



INSTITUTE OF HEALTH SCIENCES

SCHOOL OF PHARMACY

DEPARTMENT OF CLINICAL PHARMACY

INCIDENCE, TIME-TO-INFECTION AND ANTIMICROBIAL PROPHYLAXIS
USE AMONG PATIENTS ADMITTED FOR SURGERY TO TERTIARY
HOSPITALS OF NEKEMTE TOWN, WESTERN ETHIOPIA: A PROSPECTIVE
COHORT STUDY

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WOLLEGA UNIVERSITY

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COHORT STUDY, 2025

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ABBREVIATIONS AND ACRONYMS

AHR	Adjusted Hazard Ratio
AMP	Anti-Microbial Prophylaxis
ANC	Antenatal Care
ASA	American Society of Anesthesiologists
BG	Blood-Glucose
CBC	Complete Blood Count
CDC	Centers for Disease Control and Prevention
CHR	Crude Hazard Ratio
CS	Caesarean Section
HAI	Health Care-Associated Infections
IPC	Infection Prevention and Control
JMC	Jimma Medical Center
LIC	Low-Income Countries
LMIC	Lower Middle-Income Countries
LOS	Length of Stay
POD	Post Operative Day
REC	Ethical Review Committee
SSI	Surgical site infection
STATA	Statistical and Data
SUSP	Surgical Unit-Based Safety Program

ABSTRACT

Introduction: A surgical site infection (SSI) is an infection occurring within 30 days post-operation (within 90 days or 1 year if an implant is placed). SSI involves the skin/subcutaneous tissue, deep soft tissue (deep incisional), or any manipulated organ/space during the procedure.

Objective: To assess the incidence, time-to-infection, and antimicrobial prophylaxis use among patients admitted for surgery to tertiary hospitals of Nekemte town, western Ethiopia: a prospective cohort study from February 27 to April 22, 2025.

Methods: A prospective cohort study was conducted at Wollega University Comprehensive Specialized Hospitals and Nekemte Comprehensive Specialized Hospitals for 30 days; 468 surgical patients were monitored daily for SSI. A consecutive sampling technique was performed, and data was collected by two pharmacists and four nurses at admission, during the procedure, after the procedure, and post-discharge via phone; the collected data was entered into EpiData 4.6, exported to STATA 17.0 for analysis, and analyzed using a Cox regression model to identify factors associated with SSI. Proportional hazard assumptions were tested. A Cox regression model with a 95% confidence interval and p-value < 0.05 was considered statistically significant.

Result: The study included 468 patients who underwent surgery and 336 (71.79%) of them were females. The incidence density of SSI developed was 8.08 per 1000 person-days. The majority of SSIs were developed after the procedure from 3 to 7 days. Lack of antenatal care (ANC) visit (AHR: 6.26, 95% CI: 0.88-8.35), having comorbidity (AHR: 6.34, 95% CI: 2.27-7.08), beyond 30 minutes of surgical antimicrobial prophylaxis use (AHR: 7.64, 95% CI: 2.29-12.46), clean contaminated wound (AHR: 0.205, 95% CI: 0.64-4.99), American Society of Anesthesiology (ASA) score $\geq$ III (AHR: 2.50, 95% CI: 0.67-9.27), and >500 ml of blood lost during operations (AHR: 4.33, 95% CI: 0.32-8.37) were found to be the risk factors of time to development of SSI.

Conclusion: In this study, most SSIs developed within 3-7 days post-surgery, with a median onset of 5 days. Significant SSI risk factors included ASA score $\geq$ III, clean-contaminated wounds, surgical antimicrobial prophylaxis delayed >30 minutes, lack of antenatal care (ANC) visits, >500 ml of blood loss during surgery, and presence of co-morbidities. Understanding the timing and risk factors for SSI is crucial for effective prevention and management.

Keywords: *Antimicrobial Prophylaxis, Incidence, SSI, Time to SSI, Ethiopia.*

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1. INTRODUCTION

1.1. Background

SSIs (SSIs) are infections that occur at or near surgical incision within 30 days of operation or after 1 year if the implant is placed(1,2). Time from surgery to first signs/symptoms is the most common interpretation for the infection to become clinically apparent (e.g., redness, pain, pus)(3).

Understanding the timeframe and risk of developing SSI (SSI) is essential for effective prevention and management strategies(4). This is a key aspect of pathogenesis but is less apparent in daily clinical practice. It often occurs within 3-7 days post-operatively. The surgical procedure determines the category of infection that must appear (5–7).

Antimicrobials have significantly improved outcomes in surgical care, yet their overuse poses. Challenges such as antimicrobial resistance and increased healthcare costs. Effective Antimicrobial stewardship, particularly in surgical settings, is crucial for optimizing outcomes and reducing resistance(8,9).

The 2nd most frequent nosocomial infections are SSIs, which are linked to higher rates of hospitalization, treatment costs, and morbidity and mortality following surgical procedures(2).

According to the Centers for Disease and Controls (CDC) of America, SSI can be classified as superficial, deep soft tissue or organ/space(1,10). Localized symptoms and signs, such as heat, redness, discomfort, and swelling, may arise from SSIs that happen at or close to the surgical incision site(11).SSIs significantly increase the risk of death, unanticipated readmissions following surgery, extended hospital stays, and morbidity(12).

