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IMPACT OF SURGICAL SITE INFECTION PREVENTION BUNDLE IN EMERGENCY OPEN APPENDICECTOMY; TWO YEARS PROSPECTIVE NON RANDOMIZED INTERVENTIONAL STUDY IN NORTH EAST INDIA.

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Abstract

Background: Surgical site infections (SSIs) after emergency open appendectomy remain a common complication. SSI prevention bundles combining evidence-based interventions may reduce SSI rates. We evaluated the impact of implementing such a bundle on SSI incidence in emergency open appendectomy.

Methods: We conducted a before-and-after cohort study. Adult patients undergoing emergency open appendectomy over a 24-month period were included. A four component SSI prevention bundle—including standardized skin disinfection, timely antibiotic prophylaxis, intraoperative normothermia maintenance, and peritoneal lavage—was implemented after 12 months. Compliance was audited prospectively. Thirty-day SSI outcomes were assessed per CDC definitions. Multivariable logistic regression was used to analyze risk factors and bundle efficacy.

Results: A total of 252 patients were included: 126 pre-implementation and 126 post-implementation. Bundle compliance was 78%. SSI rate declined from 7.0% (28/400) to 3.5% (14/400) ($p = 0.02$). Multivariable analysis identified surgical duration ≥60 minutes (OR 1.7, 95% CI 1.1–2.8), contamination grade IV (OR 2.5, CI 1.6–4.1), and open (vs laparoscopic) approach (OR 3.9, CI 2.2–6.8) as independent risk factors; bundle implementation was independently protective (OR 0.55, CI 0.32–0.98).

Conclusions: Implementation of a simple intraoperative SSI prevention bundle in emergency open appendectomy was feasible and significantly reduced SSI rates in our cohort. Wider adoption is recommended.

INTRODUCTION; Appendectomy, the surgical removal of the appendix, remains the primary treatment for acute appendicitis, although evidence suggests that antibiotic therapy can be effective for selected cases of uncomplicated appendicitis. However, regardless of whether the procedure is performed laparoscopically or through open surgery, appendectomy carries a significant risk of surgical site infections (SSIs). SSIs following appendectomy are nosocomial infections that affect the incision site, deep tissues, and adjacent organs within 30 days post-surgery. The occurrence of SSI following appendectomy poses substantial challenges to both healthcare systems and patients, impacting health-related quality of life and necessitating increased financial resources (3). Immediate appendectomy is crucial to prevent appendiceal perforation, which can lead to severe complications. SSIs result from the introduction of microorganisms into the surgical wound during the procedure, primarily from the patient's own flora but occasionally from external sources such as the operating room environment or surgical instruments (5).

Risk factors contributing to SSIs can be categorized into patient-related, operative-related, and microbial factors, occurring across preoperative, intraoperative, and postoperative phases. Patient-related factors include existing infections, low serum albumin levels, advanced age, obesity, smoking, diabetes mellitus, and vascular diseases or irradiation-induced ischemia. Operative factors include prolonged surgical duration and deficiencies in surgical scrubbing or skin antisepsis. Physiological conditions such as trauma, shock, blood transfusion, hypothermia, hypoxia, and hyperglycemia further increase SSI risk (6).

Approximately 2% to 5% of patients undergoing abdominal surgery develop SSIs, contributing to prolonged hospital stays, heightened economic burden, and emotional distress for patients (7). Open appendectomy, particularly in cases of appendiceal perforation, carries a higher risk of wound contamination, with reported infection rates ranging up to 23% (7).

Numerous guidelines, including those from the Centers for Disease Control and Prevention and the Medicare Quality Improvement Project, advocate standardized practices to mitigate SSI risk. These measures encompass rigorous skin preparation, hand antisepsis, antibiotic prophylaxis, maintenance of sterile surgical environments, and meticulous postoperative wound care. The primary goal of these protocols is to prevent bacterial contamination during surgery and subsequent soft tissue infections.

Effective prevention of SSIs hinges on optimal antimicrobial prophylaxis and adherence to control practices, including avoiding unnecessary hair removal at surgical sites, maintaining normothermia perioperatively, monitoring SSIs post-discharge, and compliance with surgical procedure bundles (8). While tailored SSI reduction bundles have demonstrated effectiveness in elective colorectal surgeries, their implementation and compliance in emergency settings remain underexplored areas requiring further investigation.

MATERIALS AND METHOD

This Hospital based prospective study was carried out in the department of General Surgery, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur from September 2022 to August 2024 with the aim to evaluate the impact of surgical site infection prevention bundle in emergency open appendectomy. All the patients with acute appendicitis attending SOPD or Emergency and Trauma Centre RIMS hospital is screened for meeting inclusion and exclusion criteria. A total of 252 patients admitted for acute appendicitis undergoing emergency open appendectomy were enrolled in the study after due informed consent from the patients. The study was approved by the institutional ethics committee. Single blinding was adopted where patients were unaware of the groups to which they would be allocated.

INCLUSION CRITERIA:

1. Diagnosed acute appendicitis cases.
2. Operated within 24 hours of hospital admission.

EXCLUSION CRITERIA:

1. Pregnant women.
2. Under immunosuppressant or with any other abdominal pathology.
3. Patients with skin infection at operative area.
4. Appendicular lump.

The personal details of the patients like name, age/gender, date of admission, date of operations, date of discharge and complications were recorded in the proforma.

Surgical Site Infection (SSI):
SSIs after appendectomy are postoperative nosocomial infections affecting the incision site, deeptissuesandorgansattheoperativesitewithin30days after the surgical procedure. The standardized surveillance criteria for defining SSI as developed by the Centers for Disease Control(CDC) and Prevention of the National Nosocomial Infections Surveillance(NNIS) isused. SSI within30days of surgery is categorized into:

Superficial SSIs: Infection within 30days after operation, involving the skin and subcutaneous tissue of incision only. And at least Purulent discharge, with/ without laboratory confirmation. At least one of the following signs and symptoms: Pain, tenderness, local swelling, redness, or raised temperature and the Surgeon deliberately open superficial incision, unless incision is culture negative.

