Incidence, Risk Factors, Antimicrobial Susceptibility Patterns and Outcomes of Surgical Site Infections among Patients Admitted to Jimma Medical Center, South West Ethiopia: Prospective Cohort Study

By: Gemedo Misha (B.Pharm)

A Research Paper Submitted to School of Pharmacy, Institute of Health, Jimma University in Partial Fulfillment for the Requirements for Masters of Sciences Degree in Clinical Pharmacy

January, 2020

Jimma, Ethiopia

JIMMA UNIVERSITY

INSTITUTE OF HEALTH

SCHOOL OF PHARMACY

.

Incidence, Risk Factors, Antimicrobial Susceptibility Patterns and Outcomes of Surgical Site Infections among Patients Admitted to Jimma Medical Center, South West Ethiopia: Prospective Cohort Study

By: Gemedo Misha (B.Pharm)

Advisor: Dr. Legese Chelkeba (B.Pharm, MSc, PhD, Associate professor of clinical pharmacy)

Co-Advisor: Mr. Tsegaye Melaku (B.Pharm, MSc, Assistant professor of clinical pharmacy)

January, 2020

Jimma, Ethiopia

ACKNOWLEDGEMENT

First of all, I'm very grateful for Jimma University for giving me this opportunity.

Second, I would like to express my heartfelt gratitude to my advisors; Dr. Legese Chelkeba and Mr. Tsegaye Melaku for their unreserved, constructive comments, continuous advice and encouragement throughout the process of this paper.

And also, I would like to acknowledge all study participants, microbiology unit of Jimma Medical Center (JMC), data collectors for their cooperation and facilitation.

Finally, my special thanks also go to all my friends who helped me by giving constructive advice and comments throughout this paper development.

ABSTRACT

Background; Surgical site infections are one of the leading health care–associated infection in developing countries. Despite improvements in surgical technique and the use of best infection prevention strategies, surgical site infections remained the major cause of hospital acquired infections.

Objective: To assess the incidence, risk factors, antimicrobial susceptibility patterns and outcomes of surgical site infections among patients admitted to Jimma Medical Center, South West Ethiopia.

Methods: A prospective cohort study involving 251 patients that underwent surgical procedure at general, orthopedic and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019 was conducted. All patients were followed daily before, during and after operation for 30 days starting from the date of operation. Data was entered using EpiData version 4.2 and analyzed using statistical software package, SPSS version 20.0. To identify the independent predictors of outcome, multiple stepwise backward cox regression analysis was done. Statistical significance was considered at p-value <0.05. Patient's written informed consent was obtained after explaining the purpose of the study. Patients were informed about confidentiality of the information obtained.

Results: Of total of 251 participants included into study, about 126 (50.2%) were females. The mean± SD age of patients was 38 ±16.30 years. Considerable number of patients 53(21.1%) developed surgical site infections. ASA score ≥3 [AHR=2.26; 95%CI=(1.03-4.93)], postoperative antibiotic prescription [AHR=3.2; 95%CI= (1.71-6.01)],contaminated-wound [AHR=7.9; 95%CI=(4.3-14.60)],emergency surgery [AHR=2.8; 95% CI= (1.16-6.80)], duration of operation ≥ 2 hours [AHR=4; 95% CI=(2.17-7.50)] and comorbidity [AHR=2.52; 95%CI=((1.28-4.94)] were independent predictors for surgical site infections. E.coli was the most frequent pathogen associated with surgical site infections and multi drug resistance was seen in most of the isolates.

Conclusion: The incidence of surgical site infection was high in the study setting. There were significant numbers of contributing factors for the occurrence of surgical site infections. Multi drug resistance was seen in most of the isolates. Early identification of patients at risk and rational antimicrobial use is necessary to reduce burden of surgical site infections and multidrug resistance pathogens.

Key words: Surgical Site Infection, Outcomes, Antibiotics Resistance, Ethiopia

TABLE OF CONTENT

ACKNOWLEDGEMENT I
ABSTRACT II
TABLE OF CONTENT II
LIST OF TABLES V
LIST OF FIGURES VI
LIST OF ACRONOMYS AND ABBREVIATION VII
1. INTRODUCTION 1
1.1. BACKGROUND 1
1.2. STATEMENT OF THE PROBLEM 3
1.3. SIGNIFICANCE OF THE STUDY 5
2. LITERATURE REVIEW 6
2.1. INCIDENCE OF SURGICAL SITE INFECTION 6
2.2. RISK FACTORS FOR THE OCCURRENCE OF SSI 7
2.3. ETIOLOGY OF SSI AND ITS ANTIBIOTIC RESISTANCE PATTERNS 8
2.4. OUTCOMES RELATED TO SURGICAL SITE INFECTION 10
2.5. CONCEPTUAL FRAMEWORK 12
3. OBJECTIVES 13
3.1 GENERAL OBJECTIVE 13
3.2 SPECIFIC OBJECTIVES 13
4. METHOD AND MATERIALS 14
4.1. STUDY AREA AND PERIOD 14
4.2. STUDY DESIGN 14
4.3. POPULATION 14
4.3.1. Source population 14
4.3.2. Study population 14
4.4. INCLUSION AND EXCLUSION CRITERIA 14
4.4.1. Inclusion Criteria 14
4.4.2. Exclusion criteria 15
4.5. SAMPLE SIZE DETERMINATION AND SAMPLING TECHNIQUE 15

4.6. Data Collection Instrument & Procedure 16
4.7. Study variables 17
4.7.1. Dependent variable 17
4.7.2. Independent variables 17
4.8. Outcome measure and validity method 18
4.8.1. Surgical site infection 18
4.8.2. Reoperation 18
4.9. Data Quality Management 18
4.10. Data Processing and Analysis 19
4.11. Ethical consideration 19
4.12. Dissemination of the Result 20
4.13. Operational definition and Definition of terms 20
5. RESULTS 22
6. DISCUSSIONS 41
7. LIMITATION OF THE STUDY 44
8. CONCLUSION 44
9. RECOMMENDATION 45
REFERENCES 46
Annex I. American Society of Anesthesiologists (ASA) scores (5) 52
Annex II: The CDC identified four surgical wound classifications 52
Annex III: United States Centers for Disease Control and Prevention National Healthcare Safety Network surgical site infection definition criteria 53
Annex IV: Questionnaire 55

List of Tables

Table 1: Baseline socio-demographic characteristics of adult patients admitted to surgical wards of Jimma Medical Center from April 20-August 20, 2019..... 23

Table 2: Baseline clinical, procedure characteristics and medication usage patterns among adult patients admitted to Surgical wards Jimma Medical Center from April 20-August 20, 2019..... 25

Table 3: Baseline burden of co morbidity among patients admitted to surgical procedure at surgical wards of Jimma Medical Center April 20-August 20, 2019. 27

Table 4: Baseline laboratory investigations among adult patients admitted to surgical wards of Jimma Medical Center, April 20-August 20, 2019. 28

Table 5**:** Cox regression model on factors associated with surgical site infections surgical wards of Jimma Medical Center, April 20-August 20, 2019. 31

Table 6: Antimicrobial resistance patterns among types of bacteria identified at surgical wards of Jimma Medical Center,April 20-Auguest 20, 2019..... 35

Table 7: Cox regression model on factors associated with reoperation at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019..... 38

Table 8: Bivariate linear and cox regression model on outcomes of SSI at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019. 40

List of Figures

Figure 1: Conceptual frame work for factors associated with outcomes..... 12

Figure 2: Kaplan-Meier survival curve showing 30 days survival for types of surgery among patients admitted to surgical unit of Jimma Medical Center, April 20-Auguest 20 2019 29

Figure 3: Frequency and types of bacteria among surgical site infected patients at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019..... 33

Figure 4: Kaplan-Meier survival curve showing 30 days survival for SSI and reoperation among patients admitted to surgical wards of Jimma Medical Center, April 20-August 20, 2019..... 36

LIST OF ACRONOMYS AND ABBREVIATION

ASA	American Society of Anesthesiologists
BG	Blood-Glucose
BMI	Body Mass Index
BSC	Bachelor Science
CBC	Complete Blood Count
CDC	Centers for Disease Control and Prevention
CHWs	Community health workers
CS	Caesarean Section
DM	Diabetes-Mellitus
HAI	Hospital Associated Infection
JMC	Jimma Medical Center
LMICs	Low- and Middle-Income Countries
LOS	Length Of Stay
LSCS	Lower Segment Caesarean Section
NHSN	National Healthcare Safety Network
OR	Operation Room
POD	PostOperative Day
SPSS	Statistical Package for Social Sciences
SSI	Surgical Site Infection
SUSP	Surgical Unit-based Safety Programme
USA	United States of America
WHO	World Health Organization

1. INTRODUCTION

1.1. Background

Surgical site infection (SSI) is defined as an infection that occurs in surgical patients at the incision site within 30 days after surgery if there is no implant or within 1 year if there is an implant. It is a potential complication associated with any type of surgical procedure (1).

Microorganisms from the patient's own skin flora or from the environment surrounding the patient were the causes of SSIs. In both cases, there is a possibility for microorganisms to adhere on surgical instruments and consequently contaminate the incision wound, particularly during contaminated surgical procedures. Most of these infections are caused by multidrug resistant microorganisms (2,3).

SSIs increase the length of hospital stay from 4 to 32 days. Approximately 25% of patients will develop severe sepsis and shock. Moreover, it causes statistically significant morbidity, mortality, and financial burdens for individuals and communities (4).

The proportion of SSIs is determined by the type of surgery. For example, highest risk for orthopedic followed by cardiac and intra-abdominal surgery (4). The type of surgery could also determine the predominant pathogen causing it. In clean surgeries, Methicillin resistance Staphylococcus aurous (MRSA) is the predominant pathogen whereas, in surgeries involving hollow visceral organs like appendectomy, colorectal, gastro duodenal, biliary tract and urologic operations gram negative bacilli, gram positive organism, and anaerobes were the culprit etiologies (3).

SSI is reported as the second most common health care associated (HAI) in developed country. In Europe, it affects more than 500,000 people per year, in USA; it contributes to patients spending more than 400,000 extra days in hospital per year. However, it is the most frequent type of HAI in low- and middle-income countries (LMICs). For example, approximately 10% people acquire it and about 20% of caesarean section procedures lead to a wound infection in Africa (2,5,6).

There are different types of risk factors for occurrence of surgical site infections. These are patient and process related factors. The patient-related factors includes age, gender, immune

status, per operative hyperglycemia, pre-existing diabetes, obesity, malnutrition, recent tobacco use, pre-existing remote body site infection, colonization with microorganisms whereas, perioperative hypothermia, the improper use of antibiotics and inappropriate pre and intra-operative techniques, type of wound, emergency surgical procedure and prolonged duration of surgery are process related factors (5).

SSIs can be avoidable. For instance, up to one-half it can be prevented through successful implementation of clinical practice guidelines (2,4). These clinical practice guidelines use multimodal improvement strategy, hand-washing practices, core components of infection prevention and control (IPC), HAI prevention. In generally, SSI prevention is very important to improve patient outcomes, save lives, reduce morbidity, and minimize health care costs (2,4–10).

1.2. Statement of the problem

Surgical site infections (SSIs) are one of the serious complications of surgical procedures affecting patient safety worldwide and the most common type of healthcare-associated infections (HAIs) (5,11–13).

The incidence of SSI is different among developed and developing country. In developed country like USA (2.6%), Germany (1.6%) and 2.9% in different European countries. However, in developing country, it accounts two times higher than developed country (14). The occurrence of SSIs has negative impacts on patient's outcomes widely.

It is responsible for 3% of surgical mortality, prolonged lengths of hospital stay, and increased medical costs worldwide (15).

It accounts for 20% of all HAI. Patients with an SSI have approximately 7–11 additional postoperative hospital-days, 2–11-times higher risk of death. About 77% of deaths in patients with SSI are directly attributable to SSI(5,13). Patients who develop SSIs are up to 60% more likely to spend time in an intensive care unit, 5 times more likely to be readmitted and 2 times more likely to die (16). In USA, it accounts 33.7% of overall hospital-related annual costs and additional 11 days of hospitalization per patient (17). It is the most frequent cause of readmissions (18).

In England, SSI surveillance showed that, the median additional LOS attributable to SSI is 10 days, and the readmission was 24.7% (19).

The endemic burden of SSI is significantly higher in low and middle-income countries, particularly in patients admitted to intensive care units,(out of 100 hospitalized patients) at any given time, 7 in developed and 10 in developing countries will acquire at least one infection (5,11–13).

The WHO survey found that in low- and middle-income countries, the incidence rates of SSI ranged from 1.2 to 23.6 per 100 surgical procedures. This contrasted with rates between 1.2% and 5.2% in countries with more resources (2).

In Sub-Saharan Africa, SSI was associated with 3 times days of hospital stay post-operatively. It leads to increased treatment time and possible reoperation(20). In Ethiopia, studies indicated that

the rate of SSIs after CS was 6.8% at Lemlem Karl hospital (21),11.4% in Jimma (22), 9.4% in Assella (23), and 11.7% in Ayder comprehensive specialized hospital (24). In other surgical procedure in Hawassa 19.1% (25) and in east and west Gojjam hospitals 25.5% (26).

Resistance patterns of bacteria associated with SSI vary globally depending on the region, local epidemiology reports, and methodology of susceptibility testing. SSI treatment was becoming very complex and challenging due to bacterial resistance. Most of the data on drug resistance were obtained from high income countries. However, there were scarce reports on the rates of resistant bacteria causing SSI especially from LMICs (27).

In Mekelle Ethiopia, a study was done to determine the rate of Aerobic bacteria susceptibility to antibiotics in patients with SSI, and isolated bacteria's have shown multi drug resistance to the commonly used antibiotics (28). In Tikur Anbessa Specialized Hospital, resistance to two or more antimicrobials was recorded in 74 (95%) of the isolates; while, resistance to 3 or more antimicrobials was detected in 65(82.3%) of the isolates (29).

Currently many top level evidence-based guidelines for the prevention of SSIs are developed worldwide. However, its rates have not been measurably fallen, particularly in developing countries, and process related risk factors are playing significant role for this effect (30–32).

The rate and burden of surgical site infections is significantly higher in developing nations including Ethiopia (27, 28).

