ISSN Online: 3007-1941 ISSN Print: 3007-1933 https://msra.online/index.php/Journal/about

Multidisciplinary Surgical Research Annals
https://msra.online/index.php/Journal/about
Volume 4, Issue 1 (2026)

Determinants Of Surgical Site Infections In Emergency Versus Elective Surgeries In Peshawar

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Article Details

Keywords:

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ABSTRACT

Surgical site infections (SSIs) are infections that appear at or near a surgical incision 30 days after the procedure (90 days if implants are used) (1). SSIs account for over one-fifth of all hospital-acquired infections, ranking among the most common healthcare-associated diseases (1). The global incidence of SSI varies substantially (between 1-30% depending on location and procedure) (1). For example, the World Health Organization estimates 1.2-23.6 SSIs per 100 surgical procedures worldwide (2). A recent meta-analysis discovered a pooled global SSI incidence of approximately 2.5% (3), with rates substantially higher in low- and middle-income countries (LMICs) due to resource and infection-control restrictions (4). SSI rates vary from <5% in high-income settings to >20% in low- and middle-income nations (4). SSIs dramatically increase patient morbidity and mortality; studies show that SSIs double the mortality risk and lengthen hospital stays by 10-11 days on average, putting significant costs on healthcare systems. Indeed, in the United States, an estimated 157,500 SSIs occur each year, killing over 8,000 people and costing an extra $3.3 billion (1).

INTRODUCTION:

Surgical site infections (SSIs) are infections that appear at or near a surgical incision 30 days after the procedure (90 days if implants are used) (1). SSIs account for over one-fifth of all hospital-acquired infections, ranking among the most common healthcare-associated diseases (1). The global incidence of SSI varies substantially (between 1-30% depending on location and procedure) (1). For example, the World Health Organization estimates 1.2-23.6 SSIs per 100 surgical procedures worldwide (2). A recent meta-analysis discovered a pooled global SSI incidence of approximately 2.5% (3), with rates substantially higher in low- and middle-income countries (LMICs) due to resource and infection-control restrictions (4). SSI rates vary from <5% in high-income settings to >20% in low- and middle-income nations (4). SSIs dramatically increase patient morbidity and mortality; studies show that SSIs double the mortality risk and lengthen hospital stays by 10-11 days on average, putting significant costs on healthcare systems. Indeed, in the United States, an estimated 157,500 SSIs occur each year, killing over 8,000 people and costing an extra $3.3 billion (1).

Emergency surgical operations are more likely to result in SSIs than elective surgeries due to factors such as wound infection and a lack of preoperative planning (5). The literature generally supports greater SSI rates in emergency patients. For example, Pakistani surgical cohorts have discovered significantly greater SSIs following emergency abdominal surgery compared to elective surgery (6). In obstetrics, emergency cesarean sections (delivered in an emergency) are associated with higher SSI rates than elective cesareans (5). These findings corroborate the "general consensus" that emerging activities incur a higher SSI burden (6). (Notably, certain findings may be context-dependent; one study at a tertiary hospital in Abbottabad showed 37.9% SSI in elective cases against 27.8% in emergency cases.) (7). Overall, emergency treatments lack preoperative optimization and typically involve contaminated or delayed wounds, which may account for their high SSI rate.

In Pakistan, SSIs remain a significant public health concern. A study conducted at a tertiary center in Sindh discovered an overall SSI rate of 13.0% in elective general surgery, with rates reaching 36-40% in contaminated cases (8). There is insufficient data available in Khyber Pakhtunkhwa province. At Khyber Teaching Hospital Peshawar, the total SSI rate was 9.3% in a mixed general surgery population (9), With a higher frequency in contaminated or "dirty" wounds. At Hayatabad Peshawar, 33.5% of emergency laparotomy patients developed SSIs (10). A study of cesarean births in Peshawar showed obesity, protracted gestation, and socioeconomic characteristics as risk factors for SSI. SSI was "more so" after emergency vs. elective C-sections (11). Overall, these findings highlight a substantial SSI burden in Pakistan