Deep SSIs;
Infection with in 30 days of operation, Involving deep soft tissues (e.g.fascial and muscle layers) ofincision. And at least purulent drainage from the deep incision. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs/symptoms: Feverofmorethan38 degrees Celsius. Localized pain.
An abscess or other evidence of infection involving the deep incision is found on direct examination, during re-operation or by his to pathological or radiological examination.

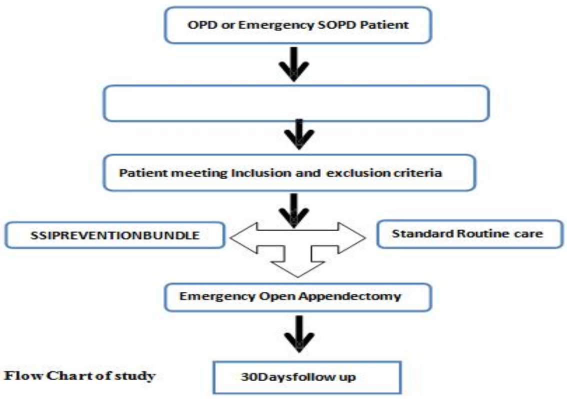
Organ/space SSIs; Infection within 30 days after operation involves any part of the anatomy (e.g organs or spaces) other than the incision, which was opened or manipulated during an operation. And at least purulent drainage from a drain placed through a stab wound into the organ/space. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space.

SSI study Pre-development of SSI Prevention Bundle:
Pre-SSI Prevention bundle implementation, SSI rate of patients undergoing emergency open appendectomy between September 1, 2022 to February 28th ,2023 is done. After emergency open appendectomies, skin closure is done by using stapling device or suture material as preferred by the concerned surgeon. Data regarding SSI is assessed according to CDC criteria by surgeon with clinical follow-up until 30 postoperative days. Data collection and maintenance for the comparative pre- implementation Cohort is done.
SSI study after implementation of SSI Prevention Bundle;
Institutional SSI prevention bundle were systematically Implemented as standard of care for Emergency open appendicectomy from March 1 2023. Items of the prevention bundle are identified based on validated international guidelines. During the post implementation study period SSI will be assessed by the concerned surgeon and Dedicated checklists will be completed by the surgeon immediately on completion of the procedure to assess compliance to 5 composite key items. These are:

Skin disinfection: Provide one iodine 10% is used for double layered painting of skin followed by spirit alcohol wipe.

Single shot antibiotic prophylaxis: Single dosing of Cefoperazone+ sulbactum and metronidazole is done within 60 minutes of skin incision and will be followed by 3 days of antibiotics post operatively.

Perioperative core temperature control: Patients core temperature is maintained at >36 ^{0}C perioperatively. Temperature reading is done by using digital thermometer on axilla 1 hour before surgery, intra operatively and 1 hour after surgery. Selective use of heated saline perfusion, pre- and perioperative use of pre- heated blankets to cover exposed skin areas or use of warm blowers or hot water bags.
Intracavity lavage: It is not recommended for uncomplicated appendicitis and lavage or suction is done for complicated appendicitis in contaminated areas only.
(1)Trimming of hairs of operative area if needed in OT room.



Flow Chart of study

Flowchart

STUDYTOOL
1.Patient information sheet.
2.Printed checklist for surgeon.
3.Physical as well as telephonic follow up.
4.DigitalThermometer.
5.Warmblanket/Hot water bags/warm saline
6.Trimmer

Fig:(1)Hot water bag,(2)Trimmer,(3)Electric warmer,(4)Digital thermo meter

Statistical analysis
Patient data is initially collected and managed using MS Excel, and subsequent statistical analyses is conducted utilizing IBM SPSS (Statistical Package for the Social Sciences) software, version 27 (IBM Corp., Armonk, NY, USA). A significance level of α = 0.05 was utilized across all statistical tests to ascertain the presence of statistically significant associations.

The methodology employed a combination of descriptive and inferential statistical techniques to examine the associations between Surgical Site Infection.

Fig.B:Setup for intraoperative temperature control

Fig.C: Post Povidone iodine wound wash

Fig. D: Post Saline wound wash

Fig E: Superficial SS

Fig F: Deep SSI

RESULTS

Age distribution

The age distribution of the 252 patients ranged from 18-60 years. The age range 18-30 has the highest proportion of individuals (43.66%), indicating a larger representation of younger adults in the population. 26.59% (67 patients) of the total, falls within the 31-43 age range. This is followed by the 44-56 age range accounts for25.8% (65patients), The smallest group,> 56, includes 3.97% (10patients) of the patients. This distribution indicates a relatively balanced age representation, with a slight concentration in the young adults categories. The mean age of patients in the study was 35.63±11.79 years and the median was 35.5 years. (Table 1, Figure 1)

Table1: Age Distribution of the patients(Years)(n=252)

Age Range	Prevention bundle		Total
	no	yes	
18-30	51(20.24%)	59(23.42%)	110(43.66%)
31-43	38(15.08%)	29(11.51%)	67(26.59%)
44-56	34(13.5%)	31(12.31%)	65(25.8%)
>56	3(1.2%)	7(2.78%)	10 (3.97%)
Total	126(50%)	126(50%)	252(100%)

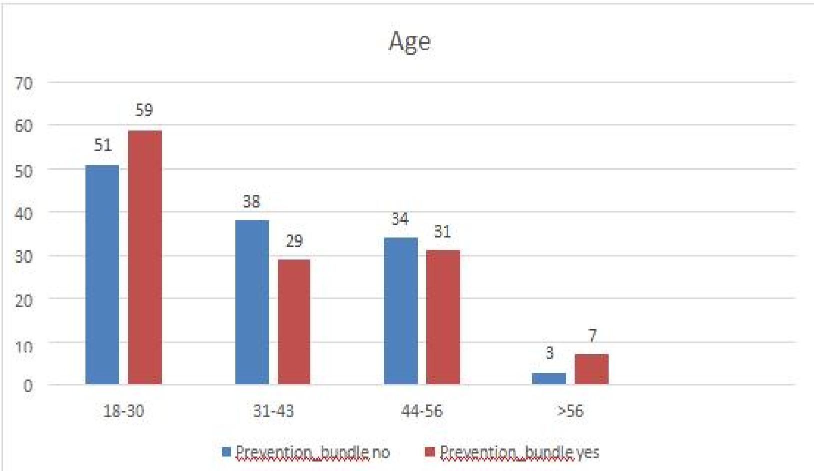


Figure1: The bar graph depicts the distribution in terms of patient's age Gender

The gender distribution of the participants was dominant by female patients over male. Specifically, 154 participants (61.12%) were female, while 98 participants (38.89%) were male. (Table 2, Figure 2).

