

ORIGINAL ARTICLE

Comparison of Surgical Site Infections in Emergency Laparotomy and Elective Laparotomy

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ABSTRACT

Objective: This study aimed to find out the frequency, microbiological profile, pattern and predictors of wound site infections comparing emergency and elective midline laparotomy.

Study Design: Prospective comparative observational study.

Place and Duration of Study: was conducted in Department of General Surgery Hayatabad Medical Complex, Peshawar from 1 February 2024 to 30 September 2025.

Materials and Methods: The complete data was collected on a standardized proforma. Patients were operated and post-operative data was collected during follow-up for one months.

Results: Among 328 patients, 200 (60.9%) underwent emergency and 128 (39.1%) elective laparotomies. Baseline demographics, ASA class, and comorbidities were comparable between groups. Emergency surgeries had longer operative duration ($p < 0.001$), higher peritoneal contamination (63% vs. 3.1%) ($p < 0.001$), more contaminated/dirty wounds ($p < 0.001$), and greater ICU admission (37.5% vs. 17.1%) ($p < 0.001$). Surgical site infection (SSI) was significantly higher after emergency surgery (17.0% vs. 7.8%), with more superficial and deeper or organ-space infections ($p < 0.001$). Emergency cases also showed higher rates of reoperation, readmission, 30-day mortality (5.5%), and longer hospital stay (8.7 ± 4.7 vs. 6.9 ± 1.9 days).

Conclusion: Surgical site infections were frequently higher in emergency laparotomy than in elective laparotomy, driven by contamination, wound class, and operative complexity. Several risk factors in emergency signify risk of SSI, like contamination, prolonged operative duration and intra-abdominal sepsis.

Key Words: *Emergency Laparotomy, Laparotomy, Midline Incision, Wound Site Infections, Wound Complications.*

Introduction

A surgical wound is an incision or cut made through the skin with a scalpel or device during a surgical procedure.^{1,2} Surgical Site Infection (SSI), as defined by the Centers for Disease Control and Prevention (CDC), is an infection at the surgical incision or deeper tissues/organs within 30 days of surgery (or up to 90 days/1 year if an implant is involved).² SSI is one of the most common complications in abdominal surgeries contributing to increase in morbidity, mortality and costs of hospitalization.^{3,4} Emergency laparotomies carry a higher risk of infections compared to elective surgeries, due to multiple factors including the emergency patients'

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burden, the poor conditions of patients which are the cause of surgery, and contaminations from complex surgical conditions.⁵⁻⁷ Surgical classification of wounds is a crucial tool to predict the future rate of SSI, complications, and reoperations in patients undergoing laparotomy.^{5,8} In emergency versus elective laparotomies, risk factors for SSI include prior presence of infectious disease, malnutrition, extremes of age, high BMI, smoking, and known comorbidities.¹ Surgical factors such as prolonged operation time, inadequate scrubbing, poor skin preparation, and complex tissue handling further increase infection risk, especially in emergency cases with contamination and poor patient condition.^{7,9} signs and symptoms of SSI include painful, red, hot, and tender swelling, purulent discharge from the wound, presence of microorganisms on culture, and delayed healing.^{2,8} Microorganisms which are already present in patients' body as natural flora can enter the body from different routes depending on the type of surgery (elective or emergency) and the healthcare setting.^{4,7} Despite implementation of

infection prevention strategies, challenges remain due to limited resources and variable training of healthcare workers.^{7,10} This study is essential to know the effective and preventive strategies of improvement in outcomes of emergency and elective surgical procedures. Although several studies from tertiary care centers in Pakistan have reported limited prospective comparative data with microbiological profiles, multivariable risk analysis and predictors of SSI in these two surgical contexts remain insufficiently characterized.^{5,11} This study aimed to find out the frequency, microbiological profile, pattern and predictors of wound site infections comparing emergency and elective midline laparotomies.

