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Prevalence of SSIs, Investigate Associated Risk Factors and Comorbidities, and Assess the Impact of Antibiotics on Their Occurrence among Patients

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Abstract | **Original Research Article**

***Background*:** Surgical site infections (SSIs) are among the most common healthcare-associated infections worldwide, leading to increased morbidity, prolonged hospital stay, and higher healthcare costs. Despite advances in surgical care, SSIs remain a significant burden in low- and middle-income countries due to resource constraints and patient-related risk factors. ***Objective*:** To determine the prevalence of SSIs, identify associated patient- and procedure-related risk factors, and evaluate the impact of comorbidities and antibiotic use among post-operative patients in a tertiary hospital in Dhaka, Bangladesh. ***Methods*:** A facility-based cross-sectional study was conducted from June 2023 to June 2024, including 236 post-operative patients admitted for at least 72 hours. Data on socio-demographic characteristics, clinical parameters, surgical and wound-related factors, antibiotic use, and post-operative outcomes were collected using a structured checklist from medical records, patient interviews, and clinical observation. Descriptive statistics summarized the prevalence of SSIs, while binary and multivariable logistic regression analyses identified factors associated with infection. Statistical significance was set at $p < 0.05$. ***Results*:** The overall prevalence of SSI was 9.8%, with 70.1% being superficial and 29.9% deep infections. Orthopaedic procedures accounted for the majority of surgeries (66.9%) and had an SSI rate of 11.4%, while neurosurgical procedures, although few, showed the highest SSI proportion (33.3%). SSI occurrence was higher among smokers (30.2% vs. 3.4% in non-smokers), patients receiving blood transfusions (16.8% vs. 5.7%), non-ambulating patients (36.0% vs. 2.1%), older patients over 40 years (54.2%), and those with contaminated/dirty wounds (28.6%). Longer operative duration (>3 hours) was also associated with increased SSI risk (33.3%). Most patients were young (61.9% aged 18–24 years), male, and had primary-level education, while comorbidities were present in 98.7% of participants. ***Conclusion*:** SSI prevalence in this tertiary hospital was moderate, with higher risk observed in older patients, smokers, those undergoing prolonged surgeries, non-ambulating patients, and those with contaminated wounds. Preventive strategies including pre-operative optimization, reduction of operative time, meticulous wound care, and early post-operative mobilization are crucial to reducing SSIs and improving surgical outcomes in similar settings.

Keywords: Surgical Site Infection (SSI), Orthopaedic Surgery, Wound Care.

INTRODUCTION

Surgical site infections (SSIs) are among the most common healthcare-associated infections, contributing substantially to patient morbidity and mortality worldwide. Defined as infections occurring at or near the surgical incision within 30 days of a procedure, SSIs can complicate recovery, prolong hospital stays, and increase healthcare costs. Despite advances in surgical techniques and infection prevention practices, SSIs remain a significant burden across healthcare settings, particularly in low- and middle-income countries where resource constraints often impede optimal perioperative care [1-3].

The prevalence of SSIs varies widely due to differences in surgical procedures, healthcare infrastructure, infection control practices, and patient populations. Globally, rates have been reported from less than 2% in some developed settings to over 20% in high-risk or resource-limited environments. Understanding the true prevalence is crucial for health systems to allocate appropriate resources and design targeted interventions. Accurate surveillance and reporting serve as the foundation for recognizing trends, benchmarking performance, and guiding quality improvement initiatives [4, 5].

Associated risk factors for SSIs are multifactorial, encompassing patient-related, procedure-related, and environmental determinants. Patient-related factors such as advanced age, obesity, poor nutritional status, and immunosuppression compromise host defenses and increase vulnerability to infection. Procedure-related characteristics, including longer operative times, emergency surgeries, and breaches in asepsis, further elevate risk. Environmental factors like operating room sterility and adherence to antiseptic protocols also significantly influence SSI occurrence [6, 7].

Comorbidities play a pivotal role in SSI risk, with conditions such as diabetes mellitus, chronic kidney disease, and smoking status frequently linked with higher infection rates. These comorbid states impair wound healing and immune responses, making it challenging for the body to resist microbial invasion at surgical sites. Additionally, the rising global prevalence of noncommunicable diseases amplifies SSI risk among surgical populations, underscoring the need for preoperative optimization and tailored perioperative care [8-10].

