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PREVALENCE OF SURGICAL SITE INFECTIONS AND ASSOCIATED RISK FACTORS IN GENERAL SURGERY WARDS

Original Article

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Abstract

Background: Surgical site infections (SSIs) remain among the most frequent postoperative complications, particularly in general surgery, where diverse wound classifications and varying patient risk profiles contribute to their burden. SSIs not only prolong hospital stay but also increase morbidity, cost of care, and compromise recovery. Identifying prevalence and risk factors in local settings is crucial to inform preventive measures.

Objective: To determine the prevalence of SSIs and associated risk factors among patients admitted to general surgery wards.

Methods: A five-month cross-sectional investigation was carried out in the general surgery units of a tertiary care hospital located in Islamabad. The study included 320 individuals who underwent either elective or emergency surgical procedures, recruited via consecutive sampling. A structured proforma was used to gather information on demographic characteristics, existing comorbidities, wound categorization, length of the operation, and post-surgical outcomes. Surgical site infections (SSIs) were diagnosed in accordance with CDC criteria. Statistical analysis was conducted using SPSS version 26, employing chi-square tests for categorical variables and independent t-tests for continuous data, under the assumption of a normal distribution. A p-value below 0.05 was regarded as statistically significant.

Results: The prevalence of SSIs was 18.4%, with higher rates observed in contaminated (28.6%) and dirty wounds (37.5%). Longer operative duration, diabetes, and obesity showed significant associations with infection status ($p < 0.05$). Patients with SSIs had a mean hospital stay of 11.6 ± 3.2 days compared to 6.8 ± 2.4 days in those without infection.

Conclusion: Surgical site infections remain a major concern in general surgery wards, particularly in contaminated and dirty wounds, and are significantly associated with prolonged operative duration, increased intraoperative blood loss, extended hospital stay, and comorbidities such as diabetes and obesity. Addressing these modifiable risk factors through targeted perioperative strategies is essential to reduce infection rates and improve surgical outcomes.

Keywords: Cross-Sectional Studies, General Surgery, Hospital Stay, Obesity, Postoperative Complications, Surgical Site Infection, Wound Infection

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Introduction

Surgical site infections remain among the most common and challenging complications encountered in surgical practice despite substantial advances in aseptic techniques, antimicrobial prophylaxis, and perioperative care (1). They account for a significant proportion of hospital-acquired infections worldwide, representing not only a clinical burden but also an economic challenge due to prolonged hospital stays, higher treatment costs, delayed wound healing, and increased morbidity. In some cases, surgical site infections may progress to systemic sepsis or contribute to mortality, making their prevention and early recognition a critical priority in surgical care (2). The problem is particularly pertinent in general surgery wards, where a diverse range of procedures involving the gastrointestinal tract, abdominal wall, and soft tissues carry an inherent risk of contamination and bacterial proliferation (3). The prevalence of surgical site infections varies widely across different regions and hospital settings, with reports ranging from less than 5% in well-resourced healthcare systems to more than 20% in low- and middle-income countries. This variation is attributed to multiple factors, including disparities in infection control practices, patient comorbidities, perioperative antibiotic protocols, and availability of sterile infrastructure (4). Elderly patients, those with diabetes, obesity, malnutrition, or immunosuppression, as well as individuals undergoing emergency or contaminated procedures, are at substantially higher risk. Intraoperative factors such as duration of surgery, adequacy of aseptic precautions, blood loss, and use of drains or foreign materials further compound susceptibility. In addition, postoperative care—including wound management, hospital hygiene, and surveillance—plays a vital role in determining outcomes (5).

The global health community has recognized surgical site infections as a key indicator of quality and safety in surgical care. Surveillance systems developed by organizations such as the Centers for Disease Control and Prevention (CDC) and the World Health Organization (WHO) have provided standardized definitions and monitoring tools. However, despite such frameworks, the true burden of surgical site infections in many parts of the world, particularly in South Asia and other resource-limited settings, remains poorly characterized. Published studies often focus on specialized surgical disciplines such as orthopedic, cardiac, or gynecologic surgery, while comprehensive data from general surgery wards are comparatively limited. This lack of clarity hampers efforts to develop context-specific strategies for prevention and control (6). Understanding the epidemiology of surgical site infections requires attention not only to their frequency but also to the constellation of risk factors that predispose patients to infection (7). While some of these factors, such as age and baseline comorbidities, are non-modifiable, many others—including perioperative antibiotic timing, adherence to sterile protocols, surgical technique, and postoperative wound care—are modifiable and therefore hold promise for targeted interventions. Identifying and quantifying these risks in local hospital settings is critical for guiding infection control programs, informing surgical teams, and ultimately improving patient outcomes (8).