Table 2: Distribution of the patients in terms of gender (n=252)

Gender	Prevention bundle		Total
	no	yes	
Male	57(22.62%)	41(16.27%)	98(38.89%)
Female	69(27.39%)	85(33.74%)	154(61.12%)
Total	126(50%)	126(50%)	252(100%)

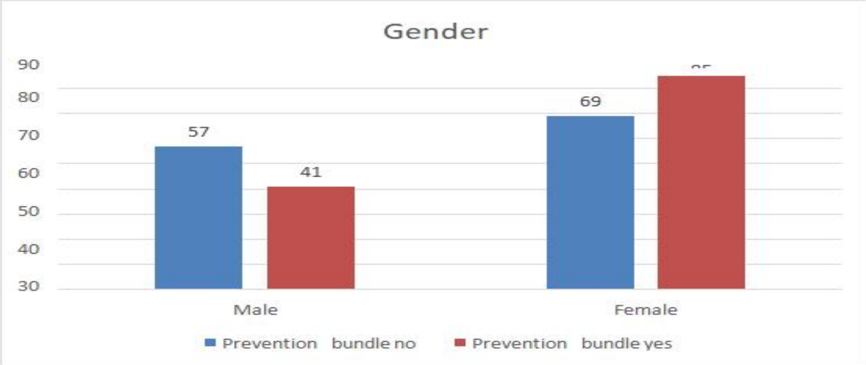


Figure2: Thepie graph depicts the distribution of patients in terms of gender.

Occupation

The participants' occupations are diverse, with the highest representation being students, who constitute 33.7% (85 individuals) of the sample. Businessmen make up 27.8% (70 individuals), while laborers account for 25.8% (65 individuals). Homemakers are the least represented group, comprising 12.7% (32 individuals) of the total participants. This distribution indicates a varied occupational background among the 252 participants. (Table 3, Figure 3).

Table3: Distribution of the patients in terms of occupation(n=252)

Occupation	Prevention bundle		Total
	no	yes	
student	45(17.86%)	40(15.88%)	85(33.74%)
home maker	16 (6.35%)	16 (6.35%)	32(12.7%)
businessman	31(12.31%)	39(15.48%)	70(27.78%)
Labour	34(13.5%)	31(12.31%)	65(25.8%)
Total	126(50%)	126(50%)	252(100%)

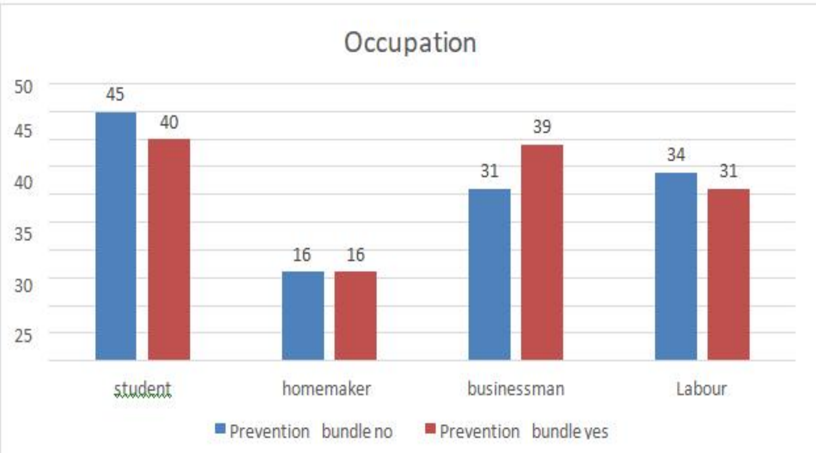


Figure3: The pie graph depicts the distribution of patients in terms of occupation

Marital Status

Marital status is evenly distributed among the participants, with a slight majority being married. Specifically, 128 participants (50.8%) are married, while 124 participants (49.2%) are unmarried. This almost equal split suggests that the sample includes a balanced mix of marital statuses, contributing to a total of 252 individuals. (Table 4, Figure 4).

Table 4: Distribution of the patients in terms of marital status (n=252)

Marital status	Prevention bundle		Total
	no	yes	
married	66(26.2%)	62(24.61%)	128(50.8%)
unmarried	60(23.81%)	64(25.4%)	124(49.21%)
Total	126(50%)	126(50%)	252(100%)

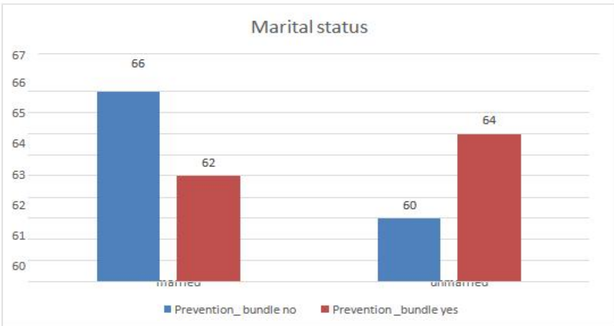


Figure4:The pie graph depicts the distribution of patients in terms of marital status.

Socio economic Status

The socioeconomic status of the participants shows a relatively even distribution across different levels. The middle socioeconomic status group is the largest, comprising 44.45% (112 individuals) of the sample. The high socio economic status group follows closely with 28.58% (72 individuals), and the low socio economic status group makes up26.99%(68individuals).This distribution across 252 participants indicates a well-represented socioeconomic diversity. (Table 5, Figure 5).

Table5: Distribution of the patients in terms of socio economic status(n=252)

Socio economic status	Prevention bundle		Total
	no	yes	
Low	40(15.88%)	28(11.12%)	68(26.99%)
Middle	51(20.24%)	61(24.21%)	112(44.45%)
High	35(13.89%)	37(14.69%)	72(28.58%)
Total	126(50%)	126(50%)	252(100%)

Figure5: The pie graph depicts the distribution of patients in terms of socio-economic status.

