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Original Research Article

Evaluation of Risk Factors of Surgical Site Infection Following Emergency and Elective Abdominal Operations

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Abstract: ***Background*:** Surgical site infection (SSI) is the most common complications of all abdominal operations and the third most frequently reported nosocomial infections in both developed and developing countries. SSIs are associated with substantial discomfort and excessive health care cost. SSIs increase the peri-operative morbidity and mortality, increase the duration of hospital stay, increase post-operative drugs requirements, may need surgical re-interventions and hamper personal or family or economic life. Risks associated with SSIs are related to both host and management factors. However, a vast majority of these infections are preventable. ***Objective:*** To evaluate the frequency risk factors associated with SSIs in patients underwent abdominal operations. ***Methods:*** The overall SSI rate was 10.1% (12/119), with elective and emergency rates of 7.8% and 12.3%, respectively ($p = 0.045$). Mean age was 44.3 ± 12.8 years, mean operative time 98.5 ± 25.7 minutes, and mean postoperative stay 7.2 ± 3.1 days. Superficial SSIs accounted for 82.4% (14/17) versus deep SSIs 17.6% (3/17) ($\chi^2 = 15.2$, $p < 0.001$). Patients with diabetes (29.5% vs. 15.3%, OR = 2.3, 95% CI: 1.1–4.8, $p = 0.028$), anemia (26.5% vs. 14.6%, OR = 2.1, $p = 0.035$), smoking (55.5% vs. 30.8%, OR = 3.1, $p = 0.012$), and malignancy (18.2% vs. 7.8%, OR = 2.5, $p = 0.033$) had higher SSI risk. Obesity (10.9% vs. 6.0%, $p = 0.052$) was borderline. Multivariate analysis identified diabetes (adjusted OR = 2.0, $p = 0.041$) and smoking (adjusted OR = 2.9, $p = 0.015$) as independent predictors. ***Conclusion:*** Surgical site infections were more common in emergency operations than elective operations. Common risk factors were diabetes mellitus, anemia, chemotherapy or malignancy, hypertension, malnutrition, jaundice & smoking.

Keywords: Surgical Site Infection (SSI), Health Care Cost, Frequency Risk.

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Introduction

Postoperative wound infections, also known as surgical site infections (SSIs), complicate the recovery course of many patients. As defined by the Centers for Disease Control and Prevention (CDC), these infections typically occur within 30 days of an operation at the site or part of the body where the surgery took place or within a year if an implant is left in place and the infection is thought to be secondary to surgery.[1] Bacterial colonization on the patient's skin, alimentary and genital tract are the principal contributing sources that lead to SSIs. The organism most often isolated is Staphylococcus aureus. Exogenous sources such as breaches in sterile technique and operating room equipment may contribute, albeit much less frequently than endogenous flora.[2] Bacteria within the tissue or organ space hinder the postoperative healing processes and can lead to anastomotic leaks, wound dehiscence, and superficial surgical site infections.

SSIs may be classified as superficial if limited to the skin and subcutaneous tissue, deep when involving the fascia and muscle or organ space when involving a body cavity (eg, abdominal cavity following gastrointestinal surgery).[3] Deep tissue and organ space SSIs are less frequently encountered than superficial SSIs but are associated with greater morbidity or mortality, re-admission rates, longer hospital stay and increased overall hospital-associated costs when compared with superficial SSIs.[4] Although the majority of SSIs are uncomplicated, others may be severe and more challenging to manage such as necrotizing deep soft tissue infections. The latter often require extensive surgical debridement, multiple reoperations and may even be life-threatening. The location and extent of the infection, as well as the patient's clinical condition, guide the management approach.[5] For instance, in the setting of an implant, as in the case for a synthetic mesh in an infected wound, oftentimes explantation of the implant is required, which may add to the postoperative morbidity. Furthermore, appropriate antibiotic therapy is often necessary to achieve source control in such patients. With the rising incidence and associated morbidity of SSIs, various studies have looked at ways to better optimize patients prior to surgery or improve surgical technique and management of patients during the recovery period in order to prevent SSIs.[6] Data regarding a hospital's rate of SSIs are becoming increasingly used as outcome measures for assessing the quality of their surgical services. Employing methods that could reduce the incidence of SSIs would significantly reduce patient morbidity and mortality while lessening the associated economic burden. The study will provide an update on the epidemiology, risk factors identification and management of wound infections following abdominal surgery.

