

Prevalence of Anaerobic Bacteria from Surgical Site Infections

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ABSTRACT

Background: Surgical site infections (SSIs) are classified as superficial, deep and organ incisions. This study was conducted to determine the prevalence of anaerobic bacteria in SSIs in Nepal.

Methods: Total 641 patients were recruited from general surgery, orthopaedics, obstetrics and gynaecology units from October 2020 to December 2022. Surgical wound specimens from suspected SSIs were collected and processed for anaerobic culture for bacterial isolation from pus, fluids and tissues with the help of conventional and rapid methods. The odds ratio for logistic regression for categorical variables was used to determine the significance of association of host risk factors with blood parameters. The antimicrobial resistance of anaerobic bacteria was observed by agar dilution method.

Results: The overall rate of SSIs was 311 (48.52%) where only anaerobic SSIs was 61 (9.52%). The anaerobic bacterial isolates from pus 43 (70.5%), fluid 14 (22.9%), tissues 4 (6.55%) from postoperative wounds accordingly. Infection rate in elective surgery cases were higher 38 (62.3%) than in the emergency surgery cases 23 (37.2%). Comorbidities and site of infections were significantly associated ($p < 0.05$) with anaerobic culture positive SSIs. Predominant isolates were *Bacteroides fragilis* 19 (31.15%), *Bacteroides thetaiotaomicron* 12 (19.67%), *Clostridium perfringens* 12 (19.67%) followed by *Peptoniphilus asaccharolyticus* and *Peptoniphilus anaerobius* 5 (8.20%) each. *Clostridium sporogens*, *Prevotella melaninogenica*, *Porphyromonas gingivalis* and *Propionibacterium* isolates were 2 (3.28%) each. Metronidazole resistance was seen the highest numbers 33 (54.09%) of the isolates.

Conclusions: Susceptibility test is essential for proper prescription of antibiotics for anaerobic bacterial infections highlighting the urgent need to revise antibiotic regimens to improve the treatment of SSIs.

Keywords: Anaerobic bacteria; blood parameters; rate; risk factors; surgical site infections

INTRODUCTION

Surgical site infections (SSIs) occurs at or near the surgical incision if prosthetic material is implanted at surgery.¹ Surgical wounds can become infected by the normal flora present in patients. According to the American College of Surgeons determination surgical wounds are classified into: clean, clean contaminated, contaminated and dirty infected.² SSIs can be caused by aerobic or anaerobic bacteria.³ Preoperative optimization can include control in diabetic patients to prevent infections, improving the immune system, and others are addressing malnutrition/obesity, optimizing skin condition, improving vascular status, smoking

cessation, and modifying intake of immunosuppressive drugs.⁴

The haematological parameters: WBC, CRP, or ESR have been included for the assessment of SSIs.^{5,6} The overuse of antibiotics has significantly impacted SSIs.⁶ *Bacteroides fragilis*, *Prevotella* spp., *Porphyromonas* spp., *Fusobacterium* spp., *Peptoniphilus* spp., and *Clostridium* spp are the significant contaminating bacteria. Our study was conducted to determine the prevalence of anaerobic bacteria in SSIs, correlate with comorbidities and determine the antibiotic susceptibility pattern of anaerobic bacteria.

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METHODS

Hospital-based descriptive study was carried out at the Birat Medical College Teaching Hospital (BMCTH), Biratnagar, after taking ethical approval from the ethical review board of the Nepal Health Research Council (Ref. No NHRC 234/2020), and written consent was taken from patient's local guardian for participation in the study before enrolment. Nepal from general surgery, obstetrics and gynaecology, and orthopaedic surgery units from October 2020 to December 2022. For sample calculation a prevalence of 38.0% was used according to Cochran formula.^{7,8} Wounds were assessed by the attending surgeon, based on intraoperative findings and surgical notes. Socio-demographic, clinical characteristics, haematological and renal related parameters were included. The study included preoperative, intraoperative, and post-operative antibiotics, following WHO guidelines (2016) with prophylactic measures.⁹