Antibiotics have long been central to SSI prevention and management, particularly through preoperative prophylaxis and targeted therapeutic regimens. When appropriately selected and timed, prophylactic antibiotics can significantly reduce microbial contamination and subsequent infection risk. However, inappropriate use — such as prolonged courses, incorrect dosing, or suboptimal spectrum coverage — contributes to antibiotic resistance, undermining effectiveness and complicating SSI control efforts. Therefore, evaluating the impact of antibiotics on SSI occurrence requires careful consideration of stewardship principles alongside clinical outcomes [11].

In light of these complexities, comprehensive investigations into the prevalence of SSIs, identification of associated risk factors and comorbidities, and assessment of antibiotic impact are essential. Such research not only enhances clinical understanding but also informs evidence-based policies and practices to reduce SSI burden. Ultimately, improving SSI outcomes depends on multidisciplinary efforts that integrate surveillance, risk mitigation, and prudent antibiotic use to enhance patient safety and quality of care.

Objective

To determine the prevalence of surgical site infections, identify associated risk factors and comorbidities, and evaluate the impact of antibiotic use on their occurrence among patients.

METHODOLOGY

This study was conducted in a tertiary-level teaching hospital located in Dhaka, Bangladesh, which serves as a major referral center providing comprehensive surgical care to patients from both urban and rural areas. The hospital has multiple surgical specialties and a high patient turnover, making it suitable for assessing postoperative outcomes such as surgical site infections. The study was carried out over a one-year period from June 2023 to June 2024 and included patients admitted to different surgical wards during this time.

A facility-based cross-sectional study design was employed. The source population comprised all patients who underwent surgical procedures and were admitted to the hospital during the study period, while the study population included post-operative patients who remained admitted for at least 72 hours following surgery. Patients with complete and accessible medical records who stayed beyond the second postoperative day were eligible for inclusion. Patients who were discharged early, referred elsewhere, lost to follow-up within 72 hours, or had incomplete or missing medical records were excluded from the study.

The sample size was determined using the single population proportion formula by considering an anticipated prevalence of surgical site infection based on previous regional studies, a 95% confidence level, and a 5% margin of error. To ensure adequate power for identifying associated risk factors, sample size calculations were also performed using a double population proportion approach for selected variables such as diabetes mellitus, smoking status, and duration of preoperative hospital stay. The final sample size was chosen based on the largest calculated estimate, with an additional allowance to compensate for incomplete records. Eligible patients were enrolled consecutively until the desired sample size was achieved.

Data were collected using a structured checklist developed from relevant literature and adapted to the local clinical context. Information was obtained through a review of patient medical records, direct patient interviews, and observation of clinical findings. The checklist included socio-demographic characteristics, comorbid conditions, behavioral factors, surgical and wound-related variables, and antibiotic use. Clinical

details such as type and duration of surgery, wound classification, use of implants or drains, perioperative antibiotic administration, blood loss, and length of hospital stay were carefully recorded. Where applicable, wounds were physically inspected during routine clinical evaluation by the attending healthcare team.

Data collection was carried out by trained research assistants under close supervision to ensure consistency and accuracy. Prior to actual data collection, the checklist was pretested on a small proportion of patients, and necessary modifications were made. Daily supervision and routine checks for completeness and accuracy were performed throughout the data collection period.

Collected data were entered, cleaned, and analyzed using statistical software. Descriptive statistics were used to summarize patient characteristics and the prevalence of surgical site infections. Binary logistic regression analysis was initially performed to identify potential factors associated with SSIs, followed by multivariable logistic regression to control for confounding variables. The strength of associations was expressed using odds ratios with 95% confidence intervals, and statistical significance was determined at a p-value of less than 0.05. Model fitness was assessed using appropriate goodness-of-fit tests.