The global pooled incidence of SSI was found to be 2.5% and the highest incidence reported in the African Region was 2.7% (13). SSIs account for 20% to 31% of all hospital-acquired infections and are associated with a 2-to11-fold increase in the risk of mortality(14).

According to WHO data, up to one-third of patients who have had surgery suffer from SSIs, which are the most common and frequently reported form of HAI in low and middle-income countries (LMICs). The combined incidence of SSI in LMICs ranged from 1.2 to 23.6, with 11.8 cases per 100 surgical operations(15).

Approximately 10% of patients undergoing surgery in LMICs develop SSIs. In Africa, up to 20% of cesarean section (CS) procedures result in a wound infection. In Europe, SSI affects over 500,000 patients annually, costing €19 million, while in the USA, SSI leads to over 400,000 additional hospital days for patients, costing \$10 billion annually(1,13,16,17).

Through several ways SSI causes; the majority is caused by an endogenous infection, exogenous infection, Procedure-related risk factors, hospital facility-related risk factors, and intraoperative risk factors which can be either modified or non-modified. It is unable to change age, recent radiation treatment, or a history of skin and soft tissue infections(18–21).

SSIs can be prevented through the successful implementation of clinical practice guidelines. These clinical practice guidelines use a multimodal improvement strategy, and preventive measures against bacterial, viral, and fungal contamination by operating room personnel, the patient's endogenous skin flora, and the operating room environment are all part of the comprehensive strategy to prevent SSIs. Other preventive measures include careful operative technique and timely administration of appropriate preoperative antimicrobials. Specifically, mechanical techniques of prevention pertain to the latter element of contamination(19,21).

In general, SSI prevention is crucial to enhancing patient outcomes, saving lives, lowering morbidity, and minimizing medical expenses, but it's also critical to recognize when they do occur. This study aims to assess the diagnostic timing of SSIs, antimicrobial prophylaxis use patterns, incidence, and risk factors (5,22).

1.2. Statement of the problem

The incidence of SSI is different among the World Health Organization (WHO) regions of the world(1). SSI rates vary globally, with developed nations reporting 1.6-4.5% and developing countries experiencing twice the prevalence. While WHO's 2017 report cites an 11.7% SSI prevalence in LMICs, Sub-Saharan Africa ranges from 11-18%. Ethiopian studies show a high pooled prevalence range from (12.3-25.22%), with specific rates of 7.2-8.6%. Overall, 11.7% of LMIC surgical patients are infected, and 20% of African CS patients develop wound infections. Ethiopian hospital studies report varying SSI prevalence: 20.6% at Tikur Anbessa, 19.3% at Dilla University Referral Hospital, 6.8-11.4% at Karl Hospital, 21.1% in Jimma, and 9.4% in Assella(13,20,23–31).

SSI development links to extrinsic (procedure, facility, pre/intraoperative) and intrinsic (patient) risk factors, modifiable or non-modifiable. Patient factors include modifiable glycemia, smoking, alcohol use, obesity, and albumin/bilirubin levels, versus non-modifiable age, gender, radiation history, and skin infections. Procedure, hospital facility (ventilation, traffic, sterilization), and intraoperative factors (surgery duration, transfusions, asepsis, hand hygiene, glove quality, hypothermia, glycemic control) also contribute(20,21,32).

SSI is the most expensive healthcare-associated infection, costing an estimated \$3.3 billion annually and adding one million inpatient days. They endanger millions of lives, contribute to antimicrobial resistance, and result in over 400,000 extra hospital days and \$10 billion in costs annually in the USA alone(12,33).

Annually, over 313 million individuals worldwide receive life-saving or life-prolonging surgery, and that figure is rising(10). SSI extends hospital stays by 4-32 days, with ~25% of patients developing shock/severe sepsis. SSIs also lead to morbidity, mortality, and significant financial burdens. SSIs cause 3% of surgical deaths and increase global medical expenses, raising mortality risk 2-11 fold and adding 7-11 post-operative days(34).

According to England's SSI surveillance, readmission rates were 24.7% (23) and the median increased length of stay (LOS) related to SSI was 10 days. Seven developed and ten developing nations will at any one time have at least one infection out of every 100 hospitalized patients, with the endemic burden of SSI being much higher in low- and middle-income countries, especially among patients admitted to intensive care units(1,12).

SSI was linked to three days of hospital stay following surgery in Sub-Saharan Africa. It results in longer recovery times and possible reoperation(25). As the study conducted in central Ethiopia in 2020 SSI places a significant burden on both the patient and health system, especially in Sub-Saharan Africa, where resources are limited and the average wound infection rates are 2 or 3 times higher than in developed countries due to malnutrition, poor, and preoperative preparation(35).

Patient outcomes are negatively impacted by the prevalence of SSIs. Based on evidence-based solutions, it is estimated that about 50% of SSIs can be prevented(12). This suggests that safety measures, such as SSI preventive interventions, must be put in place in order to lower SSI and enhance patient safety(13).