Pus aspirates, tissues, and body fluids were collected aseptically, transported anaerobically and inoculated in Robertson's cooked meat broth (RCMB) overnight, followed by subculture on Anaerobic blood agar, Brucella blood agar, and Bacteroides bile esculin agar for 48-72 h in an anaerobic jar containing AnaeroGas Pack with indicator.¹⁰ Metronidazole disc (5 µg) was placed on Anaerobic blood agar for the specific selection of anaerobic bacteria at 37°C.⁸ An aerotolerance test was carried out for isolates from Brucella blood agar to differentiate the obligate and facultative anaerobic bacteria. Susceptibility to colistin (10 µg), kanamycin (1000 µg) and metronidazole (5 µg) discs were used for identification of obligate anaerobic bacteria.¹¹ Further, bacteria were identified by conventional as well as

Vitek 2 Compact System (BioMérieux) following the manufacturer's instructions.¹² *Bacteroides fragilis* ATCC 25285 used as the control strain.¹³

Antibiotic susceptibility agar dilution test was performed for all anaerobic bacterial isolates. The minimal inhibitory concentration (MIC) for ceftiofime, tetracycline, piperacillin/tazobactam, clindamycin, imipenem and metronidazole were determined following CLSI guidelines.¹⁴ The MIC of metronidazole was tested using concentrations ranging from 0.125 to 64 µg/mL. Similarly, imipenem and clindamycin were tested with a concentrations ranging from 0.125 to 16 µg/mL. Piperacillin-tazobactam was tested with a concentration ranging from 0.125 to 128 µg/mL. Ceftiofime was tested with a concentrations ranging from 2 to 64 µg/mL, and tetracycline from 2 to 16 µg/mL.

The data analysis was done using the statistical software SPSS version 29. The odds ratio for logistic regression was used for determination of associations between anaerobic culture positive with socio-demographic, clinical characteristics, haematological and renal related parameters of SSIs patients where $p < 0.05$ was considered statistically significant.

RESULTS

Out of 641 SSIs patients, 61 (9.52%) anaerobic SSIs were observed in our study. The highest number of clinical samples obtained from anaerobic SSIs were pus 43 (70.5%), followed by fluid 14 (22.9%) and tissues 4 (6.55%). Age group, gender, units, wound category, urgency of surgery and SSIs were not significantly associated with anaerobic culture positive SSIs. Comorbidities and site of infections were significantly associated ($p < 0.05$) with anaerobic culture positive SSIs (Table 1).

Table 1. Association of anaerobic culture result with socio-demographic and clinical characteristics of the study population.

Host factors	Level	Frequency	Percentage	Odds ratio (95% CI)	p-value
Age group (years)					
	01-10	0	0.0	-	-
	11-20	5	8.2	4, 0.43 - 37.11	0.223
	21-30	8	13.1	0.4, 0.04 - 3.96	0.433
	31-40	18	29.5	0.18, 0.02-1.45	0.107
	41-50	11	18.0	0.25, 0.03 - 2.32	0.223
	51-60	8	13.1	0.11, 0.01 - 1.78	0.12
	61-70	6	9.8	0.13, 0.01 - 2.18	0.158
	71-80	5	8.2	2.67, 0.16 - 45.14	0.497

Table 1. Association of anaerobic culture result with socio-demographic and clinical characteristics of the study population.

Host factors	Level	Frequency	Percentage	Odds ratio (95% CI)	p-value
Gender					
	Male	34	55.7	1.14, 0.38 - 3.39	0.82
	Female	27	44.3	2, 0.31 - 12.92	0.467
Units					
	General surgery	40	65.6	0.29, 0.04 - 2.29	0.238
	Gynaecology	9	14.8	0.37, 0.07 - 1.94	0.24
	Orthopaedic	12	19.7	0.45, 0.04 - 5.81	0.544
Comorbidities					
	Diabetes mellitus	4	6.6	0.2, 0.04-0.91	<0.001
	Large number of visitors	9	14.8	0.29, 0.06-1.38	<0.001
	Increasing age	8	13.1	0.33, 0.07-1.65	<0.001
	Smoking/alcohol	9	14.8	0.29, 0.06-1.38	<0.001
	Weak immune system	18	29.5	0.12, 0.03-0.54	<0.001
	Obesity	5	8.2	0.67, 0.011-3.99	<0.001
	Malnutrition	3	4.9	2, 0.18-22.06	<0.001
	Prolong hospitalization	5	8.2	0.67, 0.011-3.99	<0.001
Wound category					
	Clean	27	44.3	1.34, 0.49-3.69	0.467
	Clean contaminated	16	26.2	3.66, 1.19-11.29	0.742
	Contaminated	18	29.5	0.29, 0.1-0.88	0.006
	Dirty	1	1.6	0.4, 0.09-1.82	0.006
Urgency of Surgery					
	Elective	38	62.3	1.27, 0.33 - 4.79	0.728
	Emergency	23	37.2	1.88, 0.53 - 6.74	0.331
SSIs observed (days)					
	1 to 7	7	11.5	5, 1.1-22.82	0.846
	8 to 14	22	36.1	0.17, 0.05-0.57	0.006
	15 to 21	17	27.9	5, 1.1-22.82	0.104
	21 to 30	15	24.6	1.4, 0.44-4.41	0.413
Site of infections					
	Necrotising fasciitis	12	19.7	0.09, 0.01-0.7	<0.001
	Cellulitis	12	19.7	0.28, 0.14-0.55	<0.001
	Perforative Peritonitis	5	8.2	0.24, 0.13-0.47	<0.001
	Appendicular abscess	5	8.2	0.27, 0.14-0.52	<0.001
	Periodontal abscess	3	4.9	0.26, 0.14-0.49	<0.001
	Liver abscess	8	13.1	0.28, 0.15-0.53	<0.001
	Pancreatic abscess	1	1.6	0.25, 0.13-0.47	<0.001
	Perianal abscess	7	11.5	0.26, 0.13-0.5	<0.001
	Intraabdominal abscess	8	13.1	0.29, 0.15-0.56	<0.001