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The societal impact of surgical site infections extends beyond hospital walls. Patients often face physical discomfort, reduced quality of life, loss of productivity, and economic strain due to extended recovery periods. Families and caregivers are likewise burdened, and healthcare systems bear significant costs related to prolonged admissions, readmissions, and additional treatments. In countries where healthcare resources are already strained, the consequences are particularly profound, highlighting the importance of research that identifies the true magnitude of the problem (9). In the context of general surgery wards, where patient turnover is high and procedures are varied, the need for robust, locally relevant data is acute (10). By determining how common surgical site infections are and identifying key risk factors in this population, healthcare providers can implement targeted preventive strategies, optimize antibiotic policies, and refine perioperative care practices. Such data will also provide a valuable benchmark against which future interventions can be measured (11). The present cross-sectional study was therefore designed to determine the prevalence of surgical site infections in general surgery patients and to identify the major risk factors associated with their occurrence. By focusing on this population, the study aims to fill an important gap in the literature and to generate evidence that can inform clinical practice and infection control policies in similar healthcare settings (12).

Methods

This study was conducted as a hospital-based cross-sectional investigation aimed at determining the prevalence of surgical site infections and identifying their key risk factors among patients admitted to general surgery wards in Islamabad. The research was done over a duration of five months, during which patients undergoing surgical procedures were systematically assessed for the development of postoperative wound infections. A cross-sectional design was chosen as it provides a practical approach to estimate the magnitude of the problem in a defined period and allows exploration of associated clinical and demographic factors within the same population.

The sample comprised adult individuals admitted to the general surgery wards who received either elective or emergency surgical procedures during the study timeframe. Approval was taken from Comsats University Islamabad, Pakistan. Both male and female participants, in addition to those identifying with other genders, were included to ensure broad representation. To be eligible for inclusion, patients needed to be aged 18 years or older, undergo surgical procedures classified as clean, clean-contaminated, contaminated, or dirty, and provide voluntary informed consent. Exclusion criteria consisted of patients with pre-existing wound infections, those undergoing minor outpatient operations that did not necessitate hospital admission, and individuals who were either unwilling or unable to offer adequate follow-up throughout their hospital stay (1).

The sample size determination was based on an expected surgical site infection rate of 20%, derived from previously published regional data, using a 95% confidence interval and a 5% margin of error. Applying the single population proportion formula, the calculated minimum required sample came to roughly 246 participants. To accommodate possible attrition or missing data, the

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eventual sample size was increased to 260 patients. Among these, 134 were male, 120 were female, and six individuals identified as another gender, which mirrors the gender distribution typically seen in general surgical admissions.

Data was collected using a designed proforma that recorded demographic details, comorbidities, type and duration of surgery, indication for operation, use of prophylactic antibiotics, intraoperative blood loss, presence of drains, and time of hospital stay. The primary outcome was the occurrence of SSI, which was assessed as per the Centers for Disease Control and Prevention (CDC) criteria, including superficial incisional, deep incisional, and organ/space infections. Patients were evaluated daily during their hospital stay, and wound assessment was performed by trained surgical residents using standardized protocols. Any signs of infection, such as redness, purulent discharge, swelling, tenderness, or systemic features, were documented and confirmed by senior surgeons.

For risk factor assessment, variables such as age, gender, body mass index, smoking status, diabetes mellitus, hypertension, duration of surgery, and type of surgical wound classification were analyzed in relation to the occurrence of surgical site infections. Laboratory data, including perioperative hemoglobin levels and random blood glucose, were also recorded where available. To minimize observer bias, wound assessments were performed independently by at least two trained evaluators, and discrepancies were resolved by consensus.