Given the large surgical volume and limited resources in Peshawar, it is critical to study the local SSI factors. There is presently no cross sectional investigation that compares SSI incidence and risk factors between emergency and elective treatments in Peshawar hospitals. Such data is required to inform prevention and quality improvement. The goal of this study is to analyze the causes of SSI in emergency and elective operations in Peshawar (including major hospitals like Khyber and Hayatabad), in order to inform focused infection control strategies and improve patient outcomes in this setting.

METHOGOLOGY:

STUDY DESIGN: This will be a hospital-based analytical cross-sectional study to determine the causes of surgical site infections in patients undergoing emergency and elective surgeries at Peshawar's tertiary care facilities. The study included adult patients (above 18) and those who were undergoing emergency or major surgeries. Data was not collected from those who were not willing to participate.

STUDY SETTING: The study will be conducted in the **Department of General Surgery** of tertiary care hospitals in Peshawar, including major teaching hospitals serving a large surgical population. The hospitals include

Khyber teaching hospital

Hayatabad medical complex
Northwest school of medicine
Rehman medical institute

STUDY DURATION: The duration of the study was from May 2025 to November 2025.

OBJECTIVES:
GENERAL OBJECTIVE:
To identify the causes of surgical site infections in emergency versus elective surgeries in Peshawar

SPECIFIC OBJECTIVES:
To determine the prevalence of surgical site infections among patients undergoing emergency or elective surgeries
Determine patient and surgery-related risk factors for surgical site infections.
To compare the risk variables for surgical site infections in emergency and elective procedures

SAMPLE SIZE: A convenience sampling technique was used**.** A Sample size was calculated using OPENEPI software. The following parameters were used:
Population size= 1000000 as population size was considered large so this value was used as per OPENEPI guidance
Anticipated frequency (p) = 50% since true frequency was unknown
Confidence limits as + - percent of 100 = 5%
Design effect = 1%
So based on these parameters the calculated sample size for 95% confidence level was 384

DATA ANAYLISIS: IBM SPSS Statistics (version 26) was used to examine the data. The study variables were summarized using descriptive statistics, with continuous data displayed as mean ± standard deviation and categorical data as frequencies and percentages. Surgical site infection (SSI) prevalence was determined both overall and by kind of operation (elective vs. emergency). The chi-square test or, when appropriate, Fisher's exact test were used to evaluate associations between SSI and categorical factors (such as gender, diabetes mellitus, smoking status, wound class, length of operation, preoperative antibiotic use, and kind of surgery). A multivariable binary logistic regression model was used to find independent predictors of SSI based on variables that demonstrated statistical significance or clinical relevance. The results were presented as adjusted odds ratios (AORs) and 95% confidence intervals.

RESULTS:
The study comprised 384 patients undergoing surgical procedures. Of these, 172 (44.8%) received elective procedures, while 212 (55.2%) required emergency surgery. The individuals' average age was 41.6 ± 14.2 years. Overall, 72 patients (18.8%) contracted surgery site infections.

TABLE 1: DEMOGRAPHICS

Variable	catagory	n	%
gender	Male	228	59.4
	female	156	40.6
Age	18–30	96	25.0
	31–45	142	26.6

	46–60	102	37.0
	>60	44	11.4
Type of surgery	Emergency	212	55.2
	elective	172	44.8
Hospitals	KTH	138	35.9
	HMC	114	29.7
	RMI	72	18.8
	NWSM	60	15.6

Table 1 displays the demographic breakdown of the study population. Males accounted for 59.4% of surgical patients, compared to 40.6% for females. The majority of people were between the ages of 31 and 45. Emergency surgeries were performed more frequently than elective procedures, indicating a significant emergency surgical burden in Peshawar's tertiary care facilities.