The odds ratio for logistic regression analysis of TLC showed a significant relationship while the haematological and renal functions test were not significantly associated with anaerobic culture positive SSIs (Table 2).

Table 2. Haematological and renal function tests of SSIs patients.

Haematological parameters	Frequency	Percentage	Odd ratio (95% CI)	p-value
TLC (WBCs/ul)			1.01, 0.79-1.29	0.046
Normal	41	67.2		
Increased	20	32.7		
Neutrophils (%)			3.26, 2.27-4.26	0.58
Normal	19	31.1		
Increased	42	68.8		
ESR (mm/hr)			3.41, 2.71-4.11	0.239
Normal	40	65.5		
Increased	21	34.4		
CRP (mg/L)			0.24, 0.13-0.46	0.069
12	15	24.4		
>12	46	75.4		
Albumin (g/dL)			3.07, 1.95-4.18	0.472
1-3	46	75.4		
>3	15	24.5		
Random blood sugar (mg/dl)			3.69, 2.97-4.42	0.902
1-100	36	59.01		
>100	25	40.98		
Uric acid (mmol/L)			0.96, 0.75-1.21	0.337
Normal	37	60.6		
Increased	24	39.3		
Sodium (mmol/L)			3.67, 3.11-4.22	0.998
Normal	60	98.4		
Increased	1	1.6		
Potassium (mmol/L)			3.65, 3.09-4.21	0.998
Normal	60	98.4		
Increased	1	1.6		
Creatinine (g/dl)			3, 1.69-4.31	0.147
Normal	50	81.9		
Increased	11	18.0		

Out of 61 (9.52%) anaerobic bacterial isolates *B. fragilis* 19 (31.15%) was the predominant, followed by *B. thetaiotamicron* 12 (19.67%) and *Cl. perfringens* 12 (19.67%). *P. asaccharolyticus* and *P. anaerobius* were present with 5 (8.20%) each. Again, *Cl. sporogens*, *P. melaninogenica*, *P. gingivalis* and *P. acnes* showed the same occurrence as 2 (3.28%) (Table 3).

Table 3. Anaerobic bacterial isolates from various SSIs.

Site of infections	<i>B. fragilis</i>	<i>B. thetaiotamicron</i>	<i>P. anaerobius</i>	<i>P. asaccharolyticus</i>	<i>Cl. perfringens</i>	<i>Cl. sporogens</i>	<i>P. melaninogenica</i>	<i>P. gingivalis</i>	<i>P. acnes</i>
Necrotising fasciitis	1 (8.33%)	-	-	1 (8.33%)	9 (75.0%)	1 (8.33%)	-	-	-
Cellulitis	2 (16.66%)	2 (16.66%)	3 (25.0%)	2 (16.66%)	1 (8.33%)	1 (8.33%)	-	-	1 (8.33%)
Perforative Peritonitis	-	1 (20.0%)	1 (20.0%)	-	1 (20.0%)	-	1 (20.0%)	-	1 (20.0%)
Appendicular abscess	3 (60.0%)	1 (20.0%)	-	-	-	-	1 (20.0%)	-	-
Periodontal abscess	1 (33.33%)	-	-	-	-	-	-	2 (66.66%)	-
Liver abscess	3 (37.5%)	3 (37.5%)	1 (12.5%)	1 (12.5%)	-	-	-	-	-
Pancreatic abscess	-	-	-	1 (8.33%)	-	-	-	-	-
Perianal abscess	4 (57.14%)	2 (28.57%)	-	-	1 (14.28%)	-	-	-	-
Intra-abdominal abscess	5 (62.5%)	3 (37.5%)	-	-	-	-	-	-	-