Many high-level, evidence-based guidelines are currently being developed globally to prevent SSIs. Still, its rates have not much declined especially in developing countries, and process-related risk factors are mostly to blame for this. It is challenging to prevent SSIs since the risk is associated with several aspects of the surgical patient journey, frequently after discharge(7,36–40).

Surgical site infections significantly increase the risk of death, unanticipated readmissions following surgery and reoperation, extended hospital stays, and morbidity(12). Developing countries, such as Ethiopia, have far higher rates and burdens of surgical site infections. Even though several studies in Ethiopia were carried out on SSIs most of these studies were cross-sectional and retrospective. Furthermore, the majority of research primarily examined certain operations (like as caesarean sections)(41).

The time to SSI development is a variable concept influenced by multiple factors including the type of surgery, the depth of the infection, the pathogen involved, and patient-specific risks.

While the majority of SSIs become clinically apparent within 5-10 days, some may appear later, particularly those involving implants or specific pathogens. Limited data exists on the timing of SSI (SSI) development. Tracking the timing of SSI development is crucial for effective prevention and prompt treatment(3). As SSI timing depends on factors like surgery type, infection depth, and pathogen (with some manifesting later, particularly those involving implants), active, patient-based, prospective surveillance including post-discharge monitoring is essential(42).

Therefore, this study was different from the previous study design since it conducted a prospective cohort study design, it determined the incidences of SSI in both surgical, Obstetric, and gynecology wards and assessed the time to development of surgical site infections among patients admitted to Tertiary hospitals of Nekemte Town and also to assessed the incidences of surgical site infections, Antimicrobial prophylactic use patterns, and their risk factors.

1.3. Significance of the study

SSIs are a common form of infection linked to healthcare that greatly increases patient illness, lengthens hospital stays, and increases costs and global mortality. Gaining a comprehensive understanding of the incidence, risk factors, and timing of SSIs is essential for developing evidence-based strategies to minimize their impact.

By assessing the incidence of SSIs, the research will shed light on the burden of these infections in the local context, aiding in regional and national healthcare planning. Furthermore, by examining the timing of SSI occurrences, the research will highlight the postoperative period when patients are most at risk, enabling better postoperative care strategies.

The findings will also guide hospital administrators and policymakers in allocating resources effectively for infection control protocols and enhancing surgical staff training to lower SSI rates. For patients, implementing patient education lowers SSI rates and contributes to better healthcare outcomes. This study will fill a significant gap in the literature and serve as a reference for future research in Ethiopia and other resource-constrained settings.

2. LITERATURE REVIEW

Healthcare-associated infections continue to be a significant concern for healthcare providers worldwide and represent one of the biggest risks to patients' health. One of the most often reported infections among those linked to healthcare is SSI(13).

2.1. Incidence of SSI

In affluent nations, the United States and Germany had 2.6% and 1.6%, respectively, of surgical procedures complicated by surgical-site infections. Likewise, it was 5.6% in developing nations and 2.9% in several European nations(31). According to a meta-analysis of 84 prospective observational studies conducted in mainland China, the average incidence of SSI was 4.5%(43). Annually, over 313 million individuals worldwide receive life-saving or life-prolonging surgery, and that figure is rising(10).

In the retrospective cohort study of 16,882 patients undergoing general surgery in a large Brazilian hospital, the incidence of SSI was 3.4%(44). Depending on the type of wound and the country, the global SSI estimates vary from 0.5% to over 30% (45). Compared to high-income countries (HICs), low- and middle-income countries (LMICs) had more than twice as many SSI rates in each of the wound classifications. Studies conducted in India have revealed that SSI rates vary by research setting, ranging from 4 to 40%.(46).

As a cross-sectional study was conducted in Tanzania, at Muhimbili 181 patients were included in this study; 52% of them developed SSI(47). At a tertiary healthcare facility in Abuja, Nigeria, a prospective observational study found that 35 (27.56%) of 127 surgical patients experienced SSIs(48).

Another study conducted at Bule Hora University Teaching Hospital showed that the overall prevalence of SSI was 15.8%(49), According to a cross-sectional study carried out at Debretabor General Hospital, around 8% of cesarean deliveries resulted in surgery site infections(50). According to a cross-sectional study carried out at Lemlem Karl Hospital on 384 women who had cesarean sections, the incidence of SSI was 6.8%(30).

A prospective study was conducted at Jimma Medical Center which involved 251 participants and 53 (21.1%) experienced infections at the surgery site(31). A retrospective analysis of 206 women's medical records who had C/S at Ayder Comprehensive Tertiary Hospital in Tigray

revealed that the rate of SSI was 11.7%(51). Another cross-sectional study was conducted among 165 adult patients admitted in the west and east Gojjam zone hospitals, nearly one-fourth, 42 (25.5%) of the participants developed SSI (52).

In a prospective observational research conducted at Tikur Anbessa Tertiary Hospital, 27 patients (20.6%) out of 131 experienced surgery site infections(28). A retrospective study done at the College Teaching Hospital, St Paul's Hospital Millennium Medical, showed that SSIs were 23.3%(53).

2.2. Risk factors for the occurrence of SSI

According to a systematic review of risk factors for SSI in surgical patients from developed countries, comorbidities, advanced age, complexity of the surgery, and longer surgeries were consistently found to be risk factors(41).