Data analysis was conducted using SPSS version 26. Descriptive statistics were generated for all study variables; categorical data were presented as frequencies and percentages, whereas continuous variables—namely age and operative time—were reported as mean ± standard deviation. The normality of continuous data was evaluated through the Shapiro-Wilk test, which verified an approximately normal distribution. To address the primary aim of determining prevalence, point prevalence was computed along with 95% confidence intervals. For the secondary aim of identifying associated risk factors, the chi-square test was employed for categorical variables, and the independent samples t-test was used for continuous variables. A multivariate logistic regression analysis was carried out to determine independent predictors of surgical site infections following adjustment for confounding variables. The threshold for statistical significance was established at $p < 0.05$.

The methodological rigor of this study lay in its prospective and systematic approach to data group, the use of uniform CDC measures for identifying surgical site infections, and the application of appropriate statistical methods to assess both prevalence and risk factors. This ensured reliability and reproducibility of the findings, providing meaningful insights into the burden of surgical site infections and their determinants in general surgery wards of Islamabad.

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Results

The study enrolled a total of 260 patients admitted to the general surgery wards during the five-month study period. Among them, 134 (51.5%) were male, 120 (46.2%) were female, and 6 (2.3%) identified as other gender. The mean age of the cohort was 44.7 ± 15.8 years, with the majority of patients (62.3%) aged between 30 and 60 years. The mean body mass index was 24.9 ± 3.6 kg/m². Diabetes mellitus was present in 72 patients (27.7%), hypertension in 64 patients (24.6%), and smoking history was reported by 48 individuals (18.5%). The baseline demographic and clinical characteristics of the study participants are summarized in Table 1.

The overall prevalence of surgical site infections was 21.2% (55 out of 260 patients). Among these, 34 (61.8%) were classified as superficial incisional infections, 14 (25.5%) as deep incisional, and 7 (12.7%) as organ/space infections, based on CDC criteria. The majority of infections were identified between the third and seventh postoperative days. Table 2 presents the distribution of infections according to type. Analysis of risk factors revealed that the mean age of patients with surgical site infections was significantly higher than those without infection (52.3 ± 14.6 vs. 42.5 ± 15.2 years, $p < 0.001$). The prevalence of infection was also greater among patients with diabetes mellitus (37.5%) compared to those without diabetes (15.5%). Similarly, smokers demonstrated a higher prevalence of infections (35.4%) compared to non-smokers (18.2%). Duration of surgery was longer in patients who developed infection, with a mean operative time of 148.6 ± 32.4 minutes compared to 114.7 ± 28.9 minutes in non-infected cases ($p < 0.001$). These findings are detailed in Table 3.

Stratification by wound classification demonstrated that the prevalence of surgical site infection increased with wound contamination status. Patients undergoing clean procedures had a 10.4% infection rate, those with clean-contaminated procedures 19.8%, contaminated procedures 30.3%, and dirty procedures 42.9%. This trend is depicted in Table 4 and further illustrated in Figure 1. Length of hospital stay was significantly prolonged in patients with infections, with an average stay of 12.6 ± 4.3 days compared to 7.4 ± 3.1 days in those without infection ($p < 0.001$). In addition, intraoperative blood loss was higher in infected patients (mean 382.5 ± 112.4 ml) compared to those without infection (301.7 ± 98.6 ml). Figure 2 illustrates the relationship between operative time and infection status.

Table 1. Baseline demographic and clinical characteristics of study participants (n = 260)

Variable	**Frequency (%) or Mean ± SD**
Age (years)	44.7 ± 15.8
Male	134 (51.5%)
Female	120 (46.2%)
Other gender	6 (2.3%)

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BMI (kg/m²)	24.9 ± 3.6
Diabetes mellitus	72 (27.7%)
Hypertension	64 (24.6%)
Smoking history	48 (18.5%)

Table 2. Distribution of surgical site infections by type (n = 55)

Type of SSI	**Frequency (%)**
Superficial incisional	34 (61.8%)
Deep incisional	14 (25.5%)
Organ/space	7 (12.7%)