In our research, among the 61 isolates, *B. fragilis* was highly resistant to metronidazole 14 (73.68%), followed by tetracycline 9 (47.36%) and imipenem 7 (36.84%). Similarly, *B. thetaiotamicron* was resistant to tetracycline 7 (58.33%) and metronidazole 4 (33.33%). *P. anaerobius* was resistant to metronidazole 3 (60%) and tetracycline 2 (40%). *P. asaccharolyticus* was resistant to imipenem 5 (100%) and metronidazole 3 (60%). *Cl. perfringens* was resistant to metronidazole 9 (75%) and clindamycin 5 (41.66%). *Cl. sporogens*, *P. melaninogenica*, *P. gingivalis* and *P. acnes* all were 100% sensitive to metronidazole and ceftioxin (Table 4).

Table 4. Antibiotic susceptibility pattern of anaerobic bacteria.

Bacteria	Metronidazole		Imipenem		Clindamycin		Piperacillin/Tazobactam		Ceftioxin		Tetracycline	
	Sensitive n (%)	Resistant n (%)	Sensitive n (%)	Resistant n (%)	Sensitive n (%)	Resistant n (%)	Sensitive n (%)	Resistant n (%)	Sensitive n (%)	Resistant n (%)	Sensitive n (%)	Resistant n (%)
<i>B. fragilis</i>	5 (26.3)	14 (73.7)	12 (63.1)	7 (36.8)	15 (78.9)	4 (21.1)	16 (84.2)	3 (15.8)	18 (94.7)	1 (5.3)	10 (52.6)	9 (47.4)
<i>B. thetaiotamicron</i>	8 (66.7)	4 (33.3)	9 (75.0)	3 (25.0)	10 (83.3)	2 (16.7)	9 (75.0)	3 (25.0)	11(91.8)	1 (8.2)	5(41.7)	7 (58.3)
<i>P. anaerobius</i>	2 (40.0)	3 (60.0)	3 (60.0)	2 (40.0)	4 (80.0)	1 (20.0)	4 (80.0)	1 (20.0)	5 (100.0)	0 (0.0)	3 (60.0)	2 (40.0)
<i>P. asaccharolyticus</i>	2 (40.0)	3 (60.0)	0 (0.0)	5 (100.0)	1 (20.0)	4 (80.0)	3 (60.0)	2 (40.0)	5 (100.0)	0 (0.0)	3 (60.0)	2 (40.0)
<i>Cl. perfringens</i>	3 (25.0)	9 (75.0)	8 (66.7)	4 (33.3)	7 (58.3)	5 (41.7)	10 (83.3)	2 (16.7)	10 (83.3)	2 (16.7)	8 (66.7)	4 (33.3)
<i>Cl. sporogens</i>	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)
<i>P. melaninogenica</i>	2 (100.0%)	0 (0.0)	1 (50.0)	1 (50.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	2 (100.0)
<i>P. gingivalis</i>	2 (100.0%)	0 (0.0)	2 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	0 (0.0)	2 (100.0)
<i>P. acnes</i>	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)	2 (100.0)	0 (0.0)	2 (100.0)	0 (0.0)	1 (50.0)	1 (50.0)
Total	28 (45.9)	33 (54.1)	39 (63.9)	22 (36.1)	43 (70.5)	18 (30)	50 (82)	11 (18)	57 (93.4)	4 (6.6)	31 (50.8)	30 (49.2)