Other studies showed that age, gender, duration of operation, surgical site, reason for surgery, emergency procedure, Antimicrobial prophylaxis, and American Society of Anaesthesiologists (ASA) score (54). Geriatric individuals with a high risk of surgical site infections after surgery may be identified using accurate controllable factors, operating time > 107 min, serum albumin < 41.6 g/L, BMI > 26.6 kg/m², and age > 79 years(55). A retrospective multicenter study conducted in six teaching hospitals in the southwest region of the Netherlands found that the kind of surgery and the type of wound class were independent risk factors for the prevalence of SSIs(56). A Dutch study found surgery type and wound class to be independent risk factors for SSI prevalence(55).

The most frequent hazards, according to a meta-analysis of 84 prospective observational studies conducted in mainland China, were non-intravenous drug procedures, abdominal surgery, elderly patients, LOS for more than two weeks, superficial incision wounds, and filthy wounds(43). Among the risk factors linked to SSIs in Brazilian hospitals were length of preoperative hospital stay exceeding 24 hours, length of surgery in hours, wound class clean-contaminated, contaminated, and dirty/infected, and ASA II, III, and IV/V(44). A cross-sectional study of 300 study participants at Tanzania's Muhimbili Orthopedic Institute (MOI) in Dar es Salaam revealed that the independent risks for SSI (SSIs) were longer than two hours of surgery, no preventative Antimicrobial use, and more than a week before surgery(57).

Long post-operative hospital admissions, the type of wound, and certain co-morbid diseases were found to be substantially linked with a greater SSI risk, according to a prospective observational study conducted in Nigeria(48). Prospective descriptive research carried out in Ethiopia on all 770 women who underwent delivery surgery in the Jimma University Tertiary Hospital's (JUSH) obstetric department revealed that the incidence of SSI was considerably influenced by the patient's address, the surgical situation, the amount of blood lost during the procedure, the blood transfusion given during the procedure, and the type of wound present at the time of the procedure (50).

A facility-based retrospective observational study conducted among mothers who underwent delivery-related surgery at the Asella Teaching Referral Hospital's obstetric ward indicates that the following risk variables for SSI were identified: age under 19, preterm gestation age, length of Diabetic mellitus, vertical skin incision, preoperative, blood transfusion, abdominal hysterectomy, labor lasting more than 24 hours, and membrane rupture lasting more than 12 hours (23).

In a prospective analysis of 105 patients who had major surgery at Hawasa University Referral Hospital, the risk factors included length of operation, preoperative stay greater than seven days, and advanced age. The institution-based retrospective cross-sectional analysis conducted at the Orthopedics and Traumatology Surgical Unit of TASH found that postoperative prophylaxis was linked to SSIs and that its duration was ≥ 24 hours(26).

A prospective study conducted in Jimma, Ethiopia reported that household, male gender, ASA score ≥ 3 , incision site, dirty wound, lack of prophylactic Antimicrobials before surgery, length of prophylactic Antimicrobials > 24 hours, and post-operative were significant risk factors(31).

A statistically significant correlation was found between SSI and increased white blood cells and reoperation. The findings of the multivariate Cox regression analysis indicated a statistically significant correlation between SSI and re-operation and had a statistically significant association with re-operation(31).WHO recommends that the optimal/ ideal timing of Surgical Antimicrobial Prophylaxis for surgical patients be as close to incision time as possible. Because the infection risk increases as the time interval between preoperative Antimicrobials and incision time increases(19).

2.3. Time to Development of SSI

A SSI can develop any time from 2 to 3 days after an operation, up to when the wound has healed (usually 2 to 3 weeks after the operation)(12). In a randomized clinical trial conducted in Denmark, the median time from surgery to diagnosis of SSI was 10 days, and the time was 8 days for anastomotic leakage, 5 days for pneumonia, and 3 days for respiratory failure(22). As a study conducted by the U.S. Centers for Disease Control, there were late-onset SSIs diagnosed, which were diagnosed between 31-90 days(58).

Another study conducted in 2017 revealed that the median time between the surgical procedure and SSI was 15.5 days(59). The median (range) of days between surgery and SSI was 15 days. The prospective cohort study conducted in the Amhara Region indicated the majority of infections were detected after hospital discharge between 9 to 16 postoperative days(19). The time frame following an operative procedure for monitoring and identifying an SSI event is crucial for early management(3).

As the study conducted on orthopedic surgery, Superficial SSIs were diagnosed significantly earlier, at 26.5 days, than deep or organ/space SSIs, at 53 days(60). There are local and systemic complications related to SSI. If the SSI can be identified early and treatment can be started as soon as possible, these complications can be completely avoided(61). Understanding the timeframe and risk of developing SSI (SSI) is essential for effective prevention and management strategies(4).

2.4. Surgical Antimicrobial Prophylaxis Use Patterns

A prospective observational study conducted at Tikur Anbessa Specialized Hospital (TASH) revealed that a well-documented approach is to use pre and postoperative antimicrobial prophylaxis. Of patients that received Surgical Antimicrobial Prophylaxis 30–90% are inappropriate; most antimicrobials are either given at the wrong time, wrong dosage, or the wrong strength which results in increased antibiotic usage, increased costs, prolonged hospitalization, superinfection, antimicrobial resistance and reduction of surgical Surgical Antimicrobial Prophylaxis(SAP) used(28)(62).