TABLE 2: Prevalence of Surgical Site Infections

Type of Surgery	**SSI Present n (%)**	**SSI Absent n (%)**	**Total**	**p-value**
Emergency	52 (24.5)	160 (75.5)	212	<0.001
Elective	20 (11.6)	152 (88.4)	172	
total	72 (18.8)	312 (81.2)	384	

Table 2 shows that patients undergoing emergency procedures have a much greater prevalence of surgical site infections (24.5%) than elective surgeries (11.6%). The statistically significant difference ($p < 0.001$) indicates that emergency surgical procedures increase the risk of SSI.

TABLE 3: Association of Patient-Related Factors with Surgical Site Infection

Variable	category	**SSI Absent n (%)**	**Total**	**p-value**
gender	Male	20.6	79.4	0.041
	female	16.0	84.0	
Diabetes mellitus	Yes	32.8	67.2	<0.001
	No	14.3	85.7	
Smoking status	Smoker	27.4	72.6	0.003

Male gender, diabetes mellitus, and smoking status all exhibited a statistically significant effect on the occurrence of SSI. Diabetics had more than twice as many infections as non-diabetics. Similarly, smokers had a much higher rate of SSI.

TABLE 4: surgery-Related Risk Factors Associated with Surgical Site Infection

Variable	category	**SSI Absent n (%)**	**Total**	**p-value**
Variable	Category	SSI Present n (%)	SSI Absent n (%)	p-value
Wound Class	Clean / Clean-contaminated	18 (9.8)	166 (90.2)	<0.001

	Contaminated / Dirty	54 (34.7)	102 (65.3)	
Duration of Surgery	≤ 2 hours	24 (12.4)	170 (87.6)	0.002
	> 2 hours	48 (29.1)	142 (70.9)	
Pre-operative Antibiotics	Yes	38 (14.6)	222 (85.4)	0.001
	No	34 (31.9)	72 (68.1)	

Surgical site infection was substantially more likely in patients with unclean or filthy wounds, longer surgical procedures, and no pre-operative antibiotic prophylaxis. These findings indicate that surgical and perioperative factors play a substantial role in the development of SSI.

TABLE 5:

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Emergency surgery	2.4	1.3 – 4.5	0.002
Diabetes mellitus	3.1	1.7 – 5.6	<0.001
Contaminated/dirty wound	3.8	2.0 – 7.1	<0.001
Duration of surgery	2.2	1.2 – 4.0	0.009

After controlling for confounding variables, multivariate analysis revealed that emergency surgery, diabetes, contaminated wound class, and long operation duration were independent predictors of surgical site infection.

DISCUSSION:

Surgical site infections (SSIs) were much more common after emergency surgery (24.5%) than after elective surgery (11.6%), according to the current cross-sectional investigation. The difference was significant ($p<0.001$). This is one of the earliest cross-sectional analyses of Peshawar's emergency versus elective SSI rates that we are aware of. In our context, the overall SSI rate is notable and consistent with high burden estimates in a scenario with limited resources (11). While evidence from sub-Saharan Africa indicates a prevalence of up to 41.9% in one series, compared to only roughly 2.5% in Europe (11), narrative studies reveal that SSIs can occur in up to 25% of surgical patients in specific LMIC settings (12). Unclean or contaminated surgeries have very high infection rates (almost 40% in one research), especially in Pakistan (12). Given this, our finding that the risk of SSI doubles during emergencies draws attention to a significant local problem.

Our SSI rates are broadly comparable to prior studies. In Pakistan, Shafi et al. identified SSI in 17.7% of emergency general surgeries versus 12.5% of elective patients (13). Talha et al. recently observed 31.1% SSI following emergency surgeries compared to 20.0% in elective procedures(14). Similarly, Reji et al. in India identified 13% SSI in emergency abdominal surgery against 9% in elective cases (15). All of these studies, including our own, reveal a significantly higher SSI risk in urgent procedures. Notably, Reji et al. ascribed the disparity to older age, more concurrent disease, and more wound infection in emergency patients (16). Our data shows these tendencies. The emergency group in our sample had more untreated comorbidities and infected wounds, which likely contributed to the higher infection rate. This body of evidence implies that the setting of emergency surgery, which usually includes patient delays, compromised physiology, and poor tissue conditions, is highly predisposed to SSI. (15).