DISCUSSION

Anaerobic bacteria inhabit the mucosal surfaces and prevent the colonization of exogenous microbes.¹⁵Our study showed SSIs in 48.52% with 9.52% anaerobic SSIs. Similar study by Chukwuma et al (2024) reported SSIs as 12.3% and 1.1% anaerobic SSIs.¹⁶The rate of SSIs were reported less in other countries compared to ours.^{16,17}. In our study a high

number of postoperative wound specimens 40 (65.6%) were collected from the general surgery. Therefore SSIs surveillance is crucial for infection control and improving hospital service.¹⁸ The socio-demographic and clinical characteristics of patients were not significantly associated with the anaerobic culture positive SSIs, but comorbidities and site of infections were significantly associated from the logistic regression analysis. Patients with underlying conditions such as diabetes mellitus, malignancy or immunosuppression may have impaired wound healing and altered host defence mechanism.¹⁷ The rate of SSIs was in agreement with previously reported findings.¹⁹ Our study showed the highest rate of SSIs (29.5%) in the patients aged 31 to 40 years, influenced by physiological, lifestyle, and medical factors, where males (55.7%) highly susceptible. Research suggests testosterone may inhibit immune system functions, reducing wound healing and increasing bacterial infection risk compared to females with higher estrogen levels.²⁰ Our studies showed all comorbidities, onset of SSIs observed and site of infections were significantly associated with anaerobic culture positive SSIs as in Malik et al (2013)¹⁷ and Cheadle et al (2006).²⁰ The literature showed that patients suffering from pre-morbid diseases were at a high risk.^{19,20} Operative settings (elective/emergency) play a significant role in determining infection rates due to inadequate preparation, breach in sterilization protocol, pre-existing infection and reduced immunological status of patient.^{17,18} Infection rate in elective surgery cases in our study and Cheng et al (2015)¹⁹ were 25.1% and 10.0% which is higher than in emergency cases. Both studies were not significantly correlated with anaerobic culture positive SSIs. Several factors contribute to this, such as, wound classification systems and the surgeon's assessment of contamination risk.²¹ Research indicates that Length of Hospital Stay (LOS) isn't a reliable predictor of SSIs, as modern care practices minimize risks.²² In our study a significant correlation was found between the infection site and anaerobic culture positive SSIs, highlighting that specific anatomical locations of surgeries carry risks of contamination and infection. Colorectal surgeries have an elevated SSI risks due to high bacterial loads. Orthopaedic implants and cardiac devices facilitate biofilm formation, while abdominal wounds may heal slowly due to movement, and extremity wounds are more prone to environmental contamination.^{1,23}

Hematological parameters often reflect the body's immune and inflammatory responses.²⁴ Present research showed logistic regression of blood and renal parameters were not significantly associated with

anaerobic culture positive SSIs, while WBC count was significantly associated. Muna and ALhameed (2022) showed an elevated WBC count as in our study.²⁵ WBC elevation is a useful but non-specific marker for SSIs, and should be considered with other clinical indicators like CRP.²⁶ In our study the highest percentage of isolates were from cellulitis (19.7%) followed by intra-abdominal abscess (13.11%) and liver abscess (13.11%). Singh et al (2021) reported the highest percentage of anaerobic bacteria (90.8%) from abscesses (21.39%), cellulitis (18.7%) and gas gangrene (3.74%).¹⁵ The cellulitis rate in our result was almost similar to Singh et al (2021) while abscess was higher in their study. Antony et al (2016) reported wound infections attributed by 6.0% anaerobic isolates¹¹ but in our study a higher percentage of anaerobic isolates (9.52 %) was found. The highest anaerobic bacterial isolates from abscesses, diabetic foot infection was reported by Shenoy et al (2016)²⁷ and from necrotizing fasciitis by Singh et al (2021)¹⁵, which were relatively low in our study. However, our study showed the highest *Bacteroides* spp. (31.15%) in comparison to Shenoy et al (2016) (20.9%) and Singh et al (2021) (19.12%).²⁷ *Bacteroides* spp. was the most common anaerobic bacteria in SSIs reported by Antony et al (2016).¹¹ The variation in the frequency of etiology in SSIs might be due to the differential geographic location of the studies. In our study anaerobic bacteria like *B. thetaiotamicron* (19.67%), *Cl. perfringens* (19.67%), *P. asaccharolyticus* (8.20%), *P. anaerobius* (8.20%), *Cl. sporogens* (3.28%), *P. melaninogenica* (3.28%), *P. gingivalis* (3.28%) and *P. acnes* (3.28%) were isolated.