The study done in Ghana since 2017 showed that the choice of Antimicrobials was largely similar for community- and hospital-acquired infections as well as for prophylaxis(9). The

study conducted at Saint Paul's Hospital Millennium Medical Colleges showed that the status of surgical Surgical Antimicrobial Prophylaxis of use was the risk factor associated with SSI(62).

The study conducted in India reveals that significant reliance on intravenous and broad-spectrum Antimicrobials, particularly Beta-lactams, in surgical settings at a tertiary care hospital. The predominance of Antimicrobials like Metronidazole and Piperacillin/Tazobactam, coupled with the typical therapy duration of 5-6 days, highlights the critical need for optimized Antimicrobial stewardship(8).

As study St. Paul's Hospital Millennium Medical College Surgical Antimicrobial Prophylaxis should be started before contamination, which is considered essential to control bacterial growth and significantly lower the incidence of SSIs. It is estimated that 60% of SSIs are preventable, mostly related to the use of recommended evidence-based practices such as the timing, selection, and duration of preoperative prophylactic antibiotics(63).

Surgical antibiotic prophylaxis (SAP) involves administering antibiotics to prevent SSI when given appropriately correct antibiotic choice, timing, duration, and procedure SAP effectively reduces postoperative infections(64). However, evidence indicates that antibiotics are often overused or misused in practice, including inappropriate selection, timing, and duration. Such misuse contributes to increased antibiotic resistance, adverse drug reactions, higher SSI risks, and rising healthcare costs(63). While prophylactic antimicrobial use is justified, it is crucial to administer them via the correct route, at the optimal time, and for the appropriate duration to ensure high antibiotic levels in plasma and tissues during the period of maximum bacterial contamination(65).

A study done in Wallaga University Referral Hospital before 8years revealed that the majority of the prophylactic antimicrobials (75.8%) were administered for greater than 24 hours and above half (52.3%) of the Antimicrobials were administered preoperatively(66).