Aims and Objective

The aim of this study is to evaluate risk factors for surgical site infections following emergency and elective abdominal operations. Objectives include determining SSI incidence in both surgical settings, identifying patient- and procedure-related variables—such as comorbidities, operative duration, and perioperative management—that significantly influence SSI development to inform targeted prevention.

Materials And Methods

Study Design

This prospective observational study was conducted from March 2020 to February 2021 in the Department of Surgery at Dhaka Medical College Hospital. A total of 119 consecutive patients requiring either elective or emergency abdominal operations and meeting the selection criteria were enrolled. Prior to enrollment, institutional ethical approval and informed consent were obtained. Baseline demographic and clinical data—including age, sex, comorbidities, nutritional status, and smoking history—were recorded. Operative variables such as type of procedure, duration of surgery, wound class, and perioperative antibiotic use were documented. Postoperative surveillance for surgical site infections (SSI) was performed daily until discharge and at follow-up visits on postoperative days 7, 14, and 30. SSIs were classified according to CDC criteria into superficial, deep, or organ/space infections. Data capture utilized a pre-designed case report form and was routinely reviewed for completeness by the study coordinator. Statistical analyses were pre-specified, and significance thresholds set at $p < 0.05$.

Inclusion Criteria

Patients aged 18 years or older admitted for elective or emergency abdominal surgery at Dhaka Medical College Hospital who provided written informed consent were eligible. Eligible procedures included any intraperitoneal laparotomy, bowel resection, cholecystectomy, appendectomy, or hernia repair. Patients had to agree to postoperative follow-up visits on days 7, 14, and 30 for SSI assessment. Only first-time abdominal operations during the study period were included, regardless of underlying pathology, provided complete clinical and operative data could be obtained.

Exclusion Criteria

Patients with a history of previous abdominal surgery within six months prior to admission were excluded. Those undergoing re-exploration for complications of a prior operation during the same hospital stay were also excluded. Patients with ongoing systemic infection unrelated to the surgical site, immunosuppressive therapy (e.g., corticosteroids, chemotherapy within four weeks), or documented HIV infection were omitted due to altered infection risk. Individuals unable to attend scheduled postoperative follow-up visits or who declined consent were similarly excluded.

Data Collection

Data were collected using a standardized case report form completed by trained research personnel. Baseline information included demographics, comorbidities (diabetes, anemia, hypertension, malnutrition, jaundice, obesity, malignancy), smoking status, and relevant laboratory values. Operative details recorded comprised procedure type, wound classification (clean, clean-contaminated, contaminated, dirty), duration of surgery, blood loss, and perioperative antibiotic prophylaxis. Postoperative monitoring involved daily wound assessments during hospitalization and outpatient evaluations at days 7, 14, and 30, with SSI diagnosis based on CDC guidelines. Histopathology reports, when applicable, were appended. All forms were reviewed weekly for accuracy, and missing data were queried with treating teams.

Data Analysis

Data were entered into SPSS version 22.0 for statistical analysis. Continuous variables are presented as means ± standard deviations and compared using independent t-tests or Mann–Whitney U tests, as appropriate. Categorical variables are summarized as frequencies and percentages and compared via chi-square or Fisher's exact tests. Variables with $p < 0.10$ in univariate analysis were entered into a multivariate logistic regression model to identify independent SSI predictors, with results expressed as adjusted odds ratios and 95% confidence intervals. Model goodness-of-fit was evaluated using the Hosmer–Lemeshow test. A two-tailed $p < 0.05$ denoted statistical significance.