Comorbidity

Regarding comorbidities, the participants exhibited a healthy profile with 94.05% patients with no comorbidities. Hypertension was observed in 3.97% (10 individuals) of the sample. Participants with diabetes constitute the least patients at 1.98% (5 individuals).(Table 6, Figure 6).

Table6: Distribution of the patients in terms of Comorbidity(n= 252)

Comorbidity	Prevention bundle		Total
	no	yes	
No	120(47.62%)	117(46.43%)	237(94.05%)
Hypertension	4(1.59%)	6(2.38%)	10(3.97%)
Diabetes	2(0.79%)	3(1.19%)	5(1.98%)
Total	126(50%)	126(50%)	252(100%)

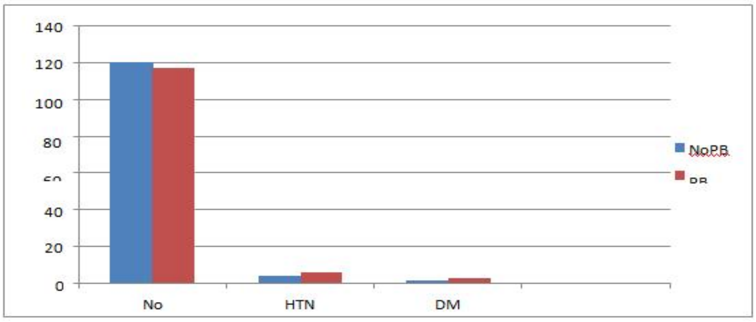


Figure 6: The pie graph depicts the distribution of patients in terms of Comorbidity.

BMI

The BMI distribution among the 252 patients reveals that the majority, 55.95% (141 patients), fall within the normal weight range (BMI 18.5 - 24.9). A significant portion, 39.68% (100 patients), are categorized as overweight (BMI 25.0 - 29.9). Only 4.36% (11 patients) have a low BMI, indicating they are underweight (BMI < 18.5). Notably, there are no patients classified as obese (BMI ≥ 30.0). This distribution indicates that while most patients have a normal BMI, a substantial number are overweight, with a smaller fraction being underweight, and none are in the obese category. (Table 7, Figure 7).

Table 7: Distribution of the patients in Terms of BMI(n=252)

BMI Category	Preventionbundle		Total
	no	yes	
LowBMI(<18.5)	4(1.59%)	7(2.78%)	11 (4.37%)
Normal(18.5-24.9)	72(28.58%)	69(27.39%)	141(55.96%)
Overweight(25.0-29.9)	50(19.85%)	50(19.85%)	100(39.69%)
Obese(≥30.0)	0(0%)	0(0%)	0(0%)
Total	126(50%)	126(50%)	252(100%)

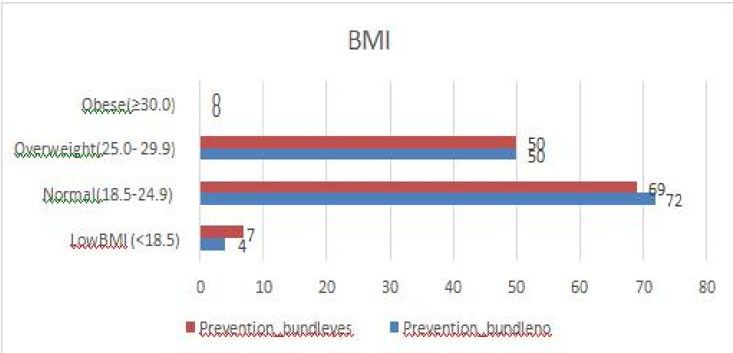


Figure7: The pie graph depicts the distribution of patients in terms of BMI.

Prevention Bundle
The use of a prevention bundle among participants is evenly split. Out of252 participants, 126 (50.0%) did not receive the prevention bundle, while the other 126 (50.0%) did. This indicates that half of the participants were provided with additional preventive measures. (Table 8, Figure 8).

Table8: Distribution of the patients in terms of prevention bundle (n= 252)

Prevention bundle	Frequency	Percent
no	126	50.0
yes	126	50.0
Total	252	100.0

Figure8: The pie graph depicts the distribution of patients in terms of prevention bundle.

Intra-Cavity Lavage

Intra-cavityla vage was rarely performed among the participants. A vast majority, 2.9 out of 252 (82.94%), did not have intra-cavity lavage, whereas 39 participants (15.48%) had a lavage and 1.59% were placed with drain along with lavage. (Table 9, Figure 9).

Table9: Distribution of the patients in terms of intra cavity lavage.(n= 252)

Intra cavity Lavage	Prevention bundle		Total
	no	yes	
Notdone	100(39.69%)	109(43.26%)	209(82.94%)
Lavage	23 (9.13%)	16 (6.35%)	39(15.48%)
Lavage+Drain	3(1.2%)	1(0.4%)	4(1.59%)
Total	126(50%)	126(50%)	252(100%)

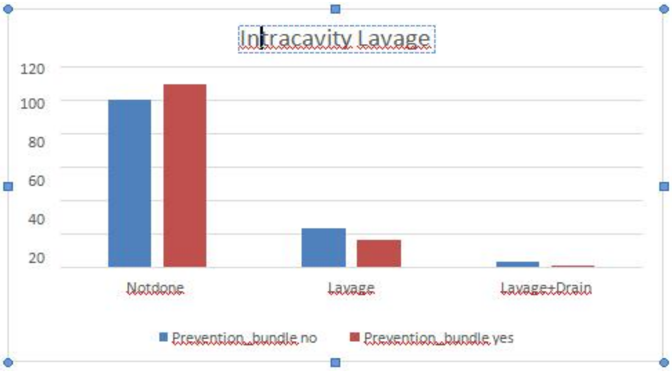


Figure 9: The pie graph depicts the distribution of patients in terms of intra cavity lavage

Temperature

The distribution of body temperatures among the 252 patients before, during, and after surgery reveals the following trends:

Before Operation: Most patients (32.1%) had temperature sranging from 97.0° F to 97.5°F. Then ext most common range was 97.6°F to 98.0°F (26.2%), followed by 98.1° F to 98.5°F (24.6%), and finally, 98.6°Fto99.0°F(17.1%).

