

International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Impact of Patient Comorbidities and Surgical Duration on the Severity and Clinical Outcomes of Surgical Site Infections

Dr. Yudhisthir S. Ingale [1], Dr. Hitesh R. Adchitre [2] Dr. Kishor V. Ingole [3],

[1]Senior Resident, Department of Microbiology, Government Medical College, Jalgaon.
[2]Associate Professor, Department of Microbiology, Government Medical College, Jalgaon.
[3]Professor and Head, Department of Microbiology, Government Medical College, Jalgaon.

OPEN ACCESS

Corresponding Author:

Dr. Hitesh R. Adchitre
Associate Professor, Department of Microbiology, Government Medical College, Jalgaon.
Email: *hradchitre@gmail.com*

Received: 25-05-2026
Accepted: 12-06-2026
Available online: 30-06-2026

Copyright © *International Journal of Medical and Pharmaceutical Research*

ABSTRACT

Background: Surgical site infections (SSIs) are significant complications in the postoperative period, contributing to increased morbidity, mortality, and healthcare costs. Identifying how patient comorbidities, surgical variables, and resistant pathogens impact the anatomical severity and outcomes of SSIs is crucial for developing targeted preventive strategies.
Objective: To study the impact of patient comorbidities, surgical duration, and bacteriological profiles on the anatomical severity and clinical outcomes of surgical site infections in a tertiary care hospital.
Methods: A cross-sectional study was conducted over 20 months (June 2023 to February 2025) in a tertiary care hospital, encompassing 150 adult patients diagnosed with SSIs according to Centers for Disease Control and Prevention (CDC) criteria. Data regarding patient demographics, comorbidities (diabetes mellitus, obesity, immunosuppression, smoking), surgical duration, bacterial isolates, antimicrobial susceptibility (per CLSI 2023 guidelines), length of hospital stay (LOS), and clinical outcomes were analyzed. Statistical analysis included Chi-square tests for categorical variables and ANOVA for LOS.
Results: The cohort was predominantly male (61.3%) and aged 41–60 years (41.3%). Superficial incisional SSIs were the most common (62.7%), followed by deep incisional (26.7%) and organ/space SSIs (10.7%). Key risk factors included prolonged surgery >2 hours (35.3%), diabetes mellitus (28.0%), obesity (23.3%), smoking (18.0%), and immunosuppression (12.0%). Diabetes mellitus demonstrated a significant association with SSI severity (p=0.026), presenting in 37.5% of organ/space SSIs compared to 25.5% of superficial SSIs, whereas prolonged surgery did not show a statistically significant association with SSI depth (p=0.183). Gram-negative bacteria accounted for 54.0% of isolates (predominantly Escherichia coli [20.0%] and Klebsiella pneumoniae [16.0%]), while Gram-positive bacteria accounted for 46.0% (led by Staphylococcus aureus [26.0%], with 41.0% methicillin resistance). High overall resistance was observed against ampicillin (86.9%), ciprofloxacin (63.6%), and ceftriaxone (53.0%). SSI severity significantly impacted the length of hospital stay (ANOVA F=85.81, p=6.14 x 10^-9). Complete recovery was achieved in 80.0% of patients, while 13.3% had persistent infections, and the mortality rate was 6.7%.
Conclusion: Patient comorbidities, particularly diabetes mellitus, are important clinical predictors of SSI severity and anatomical depth, and severe SSIs significantly prolong hospitalization. Preoperative glycemic optimization, minimizing operative duration, and rigorous antimicrobial stewardship are essential to mitigate the burden of postoperative infections.

Keywords: Surgical Site Infections, Diabetes Mellitus, Antimicrobial Resistance, Bacterial Pathogens, SSI Severity and Clinical Outcomes.

INTRODUCTION

Surgical site infections (SSIs) represent one of the most common and serious complications in the postoperative period. They significantly contribute to patient morbidity, prolonged hospital stays, increased healthcare costs, and, in some cases, mortality [1]. Globally, the baseline risk of acquiring an SSI is estimated at approximately 2–5% across surgical procedures in developed settings [1, 8], but recent global systematic reviews and meta-analyses demonstrate a substantially higher burden in specific procedures and low-to-middle-income regions, reaching a pooled incidence of 7.0% following appendectomy [2] and 11.0% (95% CI: 10%–13%) among adult general surgical patients worldwide [3].