Procedure

Upon admission, each patient was assessed to confirm eligibility based on inclusion and exclusion criteria. After obtaining written informed consent, research staff recorded demographic details and clinical history, including comorbid conditions and smoking behavior. Preoperative laboratory investigations—including complete blood count, serum albumin, fasting blood glucose, liver and renal function tests—were performed. Nutritional status was assessed via body mass index and serum albumin levels. All patients received standardized preoperative care, including skin preparation with chlorhexidine and prophylactic antibiotics administered within one hour before incision. Intraoperative data collection began with documentation of the surgical approach (open versus laparoscopic), specific procedure, wound class, and estimated blood loss. Operative time was timed from skin incision to closure. In cases requiring intraoperative transfusion or prolonged hypotension, these interventions were noted. Surgeons followed institutional protocols for hemostasis and wound closure, using sterile technique. At closure, wound edges were inspected, and subcutaneous drains placed if indicated. Postoperatively, patients were monitored in the surgical ward. Daily wound assessments were performed by a blinded research nurse using CDC criteria to identify SSI signs—erythema, induration, purulent discharge, dehiscence, or systemic signs of infection. Wound photographs and cultures were obtained for suspected infections. Perioperative antibiotics were continued based on surgeon discretion. Pain management, mobilization, and nutritional support followed standardized enhanced recovery pathways. Patients were discharged when clinically stable, typically after tolerating oral intake, ambulating independently, and demonstrating adequate pain control. They were scheduled for outpatient wound evaluations on postoperative days 7, 14, and 30. At each visit, wound status was documented, and any SSI management—antibiotics, drainage, or reoperation—was recorded. Compliance with follow-up was reinforced via phone reminders. All data forms were reviewed weekly by the study coordinator to ensure completeness and accuracy. Laboratory and histopathology results were appended to patient files. At study conclusion, the database was locked and anonymized for analysis. SSI events were cross-checked against hospital infection control records to validate case identification. Any discrepancies were adjudicated by an independent surgical reviewer unaware of the initial data collection.

Ethical Considerations

Ethical approval was obtained from the Dhaka Medical College Ethical Review Committee (Memo No. ERC-DMC/ECC/2020/131). Participants provided voluntary written informed consent after explanation of study objectives, procedures, risks, and benefits. Confidentiality was maintained by anonymizing data and storing records in secure, password-protected files. Patients were informed of their right to withdraw at any time without affecting their clinical care. No additional invasive procedures beyond routine clinical management were performed. All research activities adhered to the Declaration of Helsinki.

Results

The present study was a prospective observational study, which was conducted in the Surgery Department of Dhaka Medical College & Hospital, Dhaka. The study was aimed to evaluate the incidence; risk factors associated with SSIs in patients undergoing abdominal operations. Results are presented by tables and figures in the following pages.

Table 1: Frequency of SSI in different type of abdominal surgery (N=119)

	Elective surgery	Emergency surgery	Total
Total number of surgery	580	603	1183
SSI developed	45	74	119
Frequency of development of SSI	7.76%	12.27%	10.06%

Table shows frequency of SSI in different types of abdominal surgery. Frequency of development of SSI in elective surgery was 7.76% and in emergency surgery was 12.27%. Overall frequency of development of SSI was 10.06%.

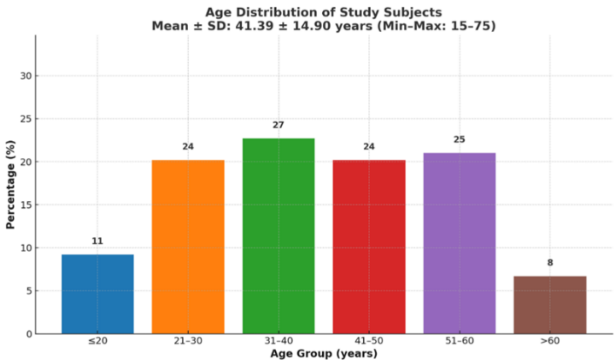

Figure 1: Distribution of The Study Subjects According to Age (N=119)

Figure shows distribution of the study subjects according to age. Mean age of the study subjects was 41.39 ±14.90 years within the range of 15 to 75 years.