There were many studies done in Ethiopia about SSIs. The majorities of these were retrospective and cross sectional study. Moreover, only certain procedures were included in most studies (e.g. cesarean section). There was also scarcity of data published in Ethiopia regarding patients outcomes related to SSI and identification of its etiology. Therefore, this study was aimed to assess the incidence, risk factors, antimicrobial susceptibility patterns and outcomes of surgical site infections.

1.3. Significance of the study

The purpose of this study was to provide care providers with an up to date summary and analysis of the credible evidence related to incidence, risk factors, bacteriologic etiology of SSI and its antimicrobial resistance patterns, as well as impacts of SSIs on patients' outcome. The study will give an evidence for governmental and non-governmental organization those working in the area of healthcare associated infections by providing updated information on incidence, risks, root causes, antibiotic resistance patterns of SSI and its effects on patients' outcomes.

Therefore, findings of the study will provide important information for health professionals, administrators, program managers, policy makers, other researchers and it will serve as an input for the planning and implementation of effective strategies to decrease the incidence, control leading factors, etiology and in the meantime complications related with SSIs.

2. LITERATURE REVIEW

2.1. Incidence of surgical site infection

In developed countries the incidence of surgical procedures complicated by surgical-site infection showed that 2.6% in USA, 1.6% in Germany similarly, it was 2.9% in different European countries and 5.6% in developing countries (14). A Meta-analysis of 84 prospective observational studies in mainland of China revealed that the average incidence of SSI was 4.5% (33).

In Brazilian hospital based retrospective cohort study of 16,882 patients undergoing general surgery, the incidence of surgical site infection was 3.4% (34). A retrospective cohort study of 365 patients who underwent a partial or total colon resection in Atlanta, Georgia, which evaluated 365 patients who underwent colon resection at a single institution, 84 (23%) of patients were acquired SSI (35).

Direct and indirect surveillance done in India, the SSI rate among 720 patients investigated was 5% (36). In Tanzania, a cross-sectional study conducted at Muhimbili Orthopedic Institute (MOI) in Dares Salaam, on 300 study participants 75(25.0%) had surgical site infection (37). A Prospective Observational Study at a Tertiary Healthcare Facility in Abuja, Nigeria reported that out of 127 surgical patients 35 (27.56%) developed SSIs (38).

In Ethiopia Hospital based cross-sectional study conducted on 384 women who following cesarean section at Lemlem Karl hospital showed that the incidence of SSI was 6.8% (21). A prospective descriptive study conducted on all 770 women who had surgery for delivery in obstetric ward of the Jimma University Specialized Hospital (JUSH) 11.4% women developed SSI(22). Retrospective study conducted on a total of 206 medical records of women who underwent C/S in Ayder comprehensive specialized hospital in Tigray, showed the magnitude of surgical site infection was 11.7% (24).

Another a cross sectional study conducted among 165 adult patients admitted in west and east Gojjam zone hospitals, Nearly one- fourth, 42 (25.5%) of the participants were developed surgical site infections (26). A prospective observational study at Tikur Anbessa Specialized Hospital, From 131 patients 27 (20.6%) patients developed surgical site infection (39).

A retrospective study done at the College Teaching Hospital, St Paul's Hospital Millennium Medical showed that surgical site infections were 51/219(23.3%) (40).

2.2. Risk factors for the occurrence of SSI

A systematic review of risk factors associated with surgical site infections among surgical patients of developed nations indicates that risk factors consistently identified were co-morbidities, advanced age, risk indices, patient frailty, and surgery complexity, longer surgeries (41). Retrospective Multicenter Study done in 6 teaching hospitals in the southwest of the Netherlands indicated that the independent risk factors for occurrence of SSIs were type of surgery and type of wound class (42).

A Meta-Analysis of 84 Prospective Observational Studies in mainland China, the most common risks were being abdominal surgery, elder, LOS over 2 weeks, superficial incision wounds, dirty wounds, operations lasting for over 2 hours emergency surgeries, and non-intra-medication operations (33).

Length of preoperative hospital stay more than 24 hours, duration of surgery in hours, wound class clean-contaminated, contaminated and dirty/infected and ASA II, III and IV/V were among the risk factors associated with SSIs in Brazilian hospitals (34).

A prospective, descriptive study conducted in Nepal showed that the risk of developing SSI after C-section is multi-factorial. These were emergency surgery, membrane rupture before surgery, vertical skin incision and interrupted skin suturing which were found statistically significant (43).

Direct and indirect surveillance methods performed in India revealed that the independent risk factors associated with SSI were wound class & surgical duration (36).

In Tanzania, a cross-sectional study conducted at Muhimbili Orthopedic Institute (MOI) in Dares Salaam, on 300 study participants reported that the independent risks for SSIs were more than 2 hours length of surgical procedure, none prophylactic use of antibiotics, more than one week stay before surgery (37).

A Prospective Observational Study in Nigeria reported that prolonged post-operative hospital stays, class of wound and some co morbid conditions were found to be significantly associated with higher SSI rate (38).

In Ethiopia a prospective descriptive study conducted on all 770 women who had surgery for delivery in obstetric ward of the Jimma University Specialized Hospital (JUSH) showed that the development of surgical site infections were significantly affected by address of the patient, ANC follow up, prolonged rupture of membranes, chorioaminities, meconium, circumstance of surgery, volume of intra-operative blood loss, per operative blood transfusion and wound class at time of surgery (22).

Another Facility based retrospective observational study carried out among mothers who had delivery related surgery at obstetric ward of Assella teaching referral hospital reveals that the risk factors for surgical site infection were age less than 19, preterm gestation age, duration of labor ≥24 h, duration of rupture of membrane ≥12 h, vertical skin incision, pre operation, preoperative blood transfusion, abdominal hysterectomy, and diabetic mellitus (23).

A prospective study involving 105 patients that undergone major surgical procedure at Hawassa University Referral Hospital, the risk factors were older age, preoperative stay >7days, duration of surgery (25).

Institution based retrospective cross-sectional study was conducted in the Orthopedics and Traumatology Surgical Unit of TASH, revealed that duration of postoperative prophylaxis ≥24hrs,Postoperative prophylaxis were associated with SSIs (44).

2.3. Etiology of SSI and its antibiotic resistance patterns

Causative microorganisms of surgical site infections are varied according type of surgey Staphylococcus aureus is the leading surgical site infections pathogens in case of orthopedic, breast, neurological. Vascular, cardiac, ob/gyn & neck surgey whereas E.coli is the predominant pathogen in abdominal surgery in hospitals worldwide (45).

A retrospective review of 2061 patients underwent orthopedic surgery in major teaching hospitals in china showed 33 out of clinical SSI were culture positive & 65.72% were gram-

positive bacteria isolated,68.6% of all bacteria were cefuroxime resistant(46). In Brazilian hospital Staphylococcus aurous and Escherichia coli were identified (34).

A retrospective chart review study among patients underwent orthopedics surgery in Saudi Arabian reported the most common pathogens were Staphylococcus species including MRSA (29.11%); Acinectobacter species (21.5%), Pseudomonas species (18.9%), and Enterococcus species (17.7%) (47).

A prospective cohort study, conducted on 1,900 Patients who had undergone orthopedic surgery at an Iranian teaching hospital showed that Methicillin Resistant Staphylococcus aureus (MRSA) 53% (n =25) and Staphylococcus coagulase-negative 32% (n =15) were the most common isolated germ(48). A prospective study was conducted at a tertiary care hospital to all the patients admitted in department of surgery, in India the most commonly isolated pathogens in the study were Staphylococcus aureus, Escherichia coli, and Pseudomonas aeruginosa. Pseudomonas aeruginosa was most common isolate from orthopedic cases of SSI, Escherichia coli was most common isolate from intestinal surgeries and Staphylococcus aureus from LSCS (49).

In Rwanda prospective study included 294 patients, the most common pathogens isolated were Klebsiella ssp (55%), followed by Escherichia coli (15%) and Proteus ssp (12%), Acinectobacter (9%), Staphylococcus aureus (6%) and coagulase-negative staphylococci (3%).The pathogens revealed different levels of antibiotic resistance; amoxy-clavilinic acid (98.8%), gentamycin (92.6%), ciprofloxacin (78.1%) and ceftriaxone (53.3%). On the other hand, Amikacin and imipinem were the only two most effective antibiotics for all isolated pathogens with 100% sensitivity (50).

In Uganda; on patients who underwent emergency surgical operations; Klebsiella pneumonia was the most predominant organism (50%) followed by Staphylococcus aureus (27.8%). E. coli and P. aeruginosa both accounted for 11.1%. All organisms had 100% resistance to ampicillin, tetracycline, septrin, and erythromycin. Ciprofloxacin and ceftriaxone are highly sensitive to all organisms (51).

Hospital based prospective cross sectional study carried-out in 128 patients who had undergone surgery in general surgery and orthopedic wards in Ayder hospital in Tigray region revealed that, the predominant bacterial isolates were Staphylococcus aureus 44 (35.77%), Klebsiella species

29 (22.76%). Isolated bacteria showed 102/123 (82.92%) multi drug resistance to the commonly used antibiotics in the hospital (28).

A cross-sectional study carried out at University of Gondar, of 111 pathogenic bacteria, Escherichia coli followed by Staphylococcus aureus were dominant isolates. This study demonstrated high level of multi-drug resistance. And the susceptibility testing of the gram-negative organisms; E. coli, P. aeruginosa and P. mirabilis showed that higher resistant to amoxicillin, ampicillin and ceftriaxone (β-lactam antibiotics (52).

2.4. Outcomes related to surgical site infection

Surgical site infections (SSIs) are one of the undesirable and potentially very serious outcomes from surgery. In developed countries, 3% to 16% of surgeries resulted in major morbidity and 0.4% to 0.8% in death (53). From Patients undergoing surgery at US hospitals, the overall, unplanned readmission rate was 5.7%. SSI was accounted for 20% of these unplanned readmission (18).

Another study of over large number of patients admitted to the USA hospitals revealed that the SSI was responsible for annual 2.7 million additional hospital days, US$ 9.5 billion excess costs and at least 12 000 in-patient deaths (54).

Other a nested case-control study of patients undergoing Cranioctomy procedures at the University of Iowa Hospitals and Clinics study in lowa city showed that SSIs were associated with increased risk of readmissions , reoperations and death (55).

The cohort study of 49,817 patients from the American College of Surgeons, found that reoperation within 30-days after surgery occurred more than 3 times as often in patients developing SSI(56). Moreover, in a prospective multicenter study in England, the readmission rate due to SSI following CS was 0.6% (57). Other SSI surveillance in England, reported that the median additional LOS attributable to SSI is 10 days, and the readmission was 24.7% as compared with who have no SSI on initial admission (19).

A Systemic Review in Pakistan retrieved that SSIs were responsible for 31% of all HAIs, 20% postsurgical readmissions and produce a greater influence on length of hospital stay (58).

Surgical site infections (SSIs) are a significant cause of morbidity and mortality in low-income and middle income countries, whereas, its rates can reach 30% (59).

In Sub-Saharan Africa Women who had SSI stayed in hospital a significantly longer amount of time which was about three times post-operatively than those who did not. It leads to increased treatment time and possible reoperation. Moreover, in hospitals where resources are limited, having patients stay for 2 weeks longer can be a burden on the healthcare system (20).

2.5. Conceptual framework

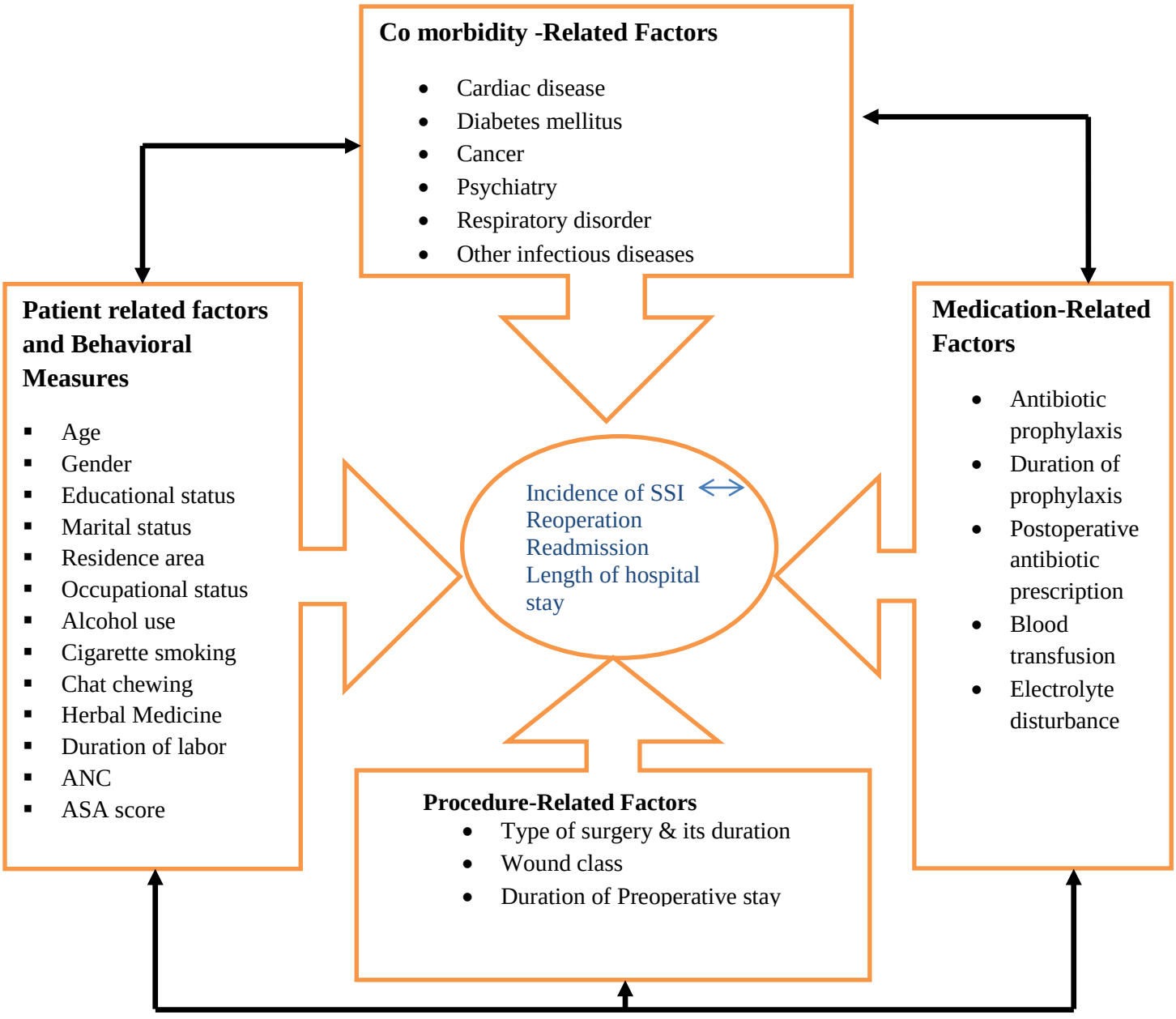

Figure 1: Conceptual frame work for factors associated with outcomes

Source: Developed after review of different literatures

3. OBJECTIVES

3.1 General objective

To assess the incidence, risk factors, antimicrobial susceptibility patterns and outcomes of SSIs among patients admitted to Jimma Medical Center, South west, Ethiopia.

