, and drain use emerged as important associated factors. Most infections were superficial incisional, but their impact on recovery was clinically meaningful, including prolonged hospital stay and increased requirement for secondary procedures. The findings support the need for focused perioperative optimization, strict aseptic practice, timely antimicrobial prophylaxis, and surveillance-based quality improvement in teaching hospitals performing abdominal surgery.

Limitations

The study was conducted at a single teaching hospital with a sample size of 100 patients, which restricts statistical precision for less frequent outcomes such as organ/space infection and mortality. Multivariable modeling was not performed in this dataset. The analysis was centered on open abdominal procedures and short-term postoperative follow-up, so the findings do not represent all surgical specialties or minimally invasive approaches.

Recommendations

Regular SSI surveillance should be institutionalized in abdominal surgery units with periodic audit of emergency cases, wound class distribution, antimicrobial prophylaxis, and drain practices. Preoperative correction of anemia, nutritional assessment, and glycemic optimization should be integrated into routine surgical preparation. Patients undergoing contaminated or dirty procedures and operations lasting more than two hours should receive intensified postoperative wound monitoring. Local microbiological trends should guide empirical treatment pathways and antibiotic policies. Prospective multicenter studies with larger samples and stratified procedure-specific analysis are needed to refine risk prediction and strengthen prevention protocols in comparable hospitals.

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Abbreviations

ASA: American Society of Anesthesiologists
CDC: Centers for Disease Control and Prevention
ICU: Intensive Care Unit
NNIS: National Nosocomial Infections Surveillance
SSI: Surgical Site Infection
WHO: World Health Organization

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

YS-Concept and design of the study, results interpretation, review of literature, and preparation of the first draft of the manuscript. Statistical analysis and interpretation, revision of manuscript.
RC results interpretation, review of literature, preparation of the first draft of the manuscript, and revision of the manuscript. **MB**-review of literature and preparing the first draft of the manuscript, revision of the manuscript.

Data availability

Data available on request

Author Biography

Dr. Yerra Sudhakar is a dedicated academic surgeon with a strong foundation in clinical practice and surgical education. He obtained his MBBS degree from Kakatiya Medical College, Warangal (2002–2008) and completed his MS in General Surgery from Mamata Medical College, Khammam (2016–2019).
In 2019, Dr. Sudhakar commenced his academic career as an Assistant Professor in the Department of General Surgery at Government Medical College, Suryapet, Telangana. Over the next five years, until June 2024, he made significant contributions to undergraduate and postgraduate training, refining his expertise in surgical education, operative techniques, and clinical mentoring.

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In mid-2024, he was appointed Associate Professor at Government Medical College & General Hospital, Bhadradri Kothagudem, where he continues to integrate evidence-based practice into both patient care and academic teaching. Known for his commitment to professional growth, Dr. Sudhakar combines scholarly rigor with compassionate care, fostering an environment that encourages innovation, research engagement, and high standards of surgical excellence. **ORCID ID:** https://orcid.org/0009-0005-2330-241X

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