During Operation: The highest frequency of temperatures fell within the 98.1°F to 98.5°F range (34.5%). This was followed by the 97.6°F to 98.0°F range (27.4%), then the 97.0°F to 97.5°F range (25.0%), and lastly, the 98.6°F to 99.0°F range (13.1%). Temperature was not measured for the surgeries where the prevention bundle was not placed.

Post Operation: The most common temperature range was 97.0°F to 97.5°F (32.9%), similar to the pre-operative distribution. This was followed by the 98.1°Fto 98.5°F range (27.8%), then the 97.6°F to 98.0°F range (23.8%), and the 98.6°F to 99.0°F range (15.5%).

Overall, the data indicates a fairly consistent temperature distribution across all three phases, with a slight tendency for higher temperatures during the operation, particularly in the 98.1°F to 98.5°F range. There is a noticeable consistency in temperature distribution before and after surgery, with most readings falling between 97.0°F and 98.8°F, indicating stable temperature management throughout the pre operation.

Table 10: Distribution of the patients in terms of temperature (n=252)

Temperature Range (°F)	Before surgery			During surgery		
	Prevention bundle		Total	Prevention bundle		Total
	no	yes		no	yes	
97.0-97.5	46 (18.26%)	35 (13.89%)	81 (32.15%)	-	28 (11.12%)	63(25%)
97.6-98.0	31 (12.31%)	35 (13.89%)	66(26.2%)	-	33(13.1%)	69 (27.39%)
98.1-98.5	25 (9.93%)	36 (14.29%)	61 (24.21%)	-	44 (17.47%)	87 (34.53%)
98.6-99.0	24 (9.53%)	20 (7.94%)	44 (17.47%)	-	21 (8.34%)	33(13.1%)
Total	126(50%)	126(50%)	252(100%)	-	126(50%)	252(100%)

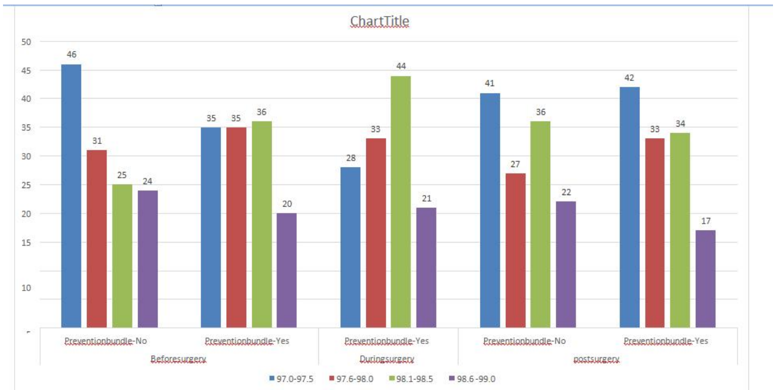


Figure10: The bar graph depicts the distribution of patients in terms of temperature.

Duration of surgery

The distribution of surgery durations reveals a diverse landscape of procedural lengths. The most prevalent durations, falling within the 31–40-minute range, represent 56.75% of the total surgeries. There's a gradual decline infrequency, with increase in duration of surgery from 41-50 minutes, 51-60 minutes and longer intervals from >60 minutes also comprising substantial portions of the dataset, accounting for 21.43%, 14.29% and 7.54% respectively. This distribution suggests a mix of routine procedures and more complex interventions within the data set, highlighting the varied nature of surgical practice. (Table 11, Figure 11).

Table11: Distribution of the patients in terms of duration of surgery(n=252)

Durationofthe surgery	Preventionbundle		Total
	no	yes	
31-40	65(25.8%)	78(30.96%)	143(56.75%)
41-50	29(11.51%)	25 (9.93%)	54(21.43%)
51-60	20 (7.94%)	16 (6.35%)	36(14.29%)
>60	12 (4.77%)	7(2.78%)	19 (7.54%)
Total	126(50%)	126(50%)	252(100%)

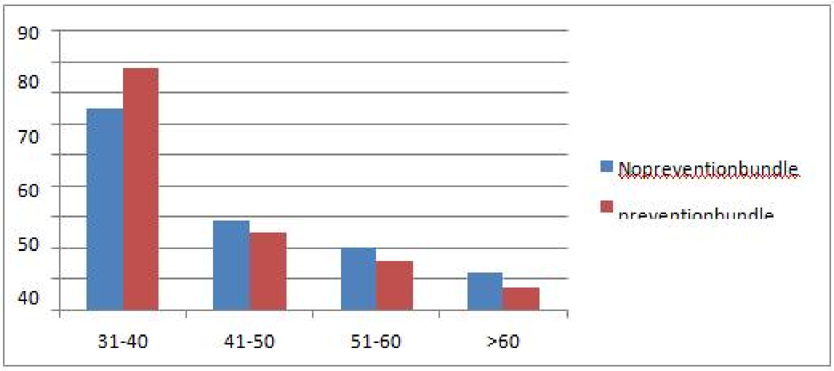


Figure 11: The bar graph depicts the distribution of patients in terms of duration of surgery

Material for Skin Closure

The majority of participants, 238 out of 252 (94.4%), had their skin closed with Ethilone 2-0, whereas a small fraction, 14 participants (5.6%), had their skin closed with Silk 2-0. This indicates a strong preference for Ethilone 2-0 for skin closure among the participants. (Table 12, Figure 12).