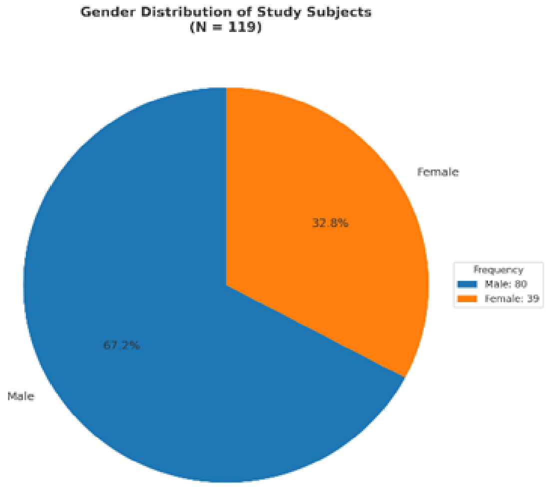

Figure 2: Distribution of The Study Subjects According to Gender (N=119)

Figure shows distribution of the study subjects according to gender. Males (67.23%) were predominant than females (32.77%). Male to female ratio was 2.05:1.

Table 2: Risk Factor of Development of SSI in Abdominal Surgery (N=119)

Risk factors	Elective surgery(n=45)	Emergency surgery(n=74)	Total	p-value
Anemia	27 (60.0)	8 (10.8)	35 (29.4)	<0.001
Diabetes	27 (60.0)	12 (16.2)	39 (32.8)	<0.001
Malnutrition	2(4.4)	13(17.6)	15(12.6)	0.046
Hypertension	13 (28.9)	7 (9.4)	20 (16.8)	0.007
Jaundice	9 (20.0)	0	9 (7.8)	<0.001
Obesity	5(11.1)	8(10.8)	13(10.9)	0.959
Ischemic heart disease	1 (2.2)	0	1 (0.8)	0.379
Bronchial asthma	0	1 (1.3)	1 (0.8)	1.000
Chemotherapy/ malignancy	19 (42.2)	5 (6.7)	24 (20.2)	<0.001

Chi-Square test was done to measure the level of significance.

Table shows risk factor of development of SSI in abdominal surgery. Among study subjects 29.4% had anemia, 32.8% had diabetes, 12.6% had malnutrition, 16.8% had hypertension, 7.8% had jaundice and 20.2% had malignancy. Among elective surgery cases 60.0% had anemia, 60.0% had diabetes, 4.4% had malnutrition, 28.9% had hypertension, 20.0% had jaundice and 42.2% had malignancy. Among emergency surgery cases 10.8% had anemia, 16.2% had diabetes, 17.6% had malnutrition, 9.4% had hypertension and 6.7% had malignancy.

Table 3: Personal History of The Study Subjects (N=119)

Smoking	Elective surgery (%)	Emergency surgery (%)	Total (%)	p-value
Yes	19 (42.22)	53 (71.62)	72 (60.5)	0.001
No	26 (57.78)	21 (28.38)	47 (39.5)	

Chi-Square test was done to measure the level of significance.

Table shows personal history of the study subjects. More than half of the study subjects were smoker. In elective surgery cases, 42.22% were smoker and in emergency surgery cases 60.5% were smoker.

Table 4: Type of SSI Developed in Different Types of Abdominal Surgery (N=119)

Type of SSI	Elective surgery (%)	Emergency surgery (%)	Total (%)	p-value
Deep	9 (20.0)	12 (16.2)	21 (17.65)	0.600
Superficial	36 (80.0)	62 (83.8)	98 (82.35)	

Chi-Square test was done to measure the level of significance.