3.2 Specific objectives

- To assess the incidence of SSIs among patients admitted to surgical and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019.
- To identify risk factors for SSIs among patients admitted to surgical and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019
- To identify etiology of SSIs among patients who develop SSI among patients admitted to surgical and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019
- To assess antimicrobial resistance patterns of culture positive microorganism among patients admitted to surgical and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019
- To evaluate outcomes associated with SSIs among patients admitted to surgical and gynecologic/obstetrics wards of Jimma Medical Center from April 20 to August 20, 2019

4. METHOD AND MATERIALS

4.1. Study area and period

The Study was conducted at Jimma Medical Center (JMC). JMC is the only teaching and referral hospital in the South western part of the country. It is located in Jimma town, South west Ethiopia, 352 km far from Addis Ababa. It provides services for the catchment population of about 15 million people. JMC has been providing services for approximately 15,000 inpatients, 160,000 outpatients, 11,000 emergency cases and 4,500 deliveries in a year. It has around 800 beds with 21 units. Surgery unit is one of the units which has around 286 beds. It has different subunits such as general surgical ward, gynecology, obstetric/maternity, and orthopedics. The JMC has more than 1448 staffs, of which 587 are supportive and 861 professionals. About 154 health professionals have been working at surgery units of JMC. The Study was conducted from April 20 to August 20, 2019.

4.2. Study design

Prospective cohort study was conducted.

4.3. Population

4.3.1. Source population

All adult patients who admitted to the surgical wards of Jimma Medical Center during the study period.

4.3.2. Study population

All adult patients who underwent surgical procedures in Jimma Medical Center at elective, emergency, gynecology/obstetric and orthopedics wards from April 20 to August 20, 2019 fulfilling the inclusion criteria.

4.4. Inclusion and Exclusion Criteria

4.4.1. Inclusion Criteria

All adult patients'≥18 years old who underwent surgery at elective, emergency, orthopedics, obstetrics and gynecology ward.

4.4.2. Exclusion criteria

- Patients with initial diagnosis of SSIs.
- Patients who was died within 2 days after surgery.
- Patients who underwent surgery involving permanent implants.
- Patients who refused to participate.

4.5. Sample size determination and sampling technique

The sample size was calculated using a single population proportion formula, by considering, 95% confidence level, 5% margin of error and 19.1% estimated proportion of surgical site infections among patients underwent surgery in Ethiopia (25).

- 10 % non-respondent rate.

$$n = \frac{\left(\frac{Z\alpha}{2}\right)^2 * p * (1 - p)}{d^2}$$

Where: n = desired sample sizes.

Zα/2 = critical value or normal distribution at 95% CI which equals to 1.96 (z -value at α=0.05),

P =proportion of patients underwent surgery who develop SSI.

- D=margin of error (0.05)

n= $(1.96)^2 \times 0.191(1\text{-}0.191) / (0.05)^2$ =237,

The number of source population (N) in the study area was the total number of patients who admitted to surgical ward within last 4 months in Jimma medical center from September 1, 2018 was 2091. This was obtained from health management information system of Jimma university surgical ward. The size of the population was less than 10,000. Therefore; the sample size was corrected using the correction formula.

Corrected sample size nf=n×N÷n+N=237×2091÷237+2091=210

The calculated sample size; by using the above correction formula was 210. When 10% of non-response added, the minimum adjusted sample size was=231.

A consecutive sampling technique was used.

4.6. Data Collection Instrument & Procedure

The questionnaire that contains several variables using English version check list was prepared after reviewing different relevant literatures with surgical site infection.

Data was collected by data collectors using pretested data collection tool prepared by principal investigator. The principal investigator had supervised the data collection process daily. The data was obtained from patient, patient's medical chart or by direct observation.

- Socio-demographic (age, gender, educational status, marital status, residence area, occupational status, alcohol use, cigarette smoking, chat chewing, herbal medicine), duration of labor, ANC follow up, co morbidities, blood transfusion, ASA score, type of wound, electrolyte disturbance
- Date of admission and operation, readmission and its date, reoperation & its date, length of hospital stay (los), duration of procedure, urgency of surgery
- Data about antimicrobials administered after operation and duration of administration.

All study participants were educated about sign or symptoms of infection during the study period. Study participants were followed until 30 days starting from the date of operation.

All patients were followed by either face-to-face or a telephone interview by using validated questionnaire using Afan Oromo or Amharic version after it was translated from English version check list.

Specimen collection and processing; briefly, the surrounding area of the surgical wound was cleaned with 70% ethyl alcohol and excess debris from the wound base removed by irrigating with normal saline before collection. Post-surgical wound swabs or pus aspirates were collected from the clinical infected surgical sites; Swabs were immediately sent to the microbiology laboratory and subcultures were made onto MacConkey agar, Blood agar and chocolate agar plates. MacConkey agar and blood agar plates were incubated in aerobic whereas the chocolate agar plates were in Capnophiles atmosphere using a candle jar at 37°C for 24 to 48 hrs. Specimen culture result with no microbial growth after 2 days were recorded as culture negative. For positive specimen culture the isolates were identified with macroscopic colony

characteristics, gram staining result and biochemical test, catalase and Coagulase test.The bacterium was identified using standard guideline(60).

Antibiotic susceptibility test: Antibiotic susceptibility testing was performed using Kirby-Bauer agar disc diffusion method for the isolated organisms according to Clinical Laboratory Standards Institute guide line(60). Pure colonies from subculture plate were picked and transferred to a tube containing 3 ml sterile normal saline and mixed thoroughly to make the suspension homogenous until its turbidity is equivalent to turbidity of 0.5 McFarland. Then suspension was swabbed onto Mueller Hinton agar and then incubated at 37^0C for 18-24 hours. The zone of inhibition was measured and interpreted according to the standardized table supplied by CLSI. After comparing diameters (zone) of the result with diameters (zone) of standardized table supplied by CLSI, the bacteria was classified as sensitive, intermediate or resistance. Laboratory data (including gram stain, culture results, and identification of the bacterial isolates as well as antimicrobial susceptibility) were recorded on a data sheet.

4.7. Study variables

4.7.1. Dependent variable

- Primary outcome
  - Incidence of surgical site infection
- Secondary outcome
  - Reoperation
    - Length of hospital stays
    - Readmission
    - Antimicrobial resistance pattern

4.7.2. Independent variables

A) Patient related factors and Behavioral Measures

Age, gender, educational status, marital status, residence area, occupational status, alcohol use, cigarette smoking, chat chewing, herbal medicine, duration of labor, ANC follow up, ASA score, co morbidity (cardiac disease, diabetes mellitus, cancer, psychiatry, respiratory disorders, other infections), electrolyte disturbance

B) ***Procedure-Related Factors***

Type of surgery, duration of surgery, wound class, preoperative duration.

C) Medication-Related Factors

Preoperative antibiotic prophylaxis, duration of prophylaxis, postoperative antibiotic prescription, blood transfusion

4.8. Outcome measure and validity method

4.8.1. Surgical site infection

In this study, the SSI definitions were based on culture positive results or physician diagnosis.

The first study outcome was the **incidence of SSIs** and the outcome measure was as follows.

$$incidence = \frac{number\ of\ SSIs\ detected\ during\ the\ study\ period}{total\ number\ of\ procedures\ \ included\ during\ the\ study\ period} \times 100$$

4.8.2. Reoperation

Reoperation is defined as any subsequent at the same site of operation within the first month after the initial procedure. This was obtained from patient medical chart. Operation at different site from the initial site was not considered.

4.9. Data Quality Management

The questionnaires were prepared in English and translated into the local language. Training was provided for data collectors (three BSc nurses) and supervisors (one pharmacist and one gynecologic resident) by the principal investigator. Pre-test on 11(5%) of eligible patients were done before the actual data collection process, and the collection tool were modified. The administered questionnaires were checked for completeness and Consistency on daily basis during data collection by supervisors.

Training on collecting specimen and overall procedures of culture process was also provided after consultation of microbiologist. Media was checked for its performance and 5%-10% of the prepared culture media were randomly selected and checked for its sterility by incubating over night to see any growth. Susceptible strains of *E. coli* (ATCC 25922), *S. Aureus* (ATCC 25923) and P. aeruginosa (27853) were used as a reference strains for performance of media and

antibiotics susceptibility testing. The whole procedure of sample processing and result interpretation was cross checked by trained professionals.

4.10. Data Processing and Analysis

All collected patient's data were entered into Epi-Data version4.2 and exported to SPSS (version20.0) for cleaning and analysis, respectively. Descriptive analysis was performed and results were presented by text, tables and charts. The survival function for occurrences of SSI was checked by Kaplan-Meier (log-rank test). Multicolleanearity test was performed to check for co linearity between independent variables. For outcome, chi-square test was performed to check adequacy of cells before performing cox regression.

Cox regression model assumption of proportional hazards was checked by testing of covariates with time. Bivariate cox regression was performed to identify candidate variables for multivariable cox regressions. Variables with p-value < 0.25 in bivariate cox regression were considered as candidates for multivariable cox regression.

A multivariable cox regression was performed to identify independent predictors of outcomes. Adjusted hazard ratio was used as a measure of strength of association and p-value < 0.05 was considered to declare statistical significance.

Bivariate linear regression analysis was performed to identify association of postoperative length of hospital stay with SSI. The slopes of the regression line and their 95% confidence interval together with p <0.05 were used as indicators for the presence of association.

4.11. Ethical consideration

The letter of ethical approval was written by Ethical Clearance Board of Jimma University (IHRPGD/585/2019). It was taken to different level of administrative bodies. An official letter of cooperation had also been given to JMC surgery department.

The study purpose, procedure and duration, possible risks (if present) and benefits of the study had been clearly explained for study participants and informed verbal or written consent were obtained from respondents. Any patient who were not willing to engage in the study and those who want to stop interview at any time were allowed.

Confidentiality was assured by excluding their name during the period of data collection.

4.12. Dissemination of the Result

The results of the study will be presented to the public defense and following the final edition (revision), it will be communicated to school of pharmacy, institute of Health, Jimma University. Dissemination of the result will also be made to the Jimma university specialized hospital and Jimma zone health office through hard and/or soft copies. Also, manuscript(s) will get submitted for publication for peer reviewed scientific reputable journal(s) and will also be presented in scientific conferences

4.13. Operational definition and Definition of terms

Adult: age ≥18 years

Outcomes: includes events happened within 30 days starting from the date of surgery such as length of hospital stay, readmission, reoperation and mortality.

Surgical site infection: definition was made according to United States CDC-NHSN surgical site infection definition criteria (9). Specific details on the definitions are provided in Annex III.

Postoperative LOS: is defined as the number of days the patient stayed in the hospital from the date of procedure to the date of discharge during initial admission and readmission if patient was readmitted within 30 days after the initial procedure.

Readmission: is defined as any unplanned readmission within 30 days after the initial procedure.

Reoperation: is defined as any subsequent operation at the same site as initial operation, either during the initial hospitalization or during readmission within 30 days.

Surgical wound: refers to a wound created when an incision is made with a scalp or other sharp cutting device and then closed in the operating room by suture, staple, adhesive tape, or glue and resulting in close approximation to the skin edges(5).(Annex II)

The **American Society of Anesthesiologists (ASA) score** is a classification system used to measure a patient's pre-operative physical condition. Class I: A normally healthy patient. Class II: A patient with mild systemic disease. Class III: A patient with severe systemic disease that is not incapacitating. Class IV: A patient with an incapacitating systemic disease that is a constant

threat to life. Class V: A moribund patient who is not expected to survive for 24 hours with or without the operation(5).(for detail annex I)

Multi-drug resistance (MDR): Resistance to ≥ 3 drugs.

Laboratory abnormality definition = any difference from normal reference range according to standards set for specific laboratory.

5. RESULTS

A total of 251 patients were included in the study. Out of 251 patients, 126 (50.2%) were females. Moreover, the Mean ± SD age of the patients included in this study was 38 ±16.30 years. Most of patients 213(84.3%) had got married. About 105(41.8%) of patients were cannot read and write, and 99(39.4%) had completed primary school while 33(13.2%) had finished high school.

The occupation of the included patients was mainly households 100(39.4%) & farmer 94(37.5%). Nearly three fourth of the patients 182(72.5%) came from rural area. From included study participants 13(5.2%) were consumed alcohol occasionally, and 5(2%) were consumed regularly.

Most of the patents 238(94.8%) were non-smokers. However, there were 9(3.6%) ex-smoker and 4 (1.6%) current smokers. Almost all of the patients 244 (97.2%) were non-users of herbal medicine whereas, 70(27.9 %) of patients were khat chewers (**Table 1**).