Table12: Distribution of the patients in terms of material for skin closure (n= 252

Material for skin clousure	Prevention bundle		Total
	no	yes	
Ethilone2-0	114(45.24%)	118(46.83%)	232(92.07%)
Silk2-0	12 (4.77%)	8(3.18%)	20 (7.94%)
Total	126(50%)	126(50%)	252(100%)

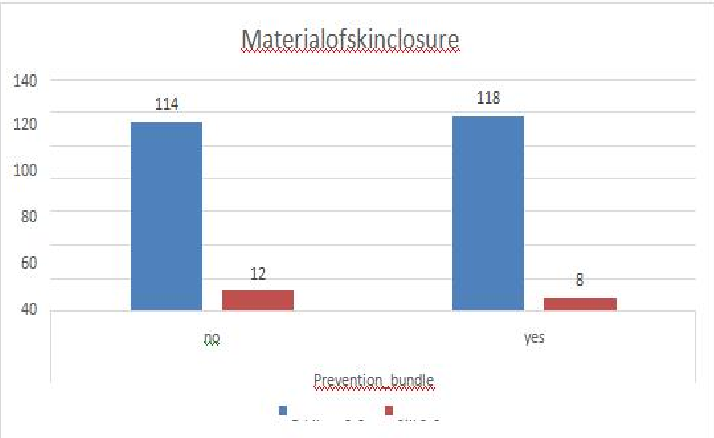


Fig:-12 The bar graph depicts the distribution of patients in terms of material for skin closure.

Surgical Site Infection(SSI)

Only23 participants (9.1%)did develop an SSI. This suggests a relatively low incidence of SSI among the study group. (Table 13, Figure 13).

Table 13: Distribution of the patients in terms of SSI(n=252)

SSI	Prevention bundle		Total
	no	yes	
no	113(44.85%)	116(46.04%)	229(90.88%)
yes	13 (5.16%)	10 (3.97%)	23 (9.13%)
Total	126(50%)	126(50%)	252(100%)

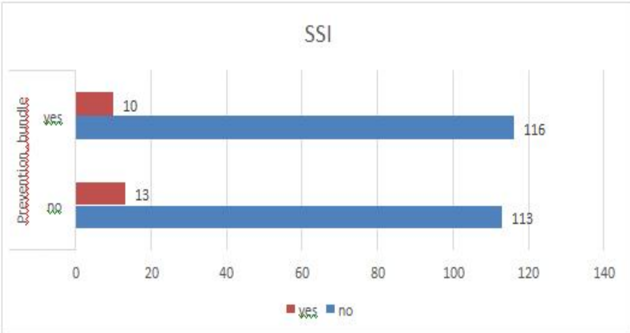


Figure13: The bar graph depicts the distribution of patients in terms of SSI Type of SSI

Among the participants, 229 (90.9%) did not develop an SSI. Of the 23 who did,19(7.54%)hadsuperficialSSIs, while4(1.59%)had deep SSIs. This indicate
That superficial SSIs were more common than deep SSIs among those affected. (Table 14, Figure 14).

Table 14:Distribution of the patients in terms of type of SSI(n=252)

SSI	Prevention bundle		Total
	no	yes	
No	113(44.85%)	116(46.04%)	229(90.88%)
Superficial	10 (3.97%)	9(3.58%)	19 (7.54%)
Deep	3(1.2%)	1(0.4%)	4(1.59%)
Total	126(50%)	126(50%)	Total

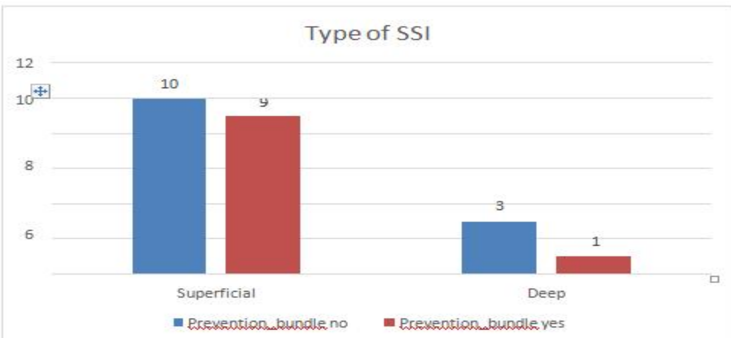


Figure14: The pie graph depicts the distribution of patients in terms of type of SSI.

Post operative Day of SSI Onset

For most participants (229outof252, or 90.9%),no SSI was reported. Among those who did develop an SSI, the onset occurred on different postoperative days: 20 participants (7.94%) between0-7days,3participants(1.2%) between 8-14days. (Table15, Figure15).

Table15:Distribution of the patients in terms of post operative day of SSI(n=252)

Post operative day of SSI	Prevention bundle		Total
	no	yes	
No SSI	113(44.85%)	116(46.04%)	229(90.88%)
0-7	10 (3.97%)	10 (3.97%)	20 (7.94%)
8-14	3(1.2%)	0(0%)	3(1.2%)
Total	126(50%)	126(50%)	252(100%)

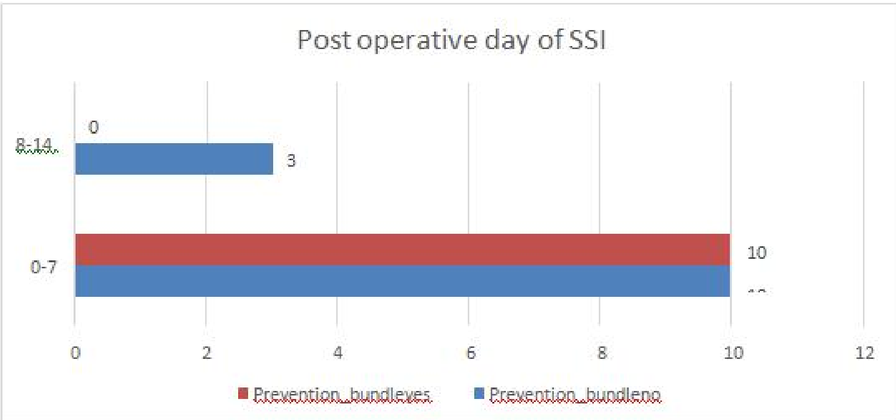


Figure 15: The pie graph depicts the distribution of patients in terms of post operative day of SSI.

Duration of Hospitalization

The vast majority of participants, 231 out of 252 (91.67%), had a hospital stayof4-7 days, followed by7.15% stayed for 8-14 days, while a small number, 13 participants(1.2%),stayed for15-21days.This suggests that most participant are relatively short duration of hospitalization. (Table 16, Figure 16).