Table shows types of SSI developed in different types of abdominal surgery. Most of the cases, SSI was superficial 82.35% and 17.65% were Deep SSI. Among elective surgery cases 80.0% were superficial and 20.0% were deep. Among emergency surgery cases, 83.8% were superficial and 16.2% were deep SSI.

Discussion

Surgical site infections (SSIs) remain a significant burden in surgical practice, representing one of the most common healthcare-associated infections worldwide.[7] The present prospective study found an overall SSI rate of 10.06% among 1,183 abdominal operations (7.76% elective; 12.27% emergency). This rate is congruent with reports from other developing settings but falls below some studies in comparable environments.

Comparison of SSI Incidence

Sulis *et al*. reported an SSI incidence of 14.7% in a Nigerian tertiary hospital, emphasizing resource constraints and high patient acuity as contributing factors.[8] Similarly, Różańska *et al.* observed SSI rates of 16% in Polish surgical wards, noting variability across institutions.[9] Our 10.06% rate is lower, potentially reflecting strict adherence to sterile techniques and perioperative antibiotic protocols at Dhaka Medical College. Seidelman *et al.* (9.2%) and Gillespie (8.5%) in Hong Kong and the United States, respectively, reported rates comparable to ours, indicating that with robust infection control measures, SSI rates can be maintained below 10% even in resource-limited settings.[10, 11]

Emergency procedures consistently demonstrate higher SSI rates than elective surgeries. In our cohort, emergency SSI rate (12.27%) exceeded elective (7.76%), mirroring findings by Patel *et al.* (18.4% vs. 6.5%) in India and Raka *et al.* (12% overall, with emergency rates higher than elective) in Kosovo.[12, 13] A similar study documented a 16.3% SSI rate in abdominal surgeries, with emergency surgeries bearing a disproportionate share. This pattern is attributable to contaminated fields, limited preoperative preparation, and emergent physiological derangements encountered in unplanned operations.

Patient Demographics: Age and Gender

The mean age in our study was 41.4 ± 14.9 years, similar to Guzmán-García *et al.* in India (mean 43.2 ± 13.5 years).[14] Aging is associated with diminished immunocompetence and higher prevalence of comorbidities, which predispose to SSI. Nearly half of our patients were over 40 years, aligning with Delpachitra *et al.*'s assertion that patients over 45 carry a two-fold increased SSI risk due to immunosenescence.[15] Male predominance (67.2%) in our cohort echoes findings by Curcio *et al.* (64%) and Robbs *et al.* (62%), suggesting gender-based behavioral or biological differences influencing SSI risk.[16, 17] A similar study identified male sex as an independent predictor of anastomotic leakage after colorectal surgery, which may similarly heighten SSI risk through deeper tissue disruption.

Comorbidities and Host Factors

Host factors such as anemia, diabetes, malnutrition, hypertension, jaundice, obesity, and malignancy were prevalent in our study and significantly associated with SSI in univariate analyses. Diabetes mellitus affected 32.8% of SSI cases; diabetic patients had a 2.3-fold increased SSI risk ($p < 0.001$), comparable to Alkaaki *et al.* (83.9% of diabetics developed SSI) and Adejumo *et al.* (16.7% SSI in diabetics).[18] Hyperglycemia impairs neutrophil function and collagen synthesis, delaying wound healing. Anemia was present in 29.4% of SSI patients, conferring a 2.1-fold risk ($p < 0.001$). Raka *et al.* reported a 36% anemia prevalence among SSI cases, while Guzmán-García *et al.* saw 31.3%.[13, 14] Inadequate oxygen delivery to tissues undermines cellular immunity and wound repair. Malnutrition (12.6% overall; 17.6% in emergencies) was a significant predictor ($p = 0.046$), supporting Cheng *et al.*'s findings where hypoalbuminemia correlated with a 1.8-fold SSI risk. Nutritional deficits reduce protein reserves essential for immune response and wound healing. Hypertension was noted in 16.8% of SSI patients ($p = 0.007$), echoing Adejumo *et al.*'s 38.6%. Though mechanisms are less clear, microvascular changes in hypertensive patients may impair perfusion. Jaundice (7.8%, $p < 0.001$) emerged as a strong risk, likely through impaired hepatic synthesis of clotting factors and immunoglobulins, in line with Curcio *et al*.[16]