Table 1: Baseline socio-demographic characteristics of adult patients admitted to surgical wards of Jimma Medical Center from April 20-August 20, 2019

Variables	Category	Frequency (%)	Surgical site infection		
			Yes N(%)=53(21.1)	No N(%)=198(78.9)	x^2(P-value)
Sex	Male	125(49.8)	34(64.15)	91(45.96)	0.019
	Female	126(50.2)	19(35.85)	107(54.04)	
Age in year	< 60	214(85.3)	42(79.2)	172(86.9)	0.614
	≥ 60	37(14.7)	11(20.8)	26(13.1)	
Marital status	Single	36(14.9)	12(22.64)	24(12.12)	0.085
	Married	213(84.3)	40(75.47)	173(87.37)	
	divorced	2(0.8)	1(1.89)	1(0.51)	
Educational status	Cannot read & write	105(41.8)	23(43.40)	82(41.41)	0.599
	Primary	99(39.4)	21(39.62)	78(39.39)	
	Secondary	33(13.2)	8(15.09)	25(12.63)	
	College/university	14(5.6)	1(1.89)	13(6.57)	
Occupation	House wife	100(39.8)	12(22.64)	88(44.44)	0.034
	Farmer	94(37.5)	26(49.06)	68(34.34)	
	Daily laborer	29(11.6)	9(16.98)	20(10.10)	
	Student	13(5.2)	4(7.55)	9(4.55)	
	Gov't employee	15(6)	2(3.77)	13(6.57)	
Residence	Rural	182(72.5)	10(18.87)	59(29.80)	0.113
	Urban	69(27.5)	43(81.13)	139(70.20)	
Herbal medicine	Yes	7(2.8)	0	7(3.5)	0.351
	No	244(97.2)	53(100)	191(96.5)	
Cigarette smoking	Non smoker	238(94.8)	51(96.20)	187(94.44)	0.744
	Ex-smoker	9(3.6)	1(1.89)	8(4.04)	
	Current smoker	4(1.6)	1(1.89)	3(1.52)	
Alcohol consumption	Never	233(92.8)	47(88.68)	186(93.94)	0.382
	Occasionally	13(5.2)	4(7.55)	9(4.55)	
	Regularly	5(2)	2(3.77)	3(1.52)	
Khat chewing	Yes	70(27.9)	14(26.42)	56(28.28)	0.788
	No	181(72.1)	39(73.58)	142(71.72)	

The majority of surgery 167(66.5%) were emergent. About 148(59%) of surgical incision site were abdominal. Most of wound type, 214(85.26%) were clean or clean contaminated, whereas only 37(14.74%) patients had contaminated wound. Three fourth of the procedure 187(74.5%) had taken duration of surgery <2hrs. With regard to patient inclusion profile; about 143(56.97%) were from surgical wards, 39(15.54%) from orthopedic wards and the rest were from gynecology and maternity wards.

Nearly one fourth of patients 61(24.3%) had extended duration of preoperative hospital stay ≥ 7 days, whereas, the rest were within 7 days.

From a total of 206 who took prophylaxis, only 40 patients took antibiotic prophylaxis according to the recommended national and international guidelines(2). Moreover, 45(17.9%) of patients were prescribed new antibiotics or reinitiated former antibiotic after discontinuation (**Table 2**).

Table 2: Baseline clinical, procedure characteristics and medication usage patterns among adult patients admitted to Surgical wards Jimma Medical Center from April 20-August 20, 2019.

Variable	Category	Frequency (%)	Surgical site infection		
			Yes N (%) = 53(21.1)	No N (%) =198(78.9)	x^2(P-value)
ASA score	<3	240(95.6)	44(83.02)	196(99)	< 0.001
	≥3	11(4.4)	9(16.98)	02(1)	
Comorbidity	Yes	50(20)	16(30.2)	34(17.2)	0.035
	No	201(80)	37(69.8)	164(82.8)	
Preoperative hospital stay	≤ 7days	190(75.7)	43(81.13)	147(74.24)	0.299
	>7days	61(24.3)	10(18.87)	51(25.76)	
Wards	Elective	54(21.5)	4(7.55)	50(25.25)	< 0.001
	Emergency	89(35.5)	23(43.40	66(33.33)	
	Orthopedics	39(15.5)	19(35.85)	20(10.1)	
	Gyn & maternity	69(27.5)	7(13.21)	62(31.31)	
Urgency of surgery	Scheduled	84(33.5)	8(15.09)	76(38.38)	0.001
	Emergent	167(65.5)	45(84.91)	122(61.62)	
Duration of surgery	< 2hrs	187(74.5)	29(54.72)	158(79.80)	< 0.001
	≥2hrs	64(25.5)	24(45.28)	40(19.20)	
Type of wound	Clean or clean contaminated	214(85.3)	25(47.17)	189(95.45)	< 0.001
	contaminated	37(14.7)	28(52.83)	9(4.55)	
Location of surgical site	Extremity	103(41)	27(50.94)	76(38.38)	0.099
	Abdominal	148(59)	26(49.06)	122(61.62)	
Blood transfusion	Yes	38(15.1)	9(16.98)	29(14.65)	0.674
	No	213(84.9)	44(83.02)	169(85.35)	
Preterm gestation	Yes	7(13)	1(16.7)	6(12.5)	1
	No	47(87)	5(83.3)	42(87.5)	
Duration of labor ≥24hrs	Yes	36(66.7)	5(83.3)	31(64.6)	0.651
	No	18(33.3)	1(16.7)	17(35.4)	

Membrane rupture≥12hrs	Yes	20(37)	3(50)	17(35.4)	0.659
	No	34(63)	3(50)	31(64.6)	
ANC follow	Yes	49(90.7)	6(100)	43(89.6)	1
	No	5(9.3)	0	5(10.4)	
Preoperative AMP use	Yes	206(82.1)	50(94.34)	156(78.79)	0.009
	No	45(17.9)	3(5.66)	42(21.21)	
Duration of AMP	Within 24hrs	40(19.4)	3(6)	37(23.7)	0.007
	>24hrs	166(80.6)	47(94)	119(76.3)	
Antibiotic use post-surgery	Yes	45(17.9)	23(43.40)	22(11.11)	< 0.001
	No	206(82.1)	30(56.60)	176(88.89)	

ANC- Antenatal care, ASA- American Society of Anesthesiologists: AMP- Antimicrobial prophylaxis

From included study participants, 50(20%) of patients were presented with one or more co-morbidities. These includes: cardiac problem 20(40%), diabetic mellitus 6(12%), malignancy 6(12%), HIV/AIDS 4(8%), psychiatry problem 3(6%), and respiratory disorder 7(14%) (**Table 3**).

Table 3: Baseline burden of co morbidity among patients admitted to surgical procedure at surgical wards of Jimma Medical Center April 20-August 20, 2019.

Variables	Category	Frequency (%)	Surgical site infection		
			Yes (n %) 53(21.1)	No (n %) 198(78.9)	x^2(P-value)
Cardiac problem	Yes	20(47.6)	6(37.5)	14(53.8)	0.303
	No	22(52.4)	10(62.5)	12(46.2)	
Diabetes mellitus	Yes	6(14.3)	5(31.2)	1(3.8)	0.023
	No	36(85.7)	11(68.8)	25(96.2)	
Malignancy	Yes	6(14.3)	2(12.5)	4(15.4)	1
	No	36(85.7)	14(87.5)	22(84.6)	
HIV/AIDS	Yes	4(9.5)	0	4(15.4)	0.280
	No	38(90.5)	16(100)	22(84.6)	
Psychiatry problem	Yes	7(16.7)	3(18.8)	4(15.4)	1
	No	35(83.3)	13(81.2)	22(84.6)	
Respiratory disorder	Yes	3(7.1)	0	3(11.5)	0.275
	No	39(92.9)	16(100)	23(88.5)	
Infectious diseases	UTI	9(20)	1(4.3)	8(36.4)	< 0.001
	Sepsis	22(48.9)	22(95.7)	0(0)	
	Pneumonia	7(15.6)	0	7(31.8)	
	HAI	7(15.6)	0	7(31.8)	

HIV- Human immune virus, UTI- urinary tract infection, HAI-Hospital acquired infection

From included study participants, complete blood count for 235 (93.6%) patients, renal function tests for 132(52.6%) and electrolyte panel for 76(30.3%) patients were done. These laboratory investigations were taken from both preoperative and postoperative (**Table 4**)

Table 4: Baseline laboratory investigations among adult patients admitted to surgical wards of Jimma Medical Center, April 20-August 20, 2019.

variables	Category	Frequency (%)	Surgical site infection		
			Yes N (%)	No N (%)	x^2(P-value)
Pre-op hemoglobin	Normal	177(75.3)	30(56.6)	147(80.8))	0.001
	Below normal	58(24.7)	23(43.4)	35(19.2)	
Post-op hemoglobin	Normal	160(68.1)	24(45.3)	136(74.7)	< 0.001
	Below normal	75(31.9)	29(54.7)	46(25.3)	
Pre-op white blood cell	Normal	164(69.8)	29(54.7)	135(74.2)	0.009
	Below normal	3(1.3)	0	3(1.6)	
	Above normal	68(28.9)	24(45.3)	44(24.2)	
Post-op white blood cell	Normal	183(77.9)	22(41.5)	161(88.5)	< 0.001
	Below normal	7(3)	5(9.4)	2(1.1)	
	Above normal	45(19.1)	26(49.1)	19(10.4)	
Pre-op sodium	Normal	64(84.20	17(81.0)	47(85.5)	0.265
	abnormal	11(15.8)	3(14.3)	8(14.5)	
Post-op sodium	Normal	69(90.8)	17(81)	52(94.5)	0.087
	abnormal	7(9.2)	4(19)	3(5.5)	
Pre-op potassium	Normal	63(82.9)	14(66.7)	49(89.1)	0.037
	abnormal	13(17.1)	7(33.3)	6(10.9)	
Post-op potassium	Normal	61(80.3)	9(42.9)	52(94.5)	< 0.001
	abnormal	15(19.7)	12(57.1)	3(5.5)	
Pre-op renal function test	Normal	122(91.7)	21(77.8)	101(95.3)	0.009
	abnormal	11(8.3)	6(22.2)	5(4.7)	
Post-op renal function test	Normal	121(91)	20(74.1)	101(95.3)	0.003
	abnormal	12(9)	7(25.9)	5(4.7)	

Post-op: Post operation; Pre-op: Pre-operation

5.1.1. Incidence rate of SSIs

The data of 251 patients was followed for 6651 person days. Over this follow up period about 53 patients were develop SSI. The overall incidence rate of SSI was 43.74 per 100,000 person year with 95% CI [33.41-57.25]. The overall proportion of SSI was 21.1% (53/ 251), of which 49(92.45%) were detected at initial hospitalization while 4(7.55%) SSIs were confirmed during readmission.

The Kaplan Meier survival curve showed that there is the significance difference of survival curve of SSI for scheduled surgery-and emergency surgery. The scheduled had an estimated mean survival time of 28 days while emergent surgery had 26 days.

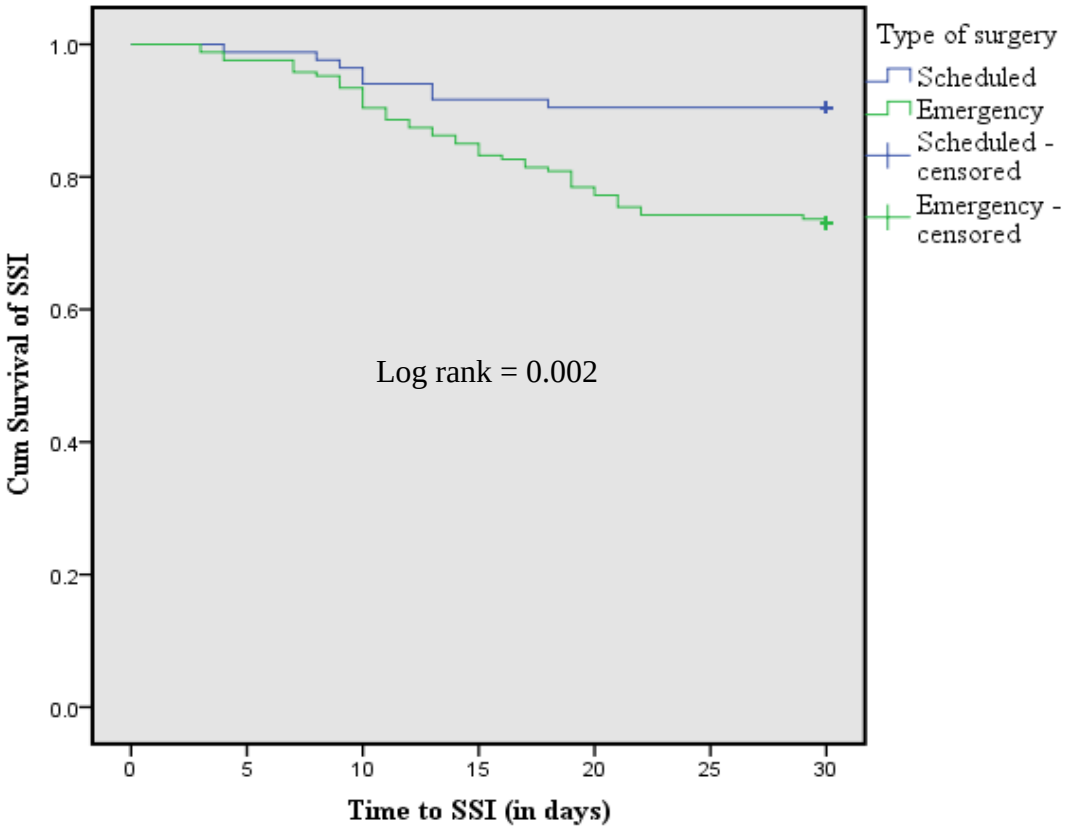

Figure 2: Kaplan-Meier survival curve showing 30 days survival for types of surgery among patients admitted to surgical unit of Jimma Medical Center, April 20-Auguest 20 2019

5.1.2. Factors associated with SSIs occurrences among study participants

The association of independent variables with the dependent variable was investigated using both bivariate and multivariate cox regression techniques. On bivariate cox regression analysis, male gender, marital status, residence, ASA score ≥3, emergence ward, orthopedics ward, emergent surgery, contaminated wound, duration of surgery ≥ 2hrs, absence of preoperative antibiotics prophylaxis, duration of prophylactic antibiotics >24hrs, postoperative- antibiotics, presence of one or more co-morbidities had statistically significant association with SSI(**Table 5**).

The result of the multivariate cox regression analysis showed that, ASA score ≥ 3 [AHR (95 % CI)=2.26(1.03-4.93)], emergency surgery [AHR(95%CI)=2.81(1.16-6.80)], contaminated wound [AHR (95 % CI)= 7.91(4.29-14.60)], duration of surgery ≥2 hours [AHR (95 % CI) = 4.03(2.17-7.50)], postsurgical antibiotic prescription [AHR (95 % CI) =3.21(1.71-6.01)] and presence of one or more co morbidity[AHR= 2.52(1.28-4.94)] had statistically significant association with SSI.

The likely hood of SSI occurrences was about 2.26 times more likely among ASA score ≥ 3 patients. And also the relative risk of SSI occurrences was about 2.81 times among patients who underwent emergency surgical procedure than those underwent scheduled surgery. Moreover, patients who had contaminated wound were 7.91 times more likely to develop SSIs compared to patients who had clean or clean-contaminated.