AMR in anaerobic bacteria often involved in polymicrobial SSIs. *B. fragilis*, *Clostridium* species, and other anaerobic bacteria have been reported for developing resistance to commonly used antibiotics such as, metronidazole, cefoxitin, imipenem, piperacillin, clindamycin and chloramphenicol, making difficult to treat infections.²⁸ In our study, metronidazole resistance (54.09%) was seen alarmingly high compared to other study, as Sood et al (2021) revealed metronidazole resistance between 7.0 to 31.0%²⁸. The highest resistance was seen in *B. fragilis* (73.68%) followed by *Cl. perfringens* (75.0%), *P. asaccharolyticus* (60.0%) and *P. anaerobius* (60.0%). Reissier et al (2023) showed the resistance to metronidazole relatively low in Gram-negative bacilli, with higher in *Bacteroides* spp. (13.0%), *Parabacteroides* spp. (<3.0%), and *Prevotella* spp. (<5.0%).^{28,29} Sood et al (2021) reported a low prevalence ranging from 0.5% to 2.8% in *Bacteroides* spp. and 0.0% to 5.3% in *Prevotella* spp.

In our study imipenem resistance was seen higher

(36.1%) compared to Sood et al (2021) (0.6%). Reissier et al (2023) reported imipenem resistance in *B. fragilis* (7.0%), *Fusobacterium* spp. (4.0%) and *Clostridium* spp. (15.0%) over 16 years where imipenem resistance *B. fragilis* (36.84%) observed was higher than in our study. A decrease susceptibility to meropenem in the *B. fragilis* group was reported in Japan between 2010 and 2018-2019 by 98.0% and 90.0% respectively.^{28,29} Carbapenem resistance ranged from 1.0 to 9.6% in Western countries.²⁹ Reissier et al (2023) reported imipenem resistance range from 9.0% to 15.0%. In contrast imipenem resistance in India was much lower (0.6%).²⁹

In our study the total resistance to clindamycin was 30%, whereas, Sood et al (2021) reported a higher total resistance to clindamycin (42.6%).²⁸ We observed highest resistance to clindamycin in *P. asaccharolyticus* (80.0%), followed by *P. gingivalis* and *P. acnes*, *B. fragilis* and *Cl. perfringens*. Over the past 20 years, resistance to clindamycin has increased 32.4% worldwide.²⁸ Most of the studies described a moderate activity of clindamycin against *Clostridium* spp., with resistance rates ranging from 16.0 to 30.0% in the US, Europe, and Korea.^{28,30}

The resistance to piperacillin-tazobactam was 18% in this study, which was less than Sood et.al. (2021).²⁸ The highest resistance to piperacillin-tazobactam was seen in *P. asaccharolyticus* (40.0%) followed by *B. thetaiotamicron* (25.0%). Piperacillin/tazobactam resistance was reported by Reissier et al (2023) for *Bacteroides* group. *Propionibacterium* spp., *Cutibacterium* spp., *Fingoldia magna*, *Peptoniphilus* spp., *Anaerococcus* spp., and *Parvimonas micra* were susceptible to β -lactams in their study.

In our study all anaerobic bacteria (9.52%) showed less resistance to cefoxitin (6.6%) compared to Sood et al (35.3%).²⁸ The highest resistance was observed in *Cl. perfringens* (16.7%) followed by *B. thetaiotamicron* (8.33%) and *B. fragilis* (5.3%) in our study. Shariff et al (2023) reported an increase in resistance for cefoxitin (17.2%).³⁰

Recent studies observed high resistance in anaerobic bacteria, although tetracycline susceptibility is rarely tested routinely.²⁹ In our study, *B. fragilis* (47.4%) and *B. thetaiotamicron* (58.3%) were resistant to tetracycline. *Bacteroides* spp., *Clostridium* spp. and *Peptoniphilus* spp. being detected in SSIs along with some resistant strains, in the tertiary care hospital in Eastern Nepal demands urgent change in implementation of hospital antibiotic prophylaxis in surgery. Though the study

was limited to post-operative SSIs only, it represents a critical component of SSIs prevention.

CONCLUSIONS

This study showed *B. fragilis* as the most common anaerobic bacterial etiology associated with SSIs. Besides, the risk factors such as comorbidities and site of infection, along with clinical feature of WBC counts linked to the anaerobic culture positive SSIs was also explained. Future research on anaerobic bacteria should emphasize selecting appropriate antibiotics based on their resistance patterns, improving empirical therapy for SSIs.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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