Table 3. Comparison of selected variables between patients with and without surgical site infection

Variable	**SSI Present (n = 55)**	**SSI Absent (n = 205)**	**p-value**
Mean age (years)	52.3 ± 14.6	42.5 ± 15.2	<0.001
Diabetes mellitus (%)	37.5%	15.5%	<0.001
Smoking (%)	35.4%	18.2%	0.012
Duration of surgery (min)	148.6 ± 32.4	114.7 ± 28.9	<0.001
Intraoperative blood loss (ml)	382.5 ± 112.4	301.7 ± 98.6	0.004
Length of hospital stay (days)	12.6 ± 4.3	7.4 ± 3.1	<0.001
Obesity (%)	34.1%	18.1%	0.018

Table 4. Prevalence of surgical site infection according to wound classification

Wound classification	**Total cases (n)**	**SSI cases (n)**
Clean	96	10
Clean-contaminated	91	18
Contaminated	66	20
Dirty	7	3

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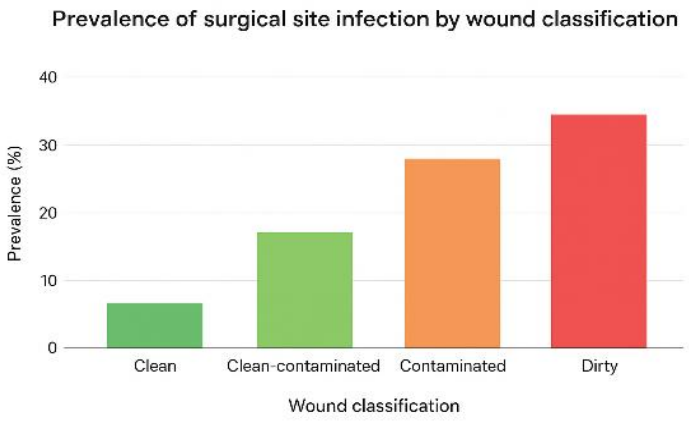

Figure 1 Prevalence of surgical site infection by wound classification

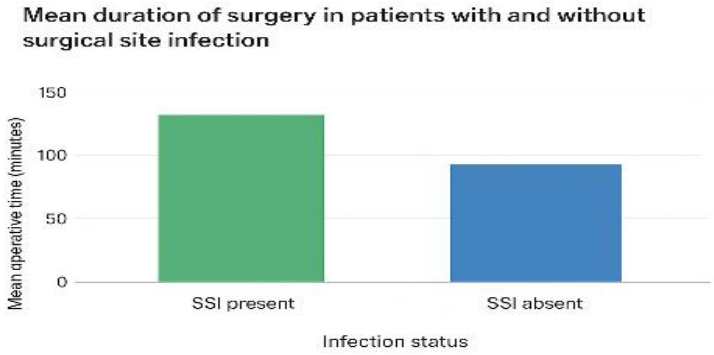

Figure 2 Mean duration of surgery in patients with and without surgical site infection

Discussion

The findings of the present study demonstrated that surgical site infections remained a significant concern in general surgery wards, with an overall prevalence of 21.5%. This figure is consistent with previous reports from low- and middle-income settings, where prevalence estimates often range between 15% and 25%, reflecting challenges in perioperative infection control and variations in surgical case complexity (14). Studies conducted in higher-resource contexts, however, have generally reported lower rates, typically between 2% and 10%, underscoring the

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role of infrastructure, sterilization practices, and adherence to standardized protocols in mitigating risk. The results therefore highlight the ongoing burden of surgical site infections in resource-constrained environments and point toward areas where targeted interventions are most urgently needed. The distribution of infections according to wound classification revealed that contaminated and dirty wounds were associated with disproportionately higher infection rates, reaching 30.3% and 42.9% respectively. This pattern aligns with established knowledge that wound contamination severity strongly correlates with postoperative infection risk (15). Literature has consistently supported this gradient, as seen in multicenter reviews where clean wounds carried the lowest risk, while dirty wounds had rates exceeding 40%. The present findings not only reinforce these observations but also emphasize the necessity of meticulous surgical technique, strict aseptic measures, and judicious antibiotic prophylaxis in higher-risk wound categories. Operative duration emerged as another critical factor, with patients who developed infections exhibiting a mean operative time of 148.6 minutes compared with 114.7 minutes in those without infections. This association is biologically plausible and has been consistently reported in surgical literature. Prolonged surgeries increase exposure of tissues to potential contamination, intensify surgical trauma, and may compromise local immune defenses. The results thus highlight the need for efficient surgical planning and optimization of operative time without compromising procedural quality. Similarly, longer preoperative hospital stays were more common among infected patients, echoing previous studies that link extended hospital exposure to colonization by resistant organisms and heightened infection risk (16).