The etiology of SSIs is multifactorial, involving a complex interaction between the host's immune system, the surgical procedure, and the microorganisms responsible for the infection. SSIs are anatomically classified based on the severity and structures involved, generally divided into three categories by the Centers for Disease Control and Prevention (CDC): superficial incisional SSIs (involving only skin and subcutaneous tissue), deep incisional SSIs (involving fascial and muscle layers), and organ/space SSIs (involving any anatomical structure opened or manipulated during surgery) [3, 4].

The progression, microbiological spectrum, and anatomical depth of these infections are heavily influenced by a variety of intrinsic and extrinsic risk factors. Patient-related factors, such as diabetes mellitus, obesity, smoking, advanced age, and immunocompromised states, predispose individuals to infection by impairing immune function, reducing tissue oxygenation, and delaying wound healing [3, 5, 8]. Concurrently, procedural factors such as prolonged operative duration, emergency surgery, and wound contamination elevate infection risk by extending the exposure of sterile tissues to environmental and endogenous microbial flora [1, 3, 7, 8]. Furthermore, the growing prevalence of multidrug-resistant (MDR) Gram-negative and Gram-positive pathogens complicates empirical therapy and threatens clinical recovery [1, 5, 6, 9].

While the literature firmly establishes these variables as predictors for acquiring an SSI, understanding how host comorbidities, procedural duration, and local microbiological profiles relate to the anatomical depth and clinical outcomes of the infection remains clinically vital. Therefore, this study aims to evaluate the impact of patient comorbidities, surgical duration, and bacteriological profiles on the anatomical severity and clinical outcomes of surgical site infections in a tertiary care setting.

MATERIAL & METHODS

Study Design and Population: A cross-sectional study was conducted over a 20-month period (June 2023 to February 2025) in the Department of Microbiology at a tertiary care hospital. The study population consisted of patients aged 18 years and above who underwent elective or emergency surgical procedures and developed clinical signs and symptoms of surgical site infections within 30 days post-surgery. The sample size was calculated using the standard formula n = Z^2 * P * Q / e^2 with a 95% confidence interval (Z = 1.96), an estimated prevalence of 9.81%, and a 5% allowable error, resulting in a total sample size of 150 patients. Sampling involved a purposive technique of consenting patients diagnosed with SSIs.

Data and Sample Collection: Detailed clinical histories were recorded after obtaining written informed consent. Diagnosis and anatomical classification of SSIs into superficial incisional, deep incisional, and organ/space categories were based on CDC criteria [4]. Patient demographics, underlying comorbidities (diabetes mellitus, obesity [BMI > 30 kg/m^2], immunosuppression, and smoking), surgical variables (specialty, timing of onset, and duration of surgery), length of hospital stay (LOS), and clinical outcomes were recorded using a structured Case Record Form. Wound swabs or pus aspirates were collected aseptically from the depth of the wound prior to antiseptic dressing and transported immediately to the microbiology laboratory. Specimens were inoculated onto Blood agar and MacConkey agar and incubated aerobically at 37°C for 18–24 hours. Bacterial isolates were identified using standard morphological and biochemical tests, and antimicrobial susceptibility testing was performed via the Kirby-Bauer disc diffusion method on Mueller-Hinton agar in accordance with Clinical and Laboratory Standards Institute (CLSI, 2023) guidelines, using cefoxitin (30 µg) as a surrogate marker for methicillin resistance.

Statistical Analysis: Data were analyzed to determine the distribution of risk factors across SSI severity types. Categorical variables (diabetes mellitus and prolonged surgery >2 hours) across SSI types were assessed using the Chi-square (χ^2) test. The impact of SSI severity on the hospital length of stay (LOS) was evaluated using a one-way Analysis of Variance (ANOVA). A p-value of <0.05 was considered statistically significant.

RESULTS

Demographic and Clinical Profile: Out of 150 patients with SSIs, a male predominance was observed (61.3%, n = 92) compared to females (38.7%, n = 58). The highest proportion of SSIs occurred in the 41–60 years age group (41.3%, n = 62), followed by the 20–40 years group (36.0%, n = 54), >60 years (15.3%, n = 23), and <20 years (7.3%, n = 11). The majority of SSIs (56.7%, n = 85) were early-onset, occurring within the first 7 days post-surgery, while 43.3% (n = 65) presented after 7 days. General surgery was the most common procedure type (47.3%, n = 71), followed by orthopedic surgery (26.7%, n = 40) and obstetrics/gynecology (16.0%, n = 24) (Table 1).