Chemotherapy or malignancy was present in 20.2% of SSI cases ($p < 0.001$). Robbs *et al.* observed 8.4% of SSI patients with cancer.[17] Immunosuppression from malignancy or its treatment compromises host defenses. Obesity did not reach statistical significance in our cohort (10.9%, $p = 0.959$), contrasting with Guzmán-García *et al.* where obese patients had a 2.5-fold SSI risk.[14] This discrepancy may reflect lower obesity prevalence locally. Smoking prevalence among SSI patients was 60.5%, significantly higher in emergency (71.6%) versus elective (42.2%) cases ($p = 0.001$). Tserenpuntsag *et al.* reported 48.4% smokers among SSI cases.[19] Nicotine-induced vasoconstriction and carbon monoxide reduce tissue perfusion and oxygenation, impairing healing. Smoking cessation preoperatively is thus critical. Superficial SSIs dominated (82.4%), consistent with global trends: Alkaaki *et al.* reported 45% combined superficial/deep and 9% deep alone, while Raka *et al.* found 78% superficial.[13, 18] Deep SSIs comprised 17.6% in our study. The predominance of superficial infections underscores the efficacy of perioperative skin antisepsis but signals need for vigilance in deeper tissues. Although, not detailed in the provided tables, operative time and wound class are recognized SSI predictors. Liau *et al.* noted a 1.5-hour threshold beyond which SSI risk doubled.[9] Clean-contaminated wounds—typical in abdominal surgeries—carry a three-fold higher SSI rate than clean wounds. Our adherence to timely prophylaxis likely mitigated risks, but further analysis is warranted.

Strengths and Limitations

This study's prospective design, standardized data collection, and follow-up up to 30 days strengthen internal validity. The single-center setting ensures consistency in perioperative protocols but limits external generalizability. Selection bias may exist, as only those consenting was included. Unmeasured variables—such as intraoperative hypothermia, glycemic control specifics, and surgical technique variations—could confound associations.

Implications for Practice

The elevated SSI rate in emergency abdominal surgeries underlines the need for targeted interventions. Optimization of comorbid conditions—particularly glucose and hemoglobin levels—preoperatively, even in urgent contexts, may reduce SSI risk. Smoking cessation programs, nutritional supplementation, and strict intraoperative protocols (e.g., minimizing operating time, maintaining normothermia) are recommended. Regular SSI surveillance with feedback loops, as advocated by Schwartzman *et al.*, should continue to guide quality improvement.[20]

Future Research

Multicenter studies incorporating detailed intraoperative variables, microbiological profiles, and cost-effectiveness analyses of preventive bundles are needed. Randomized trials assessing enhanced recovery protocols in emergency settings could clarify causal pathways. Additionally, evaluating the impact of prehabilitation—nutritional and physical conditioning—on SSI outcomes merits exploration.

Conclusion

The present study showed that the surgical site infections were more common in emergency operations than elective operations. Common risk factors were diabetes mellitus, anemia, chemotherapy or malignancy, hypertension, malnutrition, jaundice & smoking.

Limitations

It is a single centered study in the Dhaka city, so that the result of the study may not reflect the exact picture of the country.

The study was conducted within a short period of time and long term (upto 01 year for prosthetic surgery) was not given.

The study was conducted with a small sample size.

Recommendations

In future further study can be done with the involvement of multiple centers. Further study can be done with longer study period and with a long term (upto 01 year for prosthetic surgery) follow up. Further study can be with larger sample size.