2.5. Conceptual framework

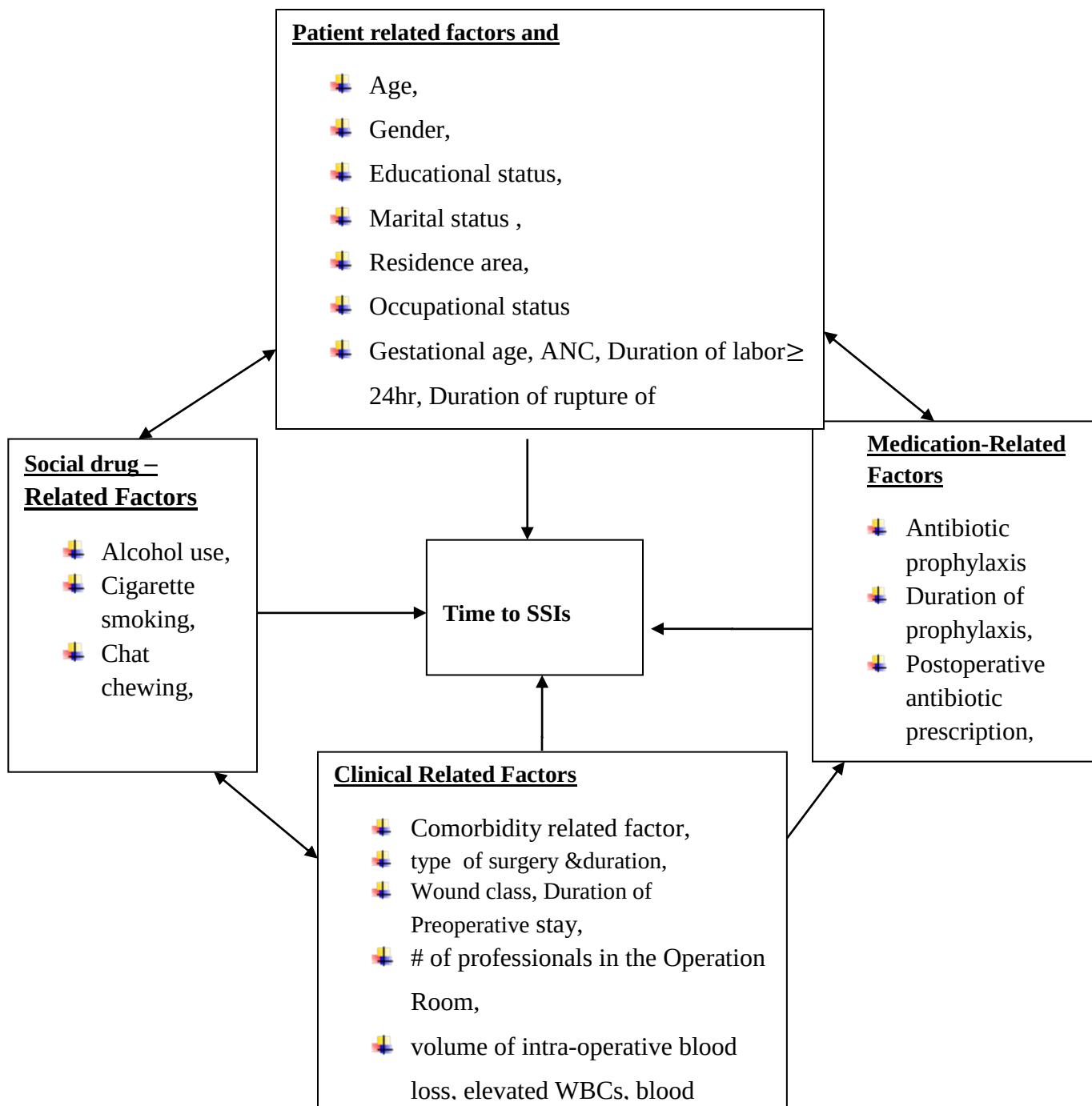


Fig 1: The conceptual framework time to SSI among patients admitted to tertiary Hospitals of Nekemte Town, West Ethiopia: Prospective Cohort Study Design, 2025(19)

3. OBJECTIVES

3.1. General objective

To assess incidence, time-to-infection, and antimicrobial prophylaxis use among patients admitted for surgery to tertiary hospitals of Nekemte town, western ethiopia: a prospective cohort study from February 27 to April 22, 2025.

3.2. Specific objectives

- ❖ To determine the incidence of SSI (SSIs) among patients admitted to surgical and Obstetric/Gynecological wards.
- ❖ To assess the time to onset of SSI among patients admitted to surgical and Obstetric/Gynecological wards.
- ❖ To evaluate the patterns of Surgical Antimicrobial Prophylaxis use among patients admitted to surgical and Obstetric/Gynecological wards
- ❖ To identify the risk factors associated with SSI among patients admitted to surgical and Obstetric/Gynecological wards

4. METHODS

4.1. Study setting and period

The study was conducted at Wollega University Comprehensive Tertiary Hospital (WUCSH) and Nekemte Comprehensive Tertiary Hospital (NCSH) from February 27 to April 22, 2025. Nekemte town is located in western Ethiopia, and 331 km away from the capital city of Ethiopia, Addis Ababa.

WUCSH was established in 2016 and functions as a teaching and referral center, providing prevention and curative services for a catchment population of about 14 million. The hospital has approximately 279 beds, including 36 in the surgical wards and 53 in the Obstetric/Gynecological ward, and is located to the west of Nekemte town.

NCSH is one of the Tertiary hospitals found in the western part of the country that was established by Sweden Missionaries in 1932 A.C. and now works under the Oromia Regional state. Currently, the hospital serves a catchment population of about 5 million; it has about 178 numbers of beds; of these, 40 beds are in the surgical wards and 54 beds are in the gynecologic/obstetrics ward, and provides services as a referral site and tertiary care for the western parts of Ethiopia. Services provided at both hospitals include: Ambulatory, Pharmacy, inpatient services, surgery, obstetrics and gynecology, pediatrics, outpatient services, emergency & intensive care, Cancer treatment, Orthopedics, ophthalmology services, and dental care services.

4.2. Study Design

A hospital-based prospective cohort study design was conducted.

4.3. Populations

4.3.1. Source of populations

All adult patients admitted to the tertiary hospital of Nekemte Town who underwent surgical procedures from February 27 to April 22, 2025.

4.3.2. Study population

All adult patients who were admitted for surgical procedures at tertiary hospital Town at the Surgical, gynecologic, and obstetrics wards from February 27 to April 22, 2025, who fulfill the eligibility criteria.

4.4. Eligibility criteria

4.4.1. Inclusion Criteria

All adult patients ≥ 18 years old who underwent surgery at the Surgical, Gynecologic, and Obstetrics wards from February 27 to April 22, 2025

4.4.2. Exclusion Criteria

- Patients who had developed SSI before the study began.
- Patients who refused to participate
- Patients who had an operation in another institution and were referred in and admitted to the wards
- All patients with non-operative wounds or abscesses are excluded.

4.5. Sample Size Determination and Sampling Techniques

4.5.1. Sample size determination

The Sample size was calculated using Stata™ Version 17.0 (Sample size analysis for Cox proportional hazards model) by considering the hazard ratio of SSI 1.819 (Diabetes Mellitus) 13), two-tailed significant level (α) of 0.05, power 80%, and a 95% confidence level(19)(67). Which is the **STATA command** “stpower cox, hratio (1.74) power (0.8)wdprob (0.1)failprob(0.243)”.(n=468)(Table 1).

Table 1: Table of Sample size determination using STATA commands for survival analysis

Variable	Assumptions					Sample size(n)	Reference
	HR	Power	Log-rank	Wdprob	Failprob(p%)		
Diabetes Mellitus	1.819	0.8	0.5	0.15	0.703	147	(19)
Contaminated wound	1.74	0.8	0.5	0.1	0.243	468	(67)

HR: Hazard Ratio

The sample from two hospitals was taken by a consecutive sampling technique of patients who underwent surgeries in both tertiary hospitals in Nekemte town since the proportion of patients from the two Hospitals is nearly the same. As data was taken from the HMIS of both hospitals in the previous 3 months, the number of patients admitted for surgeries in both wards of WUCSH was 11 per day, and the number of patients admitted for surgeries in both wards of NCSH was 12 per day. Therefore, the final sample size was based on the **STATA command** “stpower cox, hratio (1.74) power (0.8) wdprob (0.1)failprob(0.243)”(n=468) (**Table 1**).