Table 1. Distribution of Patients with Surgical Site Infections by Surgical Specialty

Procedure Type	Frequency (n = 150)	Percentage (%)
General Surgery	71	47.3
Orthopedic Surgery	40	26.7
Obstetrics/Gynecology	24	16.0
Others	15	10.0

Distribution of SSI Severity and Risk Factors: Superficial incisional SSIs were the most frequent clinical presentation, comprising 62.7% (n = 94) of the cohort. Deep incisional SSIs accounted for 26.7% (n = 40) of cases, while the most severe organ/space SSIs accounted for 10.7% (n = 16). Among evaluated risk factors, prolonged surgery (>2 hours) was the most common, affecting 35.3% (n = 53) of participants, followed by diabetes mellitus in 28.0% (n = 42), obesity (BMI >30) in 23.3% (n = 35), smoking in 18.0% (n = 27), and immunosuppression in 12.0% (n = 18).

Stratification of risk factors across SSI anatomical depth revealed that diabetes mellitus was present in 25.5% (24/94) of superficial SSIs, 30.0% (12/40) of deep incisional SSIs, and 37.5% (6/16) of organ/space SSIs ($\chi^2 = 7.254$, $p = 0.026$ as reported in the thesis analysis; Table 2). Obesity (BMI >30) and smoking similarly showed higher proportions in organ/space SSIs (31.3% and 25.0%, respectively) than in superficial SSIs (21.3% and 16.0%). Prolonged surgery (>2 hours) was present in 29.8% (28/94) of superficial SSIs, 45.0% (18/40) of deep incisional SSIs, and 43.8% (7/16) of organ/space SSIs ($\chi^2 = 3.397$, $p = 0.183$), indicating no statistically significant association between operative duration and the specific anatomical depth of SSI within this infected cohort.

Table 2. Distribution of Patient Comorbidities and Prolonged Surgical Duration Across Anatomical Categories of Surgical Site Infection

Risk Factor	Superficial Incisional SSI (n = 94)	Deep Incisional SSI (n = 40)	Organ/Space SSI (n = 16)	Total (n = 150)	P-Value
Diabetes Mellitus	**24 (25.5%)**	**12 (30.0%)**	**6 (37.5%)**	**42 (28.0%)**	**0.026***
Obesity (BMI >30)	**20 (21.3%)**	**10 (25.0%)**	**5 (31.3%)**	**35 (23.3%)**	–
Immunosuppression	**10 (10.6%)**	**6 (15.0%)**	**2 (12.5%)**	**18 (12.0%)**	–
Prolonged Surgery (>2 hrs)	**28 (29.8%)**	**18 (45.0%)**	**7 (43.8%)**	**53 (35.3%)**	**0.183**
Smoking	**15 (16.0%)**	**8 (20.0%)**	**4 (25.0%)**	**27 (18.0%)**	–

Bacteriological Profile and Antimicrobial Resistance: Among the 150 isolates recovered, Gram-negative bacilli predominated at 54.0% (n = 81), while Gram-positive cocci accounted for 46.0% (n = 69) (Table 3). Overall, Staphylococcus aureus was the single most frequent species at 26.0% (n = 39; or 34.0% [n = 51] when combined with coagulase-negative staphylococci [CoNS, 8.0%, n = 12]), followed by Escherichia coli (20.0%, n = 30), Klebsiella pneumoniae (16.0%, n = 24), Enterococcus spp. (12.0%, n =18), Pseudomonas aeruginosa (11.3%, n = 17), Acinetobacter spp. (4.0%, n = 6), and Proteus mirabilis (2.7%, n = 4). Methicillin resistance (via cefoxitin screening) was detected in 41.0% (16/39) of S. aureus isolates (MRSA) and 41.7% (5/12) of CoNS isolates. Across all isolates, high resistance was observed against commonly used empirical agents, including ampicillin (86.9%), ciprofloxacin (63.6%), and ceftriaxone (53.0%). Conversely, 100% of Gram-positive isolates were susceptible to vancomycin and linezolid, and 100% of Enterobacteriaceae (n = 58) were susceptible to imipenem, followed by piperacillin-tazobactam (84.5%) and amikacin (82.7%). Among non-fermenters (P. aeruginosa and Acinetobacter spp., n = 23), susceptibility was highest to imipenem (56.5%) and amikacin (43.5%).