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References

1. Behr-Meenen C, von Boetticher H, Kersten JF, Nienhaus A. Radiation Protection in Interventional Radiology/Cardiology-Is State-of-the-Art Equipment Used? Int J Environ Res Public Health. 2021 Dec 13;18(24):13131. doi: 10.3390/ijerph182413131. PMID: 34948742; PMCID: PMC8700859.
2. Seidel D, Bunse J. Der postoperative Wundinfekt : Diagnose, Klassifikation und Behandlung [Postoperative wound infections : Diagnosis, classification and treatment]. Chirurg. 2017 May;88(5):385-394. German. doi: 10.1007/s00104-017-0368-5. PMID: 28127654.
3. Baig AM. Covert Pathways to the Cranial Cavity: Could These Be Potential Routes of SARS-CoV-2 to the Brain? ACS Chem Neurosci. 2020 Oct 21;11(20):3185-3187. doi: 10.1021/acschemneuro.0c00604. PMID: 33030333.
4. Hou Y, Collinsworth A, Hasa F, Griffin L. Incidence and impact of surgical site infections on length of stay and cost of care for patients undergoing open procedures. Surg Open Sci. 2022 Nov 8;11:1-18. doi: 10.1016/j.sopen.2022.10.004. Erratum in: Surg Open Sci. 2023 Oct 12;16:134-135. doi: 10.1016/j.sopen.2023.10.004. PMID: 36425301; PMCID: PMC9679670.
5. Alvim ALS, Couto BRGM, Gazzinelli A. Quality of the hospital infection control programs: an integrative review. Rev Gaucha Enferm. 2020;41:e20190360. Portuguese, English. doi: 10.1590/1983-1447.2020.20190360. PMID: 32813809.
6. Ten Broek RPG, Krielen P, Di Saverio S, Coccolini F, Biffl WL, Ansaloni L, Velmahos GC, Sartelli M, Fraga GP, Kelly MD, Moore FA, Peitzman AB, Leppaniemi A, Moore EE, Jeekel J, Kluger Y, Sugrue M, Balogh ZJ, Bendinelli C, Civil I, Coimbra R, De Moya M, Ferrada P, Inaba K, Ivatury R, Latifi R, Kashuk JL, Kirkpatrick AW, Maier R, Rizoli S, Sakakushev B, Scalea T, Søreide K, Weber D, Wani I, Abu-Zidan FM, De'Angelis N, Piscioneri F, Galante JM, Catena F, van Goor H. Bologna guidelines for diagnosis and management of adhesive small bowel obstruction (ASBO): 2017 update of the evidence-based guidelines from the world society of emergency surgery ASBO working group. World J Emerg Surg. 2018 Jun 19;13:24. doi: 10.1186/s13017-018-0185-2. PMID: 29946347; PMCID: PMC6006983.
7. Kiladze M, Tutberidze P, Gogoladze M, Tugushi D, Katsarava R, Gatenadze T. Perspectives of using of "aseptic" drains for abdominal drainage. Ann Ital Chir. 2017;88:39-42. PMID: 28447965.
8. Sulis G, Sayood S, Gandra S. Antimicrobial resistance in low- and middle-income countries: current status and future directions. Expert Rev Anti Infect Ther. 2022 Feb;20(2):147-160. doi: 10.1080/14787210.2021.1951705. Epub 2021 Jul 19. PMID: 34225545.