The relative risk of SSI occurrences was also higher among patients with duration of operation ≥2hours. Furthermore, patients whose antibiotic was administered postsurgical procedure were 3.21 times more likely to develop SSI.

The relative risk of SSI occurrences was also seen among patients with comorbidity (**Table 5**).

Table 5**:** Cox regression model on factors associated with surgical site infections surgical wards of Jimma Medical Center, April 20-August 20, 2019.

Variables		Surgical site infection		P value	CHR (95% CI)	P value	AHR(95% CI)
		Yes	No				
Gender	Male	34(64.15)	91(45.96)	0.028	1.88(1.07-3.29)	0.217	1.5(0.79-2.87)
	Female	19(35.85)	107(54.04)		1		1
Age in years	< 60	42(79.8)	172(86.9)		1		
	≥ 60	11(20.2)	26(13.1)	0.471	1.6(0.84-3.2)		
Marital status	Single	12(22.64)	24(12.12)		1		1
	Married	40(75.47)	173(87.37)	0.069	0.55(0.29-1.05)	0.06	0.5(0.25-1.01)
	Divorced	1(1.89)	1(0.51)	0.719	1.46(0.19-11.19)	0.915	0.9(0.11-7.55)
Residence	Rural	10(18.87)	59(29.80)	0.129	1.71 (0.86-3.39)	0.317	0.66(0.30-1.5)
	Urban	43(81.13)	139(70.20)		1		
Cigarette smoking	Non smoker	51(96.20)	187(94.44)		1		
	Ex-smoker	1(1.89)	8(4.04)	0.451	0.47 (0.07-3.38)		
	Current smoker	1(1.89)	3(1.52)	0.892	1.15 (0.16-8.30)		
Alcohol consumption per day	Never	47(88.68)	186(93.94)		1		
	Occasionally	4(7.55)	9(4.55)	0.401	1.55 (0.56-4.30)		
	Regularly	2(3.77)	3(1.52)	0.308	2.09 (0.51-8.61)		
Khat chewing?	Yes	14(26.42)	56(28.28)	0.723	0.90 (0.49-1.65)		
	No	39(73.58)	142(71.72)		1		
American Society of Anesthesiologists score	<3	44(83.02)	196(99)		1		1
	≥3	9(16.98)	02(1)	< 0.001	6.44(3.13-13.27)	0.041	2.26(1.03-4.93)
Preoperative hospital stay	≤ 7 days	43(81.13)	147(74.24)		1		
	>7 days	10(18.87)	51(25.76)	0.356	0.72(0.36-1.44)		

Blood transfusion	Yes	9(16.98)	29(14.65)	0.646	1.18 (0.58-2.42)		
	No	44(83.02)	169(85.35)		1		
Wards	Elective	4(7.55)	50(25.25)		1		1
	Emergence	23(43.40	66(33.33)	0.014	3.8(1.31-10.97)	0.821	0.81(0.13-5.1)
	Orthopedics	19(35.85)	20(10.1)	< 0.001	7.9 (2.68-23.20)	0.405	2.2(0.35-13.3)
	Gyn/obs	7(13.21)	62(31.31)	0.591	1.40 (0.41-4.78)	0.666	0.6(0.085-4.83)
Preterm gestation	Yes	1(16.7)	6(12.5)	0.783	0.74 (0.09-6.34)		
	No	5(83.3)	42(87.5)		1		
Duration of labor ≥24hr	Yes	5(83.3)	31(64.6)	0.398	0.40 (0.05-3.39)		
	No	1(16.7)	17(35.4)		1		
Duration of rupture ≥12hr	Yes	3(50)	17(35.4)	0.484	0.57 (0.11-2.80)		
	No	3(50)	31(64.6)		1		
Urgency of surgery	Scheduled	8(15.09)	76(38.38)		1		
	Emergent	45(84.91)	122(61.62)	0.004	3.05 (1.44-6.46)	0.022	2.81(1.16-6.80)
Duration of surgery	< 2hrs	29(54.72)	158(79.80)		1		
	≥2 hrs.	24(45.28)	40(19.20)	< 0.001	2.79 (1.63-4.80)	< 0.001	4.03(2.17-7.50)
Type of wound	Clean or clean contaminated	25(47.17)	189(95.45)		1		
	Contaminated	28(52.83)	9(4.55)	< 0.001	13.4(7.72-23.27)	< 0.001	7.91(4.29-14.60)
comorbidity	Yes	16(30.20)	34(17.17)	0.045	1.82 (1.01-3.27)	0.007	2.52(1.28-4.94)
	No	37(69.80)	164(82.83)		1		
Location of surgical site	extremities	27(50.94)	76(38.38)		.1		
	Abdominal	26(49.06)	122(61.62)	0.129	0.66 (0.38-1.13)	0.60	1.2(0.62-2.32)
Use of prophylactic antibiotic	Yes	50(94.34)	156(78.79)		1		
	No	3(5.66)	42(21.21)	0.022	0.26 (0.08-0.83)	0.656	0.83(0.012-1.03)
duration of antibiotic prophylactic	Within 24hrs	3(6)	37(23.7)		1		
	>24hrs	47(94)	119(76.3)	0.015	4.3 (1.33-13.71)	0.970	0.98(0.26-3.73)
Use of antibiotic post-surgery	Yes	23(43.40)	22(11.11)	< 0.001	4.45 (2.58-7.68)	0.001	3.21(1.71-6.01)
	No	30(56.60)	176(88.89)		1		1

5.1.3. Etiology of SSIs

A positive culture was obtained from 38 out of 53 swabs. Of these 4(10.53%) were mixture of two growth. As it is depicted in Fig. 3, among the cultures with positive growth, the gram negative bacteria were the most dominant with an incidence of 78.57%. Among the types of bacteria identified Escherichia coli (21.43%), followed by pseudomonas aeruginosa 19.05%, Proteus ssp (14.29%), Staphylococcus aureus 11.90%, Klebsiella ssp 11.90%, Citrobacter (9.5%), streptococcal 7.14%, Coagulase negative S.aureus (CoNS) 2.38%.

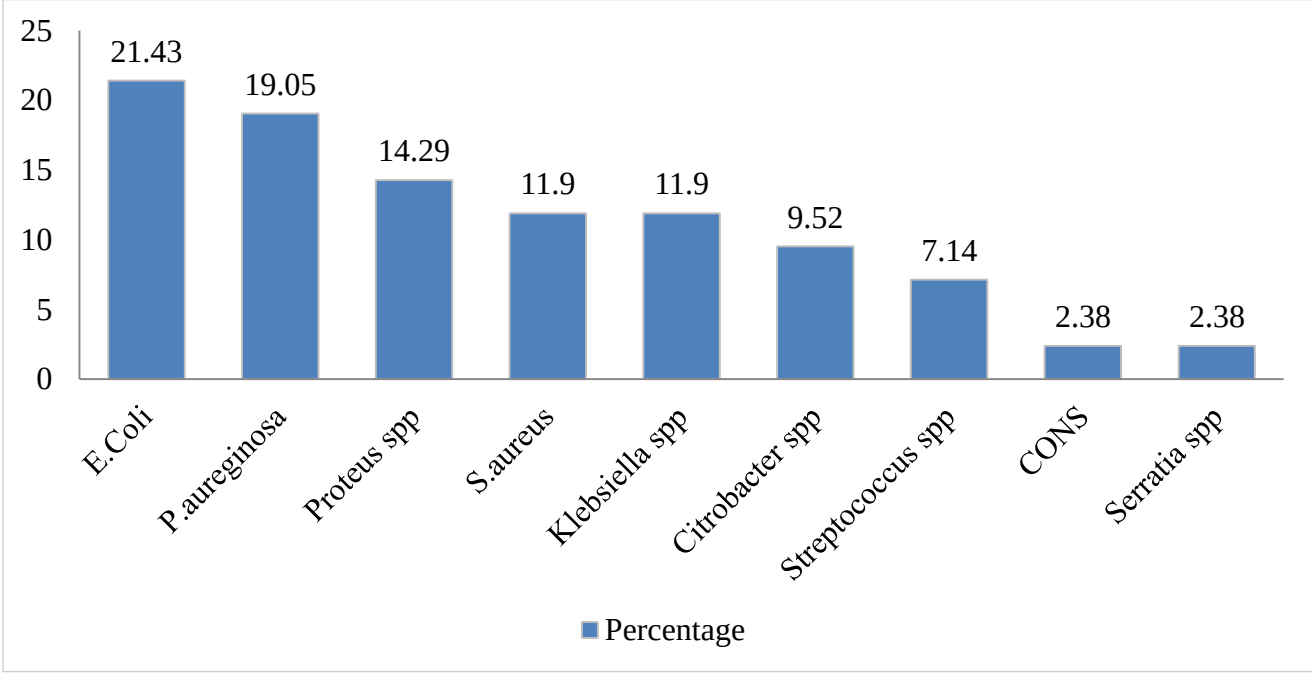

Figure 3: Frequency and types of bacteria among surgical site infected patients at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019.

Antibiotic resistance profiles were reported for the organisms isolated from surgical incision site infected patients. The gram positive pathogens showed high resistance toward Penicillin (66.67%), Erythromycin (66.67%), and Clindamycin (66.67%). Majority of resistance to Penicillin, Erythromycin & Clindamycin were seen from Staphylococcal aureus. However, only one strains of it resistant to Vancomycin. The gram-negative pathogens showed high resistance toward Cefepime (87.88%), Ceftriaxone (78.79%), Cefuroxime (63.63%), Cotrimoxazole (54.55%), Ciprofloxacin (60.60%) and Ampicillin (60.60%). All strains of pseudomonas aeruginosa and proteus spp were 100% to Ceftriaxone and majority of resistance to Meropenem were also from these two spps. Meropenem is 100% effective against E. coli which was the predominant pathogen in this study (**Table 6**).

Table 6: Antimicrobial resistance patterns among types of bacteria identified at surgical wards of Jimma Medical Center,April 20-Auguest 20, 2019.

Antibiotics	Gram positive			Gram negatives						
	S.aureus (n=5)	CoNS (n=1)	Streptococcus (n=3)	P. aeruginosa	Proteus spp(n=6)	E.col (n=9)	Klebsiella spp(n=5)	Citrobacter spp (n=4)	Serratia spp(n=1)	Total n (%)
Penicillin	3	1	2	ND	ND	ND	ND	ND	ND	6(66.7)
Erythromycin	4	Ds	2	ND	ND	ND	ND	ND	ND	6(66.7)
Vancomycin	1	Ds	2	ND	ND	ND	ND	ND	ND	3(33.3)
Clindamycin	4	Ds	2	ND	ND	ND	ND	ND	ND	6(66.7)
Cotrimoxazole	3	Ds	1	6	4	2	2	3	1	22(52.4)
Chloramphenicol	Ds	Ds	1	4	4	1	4	2	ND	16(48.48)
Tetracycline	Ds	Ds	1	ND	ND	ND	ND	ND	ND	1(11.1)
Ampicillin	ND	ND	ND	3	4	4	5	3	1	20(60.60)
Cefepime	ND	ND	ND	8	6	6	4	4	1	29(87.88)
Ceftazidime	ND	ND	ND	5	2	4	2	3	1	17(51.51)
Ceftriaxone	ND	ND	ND	8	6	5	3	3	1	26(78.79)
Cefuroxime	ND	ND	ND	6	6	5	3	1	ND	21(63.63)
Ciprofloxacin	ND	ND	ND	4	4	5	4	3	ND	20(60.60)
Meropenem	ND	ND	ND	5	3	Ds	2	1	1	12(36.36)
Gentamycin	ND	ND	ND	4	2	3	2	1	1	13(39.39)

ND: Not done, Ds: done susceptible, CONS: Coagulase negative staphylococcus aureus

5.2.1. 30 days outcomes of SSIs

Thirty days outcomes of study participants were also evaluated. Overall, the finding of the present study revealed that the mean ± (SD) length of hospital stay was 14.4± 9.7 days. About 45(17.93%) patients were remained in hospital until the end of study period. Twenty nine (11.6%) patients returned to operation room and 8(3.88%) patients were readmitted after their initial discharge. However, there was no death among the included study participants during the study period. The Kaplan Meier survival curve showed that there is the significant difference of survival curve of reoperation for SSI. Patient with SSI had an estimated mean survival time of 25 days while those without SSI had 29 days (Figure 4).

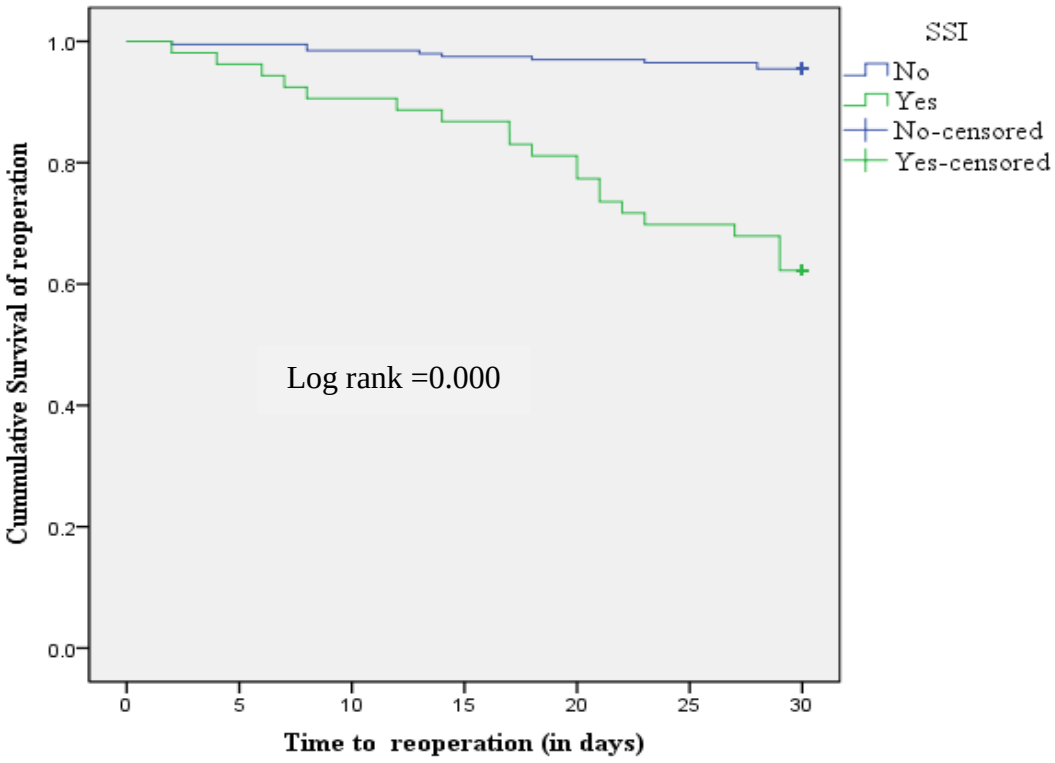

Figure 4: Kaplan-Meier survival curve showing 30 days survival for SSI and reoperation among patients admitted to surgical wards of Jimma Medical Center, April 20-August 20, 2019.