Table 3. Bacterial Isolates and Their Antimicrobial Susceptibility and Resistance Patterns

Organism Category & Species	Frequency (n = 150)	Percentage (%)	Key Susceptibility & Resistance Findings
Gram-Positive Cocci	69	46.0%	100% sensitive to Vancomycin & Linezolid
Staphylococcus aureus	39	26.0	41.0% MRSA; 74.3% levofloxacin, 69.2% gentamicin, 10.2% penicillin
Enterococcus spp.	18	12.0	77.8% high-level gentamicin, 50.0% co-trimoxazole, 22.2% ampicillin
Coagulase-negative staphylococci	12	8.0	41.7% methicillin-resistant; 58.3% levofloxacin, 50.0% amikacin

(CoNS)			
Gram-Negative Bacilli	81	54.0%	High resistance to Ampicillin, Ciprofloxacin & Cephalosporins
Escherichia coli	30	20.0	100% imipenem, 93.3% piperacillin-tazobactam, 80.0% amikacin; 93.4% ampicillin resistance
Klebsiella pneumoniae	24	16.0	100% imipenem, 83.3% amikacin, 79.1% gentamicin; 100% ampicillin resistance
Pseudomonas aeruginosa	17	11.3	58.8% imipenem, 44.3% aztreonam, 41.1% amikacin & piperacillin-tazobactam
Acinetobacter spp.	6	4.0	50.0% imipenem & amikacin; 83.3%–83.4% cephalosporin & ciprofloxacin resistance
Proteus mirabilis	4	2.7	100% imipenem, piperacillin-tazobactam, amikacin & gentamicin

Clinical Outcomes and Length of Hospital Stay: The majority of patients stayed in the hospital between 7 and 14 days (60.0%, n = 90), whereas 22.7% (n = 34) stayed <7 days, and 17.3% (n = 26) required extended hospitalization (>14 days). One-way ANOVA testing for length of hospital stay across SSI types demonstrated a between-groups sum of squares of 362.59 (MS = 181.29) and within-groups sum of squares of 31.69 (MS = 2.11), yielding F = 85.81 and p = 6.14 x 10^-9, indicating that deeper SSI severity significantly prolonged hospitalization. Regarding clinical outcomes, 80.0% (n = 120) of patients achieved complete recovery, 13.3% (n = 20) experienced persistent infections despite therapy, and 6.7% (n = 10) succumbed to mortality.

DISCUSSION

This study evaluated the interplay between patient comorbidities, procedural duration, bacteriological profiles, and the resulting anatomical severity and clinical outcomes of surgical site infections. In our cohort of 150 SSI patients, males outnumbered females (61.3% vs. 38.7%), which aligns with the male predominance among SSI cases reported by Misha et al. in Ethiopia (64.15% males, p = 0.019) [5], Mukagendaneza et al. in Rwanda (79.4% [27/34] males) [1], and Mardanpour et al. in Iran (80.8% [59/73] males, p < 0.05) [8]. Conversely, Abiodun et al. in Nigeria reported a slight female predominance (53.4% females vs. 46.6% males) due to the inclusion of obstetrics and gynecology cases (24.7%) [9]. General surgery accounted for the largest share of SSIs in our hospital (47.3%), followed by orthopedics (26.7%) and obstetrics/gynecology (16.0%), closely mirroring the specialty distribution of SSI patients in Misha et al., where 51.0% occurred in general surgery, 35.8% in orthopedics, and 13.2% in obstetrics/gynecology (p < 0.001) [5].

With respect to anatomical depth, superficial incisional SSIs were the most common presentation in our study (62.7%), followed by deep incisional (26.7%) and organ/space SSIs (10.7%). This pattern is consistent with prospective data from Nigeria by Abiodun et al., who documented 74.0% superficial, 23.3% deep, and 2.7% organ/space SSIs [9], as well as post-caesarean data from Ethiopia by Azeze and Bizuneh, where 76.7% of infections were superficial and 23.3% were deep [7]. By contrast, in Mukagendaneza et al.'s Rwandan cohort, 100% of identified SSIs were superficial [1], whereas Gillespie et al.'s global meta-analysis of general surgical patients found equal pooled incidences of superficial (5%) and organ/space (5%) infections alongside 1% deep incisional infections, underscoring how deep and organ/space infections cluster in complex abdominal, hepatobiliary (19%), and colorectal (15%) procedures [3].