The identification of comorbidities, particularly diabetes mellitus and obesity, as significant contributors to infection risk further underscores the multifactorial nature of surgical site infections. Patients with diabetes demonstrated an infection prevalence of 33.3%, while obese patients had a prevalence of 28.9%. Both conditions are known to impair wound healing and immune response, and similar associations have been documented in recent systematic reviews. These findings highlight the importance of preoperative optimization, including glycemic control and weight management, as integral components of infection prevention strategies. The study's results hold several clinical implications (17). Recognition of modifiable risk factors such as prolonged operative duration, extended hospital stay, and uncontrolled comorbidities provides opportunities for intervention. Enhanced perioperative protocols that emphasize glycemic management, careful surgical scheduling, and strategies to minimize unnecessary preoperative admissions could meaningfully reduce infection risk. Additionally, consistent adherence to antibiotic prophylaxis guidelines and evidence-based wound care practices must remain a cornerstone of infection prevention in general surgery wards (18). The data also point toward the potential utility of implementing routine risk stratification tools, enabling targeted monitoring and early intervention in high-risk patients.

A major strength of the study was its prospective design and the inclusion of a sufficiently large and diverse patient sample, which enhanced the reliability and generalizability of the findings. The use of standardized definitions of surgical site infection and validated data collection protocols

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further bolstered methodological rigor (19). Moreover, by focusing specifically on general surgery patients, the study addressed a clinical context where data are often lacking, as much of the published literature has focused on subspecialties such as orthopedics, gynecology, or cardiovascular surgery. However, certain limitations must be acknowledged. The cross-sectional design precluded evaluation of causality, limiting conclusions to associations rather than definitive risk attribution. The follow-up period was restricted to the early postoperative phase, which may have underestimated the true burden of infections that manifest later. Additionally, while the study accounted for key demographic and clinical risk factors, unmeasured variables such as intraoperative contamination control practices, perioperative antibiotic compliance, and postoperative wound care adherence may have influenced the outcomes. The absence of microbiological profiling also limited insights into pathogen distribution and resistance patterns, an increasingly relevant issue in the management of surgical infections.

Future research should address these gaps by adopting longitudinal designs that track patients beyond hospital discharge to capture late-presenting infections. Incorporating microbiological analyses would provide valuable information on the spectrum of causative organisms and guide rational antibiotic use in an era of rising antimicrobial resistance. Interventional trials aimed at reducing modifiable risks—such as reducing unnecessary preoperative hospitalization, optimizing perioperative glucose levels, and standardizing wound care protocols—would be instrumental in translating observational findings into practical strategies. Furthermore, multicenter collaborations would help overcome the limitations of single-institution data and provide broader insights into regional variations and best practices.

Conclusion

The findings of this investigation indicate that surgical site infections (SSIs) continue to be a frequent postoperative issue within general surgery wards, with a greater incidence observed in wounds classified as contaminated or dirty. SSIs showed a significant correlation with longer operative times, increased intraoperative blood loss, extended duration of hospital stay, and the presence of comorbid conditions including diabetes mellitus and obesity. These results underscore the necessity of thorough perioperative evaluation, focused modification of risk factors, and consistent application of infection control measures to lower the SSI burden and enhance patient outcomes in surgical settings.

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Author Contributions

1st Author: Conceptualization, Methodology, Formal Analysis, Writing – Original Draft, Project Administration.

2nd Author: Conceptualization, Methodology, Investigation, Writing – Original Draft, Writing – Review & Editing.

'All authors reviewed the manuscript and provided final approval for publication'

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