Materials and Methods

This prospective comparative observational cohort study was conducted in Department of General Surgery Hayatabad Medical Complex, Peshawar during period of 1 February 2024 to 30 September 2025. The sample was calculated using Cochran's formula for estimation of a single proportion with a 95% confidence level ($Z = 1.96$), a precision (margin of error) of 5% ($d = 0.05$), and an expected surgical site infection (SSI) proportion of 20.8% ($p = 0.208$), based on the local study by Nawab et al.¹⁰ Using Cochran's formula $n = (Z^2 p (1-p)) / d^2$, the required sample size was

$$n = \frac{1.96^2 \times 0.208 \times 0.792}{0.05^2} = \frac{(3.8416 \times 0.164736)}{0.0025} = 0.632 / 0.0025 \approx 253.$$

To account for an anticipated 10% loss to follow-up, the final target sample size was increased to 278 patients. However, we include 328 cases into the study for increasing the study power and precision of the estimates. The study population was categorized into elective (128) and emergency groups (200). Those patients are encompassed in this study who aged 18-70 years, undergoing elective or emergency midline laparotomy, Complete perioperative and 30-day follow-up data could be recorded. However, patients <18 years, non-laparotomy procedures, pre-existing wound infection, implant-only procedures, incomplete follow-up data or loss of follow-up, those who refuse to provide consent are excluded from the study.

Elective laparotomy was planned surgical procedure with preoperative optimization, whereas emergency laparotomy is an urgent unplanned surgery

performed due to acute abdominal pathology. Data were collected in a standardized proforma after securing an informed consent in Urdu from every patient, after taking ethical approval from ethical board of our Institution with (HMC-QAD-F-00-IREB NO. 1740). This observational study was conducted and reported in accordance with the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines.¹² A single prophylactic dose of Cefuroxime Sodium 1.5 grams was administered intravenously at the time of induction of anesthesia and redosing was considered if the duration of surgery exceeded 4 hours, in accordance with standard surgical prophylaxis guidelines. The patients were monitored during hospital stay subsequently followed for 30 days after discharge. Post-discharge follow-up was conducted through scheduled outpatient clinic visits, during which surgical wounds were examined and wound swabs were obtained in aseptic conditions. In addition, telephonic follow-up was performed to confirm culture reports and identify any wound-related complications for 30 days. Data were collected using a structured proforma that included both demographic and clinical variables like group classification (elective or emergency laparotomy), age, gender, ASA class (I-VI), and comorbidities such as diabetes mellitus, hypertension, chronic obstructive pulmonary disease and cardiovascular disease. Surgical data included the indication for surgery, procedure performed, duration of operation, peritoneal contamination status, wound class according to CDC classification (I-IV), and whether ICU care was required or not. Postoperative outcomes were documented for 30 days and included SSI classified according to the Centers for Disease Control and Prevention (CDC) criteria into (superficial, deep or organ space), type of microorganism isolated at first and second follow-up, need for reoperation, readmission within 30 days, mortality within 30 days, and length of hospital stay. A total of 342 patients were initially enrolled, of whom 14 were lost to follow-up during the 30-day postoperative period.

Data collected were entered into SPSS version 23.0 and statistical analysis was conducted. Mean and standard deviations were calculated for normally distributed variables, while medians and

interquartile (IQR) ranges were used for non-normal distributions. Frequency and percentages for both groups were computed for qualitative variables. Multivariable binary logistic regression analysis was performed to identify independent predictors of surgical site infection, variables including emergency versus elective surgery, age, gender, ASA class, diabetes mellitus, duration of operation, peritoneal contamination, and ICU requirement, with results expressed as odds ratios, 95% confidence intervals, and p-values. Model fitness was assessed using the Hosmer-Lemeshow goodness-of-fit test, and multicollinearity was evaluated prior to regression analysis. A p-value of ≤ 0.05 was considered statistically significant according to the normal theory method.

Results

A total of 328, 128 (39.1%) patients underwent elective laparotomy and 200 (60.9%) underwent emergency surgery. In table I; showing baseline and clinical features, overall, 200 (60.9%) of patients underwent emergency laparotomy compared to 128 (39.1%) electives, with 146 (44.5%) male (58 elective, 88 emergency) and 182 (55.5%) were female (70 elective, 112 emergency). Females constituted a slightly higher proportion of the study population. The mean age was 40.8 ± 13.5 years, with no significant difference between elective and emergency group. Table I also shows that, ASA class I and II were frequently involved with no significant differences in distribution between two groups. Additionally, Table I show comparable co-morbidity profiles including the prevalence of diabetes mellitus, hypertension, chronic obstructive pulmonary disease, cardiovascular disease with no statistical significance.