4.6. Study variables

4.6.1. Dependent variable

Primary outcome

 Time to SSI

Secondary outcome

 Surgical Antimicrobial Prophylaxis uses patterns

4.6.2. Independent variables

Socio-demographic Factors and Behavioral Measures

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

Procedure-Related Factors

Urgency of surgery, duration of surgery, wound class, preoperative duration, number of professionals in the operating room

Medication-Related Factors

Preoperative antimicrobial prophylaxis, duration of prophylaxis, postoperative Antimicrobial prophylaxis

4.7. Data Collection Instrument & Procedure

A validated data collection tool was adapted from ‘WHO Protocol for SSI Surveillance with a Focus on Settings with Limited Resources’, and it was amended according to local circumstances(12,19,41). The supervisors supervise the data collection process daily. Data was collected from patients, SSI registration books, medical charts, and direct observation. At discharge, patients provided phone numbers for follow-up. Patients/attendants received health information with clear instructions and training on identifying and reporting SSI signs/symptoms, emphasizing twice-daily incision site checks.

There were two major periods in this study. Per operative (in-patient) time and out-patient (post-discharge) time; during the in-patient data collection, each participant had one form per operation. To gain the most accurate data and encourage surgical staff to record all the appropriate information in the patient notes, the perioperative data collection form was completed before and during the surgery, when it was possible. When surgery takes place overnight, when the data collectors are not in the hospital, the following day is the first task in the morning.

SSI development information was obtained directly from patients, operation notes, medical and medication charts, as well as direct observation (when possible). The data collectors follow the

patients and review their charts on the 3rd, 5th, 7th, 14th, 30th and in between from the operation procedure until the end of the follow-up period.

Socio-demographic and clinical factors data were collected using a pre-designed semi-structured questionnaire through face-to-face interviews and medical record review. This study followed CDC SSI surveillance methods(12).

The clinical diagnosis of SSI was performed by the attending physician. All study participants were educated about the clinical features of SSI during the study period. Clinical features of SSI, such as pain, redness, swelling, warm skin around the wound, yellow or green discharge, unpleasant odor, fever, and chills, were considered as clinical diagnoses of SSI(49). Then participants were requested and sign an informed consent form to participate in the study. Study participants were followed up for 30 days starting from the date of operation.

Post-discharge telephone call communication was designed to represent a form of clinical interaction and have an appropriate degree of politeness, sensitivity, and confidentiality. When a patient or attendant reports the presence of unambiguous signs and symptoms (i.e., previously mentioned), SSI will be diagnosed with only a phone call examination.

However, to diagnose SSI in situations where the patient/attendant is not sure about the absence of SSI, suggestive signs, and symptoms, the diagnosis was made in three different strategies. First, patients were asked to go to the nearby health facility and check their wound status. Second, patients were asked if their outpatient department (OPD) appointment for their surgical wound was closer. The OPD appointment of discharged surgical patients in the study hospitals was usually 1 week after discharge. Third, a link with a health extension worker, where available, and the data collectors inquire the HEWs about the patient's condition and incision site. The day when patients reported developing the first sign or symptom of SSI was recorded as their failure time.

4.8. Data validity and Quality Management

The questionnaires were prepared in English and training was provided for data collectors and supervisors by the principal investigator. Data was collected by two pharmacists and four Nurses, using a pretested data collection tool. A pre-test on 23(5%) eligible patients was done at Dembi Dollo Comprehensive Tertiary Hospital before the actual data collection process, and

the collection tool was modified. The administered questionnaires were checked for completeness and consistency daily during data collection by supervisors. The whole procedure of sample processing and result interpretation was cross-checked.

4.9. Data analysis and interpretations

All collected data were coded and entered by EPI-data version 4.6, and then the data were exported to STATA version 14 for analysis. 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). A collinearity test was performed by VIF to check for collinearity between independent variables (**Table 11**).

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

A multivariable Cox regression was performed to identify independent predictors of the outcome variable. The adjusted hazard ratio was used as a measure of the strength of the association, and a p-value < 0.05 was considered to declare statistical significance.

4.10. Ethical consideration

The study was approved by the Ethics Review Committee (REC) of Wollega University by Ref.No: IHSREC/03/123/2025. It was taken to different levels of administrative bodies. An official letter of cooperation was also given to each department. The study's purpose, procedure, duration, and benefits of the study were clearly explained to study participants, and written consent was obtained from respondents. Any patients who were not willing to engage in the study and those who wanted to stop the interview at any time would be allowed. Confidentiality was assured by excluding their name during the period of data collection.

4.11. Dissemination plan

The results of the study will be presented to the School of Pharmacy, and Institute of Health, Dissemination of the results will also be made to WU, WUCSH, NCSH, and East Wollega Zone health office through hard and/or soft copies. Also, the manuscript(s) will be submitted

for publication for peer review in a scientific reputable journal(s) and will also be presented at scientific conferences

4.12. Operational definition and Definition of terms

Adult: age ≥ 18 years

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 patient who is not expected to survive for 24 hours with or without the operation(1).