Table 16: Distribution of the patients in terms of duration of hospitalization. (n =252

Duration of hospitalization	Prevention bundle		Total
	no	yes	
4-7days	114(45.24%)	117(46.43%)	231(91.67%)
8-14days	10 (3.97%)	8(3.18%)	18 (7.15%)
15-21days	2(0.8%)	1(0.4%)	3(1.2%)
Total	126(50%)	126(50%)	252(100%)

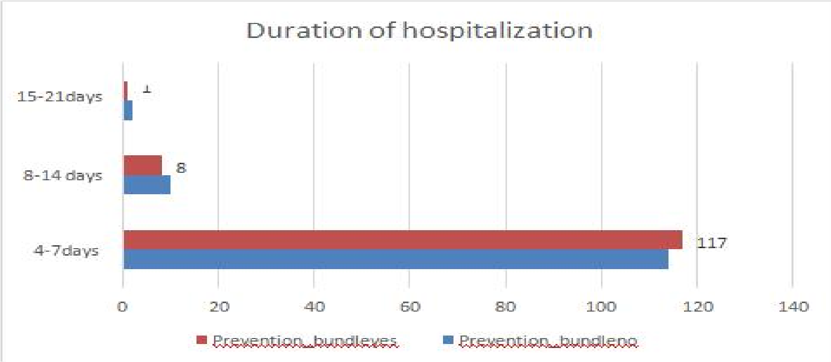


Figure 16: The pie graph depicts the distribution of patients in terms of duration of hospitalization.

Inferential statistics

The inferential statistics comparing Surgical Site Infection (SSI) and the implementation of a Prevention Bundle indicates no significant association between the two variables. when considering cases where SSI occur, there were 13 instances without the Prevention Bundle and 10 instances with it, further suggesting no clear relationship. The calculated p-value of 0.512 indicates no statistically significant difference, with a level of significance set at 0.05. Therefore, based on this analysis, it can be inferred that the implementation of the Prevention Bundle does not have a significant impact on reducing the incidence of Surgical Site Infections. (Table 17).

Table 17: Inferential statistics of Surgical Site Infection (SSI) and the implementation of a Prevention Bundle (n = 252)

SSI	Prevention bundle		Total	Chi square value	P Value
	no	yes			
no	113	116	229	0.431	0.512
yes	13	10	23		
Total	126	126	252		

DISCUSSION

In the study, 252 patients undergoing emergency open appendectomy were analysed to evaluate the impact of an SSI prevention bundle. The demographic and clinical characteristics of the patient population revealed that the majority were young adults aged 18-30 years (43.66%), with a mean age of 35.63 years. Females were predominant (61.12%), and students formed the largest occupational group (33.7%). Marital status was almost equally split between married and unmarried participants, and socioeconomic status was balanced, with the middle class being the most represented (44.45%). Most patients (82.15%) had no comorbidities, and the majority had a normal BMI (55.95%), although a significant portion were overweight (39.68%). Preventive measures were evenly split among the patients, though intra-cavity lavage was rarely performed (15.48%). Temperature management during surgery was consistent, and the most common surgery duration was 40-49 minutes (56.75%). Ethilone 2-0 was predominantly used for skin closure (94.4%). The incidence of SSIs was low, affecting only 9.1% of patients, primarily presenting as superficial infections. Hospital stays mostly lasted 4-7 days (91.67%). Despite these preventive measures, our inferential statistics showed no significant impact of the prevention bundle on reducing SSIs, with a p-value of 0.512,indicating that the prevention bundle did not significantly reduce the incidence of SSIs in our setting.

Incidence of SSIs
The study showed that 90.9% of participants did not develop an SSI, with a relatively low incidence of 9.1% among those who did. This aligns with findings from other studies, such as those conducted by **Tanner et al[19]. (2015)** and **Berríos- Torres et al[20]. (2017)**, who also reported that comprehensive prevention bundles could reduce the incidence of SSIs in various surgical settings.

Type and On set of SSIs
Among those who developed SSIs, the majority had superficial infections (7.54%), while deep infections were less common (1.59%). This distribution is consistent with previous findings by **de Lissovoy et al[21]. (2009),** indicating that superficial infections are more prevalent than deep infections post-surgery. Additionally, the onset of SSIs predominantly occurred within the first seven days postoperatively, a critical period identified in other studies such as those by **Mangram et al[22]. (1999).**

Duration of Hospitalization
The duration of hospitalization data showed that 91.67% of patients stayed between 4-7 days, with only a small percentage requiring extended hospital stays. This relatively short duration is comparable to findings by **Anderson et al[10].(2014),** who reported similar hospitalization periods in patients undergoing open appendectomies. Other factors associated with SSI risk in appendectomy patients include prolonged duration of operation **(Kasatpibal et al[11].,** 2006), complex appendicitis (**Giesen et al[12]., 2017),** and thickness of subcutaneous fat **(Thapa et al[13].,2019). DiSaverioetal[2]. (2016)**published guide lines for the diagnosis and treatment of acute appendicitis, recommending that a short, in-hospital surgical delay of up to 12-24 hours is safe in uncomplicated acute appendicitis and does not increase complications or perforation rates.

Inferential Statistics and Effectiveness of the Prevention Bundle
In the current study, the implementation of a prevention bundle in emergency open appendectomy procedures did not result in a significant reduction in SSI rates (p=0.512). This finding is consistent with several other studies that have reported no significant impact of prevention bundles on SSI rates in different surgical contexts. **Sartelli et al[23]. (2016)** conducted a prospective observational study involving 4,533 patients undergoing emergency appendectomy across 116 hospitals worldwide.They also found no significant difference in SSI rates between patients who received the bundle(6.7%) and those who did not(6.9%)(p=0.84). Similarly**, Crollaet al[24]. (2012), Cima et al[25]. (2013), and Andrade LS et al[26], (2019)** evaluated the effect of SSI prevention bundles in colorectal surgery, abdominal surgery, and cardiac surgery, respectively. Despite the implementation of prevention bundles, these studies did not observe significant reductions in overall SSI rates.
The lack of significant impact of prevention bundles on SSI rates in these studies, including the current study, highlights the complexity of SSI prevention and the potential influence of various factors such as bundle adherence, baseline SSI rates, and the specific components of the bundle. **Hawn et al[27]. (2011)** emphasized that the effectiveness of preventive measures can vary based on the specific surgical procedure and patient demographics.