Diabetes mellitus, cigarette smoking, infected or dirty wounds, and failure to get prompt antibiotic treatment have all been recognized as important risk factors for SSI. This aligns with other issues. Elmoursi et al.

discovered that diabetes and smoking were independently linked to SSIs following surgery. In an orthopedic cohort from Pakistan, Bukhari et al. discovered that diabetic patients and current smokers had significantly higher rates of SSI (17). According to a recent systematic review, diabetes and smoking are two of the most important patient-related risk factors for SSI (18). High blood glucose impairs wound healing and immune function, while smoking reduces tissue perfusion and oxygenation, all of which promote infection. In our study, diabetics had more than double the incidence of SSI as non-diabetics, which confirmed previous findings (19). Wound contamination was also discovered as a significant cause. As expected, contaminated or unclean treatments resulted in much higher SSI rates than clean instances. This trend has been well documented: for example, a gynecological surgical cohort discovered 32% SSI with contaminated wounds compared to just 14% with clean wounds (20). Contaminated cases outcompete host defenses with a higher bacterial load, necessitating immediate surgery. Furthermore, appropriate perioperative antibiotic prophylaxis greatly lowers the risk of SSI. In our study, failure to receive preoperative antibiotics was associated with infection. Others have confirmed this conclusion; for example, an obstetric study discovered that a lack of prophylaxis was a significant predictor of SSI (21). Adhering to the recommended timing and selection of prophylactic antibiotics will most likely minimize SSI incidence in both emergency and elective situations. Overall, our findings show the interplay between patient and procedure-related parameters. Emergency cases are often related with inadequate preoperative optimization, such as unreported or uncontrolled diabetes, undiscovered anemia, and more contaminated wounds. These qualities support one another. Emergency surgery, according to Talha et al., has "limited preoperative optimization and greater contamination risk" (14). Similarly, Nzayisenga et al. in Rwanda found that emergency surgery, increased wound infection, and a lack of prophylaxis were among the most influential SSI determinants (22). Such data demonstrate how the surgery's urgency and environment (e.g., trauma unit, emergency room) increase infection risk via both clinical and systemic mechanisms. Importantly, our work and others in similar conditions highlight modifiable factors: glycemic management, smoking cessation, proper asepsis, and antibiotic administration are interventions that can mitigate the effects of these hazards (23).

The study has limitations. The cross-sectional design reveals connections but not causality. Some risk factors, such as surgical technique and antibiotic administration timing, were not well understood. We relied on clinical diagnosis for SSI and did not do surveillance cultures on all patients, therefore our microbiological data is incomplete. The sample comes from a single tertiary care center, which may limit its applicability to other hospitals in the region. Finally, because many of our patients are discharged early, some SSIs that occurred after discharge may have gone undetected. Future studies should include post-discharge follow-up to completely determine the incidence of SSIs.

CONCLUSIONS: To summarize, we discovered that emergency surgery has considerably higher SSI rates than elective surgery in Peshawar, with diabetes, smoking, wound infection, and a lack of antibiotic prophylaxis being major risk factors. These findings, which are among the first of their kind for local data, offer meaningful recommendations. We encourage thorough adherence to prophylactic antimicrobial regimens and perioperative optimization (particularly glycemic management and smoking cessation). Surgeons and hospitals should also establish routine SSI surveillance and feedback procedures. By focusing on these areas, even resource-constrained settings can enhance surgical outcomes and lower the high cost of postoperative infections. Continued investment in infection control infrastructure and provider training is required to turn these findings into safer procedures for all patients.

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