Table II; surgical features, showing elective laparotomies were frequently indicated for biliary tract disease, malignancy, and other planned procedures whereas emergency laparotomies were performed for broader spectrum of acute pathologies, including hollow viscus perforations, abdominal abscesses, peritonitis, and trauma. The indication for surgery differed significantly between the two groups. The mean duration of surgery was 155.3 ± 44.5 minutes longer significantly in emergency compare to 146.1 ± 41.3 minutes in elective surgery. It was also noted that in emergency

cases there was significantly high level of peritoneal contamination 126 (63%), compare to the only 4 (3.1%) in elective cases. Similarly in table II, results show that contaminated and dirty wound classes (CDC III–IV) were significantly more frequent in emergency surgeries, whereas elective procedures were predominantly clean-contaminated. Postoperative ICU admission was also significantly higher among emergency patients 75 vs 22 (37.5% vs. 17.1%) shown in Table II.

Figure 1, show that SSI occurred more frequently in emergency group 34 (17.0%) compared to 10(7.8%) elective group. Loss to follow-up or death occurred in 14 (4.2%) of patients, predominantly in the emergency group in which SSI could not be documented in 30 days assessment and excluded from final analysis. Microbiological profile and wound healing assessed in 1 month follow-up and wounds cultures were noted. Among patients with SSI, at **first follow-up**, where normal wound healing was observed in 121 (95.7%) of elective cases compared to 145 (72.5%) of emergency cases. Gram-negative organisms *Escherichia coli* 15 (5.3%) being the most frequently isolated pathogen, followed by *Streptococcus pyogenes* 8(2.4%), *Enterococcus* species {*E. faecalis* 6 (1.8%) and *E. Faecium* 1 (0.3%)}, *Pseudomonas spp.* 1(0.3%), and *Staphylococcus aureus* 4 (1.2%). Other isolates included *Acinetobacter* 2 (0.6%) and *Klebsiella pneumoniae* 2 (0.6%). At the **second follow-up**, most wounds assessment shows normal wound healing in 125 (97.7%) of elective and 145 (72.5%) of emergency cases. A marked reduction in positive culture results was observed. The organisms isolated included *Escherichia coli* 3 (0.9%), *Mycobacterium tuberculosis* 1 (0.3%), *Pseudomonas spp.* 3 (0.9%), *Staphylococcus aureus* 1 (0.3%), and *Streptococcus pyogenes* 1 (0.3%). The majority of emergency cases showed no microbial growth 35 (10.7%), indicating resolution of infection following appropriate management.

Table III and **Figure 2** shows post operative outcomes; that reoperation 55 (27.5%), readmission 55(27.5%) and mortality within 30days 11(5.5%), were most frequently associated with emergency cases compared to elective cases. Additionally, the length of hospital stay was significantly longer among emergency patients (8.7 ± 4.7 days)

compared to elective patients (6.9 ± 1.9 days). In Table IV predictors of SSI are analyzed through logistic regression. This show that peritoneal contamination and duration of operation emerged as the strongest independent predictors of SSI (OR =

7.19; 95% CI: 3.58–14.45; p < 0.001) and (OR = 11.00; 95% CI: 0.99 – 13.01; p < 0.001) respectively. Age, gender, ASA class, diabetes mellitus and ICU requirement were not independently associated with SSI development.