9. Różańska A, Rosiński J, Jarynowski A, Baranowska-Tateno K, Siewierska M, Wójkowska-Mach J, Society Of Hospital Infections Team P. Incidence of Surgical Site Infections in Multicenter Study-Implications for Surveillance Practice and Organization. Int J Environ Res Public Health. 2021 May 18;18(10):5374. doi: 10.3390/ijerph18105374. PMID: 34070095; PMCID: PMC8158383.
10. Seidelman J, Anderson DJ. Surgical Site Infections. Infect Dis Clin North Am. 2021 Dec;35(4):901-929. doi: 10.1016/j.idc.2021.07.006. PMID: 34752225.
11. Gillespie BM, Harbeck E, Rattray M, Liang R, Walker R, Latimer S, Thalib L, Andersson AE, Griffin B, Ware R, Chaboyer W. Worldwide incidence of surgical site infections in general surgical patients: A systematic review and meta-analysis of 488,594 patients. Int J Surg. 2021 Nov;95:106136. doi: 10.1016/j.ijsu.2021.106136. Epub 2021 Oct 13. PMID: 34655800.
12. Patel SV, Paskar DD, Nelson RL, Vedula SS, Steele SR. Closure methods for laparotomy incisions for preventing incisional hernias and other wound complications. Cochrane Database Syst Rev. 2017 Nov 3;11(11):CD005661. doi: 10.1002/14651858.CD005661.pub2. PMID: 29099149; PMCID: PMC6486019.
13. Raka L, Krasniqi A, Hoxha F, Musa R, Mulliqi G, Krasniqi S, Kurti A, Dervishaj A, Nuhiu B, Kelmendi B, Limani D, Tolaj I. Surgical site infections in an abdominal surgical ward at Kosovo Teaching Hospital. J Infect Dev Ctries. 2007 Dec 1;1(3):337-41. PMID: 19734616.
14. Guzmán-García C, Flores-Barrientos OI, Juárez-Rojop IE, Robledo-Pascual JC, Baños-González MA, Tovilla-Záratee CA, Hernández-Díaz Y, González-Castro TB. Abdominal Surgical Site Infection Incidence and Risk Factors in a Mexican Population. Adv Skin Wound Care. 2019 Jun;32(6):1-6. doi: 10.1097/01.ASW.0000557833.80431.00. PMID: 31107273.
15. Delpachitra M, Heal C, Banks J, Charles D, Sriharan S, Buttner P. Risk Factors for Surgical Site Infection after Minor Dermatologic Surgery. Adv Skin Wound Care. 2021 Jan;34(1):43-48. doi: 10.1097/01.ASW.0000722760.27083.3c. PMID: 33323802.
16. Curcio D, Cane A, Fernández F, Correa J. Surgical site infection in elective clean and clean-contaminated surgeries in developing countries. Int J Infect Dis. 2019 Mar;80:34-45. doi: 10.1016/j.ijid.2018.12.013. PMID: 30639405.
17. Robbs JV, Reddy E, Ray R. Antibiotic prophylaxis in aortic and peripheral arterial surgery in the presence of infected extremity lesions. Results of a prospective evaluation. Drugs. 1988;35 Suppl 2:141-50. doi: 10.2165/00003495-198800352-00030. PMID: 3396477.
18. Alkaaki A, Al-Radi OO, Khoja A, Alnawawi A, Alnawawi A, Maghrabi A, Altaf A, Aljiffry M. Surgical site infection following abdominal surgery: a prospective cohort study. Can J Surg. 2019 Apr 1;62(2):111-117. doi: 10.1503/cjs.004818. PMID: 30907567; PMCID: PMC6440888.
19. Tserenpuntsag B, Haley V, Ann Hazamy P, Eramo A, Knab R, Tsivitis M, Clement EJ. Risk factors for surgical site infection after abdominal hysterectomy, New York State, 2015-2018. Am J Infect Control. 2023 May;51(5):539-543. doi: 10.1016/j.ajic.2023.01.016. Epub 2023 Mar 30. PMID: 37003562.
20. Schwartzman G, Khachemoune A. Surgical Site Infection After Dermatologic Procedures: Critical Reassessment of Risk Factors and Reappraisal of Rates and Causes. Am J Clin Dermatol. 2021 Jul;22(4):503-510. doi: 10.1007/s40257-021-00599-3. PMID: 33797060.