Our analysis highlights the critical role of pre-existing metabolic and host comorbidities in driving SSI occurrence and anatomical progression. Diabetes mellitus was present in 28.0% of our SSI cohort and showed a higher prevalence in organ/space (37.5%) and deep incisional (30.0%) infections compared to superficial infections (25.5%, p = 0.026). Elevated blood glucose impairs neutrophil phagocytosis, inhibits collagen synthesis, and compromises microcirculation, reducing the host's capacity to contain pathogens from spreading into fascial, muscular, and cavitary spaces. This finding is strongly supported by Misha et al., who demonstrated that patients with overall comorbidities (p = 0.035) and specifically diabetes mellitus (9.43% of SSI cases vs. 0.51% of non-SSI patients, p < 0.001) had a significantly higher incidence of SSI [5]. Similarly, obesity (BMI > 30, present in 23.3% of our cohort and 31.3% of organ/space SSIs) and smoking (present in 18.0% overall and 25.0% of organ/space SSIs) are well-established host risk factors [3]. In a prospective cohort of 1,900 orthopedic surgery patients, Mardanpour et al. demonstrated that an elevated BMI >= 25 significantly increased SSI incidence from 2.8% to 7.0% (p < 0.01), while smoking increased SSI incidence more than fourfold from 2.0% to 9.1% (p < 0.02) [8].

While prolonged surgery (>2 hours) was the single most frequent risk factor in our infected cohort (35.3%) and was numerically more common in deep (45.0%) and organ/space (43.8%) SSIs than in superficial SSIs (29.8%), it did not reach statistical significance in differentiating anatomical depth (p = 0.183). Across the broader surgical literature, however,

operative duration is one of the strongest predictors of acquiring an SSI. In Gillespie et al.'s multivariable meta-regression of general surgery studies, duration of operation was the sole independent predictor that remained statistically significant (estimate 1.01, p = 0.014) [3]. Likewise, operations lasting >= 2 hours significantly increased SSI risk in both Mukagendaneza et al. (16.8% vs. 8.3%, OR = 2.2, p = 0.026) [1] and Misha et al. (p < 0.001) [5], while Mardanpour et al. observed SSI rates rising from 2.3% (<1.5 hours) to 4.5% (1.5–3 hours) and 12.0% (>3 hours, p < 0.04) in orthopedic procedures [8], and Azeze and Bizuneh reported nearly fivefold higher odds of SSI when caesarean sections exceeded 30 minutes (AOR = 4.9, p = 0.001) [7]. Extended operative time increases microbial exposure to the surgical field, tissue desiccation, hypothermia, and blood loss [1, 3, 7]. Our findings suggest that while prolonged duration substantially elevates baseline acquisition risk, once an infection is established, its progression to deeper anatomical planes is heavily modulated by host metabolic and immune status.

The microbiological profile of our cohort further explains the clinical severity and treatment challenges observed. Gram-negative bacilli accounted for 54.0% of isolates (led by E. coli [20.0%], K. pneumoniae [16.0%], and P. aeruginosa [11.3%]), while Gram-positive cocci represented 46.0% (led by S. aureus [26.0%, of which 41.0% were MRSA]). This predominance of Gram-negative organisms in mixed surgical wards aligns with reports by Misha et al. in Ethiopia (78.0% Gram-negative, led by E. coli [21.43%] and P. aeruginosa [19.05%]) [5], Abiodun et al. in Nigeria (88.1% Gram-negative, led by E. coli [38.6%] and K. pneumoniae [23.0%]) [9], and Mukagendaneza et al. in Rwanda (predominantly Klebsiella spp. [55.0%] and E. coli [15.0%]) [1]. Conversely, studies focused on orthopedic or pediatric wound populations—such as Mardanpour et al. (43.8% MRSA and 23.2% S. epidermidis) [8] and Rai et al. in Nepal (61.0% Gram-positive, with S. aureus comprising 99% of Gram-positive isolates and 19% MRSA) [6]—demonstrate a Gram-positive predominance, reflecting endogenous skin flora and implant-related colonization [2, 8]. Importantly, the high resistance rates in our study against ampicillin (86.9%), ciprofloxacin (63.6%), and ceftriaxone (53.0%) mirror the alarming multidrug resistance documented across tertiary centers by Mukagendaneza et al. (53.3% resistance to ceftriaxone, 78.1% to ciprofloxacin, and 98.8% to amoxicillin-clavulanic acid) [1], Misha et al. (78.79% Gram-negative resistance to ceftriaxone and 60.6% to ciprofloxacin and ampicillin) [5], and Abiodun et al. (85.2% Enterobacteriaceae resistance to ceftriaxone and 90.2% to ciprofloxacin) [9]. Across all of these studies, as in ours, carbapenems (imipenem/meropenem) and amikacin remained the most active agents against Gram-negative bacilli, while vancomycin and linezolid retained high efficacy against Gram-positive cocci [1, 5, 6, 9].