Table I: Baseline Demographic and Clinical Characteristics

Variable	Subgroup	Elective (n=128/328)	Emergency (n=200/328)	Total (N=328)	p-value
Age	(mean ± SD)	41± 13.1	40.6 ±13.7	40.8 ±13.5	0.111
Gender	Male	58 (17.7%)	88(26.8%)	146 (44.5%)	0.816
	Female	70 (21.3%)	112(34.1%)	182 (55.5%)	
ASA Class	I	82(64.0%)	139(69.5%)	221(67.37%)	0.129
	II	38(29.6%)	43(21.5%)	81(24.6%)	
	III	8(6.2%)	13(6.5%)	21(6.4%)	
	IV	0	5(2.5%)	5(1.5%)	
Diabetes Mellitus (%)	Yes	11(8.5%)	16(8%)	27(8.2%)	0.849
	No	117(91.4%)	184(92 %)	301(91.7%)	
Hypertension (%)	Yes	20(15.6%)	29 (14.5%)	49(14.9%)	0.069
	No	108(84.3%)	170(85%)	278(84.7%)	
COPD (%)	Yes	3(2.3%)	1(0.5%)	4(1.21%)	0.139
	No	125(97.6%)	199(99.5%)	324(98.7%)	
Cardiovascular Disease (%)	Yes	1(0.78%)	4(2%)	5(1.5%)	0.772
	No	127(99.2%)	196(98%)	323(98.4%)	
Independent t-test: age					
Chi-square test: gender, ASA class, comorbidities.					

Table II: Surgical Features

Variable	Subgroup	Elective (n=128) n (%)	Emergency (n=200) n (%)	Total (N=328) n (%)	p-value
Indication of Surgery					
Hepatobiliary	Biliary Tract	19 (14.8)	35 (17.5)	54 (16.5)	0.000
	Liver	17 (13.3)	9 (4.5)	26 (7.9)	
	Spleen	3 (2.3)	3 (1.5)	6 (1.8)	
Renal / Urinary	Kidney/Ureter/Bladder	13 (10.2)	6 (3.0)	19 (5.8)	
Perforation	Small Bowel Perforation	0 (0.0)	30 (15.0)	30 (9.1)	
	Stomach Perforation	0 (0.0)	26 (13.0)	26 (7.9)	
	Perforated Duodenal Ulcer	0 (0.0)	65 (32.5)	65 (19.8)	
	Abdominal Abscess	0 (0.0)	10 (5.0)	10 (3.0)	
Trauma	Blunt or stab trauma	0 (0.0)	13 (6.5)	13 (4.0)	
Malignancy	Malignancy	0 (0.0)	3 (1.5)	3 (0.9)	
Other Pathology	Other	41 (32.0)	16 (8.0)	57 (15.5)	
Duration of Operation (min)	Mean ± SD	146.1 ± 41.3	155.3 ± 44.5	149 ± 42.2	0.000
Level of Peritoneal Contamination	No peritonitis / aseptic ascites	103 (80.4)	17 (8.5)	120 (39.6)	0.000
	Localized Peritonitis	21 (16.4)	57 (28.5)	78 (23.8)	
	Contaminated / Dirty Peritoneum	4 (3.1)	126 (63.0)	130 (39.6)	

Wound Class (CDC I–IV)	I	0 (0.0)	0 (0.0)	0 (0.0)	0.000
	II	125 (97.7)	54 (27.0)	179 (54.6)	
	III	3 (2.3)	99 (49.5)	102 (31.1)	
	IV	0 (0.0)	47 (23.5)	47 (14.3)	
ICU Requirement	Yes	22 (17.2)	75 (37.5)	97 (29.6)	0.000
	No	106 (82.8)	125 (62.5)	231 (70.4)	

T-test: duration of operation
Chi-square test/Fisher’s exact: indications of surgery, peritoneal contamination, wound class, ICU requirement.

Table III: Postoperative Outcomes

Variable	Sub groups	Elective (n=128)	Emergency (n=200)	Total (N=328)	p-value (chi square test)
Re-operation (%)	Yes	8 (6.2%)	55 (27.5%)	63 (19.2%)	0.000
	No	120 (93.75%)	145 (72.5%)	265 (80.8%)	
Readmission within 30 days (%)	Yes	8 (6.2%)	55 (27.5%)	63(19.2%)	0.000
	No	120 (93.75%)	145 (72.5%)	265 (80.8%)	
Mortality within 30 days (%)	Yes	3 (3.2%)	11(5.5%)	14 (4.2%)	0.000
	No	125 (97.85%)	189 (94.5%)	314 (95.8%)	
Length of Stay (mean ± SD)	days	6.9 ± 1.9	8.7±4.7	8.0±4.0	

All patients who underwent re-operation were also readmitted within 30 days; overlap explains identical values.