RESULTS

The socio-demographic characteristics of the study participants showed that the majority were aged 18–24 years (61.9%), followed by those aged 25–40 years (27.8%), while patients older than 40 years constituted 10.3% of the study population. All participants were male. Most patients had primary-level education (76.3%), with smaller proportions having secondary or higher education (19.0%) or no formal education (4.7%). A large majority were unmarried (83.9%), and more than half resided in rural areas (58.8%). Regarding behavioral factors, 21.2% of participants reported a history of smoking and 17.4% reported alcohol intake. The duration between injury and hospital admission was most commonly 1–7 days (70.8%), while 8.1% were admitted within one day and 21.1% after more than seven days. Over half of the patients underwent surgery within seven days of admission (52.1%), whereas 28.4% and 19.5% had surgery after 8–14 days and more than 14 days, respectively. Most participants experienced prolonged hospitalization, with 88.6% staying for more than 21 days.

Table 1: Socio-demographic characteristics of the study participants (n = 236)

Variables	Categories	Percentage (%)
Age	18–24 years	61.9
	25–40 years	27.8
	> 40 years	10.3
Sex	Male	100
Educational status	Illiterate	4.7
	Primary education	76.3
	Secondary and above	19
Marital status	Married	16.1
	Unmarried	83.9
Place of residence	Urban	41.2
	Rural	58.8
History of smoking	No	78.8
	Yes	21.2
History of alcohol intake	No	82.6
	Yes	17.4
Duration between injury and admission	< 1 day	8.1
	1–7 days	70.8
	> 7 days	21.1
Duration between admission and surgery	≤ 7 days	52.1
	8–14 days	28.4
	> 14 days	19.5
Length of hospital stay	< 14 days	5.1
	15–21 days	6.3
	> 21 days	88.6

The wound- and operation-related characteristics indicated that the vast majority of procedures were elective in nature (92.8%), while a smaller proportion were performed on an emergency basis (7.2%). More than half of the surgical wounds were classified as clean-contaminated (52.1%), followed by clean wounds (26.7%) and contaminated or dirty wounds (21.2%). An implant was present in 43.6% of the

patients, whereas 56.4% had no implant in situ. Regarding anaesthesia, spinal anaesthesia was most commonly used (62.9%), followed by general anaesthesia (21.8%), while regional anaesthesia accounted for 15.3% of cases.

Table 2: Wound- and operation-related characteristics of the participants (n = 236)

Variables	Categories	Percentage (%)
Type of surgery	Elective	92.8
	Emergency	7.2
Type of wound	Clean	26.7
	Clean-contaminated	52.1
	Contaminated/dirty	21.2
Implant in situ	Yes	43.6
	No	56.4
Type of anaesthesia	Regional	15.3
	Spinal	62.9
	General	21.8

The duration of surgical procedures varied among the study participants. Nearly half of the operations were completed within 1–2 hours (45.3%), while 24.6% of procedures lasted less than one hour. Operations with a duration of 2–3 hours accounted for 18.9% of cases, whereas prolonged surgeries exceeding three hours were observed in 11.2% of the participants.

Table 3: Duration of operation among study participants (n = 236)

Duration of operation	Percentage (%)
< 1 hour	24.6
1–2 hours	45.3
2–3 hours	18.9
> 3 hours	11.2

The clinical characteristics of the study participants showed that most patients had a pre-operative hemoglobin level greater than 10 g/dL (60.2%), while 32.6% had levels between 8–10 g/dL and 7.2% had levels below 8 g/dL. Post-operatively, the majority maintained hemoglobin levels above 10 g/dL (79.2%), with only a small proportion falling below 8 g/dL (1.7%). A history of blood transfusion during the current admission was reported by 34.7% of patients, and most participants experienced an estimated intraoperative blood loss of less than 500 mL (87.4%). Wound care was predominantly performed once daily (84.3%), and the most common duration of intravenous antibiotic therapy was 8–14 days (42.8%), followed by courses shorter than 8 days (21.6%). Nearly all patients had at least one comorbid condition (98.7%), while re-operation due to SSI was required in 21.6% of cases. The majority of patients were ambulating at the time of assessment (77.9%). Overall, the prevalence of surgical site infection was 9.8%, of which most were superficial infections (70.1%), whereas deep infections accounted for 29.9% of cases.