5.2.2. Factors associated with Re-operation among study participants

The association of independent variables with the dependent variable was investigated using both bivariate and multivariate cox regression techniques. On bivariate cox regression analysis, male gender, Residence, ASA score ≥3, incision site, contaminated wound, absence of preoperative antibiotics prophylaxis, duration of prophylactic antibiotics >24hrs, post-operative elevated white blood cells and SSI had statistically association with reoperation (**Table 7**).

The result of the multivariate cox regression analysis showed that, SSI [AHR (95 % CI) =7(3.16-15.72)], and incision site [AHR (95 % CI) =2.5(1.14-5.42)] had statistically significant association with re-operation (**Table 7**).

Table 7: Cox regression model on factors associated with reoperation at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019.

Variable		Reoperation		P-value	CHR(95% CI)	p-value	AHR(95% CI)
		Yes	No				
SSI	Yes	20(37.74)	33(62.26)	< 0.001	10 (4.5-21.7)	< 0.001	7(3.16-15.72)
	No	09(4.55)	189(95.45)	1	1		1
Age	< 60yrs	24(82.8)	190(85.6)		1		1
	≥60 yrs	5(17.2)	32(14.4)	0.695	1.2(0.46-3.2)		
Incision site	Extremity	19(65.5)	84(37.8)	0.007	2.87(1.3-6.2)	0.023	2.5(1.14-5.42)
	Abdominal	10(34.5)	138(62.2)		1		1
Duration of surgery	<2hrs	21(72.4)	166(74.8)		1		
	≥2hrs	8(27.6)	56(25.2)	0.734	1.15(0.51-2.6)		
Urgency of surgery	Scheduled	7(24.1)	77(34.7)				
	Emergent	22(75.9)	145(65.3)	0.257	1.64(0.7-3.83)		
Duration of AMP	Within 24hrs	1(3.4)	39(22.2)		1		1
	> 24hrs	28(96.6)	137(77.8)	0.052	7.2(0.98-53.1)	0.274	3.1(0.41-23.3)
ASA score	<3	26(89.7)	214(96.40				1
	≥3	3(10.3)	8(3.6)	0.117	2.6(0.79-8.6)	0.260	0.5(0.14-1.7)
Comorbidity	Yes	6(20.7)	44(19.8)	0.942	1.03(0.4-2.5)		
	No	23(79.3)	178(80.2)		1		
Gender	Male	18(62.1)	107(48.20	0.162	1.7(0.81-3.61)	0.125	0.53(0.23-1.2)
	Female	11(37.9)	115(51.8)		1		1
Type of wound	Clean or clean-contaminate	17(58.6)	197(88.7)		1		1
	Contaminated	12(41.4)	25(11.3)	< 0.001	4.7(2.23-9.80	0.739	1.2(0.49-2.73)
Residence	Urban	2(6.9)	67(30.2)		1		
	Rural	27(93.1)	155(69.8)	0.021	5.4(1.29-22.86)	0.150	2.91(0.68-12.4)
AMP use	Yes	29(100)	177(79.7)				
	No	0	45(20.3)	0.103	0.04(0.001-2)	-	-

Khat chewing	Yes	7(24.1)	63(28.4)	0.579	0.8(0.34-1.84)		
	No	22(75.9)	159(71.6)				
Preoperative hospital stay	<7 days	22(75.9)	168(75.7)				
	≥7 days	7(24.1)	54(24.3)	0.988	1(0.43-2.40)		
Postoperative WBC	normal	17(58.6)	166(80.6)		1		1
	Low	1(3.4)	6(2.9)	0.712	1.5(0.2-11)	0.474	0.46(0.05-3.9)
	High	11(37.9)	34(16.5)	0.008	2.8(1.3-5.98)	0.643	1.2(0.53-2.8)

NB-SSI-surgical-site-infection, WBC-white-blood-cell, AMP-antimicrobial-prophylaxis, ASA- American Society of Anesthesiologists

There was significant association between length of hospital stay, readmission and SSI. The patients who were developed SSI had additional 14 days of hospital stay. And also relative risk of readmission was about 6.6 times more likely among patients with SSI [HR (95% CI) = 6.6(1.6-27.5) **(Table 8).**

Table 8: Bivariate linear and cox regression model on outcomes of SSI at surgical wards of Jimma Medical Center, April 20-Auguest 20, 2019.

Variable	Total length of hospital stay				
	Category	mean ± SD		p-value	b(95% CI)
SSI	Yes	14.4 ± 9.7 days		0.0001	14(11.6-16.36)
	No				1
	Readmission				
	Category	Yes	No	P-value	HR(95% CI)
	Yes	6(11.32)	47(88.68)	0.010	6.6(1.6-27.5)
	No	2(1)	196(99)		1

NB-SSI-surgical-site-infection, b= slope of regression line

6. DISCUSSIONS

Surgical site infections are one of the serious complications of surgical procedures and preventable type of healthcare-associated infections (HAIs) (2,5,13). However, still they are the leading HAIs reported hospital-wide in low and middle income countries (LMICs) and represent a significant burden in terms of patient morbidity, disability, mortality and additional costs to the health systems and service payers throughout the world. Patients who develop SSIs are up to 60% more likely to spend time in an intensive care unit, 5 times more likely to be readmitted and 2 times more likely to die (16).

In this study, 21.1 % of the patients had developed surgical site infection. This finding was slightly in line with other studies done in Ethiopia at Hawassa university referral hospital 19.1% (25), St Paul's Hospital Millennium Medical 23.3% (40),Tikur Anbessa Specialized Hospital 20.6% (44) and Atlanta Georgia 23% (35).

However, this finding was higher than a previous studies done in Ethiopia at Lemlem Karl hospital 6.8% (21), Assella 9.4% (23), Jimma University Specialized Hospital (11.4%) (22) and Ayder comprehensive specialized hospital in Tigray 11.7% (24). The differences might be due to these studies includes only cesarean section. Our founding was also higher than the study in a teaching hospital in Ujjain, India 5% (36). This might be due to exclusion of orthopedics & Gynecology/obstetric surgery in Indian study. Incidence of present study was lower than the previous reports from Ethiopia 25.5%, Tanzania 25%, Nigeria 27.56% (26,37,38).The difference might be due to inclusion of dirty wound type in Nigerian study.

In this study, the incidence was higher than those of several high and middle income nations. For example, 2.6% in USA, 1.6% in Germany, 4.5% in China and 3.4% in Brazil (14,33,34).The observed differences in low income countries like Ethiopia might be due to several reasons such as lack of equipment and materials necessary to maintain strict aseptic conditions, poor hygiene of patients increasing colonization of skin by bacterial flora, late presentation of patients to healthcare system leading to contaminated wounds, and overwhelmed emergency services due to population burden.

The present study found that, ASA score ≥ 3, type of wound, duration of surgery, type of surgery, postsurgical antibiotic prescription and presence of co morbidity had statistically significant association with SSI.

The higher scoring on ASA was statistically associated with SSI. The likely hood of SSI occurrences among patients with ASA score of ≥3 were increased by 2.3. These results were consistent with other previous studies (35,50). This might be due to higher ASA score leads to a worsening of the general clinical status of the patient, prolonging duration of surgery and making it more susceptible to infections.

In this study, patients who had contaminated wound class were more likely to develop SSI as compared with patients who had clean & clean contaminated wound. This result was supported with many other finding (22,28,37,44,49,50). Other variable found to be associated with a high incidence of SSIs were duration of surgery ≥2hrs.The risks of developing SSI among patients whose duration of surgery ≥2hrs was 4 times than those with shorter duration. This was agree with many other studies (25,37,44,49,50). This might be due to a prolonged exposure of tissue to the environment, prolonged hypothermia and declining levels of antibiotics or a greater chance of breach of the aseptic technique in the procedure.

The type of surgery was also statistically associated with SSI in the present study. Being undergoing emergency surgery showed approximately 3 times in the chances of acquiring SSIs when compared to elective surgery. The type of surgery was reported in other literatures as a risk factor associated with SSI(28,50). This might be due to inadequate preoperative preparation, lack of proper control of other medical co morbidities, and higher risks for contamination in emergency surgeries.

Another independent risk factor was post-surgical prescription of antibiotic. Patients who were prescribed new antibiotic or reinitiating discontinued antibiotic after surgery were about 3 times more likely to develop SSIs compared to patients who were not prescribed new or reinitiated antibiotics. This might be due to broad-spectrum and long duration of antibiotic treatment could increase the risk of super infection. Due to the fact that unrelated infections for which the antibiotic was originally taken, the antibiotic treatment could possibly disturb the normal flora in

the body and creates an opportunity for pathogenic microbes to grow and potentially cause a new infection.

In our study presence of co morbidity was found to be predicator of SSIs. Patients with co morbidity had 2.5 times more likely to develop SSIs. And this was agree with other study (41,50). These results suggest that patient comorbidity is the primary driver of infection and poor wound healing.

In the present study, the commonest bacterial isolate was Escherichia coli (21.43%).This finding was agree with the study done in Ethiopia(Gondar university,2011) which reported that Escherichia coli as major isolate (52). However, this finding was in contrast with many other studies (28,34,46–48,51). In these studies, S. aureus had been found to be the predominant cause of SSI. This might be due Escherichia coli's natural habitat is the gastrointestinal tract. Most of the operations performed were laparotomies and most wounds were either clean contaminated, or contaminated this spillage from the GIT.

In this study, multi-drug resistances (MDR) to commonly used antibiotics were identified. Resistance to antibiotics ranged from 11.1% to 100%. These findings were in consistent with many other global studies (2,3,5,6,28,29,50–52). This might be due to the fact that these antibiotics are widely prescribed empirically for treatment of various infections in our setting.

The overall, ceftriaxone resistance in this study were about 78.79%. All pseudomonas and proteus spps isolated were 100% resistance to ceftriaxone. This remarkably higher resistance might be due to ceftriaxone was prescribed as prophylaxis to all who underwent surgery in our hospital. Even though, high drug resistance was observed by this study Meropenem was 100% effective against Escherichia coli which was the predominant cause of SSI in our study.

The present study found that SSI was the independent attributer for length of hospital stay, reoperation and readmission. It was associated with significantly prolonged LOS during initial hospitalizations. Post-operative length of hospital stay for patients who develop SSI was 14 times more likely than those of patients who didn't develop. Additional 14 days of hospital stay was attributed by SSI. This result was in line with other studies 10 days in England, 14 days in sub-Saharan Africa (19,20). There were also many literatures those agree with prolonged hospital stay was attributed by SSIs (5,13,17,55).

The reoperation among patients who develop SSI was 7 times more likely than those who didn't develop SSI. Our findings was agreed with study done in lowa city in which SSIs were independent risk factor for reoperation (55).

Finally, patients who develop SSI were 6.6 times more likely to be readmitted when compared with those who didn't develop SSI. Our finding was in line with (16, 18,19,55,58) in which SSIs were associated with increased risk of readmission.

7. LIMITATION OF THE STUDY

This study had certain limitations such as too short study period which could not finalize outcomes related to patient that could possibly observed after the study period and therefore underestimate rates of these outcomes. Our study could not address etiology of SSI due to anaerobic bacteria or fungal infection.

8. CONCLUSION

SSI incidence rate was revealed to be higher than acceptable international ranges. Occurrence of SSI was associated with contaminated wound class, longer duration of surgery, presence of co morbidity, ASA score of ≥3, postoperative antibiotic prescription, and emergency surgeries. The majority of SSI was caused by E.coli and Pseudomonas. However, multi drug resistance was seen in most of the isolates leaving clinicians with few choices of drugs for the treatment of patients with SSI. SSI has linear relationship with length of hospital stay, reoperation and readmission.

9. RECOMMENDATION

The surgical site infection, problems related to reoperation and drug resistance were highly affecting surgical patients. Therefore, the following recommendations are forwarded based on the result of the study.

Jimma University Medical Center

The need for improved surveillance of SSIs and review of infection control policies of the hospital is important to minimize the burden of SSI.

Health professionals

Early identification of patients at risk and rational antimicrobial use is necessary to reduce burden of SSIs and multidrug resistance pathogens. The implementation of effective transitional care focused on wound management and monitoring holds promise to decrease the burden of severe SSI in vulnerable patients.

Researcher

Further researches with long study period and extended to include cultures under anaerobic conditions should be done.