Table IV: Predictors of SSI

Variable	Odds Ratio (OR)	95% CI	p-value (Logistic Regression)
Age	0.99	0.97 – 1.02	0.875
Gender	0.95	0.47 – 1.91	0.888
ASA Class	1.37	0.82 – 2.30	0.234
Diabetes Mellitus	2.29	0.45 – 11.60	0.316
Duration of Operation	11.00	1.99 – 13.01	0.000
Peritoneal Contamination	7.19	3.58 – 14.45	0.000
ICU Required	1.12	0.44 – 2.84	0.814

Duration of operation and peritoneal contamination were identified as significant predictors of surgical site infection (p < 0.001).

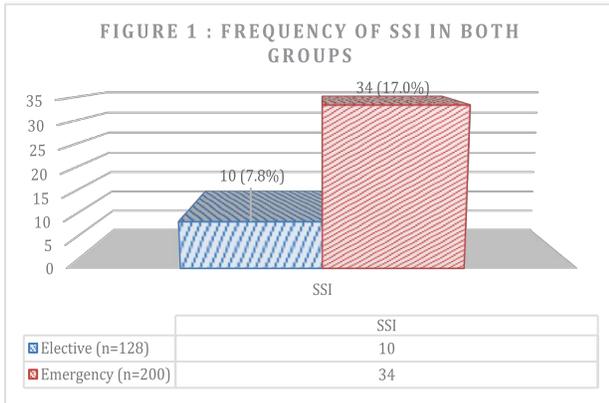


Figure 1: Frequency of SSI in both Groups.

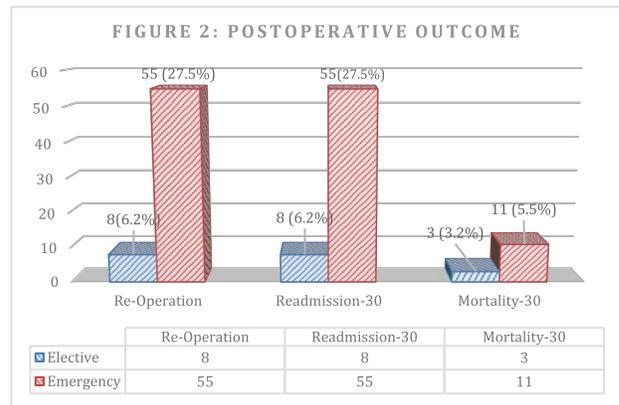


Figure 2: Postoperative Outcomes of Cohort

Discussion

The study revealed that surgical site infections (SSI) occurred more frequently and with greater postoperative morbidity in emergency procedures compared to elective procedures.⁵ This increased risk in emergency cases is likely due to delayed presentation, higher level of contamination, longer operative durations and inadequate preoperative optimization.^{5,13} The improved outcomes of our cohort highlighted the protective role of planned surgery and controlled operative conditions in elective surgery.

Age was not an independent predictor of SSI in our cohort, suggesting that rather than chronological

age alone, physiological status and comorbid burden determine postoperative infection.¹⁴ Similarly, the prevalence of comorbidities and higher ASA class did not independently predict SSI, consistently reported by Mukagendaneza et al. and Shamail Zahra et al.^{5,14} Gender did not significantly affect SSI rates following emergency surgery, consistent with reporting negligible differences.⁵