Table 4: Distribution of clinical characteristics and SSI status (n = 236)

Variables	Categories	Percentage (%)
Pre-operative hemoglobin	< 8 g/dL	7.2
	8–10 g/dL	32.6
	> 10 g/dL	60.2
Post-operative hemoglobin	< 8 g/dL	1.7
	8–10 g/dL	19.1
	> 10 g/dL	79.2
History of blood transfusion	Yes	34.7
	No	65.3
Estimated blood loss	< 500 mL	87.4
	≥ 500 mL	12.6
Wound care frequency	Once daily	84.3
	Twice daily	8.2
	More than twice	7.5
Duration of IV antibiotics	< 8 days	21.6
	8–14 days	42.8

	15–21 days	15.3
	> 21 days	20.3
Presence of comorbidity	Yes	98.7
	No	1.3
Re-operation due to SSI	Yes	21.6
	No	78.4
Patient ambulating	Yes	77.9
	No	22.1
Surgical site infection	Yes	9.8
	No	90.2
Type of SSI (among SSI cases)	Superficial	70.1
	Deep	29.9

The distribution of surgical site infections varied across surgical specialties. Orthopaedic procedures accounted for the majority of surgeries (66.9%) and demonstrated an SSI rate of 11.4%. General surgery comprised 22.5% of procedures, with a comparatively lower SSI occurrence of 4.1%. Although neurosurgical procedures represented a small proportion of the total cases (1.7%), they exhibited the highest proportion of SSIs (33.3%). No surgical site infections were observed among patients undergoing plastic and reconstructive surgeries (7.6%) or other surgical specialties (1.3%).

Table 5: Distribution of surgical site infection by surgical specialty (n = 236)

Surgical specialty	Percentage of procedures (%)	SSI present (%)
Orthopaedics	66.9	11.4
General surgery	22.5	4.1
Neurosurgery	1.7	33.3
Plastic/Reconstructive	7.6	0.0
Other specialties	1.3	0.0

The analysis of factors associated with surgical site infection showed marked variations across patient and procedural characteristics. Surgical site infections were substantially more common among patients with a history of smoking (30.2%) compared to non-smokers (3.4%). Patients who received blood transfusions also demonstrated a higher proportion of SSIs (16.8%) than those who did not (5.7%). Ambulation status showed a strong association, with non-ambulating patients experiencing a considerably higher SSI rate (36.0%) compared to those who were ambulating (2.1%). Age-related differences were evident, as patients aged over 40 years had the highest proportion of SSIs (54.2%), followed by those aged 25–40 years (8.1%), while the lowest rate was observed among patients aged 18–24 years (2.7%). With respect to wound characteristics, contaminated or dirty wounds had a notably higher SSI rate (28.6%) compared to clean-contaminated (5.6%) and clean wounds (1.6%). Additionally, longer operative duration was associated with increased SSI occurrence, with procedures lasting more than three hours showing a higher proportion of infections (33.3%) compared to surgeries of shorter duration.

Table 6: Factors associated with surgical site infection (percent distribution)

Variable	Category	SSI (%)	No SSI (%)
Smoking history	Yes	30.2	69.8
	No	3.4	96.6
Blood transfusion	Yes	16.8	83.2
	No	5.7	94.3
Ambulation status	Ambulating	2.1	97.9
	Not ambulating	36.0	64.0
Age group	18–24 years	2.7	97.3
	25–40 years	8.1	91.9
	> 40 years	54.2	45.8
Type of wound	Clean	1.6	98.4
	Clean-contaminated	5.6	94.4
	Contaminated/dirty	28.6	71.4
Duration of operation	< 1 hour	5.4	94.6
	1–2 hours	4.6	95.4
	2–3 hours	11.4	88.6
	> 3 hours	33.3	66.7

DISCUSSION

The present study examined the prevalence of surgical site infections (SSIs) and associated factors among 236 post-operative patients in a tertiary hospital in Dhaka. The socio-demographic profile revealed a predominantly young population, with most participants aged 18–24 years (61.9%) and all being male. This age distribution is comparable to other regional studies in South Asia, where the majority of surgical patients tend to be young adults undergoing trauma- or elective-related procedures [12]. The high proportion of patients from rural areas (58.8%) aligns with findings from Bangladesh and neighboring countries, reflecting the reliance of rural populations on tertiary care centers for advanced surgical management. Behavioral factors such as smoking (21.2%) and alcohol intake (17.4%) were lower than reported in studies from Western countries, possibly reflecting socio-cultural differences.