REFERENCES

1. Control Centre for Disease. Procedure-associated Module SSI Surgical. 2019. 20–31.
2. WHO. Preventing surgical infections: implementatio approaches for evidence-based recomendations. 2018. 1–60. Available from: http://apps.who.int/
3. Singh R, Singla P, Chaudhary U. Surgical Site Infections : Classification , Risk factors , Pathogenesis and Preventive Management. Int J Pharma Res Heal Sci. 2014;2(3):203–14.
4. Haque M, Sartelli M, McKimm J, Abu Bakar M. Health care-associated infections - an overview. Infect Drug Resist. 2018;11:2321–33. Available from: http://www.ncbi.nlm.nih.gov/pubmed/30532565%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC6245375
5. World Health Organization (WHO). Protocol for surgical site infection surveillance with a focus on settings with limited resources. 2018. 1–39 . Available from: http://www.who.int/infection-prevention/tools/surgical/SSI-surveillance-protocol.pdf
6. Allegranzi B, Mugarura R, Musowoya J, Zeynep Kubilay N, Gayet-Ageron A, Aiken AM, et al. A multimodal infection control and patient safety intervention to reduce surgical site infections in Africa: a multicentre, before–after, cohort study. Lancet Infect Dis. 2018;18(5):507–15.
7. Karellis A, Sampalis JS. Development Of Risk-Index Tool To Predict Surgical Site Infections. SOJ Surg. 2014;2(2):1–10.
8. Porter K. Improving infection prevention and control. Dent Nurs. 2014;5(4):198–200.
9. Centers for Disease Control and Prevention. National and State Healthcare Associated Infections Progress Report.2016;1–147. Available from: https://www.cdc.gov/HAI/pdfs/progress-report/hai-progress-report.pdf
10. Bratzler DW, Dellinger EP, Greene L. Hospitals : 2014 Update. 2015;35(6):605–27.
11. Leaper DJ, Edmiston CE. World Health Organization: global guidelines for the prevention of surgical site infection. J Hosp Infect. 2017;95(2):135–6.
12. WHO Health care-associated infections FACT SHEET. 2010;1–4.
13. Ban KA, Minei JP, Laronga C, Harbrecht BG, Jensen EH, Fry DE, et al. American College of Surgeons and Surgical Infection Society. J Am Coll Surg. 2017;224(1):59–74.
14. Graafmans W, Attar H, Allegranzi B, Nejad SB, Donaldson L, Pittet D, et al. Burden of

endemic health-care-associated infection in developing countries: systematic review and meta-analysis. Lancet. 2010;377(9761):228–41.

15. CDR Valerie Diaz, CRNA, DNP, USN Johanna Newman, CRNA D, Each. Surgical Site Infection and Prevention Guidelines: A Primer for Certified Registered Nurse Anesthetists. AANA J. 2015;83(1):63–8.
16. Gagliardi AR, Fenech D, Mcleod R. Surgery : a Review of the Literature. Recherche. 2009;52(6):481–9.
17. Zimlichman E, Henderson D, Tamir O, Franz C. Health Care–Associated Infections A Meta-analysis of Costs and Financial Impact on the US Health Care System. 2013;02120(22):2039–46.
18. Merkow RP, Ju MH, Chung JW, Hall BL, Cohen ME, Williams M V, et al. Underlying Reasons Associated With Hospital Readmission Following Surgery in the United States. 2015;60611(5):483–95.
19. Jenks PJ, Laurent M, McQuarry S, Watkins R. Clinical and economic burden of surgical site infection (SSI) and predicted financial consequences of elimination of SSI from an English hospital. J Hosp Infect. 2014;86(1):24–33.
20. Chu K, Maine R, Trelles M. Cesarean Section Surgical Site Infections in Sub-Saharan Africa : A Multi-Country Study from Medecins Sans Frontieres. 2015;350–5.
21. Gelaw KA, Aweke AM, Astawesegn FH, Demissie BW, Zeleke LB. Surgical site infection and its associated factors following cesarean section: A cross sectional study from a public hospital in Ethiopia. Patient Saf Surg. 2017;11(1):18.
22. Amenu D, Belachew T, Araya F. Surgical site infection rate and risk factors among obstetric cases of jimma university specialized hospital, southwest ethiopia. Ethiop J Health Sci. 2011;21(2):91–100.
23. Mamo T, Abebe TW, Chichiabellu TY, Anjulo AA. Risk factors for surgical site infections in obstetrics: A retrospective study in an Ethiopian referral hospital. Patient Saf Surg. 2017;11(1):24.
24. Wendmagegn TA, Abera GB, Tsehaye WT, Gebresslasie KB, Tella BG. Magnitude and determinants of surgical site infecion among women underwent cesarean section in Ayder comprehensive specialized hospital, Northern Ethiopia . BMC Pregnancy Childbirth.

2018;18(1):489.

25. Legesse Laloto T, Hiko Gemeda D, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: Prospective cohort. BMC Infect Dis. 2017;17(1):1–9.
26. Afenigus AD, Shbabawu AT, Melese TG, Emrie HC. Surgical site infection and associated factors among adult patients admitted in west and east Gojjam zone hospitals , Amhara region , Ethiopia. Nurse Care Open Acces J. 2019;6(3):107–12.
27. Iskandar K, Sartelli M, Tabbal M, Ansaloni L, Baiocchi GL, Catena F, et al. Highlighting the gaps in quantifying the economic burden of surgical site infections associated with antimicrobial-resistant bacteria. World J Emerg Surg. 2019;14(1):50.
28. R.E.Mengesha et al. Aerobic bacteria in post surgical wound infections and pattern of their antimicrobial susceptibility in Ayder Teaching and Referral Hospital, Mekelle, Ethiopia. BMC Res Notes. 2014;7:575.
29. Sileshi Tadesse, Haile Alemayehu, Admasu Tenna, Getachew Tadesse, Tefaye Sisay Tessema WS and TE. Antimicrobial resistance profile of Staphylococcus aureus isolated from patients with infection at Tikur Anbessa. BMC Pharmacol Toxicol. 2018;19:24.
30. Manian FA. The role of postoperative factors in surgical site infections: Time to take notice. Clin Infect Dis. 2014;59(9):1272–6.
31. A. Abdel-Aziz et al. Adherence of surgeons to antimicrobial prophylaxis guidelines in a tertiary general hospital in a rapidly developing country. Adv Pharmacol Sci. 2013;2013(1):1–6.
32. S.W. De Jonge.et al. Timing of preoperative antibiotic prophylaxis in 54,552 patients and the risk of surgical site infection. Med (United States). 2017;96(1):29.
33. Fan Y, Wei Z, Wang W, Tan L, Jiang H, Tian L, et al. The Incidence and Distribution of. 2014;1–8.
34. Lima R, Carvalho R De. Incidence and risk factors for surgical site infection in general surgeries. Rev Latino-Am Enferm. 2017;25(1):2848.
35. Shaffer VO, Baptiste CD, Liu Y, Srinivasan JK, Galloway JR, Sullivan PS, et al. Improving quality of surgical care and outcomes: Factors impacting surgical site infection after colorectal resection. Am Surg. 2014;80(8):759–63.
36. Shah H, Sharma S, Saliba EA, Pathak A, Mahadik VK, Lundborg CS. Incidence and

factors associated with surgical site infections in a teaching hospital in Ujjain, India. Am J Infect Control. 2013;42(1):e11–5.

37. Kisibo A, Ndume VA, Semiono A, Mika E, Sariah A, Protas J, et al. Surgical Site Infection among Patients Undergone Orthopaedic Surgery at Muhimbili Orthopaedic Institute , Dar es Salaam , Tanzania . 2017;22(1):49–58.
38. Olowo-okere A, Kokori Y, Ibrahim E, Sani AS. medical sciences Occurrence of Surgical Site Infections at a Tertiary Healthcare Facility in Abuja , Nigeria : A Prospective Observational Study. Med Sci. 2018;6(60):1–10.
39. Halawi E, Assefa T, Hussen S. Pattern of antibiotics use , incidence and predictors of surgical site infections in a Tertiary Care Teaching Hospital. BMC Res Notes. 2018;11(1):538.
40. Engida A, Ayelign T, Mahteme B, Aida T, Abreham B. Types and Indications of Colostomy and Determinants of Outcomes of Patients After Surgery. Ethiop J Health Sci. 2016;26(2):117.
41. Korol E, Johnston K, Waser N, Sifakis F, Jafri HS, Lo M, et al. A systematic review of risk factors associated with surgical site infections among surgical patients. PLoS One. 2013;8(12):1–9.
42. Giesen LJX, Van Den Boom AL, Van Rossem CC, Den Hoed PT, Wijnhoven BPL. Retrospective Multicenter Study on Risk Factors for Surgical Site Infections after Appendectomy for Acute Appendicitis. Dig Surg. 2017;34(2):103–7.
43. Shrestha S, Shrestha R, Shrestha B, Dongol A. Incidence and risk factors of surgical site infection following cesarean section at Dhulikhel hospital. Kathmandu Univ Med J. 2014;12(2):113–6.
44. Argaw NA, Shumbash KZ, Asfaw AA. Assessment of surgical antimicrobial prophylaxis in Orthopaedics and Traumatology Surgical Unit of a Tertiary Care Teaching Hospital in Addis Ababa. BMC Res Notes. 2017;10(160):1–8.
45. Allegranzi B. The burden of surgical site infections worldwide. Public Health Rep. 2014;12–5.
46. Ms GL, Ms FG, Ou Y, Ms GD, Zhou W. American Journal of Infection Control Epidemiology and outcomes of surgical site infections following orthopedic surgery. Am J

Infect Control. 2013;41(12):1268–71.
47. Al-mulhim FA, Baragbah MA, Sadat-ali M, Alomran AS. Prevalence of Surgical Site Infection in Orthopedic Surgery : A 5-year Analysis. Int Surg. 2014;99:264–8.
48. 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.
49. Reddy Chada CK, Kandati J, Ponugoti M. A prospective study of surgical site infections in a tertiary care hospital. Int Surg J. 2017;4(6):1945.
50. 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. 2019;8:4–11.
51. Lubega A, Joel B, Lucy NJ. Incidence and Etiology of Surgical Site Infections among Emergency Postoperative Patients in Mbarara Regional Referral Hospital , South Western Uganda. Surg Res Pract. 2017;2017:1–7.
52. Tedla BA, Moges B, Mahdi JA, Alemayehu M. Postoperative Surgical Site Bacterial Infections and Drug Susceptibility Patterns at Gondar University Teaching Hospital, Northwest Ethiopia. J Bacteriol Parasitol. 2011;2(1):126.
53. International JC. Evidence-Based Principles and Practices for Preventing Surgical Site Infections. 2018. 1–191.
54. WHO Summary of a systematic review on decolonization with mupirocin ointment with or without chlorhexidine gluconate body wash for the prevention of Staphylococcus aureus infection in nasal carriers undergoing surgery. WHO Surg Site Infect Prev Guidel Web. 2018;1–18. Available from: http://www.who.int/gpsc/appendix3.pdf?ua=1
55. Chiang H-Y, Kamath AS, Pottinger JM, Greenlee JDW, Howard MA, Cavanaugh JE, et al. Risk factors and outcomes associated with surgical site infections after craniotomy or craniectomy. J Neurosurg. 2013;120(2):509–21.
56. Saha S, Havlena J, Rathouz PJ. Predictors of Surgical Site Infection after Hospital Discharge in Patients Undergoing Major Vascular Surgery. J Vasc Surg. 2016;62(4):1023–31.
57. Wloch C, Wilson J, Lamagni T, Harrington P, Charlett A, Sheridan E. Risk factors for

surgical site infection following caesarean section in England: Results from a multicentre cohort study. BJOG An Int J Obstet Gynaecol. 2012;119(11):1324–33.

58. A T, H A, F Z. A Systemic Review on Surgical Site Infections: Classification, Risk Factors, Treatment Complexities, Economical and Clinical Scenarios. J Bioequiv Availab. 2017;09(01):336–40.

59. Sonderman KA, Nkurunziza T, Kateera F, Gruendl M, Koch R, Gaju E, et al. Using mobile health technology and community health workers to identify and refer caesarean-related surgical site infections in rural Rwanda: A randomised controlled trial protocol. BMJ Open. 2018;8(5):1–7.

60. Testing S. Performance Standards for Antimicrobial. Clinical and Laboratory Standards Institute.2017. 1–282.

Annex I. American Society of Anesthesiologists (ASA) scores (5)

ASA score	Preoperative physical status	Examples including a lot but not limited to
1	Normal healthy patient	Healthy, non-smoking, no or minimal alcohol use
2	Patient with mild systematic disease	Mild diseases only without substantive functional limitations. current smoker, social alcohol drinker, pregnancy, well-controlled DM/HTN, and mild lung disease
3	Patient with severe systematic disease that is not incapacitating	Substantive functional limitations: one or more moderate to severe diseases. poorly controlled DM or HTN, COPD, alcohol dependence or abuse
4	Patient with an incapacitating systematic disease that is constant threat to life	Recent (<3 months) MI, sepsis, and ARD or ESRD not undergoing regularly scheduled dialysis
5	Moribund Patient who is not expected to survive for 24 hours with or without operation	ruptured abdominal/thoracic aneurysm, massive trauma, intracranial bleeding with mass effect, and ischemic bowel in the face of significant cardiac pathology or multiple organ/system dysfunction

***NB**: DM: Diabetes Mellitus, HTN: Hypertension, COPD: Chronic Obstructive Lung Disease, MI: Myocardial Infarction, ARD: Acute Respiratory Distress, ESRD: End Stage Renal Disorder.*

Source **:(**ASA Physical Status Classification System, 2009)

Annex II: The CDC identified four surgical wound classifications (5).

1. Clean: An uninfected operative wound in which no inflammation is encountered and the respiratory, alimentary, genital, or uninfected urinary tracts are not entered. In addition, clean wounds are primarily closed and, if necessary, drained with closed drainage. Operative incision wounds that follow non-penetrating (blunt) trauma should be included in this category if they meet the criteria.

2. Clean-contaminated: Operative wounds in which the respiratory, alimentary, genital, or urinary tracts are entered under controlled conditions and without unusual contamination. Specifically, operations involving the biliary tract, appendix, vagina, and oropharynx are included in this category, provided no evidence of infection or major break in technique is encountered.

3. Contaminated: Open, fresh, accidental wounds. In addition, operations with major breaks in sterile technique (for example, open cardiac massage) or gross spillage from the gastrointestinal tract, and incisions in which acute, non-purulent inflammation is encountered including necrotic tissue without evidence of purulent drainage (for example, dry gangrene) are included in this category.

Annex III: United States Centers for Disease Control and Prevention National Healthcare Safety Network surgical site infection definition criteria(5).

Superficial incision SSI*

Date of event for infection occurs within 30 days after surgical procedure (where day 1=procedure date) AND involves only skin and subcutaneous tissue of the incision AND patient has at least one of the following:

a. Purulent drainage from the superficial incision.

b. Organisms identified from an aseptically-obtained specimen from the superficial incision or subcutaneous tissue by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment.

c. Superficial incision that is deliberately opened by a surgeon or attending physician or other designee and culture or non-culture based testing is not performed. AND Patient has at least one of the following signs or symptoms: pain or tenderness; localized swelling; erythematic; or heat.

d. Diagnosis of a superficial incision SSI by the surgeon or attending physician or other designee.