Although operative duration independently predict SSI, the longer duration of emergency surgeries likely reflects greater procedural complexity, severity of disease and elevated infection risk.^{5,15} Megahed et al. and Ansari et al. reported a disparity that strongly explains the higher SSI rates observed in emergency surgeries and corroborates our microbiological findings in patients predominantly with contaminated and dirty wound classes.^{7,15} It emphasizes the need for good source control and antimicrobial stewardship in emergency cases. The association between higher wound class and infection risk is well documented and corroborated by microbiological profiles observed in Maged et al. and Akter et al.^{7,16} There was reduction in positive culture at the second follow-up indicating good infection control and antibiotic therapy in elective cases claiming similarity with reports by Megahed et al. and Ortega et al.^{7,17} The elective cases had near normal wound healing at both follow-ups, whereas emergency cases demonstrated delayed healing and persistent infection in a subset of patients. This might be due to cumulative effect of contamination, emergency pathology and systemic stress on wound recovery and it might reinforce the importance of early intervention and standardized postoperative wound care protocols.⁷ Emergency procedures were reported with higher rates of reoperation, and prolonged hospital stay, necessity of readmission and higher morbidity and mortality.^{13,18} In conclusion this study demonstrated that emergency laparotomy is associated with significantly higher SSI rate and worse postoperative outcomes compared to elective laparotomy. The most critical modifiable predictor of SSI is adherent to peritoneal contamination, which highlight the need for prompt diagnosis, timely surgical intervention, optimization and infection prevention measures in emergency settings. Being a single-center observational study, the findings may have limited generalizability with other

institutions and populations. Despite these limitations, the study highlights important and clinically relevant differences between emergency and elective laparotomy. We recommend that future studies that are multicenter, detailed perioperative antibiotic protocols and stratification by wound contamination level to better define modifiable risk factors.

Conclusion

This study demonstrates that surgical site infections occur significantly more frequent and severe in emergency laparotomy compared to elective laparotomy. Peritoneal contamination, prolonged operative duration and intra-abdominal sepsis were strong predictors of SSI. Strategies aimed at early surgical intervention, effective contamination control, and optimized perioperative care may reduce infection rates and improve postoperative outcomes.

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REFERENCES

1. Kujath P, Michelsen A. Wounds – From Physiology to Wound Dressing. *Dtsch Arztebl Int.* 2008 Mar;105(13):239–48. doi:10.3238/arztebl.2008.0239 PubMed PMID: 19629204; PubMed Central PMCID: PMC2696775.
2. Ayandipo OO, Afuwape OO, Irabor D, Oluwatosin OM, Odigie V. Diathermy versus Scalpel Incision in a Heterogeneous Cohort of General Surgery Patients in a Nigerian Teaching Hospital. *Niger J Surg.* 2015;21(1):43–7. doi:10.4103/1117-6806.153193 PubMed PMID: 25838766; PubMed Central PMCID: PMC4382642.
3. Aga E, Keinan-Boker L, Eithan A, Mais T, Rabinovich A, Nassar F. Surgical site infections after abdominal surgery: incidence and risk factors. A prospective cohort study. *Infectious Diseases.* 2015 Nov 2;47(11):761–7. doi:10.3109/23744235.2015.1055587
4. Rezaei AR, Zienkiewicz D, Rezaei AR. Surgical site infections: a comprehensive review. *J Trauma Inj.* 2025 Jun;38(2):71–81. doi:10.20408/jti.2025.0019 PubMed PMID: 40571954; PubMed Central PMCID: PMC12229807.
5. Zahra S, Waris H, Khan BI, Zafar MH, Shahram H, Shafiq MH. Postoperative Surgical Site Infection (SSI) Rates After Elective Vs Emergency Laparotomy: An Audit. *Biological and*