Regarding wound- and operation-related characteristics, elective procedures dominated the study population (92.8%), which is higher than the 70–80% reported in similar hospital-based studies in India and Nepal. Clean-contaminated wounds were the most common (52.1%), followed by clean (26.7%) and contaminated/dirty wounds (21.2%), similar to findings from other tertiary hospitals in low- and middle-income countries where infection risk is often influenced by delayed presentation and pre-existing comorbidities [13]. The use of spinal anaesthesia (62.9%) reflects local surgical practices and may have contributed to relatively lower systemic complications compared to general anaesthesia. Implant placement was common (43.6%), particularly in orthopaedic procedures, which aligns with the predominance of orthopaedic surgeries in the cohort.

Operation duration varied, with nearly half of the surgeries (45.3%) lasting 1–2 hours, while 11.2% extended beyond three hours. Longer operative times were associated with higher SSI rates, consistent with global literature indicating that prolonged procedures increase exposure to potential contaminants and tissue handling, which can compromise wound healing. These findings mirror other studies from South and Southeast Asia, where surgeries exceeding three hours often show 2–3 times higher infection rates [13].

Clinical characteristics showed that most patients had adequate pre- and post-operative hemoglobin levels (>10 g/dL), and the majority had less than 500 mL estimated blood loss. Despite this, 34.7% received blood transfusions, highlighting that transfusions remain a notable risk factor for SSI, as confirmed in multiple studies from Ethiopia and India [14]. Most patients had comorbidities (98.7%), consistent with the literature suggesting that chronic conditions such as diabetes, hypertension, and anemia are prevalent among surgical populations in tertiary care settings and contribute to infection risk [13]. The prevalence of SSI was 9.8%, predominantly superficial infections (70.1%), which is comparable to rates reported in regional studies in Bangladesh (8–11%) but lower than reports from some African tertiary hospitals (15–25%).

The distribution of SSI across surgical specialties showed that orthopaedic procedures accounted for most surgeries (66.9%) and had an SSI rate of 11.4%. Neurosurgical procedures, although few in number (1.7%), had the highest infection proportion (33.3%), reflecting the high-risk nature of these interventions. General surgery and plastic/reconstructive procedures showed lower SSI rates (4.1% and 0%, respectively), which aligns with findings from hospitals in India and Pakistan, where specialized surgical care and aseptic techniques reduce infection rates in elective and reconstructive surgeries [11].

Analysis of factors associated with SSI revealed that smoking, blood transfusion, non-ambulation, older age (>40 years), contaminated/dirty wounds, and prolonged operative duration (>3 hours) were strongly associated with infection. The SSI rate among smokers (30.2%) and older patients (54.2%) was substantially higher than non-smokers (3.4%) and younger patients (2.7%), highlighting the compounding effect of behavioral and physiological risk factors. Non-ambulating patients had a 36% SSI rate compared to 2.1% among those ambulating, emphasizing the protective role of early mobilization. These findings are in agreement with previous studies from Ethiopia, China, and India, confirming that modifiable risk factors such as smoking cessation, early ambulation, and careful intraoperative management can substantially reduce SSI incidence [10].

CONCLUSION

In conclusion, the study found that the prevalence of surgical site infection (SSI) among post-operative patients in this tertiary hospital was 9.8%, with most infections being superficial. SSI occurrence was strongly associated with modifiable and non-modifiable factors, including smoking, blood transfusion, non-ambulation, older age, contaminated or dirty wounds, and prolonged operative duration. Orthopaedic and neurosurgical procedures demonstrated higher infection rates compared to general and reconstructive surgeries. These findings highlight the importance of targeted preventive strategies such as optimizing pre-operative health, minimizing operative time, ensuring proper wound care, and promoting early post-operative ambulation to reduce SSI risk and improve surgical outcomes.

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