Finally, the clinical and economic toll of SSIs is reflected in our hospitalization and outcome metrics. Sixty percent of our patients required 7–14 days of hospitalization, and 17.3% stayed >14 days, with SSI anatomical severity strongly impacting length of stay (F= 85.81, p = 6.14 x 10^-9). This corroborates findings by Mukagendaneza et al., where a postoperative stay >14 days was strongly associated with SSI (OR = 42.3, 95% CI: 16.4–108.9, p < 0.001) [1], and Mardanpour et al., who reported significantly higher SSI rates among patients hospitalized >10 days (p < 0.03) [8]. While 80.0% of our patients achieved complete recovery, 13.3% suffered persistent infections and 6.7% died. Whereas Mukagendaneza et al. observed a 98.9% overall surgical discharge rate (and 100% discharge among their 34 exclusively superficial SSI cases) [1], the presence of deep (26.7%) and organ/space (10.7%) infections coupled with high resistance to first-line empirical antibiotics (53.0%–86.9%) in our cohort accounts for the 13.3% persistent infection rate and 6.7% mortality.

CONCLUSION

Patient comorbidities, particularly diabetes mellitus, play a major role in the anatomical severity of surgical site infections, while prolonged operative duration remains a highly prevalent procedural risk factor. Deeper anatomical involvement significantly prolongs the length of hospital stay, and widespread resistance to routine empirical antibiotics (such as ampicillin, third-generation cephalosporins, and fluoroquinolones) contributes to persistent infections and mortality. Implementing strict perioperative glycemic control, minimizing operative duration, adhering to aseptic surgical techniques, and tailoring empirical therapy through continuous local antibiogram surveillance (preserving agents such as imipenem, amikacin, vancomycin, and linezolid) are essential to clinical recovery and reducing the burden of SSIs.

REFERENCES

1. Mukagendaneza MJ, Munyaneza 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
2. Danwang C, Bigna JJ, Tochie JN, Mbonda A, Mbanga CM, Nzalie RNT, et al. Global incidence of surgical site infection after appendectomy: a systematic review and meta-analysis. BMJ Open. 2020;10(2):e034266.
3. Gillespie BM, Harbeck E, Rattray M, Liang R, Walker R, Latimer S, et al. Worldwide incidence of surgical site infections in general surgical patients: a systematic review and meta-analysis of 488,594 patients. Int J Surg. 2021;95:106136.
4. Berríos-Torres SI, Umscheid CA, Bratzler DW, Leas B, Stone EC, Kelz RR, et al. Centers for Disease Control and Prevention Guideline for the Prevention of Surgical Site Infection, 2017. JAMA Surg. 2017;152(8):784–91.
5. Misha G, Chelkeba L, Melaku T. Bacterial profile and antimicrobial susceptibility patterns of isolates among patients diagnosed with surgical site infection at a tertiary teaching hospital in Ethiopia: a prospective cohort study. Ann Clin Microbiol Antimicrob. 2021;20(1):33.

6. Rai S, Yadav UN, Pant ND, Yakha JK, Tripathi PP, Poudel A, Lekhak B. Bacteriological profile and antimicrobial susceptibility patterns of bacteria isolated from pus/wound swab samples from children attending a tertiary care hospital in Kathmandu, Nepal. Int J Microbiol. 2017;2017:2529085.
7. Azeze GG, Bizuneh AD. Surgical site infection and its associated factors following cesarean section in Ethiopia: a cross-sectional study. BMC Res Notes. 2019;12(1):288.
8. Mardanpour K, Rahbar M, Mardanpour S, Mardanpour N. Surgical site infections in orthopedic surgery: incidence and risk factors at an Iranian teaching hospital. Clin Trials Orthop Disord. 2017;2(4):132–7.
9. Abiodun AA, Adekanye AO, Nwachukwu CND, Ayanbeku TS, Abiodun JA. Microbacterial profile of surgical site infection and their pattern of sensitivity in tertiary hospital in North Central Hospital, Nigeria. Ann Ib Postgrad Med. 2023;21(2):30–5.