- Clinical Sciences Research Journal. 2025 Aug 31;6(8):67–70. doi:10.54112/bcsrj.v6i8.1957.
6. Alam I, Amin S, Iqbal S, Samad M, Tahir R. THE FREQUENCY OF WOUND DEHISCENCE IN ADULTS UNDERGOING MIDLINE EXPLORATORY LAPAROTOMY IN A TERTIARY CARE HOSPITAL IN PESHAWAR. NORTHWEST JOURNAL OF MEDICAL SCIENCES. 2025 Sep 30;4(3). doi:10.69723/njms.04.03.0595.
 7. A. Megahed H, Taki-Eldin A, A. Mohamed A monem, Kh El-Syed Ibrahim M, Abdel Aziz AA, A. Megahed H, et al. Risk Factors for Surgical Site Infections in Elective and Emergency Surgeries: A Prospective Cohort Study. Med J Islam Repub Iran. 2025 Apr 15;39:55. doi:10.47176/mjiri.39.55 PubMed PMID: 40740553; PubMed Central PMCID: PMC12309327.
 8. Campwala I, Unsell K, Gupta S. A Comparative Analysis of Surgical Wound Infection Methods: Predictive Values of the CDC, ASEPSIS, and Southampton Scoring Systems in Evaluating Breast Reconstruction Surgical Site Infections. Plast Surg (Oakv). 2019 May;27(2):93–9. doi:10.1177/2292550319826095 PubMed PMID: 31106164; PubMed Central PMCID: PMC6505358.
 9. Koppolu S, Mittal G, Pascal S, Variya Takodara Y, Singh AA. Factors Influencing Surgical Site Infections in a Tertiary Care Hospital: A Prospective Analysis. Cureus. 16(10):e72767. doi:10.7759/cureus.72767 PubMed PMID: 39618578; PubMed Central PMCID: PMC11608075.
 10. Nawab U, Ashraf I, Ayub A, Tahir M, Nawab M, Javed H. Comparison of Frequency of Surgical Site Infection in Patients of Peritonitis Undergoing Laparotomy with Closed Wound and Drain Placed vs Open Wound Without Drain. Pakistan Armed Forces Medical Journal. 2025 Jul 31;75(SUPPL-5):S763–7. doi:10.51253/pafmj.v75iSUPPL-5.12052.
 11. Hamid T, Khan K, Farhana, Ali M, Ayoob S, Ahmed HH. Incidence and Predictors of Surgical Site Infections in General Surgery Departments of Public Sector Hospitals. Pakistan Journal of Medical & Health Sciences. 2023 Jul 30;17(07):66–66. doi:10.53350/pjmhs202317766.
 12. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. J Clin Epidemiol. 2008 Apr;61(4):344–9. doi:10.1016/j.jclinepi.2007.11.008 PubMed PMID: 18313558.
 13. Gowthaam Ramesh, R M, aykanthan N, Selvaraj K. Surgical Site Infection After Abdominal Surgery: Distribution and Determinants From a Cross-Sectional Study | Cureus [Internet]. [cited 2026 Jan 3]. Available from: <https://www.cureus.com/articles/397068-surgical-site-infection-after-abdominal-surgery-distribution-and-determinants-from-a-cross-sectional-study#!/>.
 14. Mukagendaneza MJ, Munyanza E, Muhawenayo E, Nyirasebura D, Abahuje E, Nyirigira J, et al. Incidence, root causes, and outcomes of surgical site infections in a tertiary care hospital in Rwanda: a prospective observational cohort study. Patient Saf Surg. 2019;13:10. doi:10.1186/s13037-019-0190-8 PubMed PMID: 30820247; PubMed Central PMCID: PMC6378727.
 15. Ansari SS, Shakila, Naeem M, Mustafa A, Ashraf Z, Mooghal M. Frequency of Surgical Site Infection in Patients Undergoing Exploratory Laparotomy in Tertiary Care Hospital, Karachi. Pakistan Journal of Medicine and Dentistry. 2025 Apr 13;14(2):327–33. doi:10.36283/ziun-pjmd14-2/050.
 16. Akter DMB, Bahar DMAA, Islam DMT, Baishnab DAK, Quadir DMA, Haque DMF, et al. Incidence of surgical site infections after emergency laparotomy for perforation peritonitis. Int J Surg Sci. 2021;5(2):335–8. doi:10.33545/surgery.2021.v5.i2f.718.
 17. Ortega G, Rhee DS, Papandria DJ, Yang J, Ibrahim AM, Shore AD, et al. An evaluation of surgical site infections by wound classification system using the ACS-NSQIP. J Surg Res. 2012 May 1;174(1):33–8. doi:10.1016/j.jss.2011.05.056 PubMed PMID: 21962737.
 18. Frassini S, Cobiauchi L, Fugazzola P, Biffi WL, Coccolini F, Damaskos D, et al. ECLAPTE: Effective Closure of LAParotomy in Emergency—2023 World Society of Emergency Surgery guidelines for the closure of laparotomy in emergency settings. World Journal of Emergency Surgery. 2023 Jul 26;18(1):42. doi:10.1186/s13017-023-00511-w.

CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

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DATA SHARING STATEMENT

The data that support the findings of this study are available from the corresponding author upon request.

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