In contrast, some studies have reported significant reductions in SSI rates following the implementation of prevention bundles. **Falconer R et al[31].** found a more pronounced reduction in SSI rates with the implementation of a similar prevention bundle in colorectal surgeries, highlighting the variability ineffectiveness across different types of surgeries. **Jurt et al[1]. (2022)**

found that an intra operative SSI prevention bundle reduced over all SSI ratesfrom6.5% to3.8% (p= 0.014) in a retrospective study involving 1,901 patients. **Rozario et al[15]. (2018)** also reported a significant reduction in SSI ratesfrom3.4%to 1.0% (p=0.001) after implementing a bundle of simultaneous interventions. These findings suggest that multi-component interventions can be effective in certain contexts. However, **Jurtet al[9]. (2021)** in another study with 1,516 patients, found no beneficial impact of an SSI prevention bundle on SSI rates, citing lower compliance rates (77%) with critical steps as a potential reason for the lack of effectiveness. This aligns with the current study's findings and highlights the importance of compliance and proper implementation for the success of prevention bundles.

The role of surgical approach in SSI rates has also been in vestigated. **Pandey et al[4]. (2021)** demonstrated that laparoscopic appendectomies had significantly fewer SSIs compared to open appendectomies, emphasizing the influence of surgical technique on infection rates. **Danwangetal[3]'s (2020)** systematic review highlighted the high global incidence of SSIs post-appendectomy, particularly in low-income countries, and called for the implementation of existing guidelines to reduce the SSI burden.

Risk factors for surgical site infections

In addition to the aforementioned factors influencing the effectiveness of an SSI prevention bundle in open appendectomy procedures, it is also crucial to consider patient comorbidities. Patients with certain comorbidities, such as diabetes mellitus and obesity, area to a higher risk of developing SSIs. Therefore, it is essential to account for these comorbidities when evaluating the effectiveness of an SSI prevention bundle. However, in this study Most patients (82.15%) had no comorbidities and had normal BMI (55.95%), although a significant portion were overweight (39.68%).

In a study by **Leaperet al[28]. (2015**), it was found that diabetic patients had a significantly higher risk of developing SSIs following open hernia repair. Similarly, obese patients have been shown to have increased rates of SSIs following various surgical procedures, including appendectomies (**Gurunathan Uet al[29]., 2017).**Given the higher baseline risk of SSIs in these patient populations, it is crucial to account for these comorbidities when evaluating the effectiveness of an SSI prevention bundle. Prophylactic antibiotic use has been extensively studied in appendectomy patients. **Kasatpibal et al[11]. (2006)** conducted a prospective cohort study in eight Thai hospitals and found that antibiotic prophylaxis was significantly associated with a decreased risk of SSI, regardless of whether the antibiotic was administered preoperatively or intra operatively. The study recommended preoperative use of antibiotic prophylaxis in all patients undergoing appendectomy. **Giesen et al[12]. (2017)** also emphasized that preoperative antibiotic prophylaxis reduces the number of SSIs and should be continued postoperatively in patients with complex appendicitis. **Garcell et al[8]. (2017)** reported a high frequency of multidrug-resistant organisms in SSIs after appendectomy, highlighting the need for additional studiesto evaluate the effectiveness of current preventive practices, particularly antimicrobial prophylaxis. The use of wound protection devices has also been investigated as a means to reduce SSI rates in appendectomy. **Lee et al[7]. (2010)** conducted a randomized prospective trial and found a statistically significant reduction in wound infection incidence with the use of a wound protection device (1.6% vs. 14.6%, p = 0.02). The study suggested that this simple intervention could have a large impact on the incidence of surgical wound infection and ultimately reduce the economic and emotional burden of preventable SSIs. **Madrigal et al[17]. (2018)** conducted a retrospective study using a national cohortto assess trends in the incidence and impact of postoperative infections.

Despite encouraging trends, postoperative infections continue to serve as a suitable quality improvement target, particularly in specialties with a high burden of infections. **Weiser et al[18]. (2019)** investigated the effectiveness of a multi disciplinary patient care bundle for reducing SSIs in a pragmatic study involving patients treated consecutively between2013 and 2016. The intervention included 13 components related to bowel preparation, antibiotic selection and administration, skin preparation, maintenance of normothermia, and use of clean instruments for closure. The study found that meaningful reductions in SSI rates (from11.0%to 4.1%, p =0.001) can be achieved by implementing a multidisciplinary care bundle at a hospital-wide level, with the greatest reductions observed in patients at intermediate or high risk of SSI.

The gap between theoretical measures and their compliance in preventing SSIs has been addressed by **Badia et al[16]. (2017).**In a qualitative study using a web- based survey, they found that 50.5% of responders received no feedback on their SSI rates, and there were gaps in the translation of evidence into practice among different surgical specialties. Several areas for improvement were identified, as some core prevention measures were not in common use. In light of these findings, it is possible that the lack of a significant association between the prevention bundle and reduced SSI rates in our study could be attributed to differences inpatient comorbidities between the pre-intervention and post-intervention groups. Further analysis is needed to determine whether patient comorbidities may have influenced the effectiveness of the prevention bundle in our study population

conclusion

while SSI prevention bundles have shown effectiveness in reducing SSI rates in some studies, the current study and several others have not found a significant association between prevention bundles and reduced SSIs. This discrepancy may be attributed to differences in bundle components, compliance rates, and contextual factors such as surgical techniques and patient populations. The lack of significant reduction in SSIs despite the implementation of a prevention bundle underscores the complexity of SSI prevention and the need for continuous evaluation and adaptation of prevention strategies. The inferential statistics in the current study further emphasize that the direct impact of prevention bundles on SSI rates may be limited, highlighting the importance of considering multiple factors that influence SSI prevention. These factors include surgical approach, prophylactic antibiotic use, timing of appendectomy, wound protection devices,and multidisciplinary care bundles. Further research is necessary to identify the most effective components of prevention bundles and ensure high compliance rates to achieve meaningful reductions in SSI rates across various surgical procedures and healthcare settings. Additionally, future studies should focus on understanding the interplay between prevention bundles, surgical techniques, and patient-specific factors to develop more targeted and effective SSI prevention strategies.

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