Deep incision SSI

Date of event for infection occurs within 30 days or 90 days after the surgical procedure (where day 1=procedure date) AND involves deep soft tissues of the incision (for example, fascial and muscle layers) AND patient has at least one of the following:

a. Purulent drainage from the deep incision.

b. A deep incision that spontaneously dehisces, or is deliberately opened or aspirated by a surgeon or attending physician or other designee and organism is identified by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment or culture or non-culture based microbiological method is not performed patient has at least one of the following symptoms: fever (>38oC); localized pain or tenderness. A culture or non-culture based test that has a negative finding does not meet this criterion.

c. An abscess or other evidence of infection involving the deep incision that is detected on gross anatomical or histopathology exam, or imaging test

Organ/Space SSI**

Date of event for infection occurs within 30 days or 90 days after the surgical procedure (where day 1=procedure date)

AND infection involves any part of the body deeper than the fascial/muscle layers, that is opened or manipulated during the operative procedure AND patient has at least one of the following:

a. Purulent drainage from the drain that is placed into the organ/space (for example, closed suction drainage system, open drain, T-tube drain, and CT guided drainage)

b. Organism identified from an aseptically-obtained fluid or tissue in the organ/space by a culture or non-culture based microbiologic testing method which is performed for purpose of clinical diagnosis or treatment.

c. An abscess or other evidence of infection involving the organ/space that is detected on gross anatomical or histopathology exam, or imaging test evidence suggestive of infection AND meets at least one criterion for a specific organ.

Annex IV: Questionnaire

Information sheet and consent form

JIMMA UNIVERSITY

INSTITUTE OF HEALTH SCIENCE

SCHOOL OF PHARMACY

A questionnaire/checklist paper to assess incidence, clinical outcomes and associated factors of surgical site infections among patients admitted to surgical wards of Jimma University Medical Center (JUMC), south western Ethiopia. A prospective cohort study.

Dear participants, the aim of this study is to assess incidence, clinical outcomes and associated factors of surgical site infections among patients admitted to surgical wards of Jimma University Medical Center (JUMC), south western Ethiopia. Your correct and genuine answer to the questions can make the study achieve its goals. Based on such result and commitments from the researcher the findings will be disseminated to different stakeholders and the problem will be solved accordingly. I kindly request you to answer the questions honestly and anonymously. Since this questionnaire is based on willingness you have the right not to participate, to participate partially and wholly. I would like to promise you that it will not have any risk on you and confidentiality of the information you rendered will be kept. For that reason you don't need of writing your name. It will take approximately 10 minutes to complete the questionnaire.

Participant: I am informed fully in the language I understand about the aim of above mentioned research. I understood all the conditions above and have agreed to take part in this study of my own will.

Participants signature……..

Data collector name……..signature……date……

Supervisors name……signature……date……

Data Collection Tool

1. Card number _____
2. Phone no ____
3. Primary diagnosis (pathology)
   A. Appendicitis
   B. Gallstone disease
   C. Malignancy
   D. Thyroid disorder
   E. Trauma or injury
   F. Complication of previous Procedure
   G. Others specify_____
4. Date of admission___/___/____
5. Date of procedure ___/___/____
   A. Start time. _____ B. End time_____
6. Age _____
7. Gender (encircle answer): Male__ Female __
8. Marital status (encircle answer)
   A. Single
   B. Married
   C. Divorced
   D. Widowed
9. Educational status (encircle answer)
   A. Cannot read & write
   B. Primary school
   C. secondary school
   D. College/university
10. Residence area (encircle answer)
    A. Urban
    B. Rural
11. Occupational status (encircle answer)
    A. Farmer
    B. House hold
    C. Daily laborer
    D. Government employee
    E. Merchant
    F. NGO worker
    G. Others (specify) _____
12. Herbal Medicine use : Yes_____ No _____
13. Cigarette or cigar smoker: Ex-smoker ____Current smoker_____Non smoker_____
14. Alcohol consumption per day: Never___Occasionally___Regularly___
15. Khat chewing : Yes___ No ____
16. ASA score: category (encircle answer): 1_____2_____3____4___5___

17. Number of days after admission when procedure was done _____

18. Number of days after the procedure when patient was discharged? _____

19. Wound class (encircle answer)

A. Clean
B. Clean –contaminated
C. Contaminated
D. Dirty

20. Type of surgery (encircle answer)

A. Emergence
B. Elective
C. Gyn. and labor
D. Orthopedic
E. Others (specify) _____

21. If your answer is ''C' on question number ''20'', then answer the following accordingly

A. Preterm gestation age? Yes__ No ___
B. Duration of labor ≥24 h? Yes__ No ___
C. Duration of rupture of membrane ≥12 hrs? Yes__ No ___
D. Antenatal care (ANC) follows up? Yes__ No __
E. Others (specify)_____

22. Have you any other disease (Co morbidities)? Yes__ no __

23. If yes to question number ''22'', encircle your answer

A. Hypertension
B. Heart
C. DM
D. Anemia
E. HIV
F. Others (specify)_____

24. Preoperative prophylactic antimicrobial agents Yes__ No __

25. If yes, for how long did taken?

A. Time given _____ Time discontinued_____
B. Time given _____ Time discontinued_____
C. Time given _____ Time discontinued_____

26. If yes, to question number 24 above, did patient get a second dose during the procedure? Yes___ no _____

27. If **yes**, to question number **24** above, did patient get additional doses initiation of the same antibiotic continuously post-operation or new antibiotic? Yes_____ no_____

28. If the same, to question number **27** above, how many times the doses were administered continuously postop?

A. Agent 1 _____ B. Agent 2 _____ C. Agent 3 _____

36. If **new**, to question number **27** above, which medication?

Agent 1 _____ Agent 2 _____ Agent 3 _____

29. If new antibiotic or initiation of the discontinued former antibiotic for what reason it was prescribed? _____.

30. Did patient receive blood transfusions? A. yes_____. B. No _____.

31. Preoperative medications use within 30 days prior to surgery

A. Was the patient taking oral or parenteral steroids or other immunosuppressive therapy? Yes _____No_____

If yes, which agent**(s)? _____**

B. Was the patient taking cancer chemotherapy? Yes_____No_____

If yes, which agent(s)? **_____**

C. Intraoperative fluid use? Yes ____ No _____

D. If other, please describe _____

_____

32. Laboratory results

S.No	Lab investigation	Pre-operation or Post operation
1.	Pre-Hemoglobin Abnormality	Yes,_____ units No,_____ units
2.	Post-Hemoglobin Abnormality	Yes,_____ units No,_____ units
3.	Pre-Total WBC Count Abnormality	Yes,_____ units No,_____ units
4.	Post-Total WBC Count Abnormality	Yes,_____ units No,_____ units
5.	Pre-Electrolyte Disturbance	Yes,_____ units No,_____ units
6.	Post-Electrolyte Disturbance	Yes,_____ units No,_____ units
7.	Pre-RFT Abnormality	Yes,_____ units No,_____ units
8.	Post-RFT Abnormality	Yes,_____ units No,_____ units
9.	Others, if any_____	

33. Was a postoperative SSI identified within 30 days of procedure? Yes____ No____

34. If yes, when it was confirmed? _____.

35. If yes, in what setting was the post-operative SSI identified? (Encircle answer)

A. Initial stay
B. Re-admission
C. Post-discharge (outpatient)

36. If yes, to question number 34 above in what follow up method SSI was detected?

A. Clinic review
B. Culture support
C. Telephone review
D. Physician diagnosis
E. No contact after discharge
F. Others, specify_____

37. The result of gram stains if culture detects the growth of organism_____.

38. The specific etiology of SSI if culture was positive_____.

39. Antimicrobial susceptibility patterns _____ _____

_____ _____

40. Did patient return to OR to treat infection after the initial procedure? Yes__ NO ___

41. If yes, date of the procedure ___/___/____

42. Does patient have readmitted after discharged from the hospital? Yes__ No ___

43. If yes, when was the readmission? Date ___/___/_____

44. If the patient was died, when was the death? Date ___/___/_____

THANK YOU FOR PARTICIPATION

Annex I: Consent

Greeting: Good morning/afternoon. My name is……I am working on the behalf of research conduct by Gemedo Misha who is the student of Jimma University. I would like to ask few questions which take around 10 minutes. Your responses that you are going to give are very important to assess incidence, clinical outcomes and associated factors of surgical site infections. You are selected to be the participant of this study if your consent after you have understood the following information sheet.

Title of the study: incidence, clinical outcomes and associated factors of surgical site infections **Objective of the study**: To assess the incidence, clinical outcomes and associated factors of surgical site infections.

Procedure of the study: you will be undergoing exit interview only.

Benefit: there is no special benefit for you since you participate in the study.

Risk: there will be no risk for you since the study only interview

Confidentiality: privacy during the study and confidentiality of the information will be guaranteed. You will be interviewed separately from other clients. In case you know one of the researchers, you can you can be interviewed by someone else or withdraw from the study. You are not required to give your name so information cannot be traced back to you. The information collected will only be accessible to the research team.

Compensation: No compensation will be available for your time and any inconvenience but we are very grateful to you for taking part in the study.

Contacts: If you have any question please feel free to ask me, in case you have any later on, you can contact the principal investigator Mr Gemedo Misha, on the telephone number **0934074610**

Right of participants: You have full right to participate or not to participate in the study. You can as to any question which is not clear for you, jump any questions that you don't want to answer and can end interview.

Participant: I understand all the conditions above and have agreed to take part in this study of my own will.

Participants signature……

Data collector name……..signature……date……

Afan Oromo version of informed consent: Odeeffannoo hirmaattotaaf kennamu

Akkam bultan/ooltan? Maqaan Koo…….jedhama yuunivarsiitii Jimmaa irraa kan dhufe yoo ta'u; qorannoo mata dureen isaa hubaatii fi sababoota jaarmiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabatan qorachuu jedhurratti Gammadoo Mishaa bakka bu'een hojjachaa jira. Gaafilee muraasa kan daqiiqaa kudhan caala hin fudhanne isin gaaafadha. Deebiin isin naaf laattan waa'ee hubaatii fi sababoota jaarmiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabatan adda baafachuuf baayyee barbaachisaadha. Kanaaf kaayyoo fi barbaachisummaa qorannoo kana erga hubattanii booda walii galuu keenya mallattoo keessanin mirkaneessuun gara gaafileetti darbina.

Mata duree qorannoo: hubaatii fi sababoota jaarmiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabata.

Kaayyoo qorannoo: kaayyoo qorannoo kanaa hubaatii fi sababoota jaarmiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabatan qorachuu

Faayidaa qorannoo: Qorannoo kana keessatti hirmaachuun faayidaa addaa isiniif qabu hinjiru.

Miidhaa qorannoo: Qorannoo kana keessatti hirmaachuun keessan miidhaan isin irra gahu tokkollee hinjiru.

Mirga Himaattotaa: Qorannoo kanarratti hirmaachuufis ta'e, dhiisuufis mirga guutuu qabdu. Gaafii ifa isiniif hin taane yoo jiraate gaafachuuf mirga qabdu, gaafii deebisuu hin barbaannne deebisuu dhiisuu akkasumas gaafilee jidduudhaan addaan kutuufis mirga guutuu qabdu.

Icciitii eeguu: yeroo gaafii fi deebii akkasumas odeeffannoo isin irra argannes iccitiin qabna. Gaafilee irratti maqaa keessan ibsuun hin barbaachisu.bu'aan qoranichaas akka waliigalitti malee dhuunfaan hin ibsamu.

Bakka bu'iinsa: hirmaannaa keessaniif baayyee galatooma, yeroo nuuf laattaniif wanti isiniif laadhu hin jiru

Yoo gaaffiii qabaatte soda tokko malee abbaa qorannichaa lakk. 0934074610 bilbilaan gaafachuu ni dandeessu**.**

Mallattoo hirmaataa: ……

Maqaa raga funaanaa…….Mallattoo…… guyyaa……

Amharic written informed consent Form:

<u>የስምምነት ሰነድ</u>

<u>ዉድ የጥናቱ ተሳተፊዎች</u>

አቶ ገመዶ ሚሻ በፋርማሲ ት/ት ክፍል የሁለተኛ ድግሪ የመመረቅያ ምርምሩን በጅማ ሀክምና ማኣከል በ ቀዶ ጥገና ህክምና ክፍል በተኙ ታካሚዎች ላይ ስለ *incidence, associated factors of surgical site infections* ኣና የህክምና ውጤት ግምገማ የሚያጠና፤ሲሆን የጥናቱ ዋና አላማ መረጃ ተኮር ስለ ሰርጅካል ሳት ኢንፈክሽን ጋር የተያያዘ ህመም አና የህክምና ውጤት እንድሁም ምክንያናተቸዉን ምን እንደ ሆነ ማቅረብ፤ለድሪጅቱም ሆነ ለጤና በለሞያ እጅግ በጣም አስፈላጊ ይሆናል። ይህ ጥናት አስፈላጊነቱ በዋናነት እንደዚህ አይነት ችግሮች ወደ ፊት ለመከላከል የሚያስችል ስልት ለመቀየስ የሚጠቅም ነው።

የእናንተ ተሳትፎ በዚህ ምርምር ላይ በፍቃደኝነት ላይ የተመሰረተ ሲሆን በማንኛውም ሰዓት በምትፈልጉበት ግዜ ከምርምሩ ራሳችሁን ማግለል ትችላላችሁ። ስለ እናንተ ማንነት የሚገልጹ መረጃዎች ጥናቱ በሚስጥር የሚይዝ ሲሆን መረጃዎችንም ለሌላ ሶስተኛ ወገን አሳልፎ አይሰጥም።

በዚህ ምርምር ላይ በመሳተፍ በቀጥታ የሚያስገኝልዎት ጥቅም ባይኖርም ምርምሩ በርስዎ ላይ ምንም አይነት ጉዳት አያደርስም። በጥናቱ ላይ ያለዎትን ጥያቄ ለአቶ ገመዶ ሚሻ በስልክ ቁጥር 0934074610 ወይም Email: mishademe@gmail.com ማስተላለፍ እንደሚችሉ እየገለጽኩ ስለትብብርዎ እናመሰግናለን።

የጠያቂው ፊርማ_____

የጥናቱ ተሳታፊ ፊርማ_____

ቀን_____

DEICLARATION

I the undersigned agrees to accept responsibility for the scientific ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the school of pharmacy in effect at the time of grant is forwarded as the result of this application.

Name of the student: _____

Date._____ Signature _____

Approval of Advisor

Name of the first advisor: _____

Date._____ Signature _____

Approval of the examiner

Name of the examiner: _____

Date._____ Signature _____