Censoring: Patients who died during the follow-up without developing SSI, patients referred to other hospitals, patients who do not develop SSI until postoperative day 30, Non- response patients (after three to five calls), patients whose phone did not work after 3 consecutive days of trial (lost to follow up), and patients who refused to participate during the follow-up.

The event was the development of the first SSI following a particular general surgery procedure.

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

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

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 the patient was readmitted within 30 days after the initial procedure.

Prophylactic antimicrobials: Refers to a very brief course of antimicrobial agent initiated just before an operation begins with an attempt to sterilize the tissue, but a critically timed adjunct

used to reduce the microbial burden of intra-operative contamination to a level that cannot overwhelm host defense(62).

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 the initial operation, either during the initial hospitalization or during readmission within 30 days.

Start time: was post-operative day one (i.e., the procedure day), while the end time was Post-operative 30 days.

SSI is infections that develop within 30 days after an operation or surveillance of surgical wound infection implementation within 90 days after surgery when an implant is placed.

Surgical Antimicrobial Prophylaxis refers to the use of antibiotics for the prevention of SSIs and does not include preoperative decolonization or treatment of established infections(63).

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

Time to SSI: time (in days), from the end of the operation to the development of SSI following general surgery.

SSI (SSI):

Superficial incision SSI must meet the following criteria:

The date of event occurs within 30 days following the NHSN operative procedure (where day 1 = the procedure date) and involves only skin and subcutaneous tissue of the incision, and the patient has at least one of the following:

- A. purulent drainage from the superficial incision.
- B. organism(s) 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 purposes of clinical diagnosis or treatment
- C. a superficial incision that is deliberately opened or re-accessed by a surgeon, physician, or physician designee, and culture or non-culture-based testing of the superficial incision or

subcutaneous tissue is not performed and the patient has at least one of the following signs or symptoms: localized pain or tenderness; localized swelling; erythema; or heat

d. diagnosis of a superficial incisional SSI by a physician or physician designee(68).

Deep incisional SSI

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

A. purulent drainage from the deep incision

B. a deep incision that is deliberately opened, re-accessed, or aspirated by a surgeon, physician, or physician designee or spontaneously dehisces and organism(s) identified from the deep soft tissues of the incision by a culture or non-culture-based microbiologic testing method which is performed for purposes of clinical diagnosis or treatment and patient has at least one of the following signs or symptoms: fever ($>38^{\circ}\text{C}$); localized pain or tenderness

C. an abscess or other evidence of infection involving the deep incision detected on gross anatomical exam, histopathology exam, or imaging test(68).

Organ/Space SSI must meet the following criteria:

The date of the event occurs within 30 or 90 days following the NHSN operative procedure (where day 1 = the procedure date) and involves the organ/space tissues (deeper than the fascia/muscle), and the patient has at least one of the following:

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

B. organism(s) identified from fluid or tissue in the organ/space by a culture or on-culture-based microbiologic testing method, which is performed for purposes of clinical diagnosis or treatment(68).

5. RESULT

The response rate of study participants

Upon completion of the 30-day follow-up period, the final analysis comprised 468 patients, resulting in a 100% response rate. Among these, 241 (51.5%) were from NCSH, while 227 (48.5%) of participants were from WUCSH. Among 468 surgical patients, 233 (49.79%) were from surgical wards, 204 (43.59%) from maternity wards, and 31 (6.62%) from gynecological wards. Senior surgeons performed 411 (87.82%) of the procedures. The mean number of professionals attending each surgery was six (**Table 2**).

Table 2: Facility-related factors of SSI patients underwent general surgery at tertiary hospitals in Nekemte town from February 27 to April 22, 2025

Variables	Category	Total
		N (%)
Hospitals	NCSH	241(51.5)
	WUCSH	227(48.5)
Ward	Surgical wards	233(49.79)
	Maternity wards	204(43.59)
	Gyn/wards	31(6.62)
Qualification of Surgeon	Senior physician	411(87.82)
	Resident (R4)	36(7.69)
	IESO	21(4.49)

Socio-demographic characteristics of study participants

Out of the total 468 patients in the cohort, 132 patients (28%) were males, and more than two-thirds, 336 patients (72%), were females. With a mean age of 35.27 ± 13.16 SD years, the majority of patients were in the 18–40 age categories. There were 254 (54.27%) rural resident participants. Also, participants were identified as either events or censored.

A comparable percentage of patients were merchants, 105 (22.43%), and farmers, 176 (37.6%). A total of 184 individuals (39.36%) had only completed primary school, 22.22% were college-level and above, and 76 (16.26%) could not read or write. Among admitted surgical patients, married marital status was 399 (85.26%), followed by single 137 (11.54%), widowed 8 (1.71%), and divorced 7 (1.50%) (**Table 3**).

Table 2 Distribution of socio-demographic characteristics of patients who underwent surgery at tertiary hospitals in Nekemte Town, Oromia, from February 27 to April 22, 2025 (n=468)

Variables	Category	Total N (%)
Age	18-40	375(80.13)
	41-64	71(15.17)
	≥65yrs	22 (4.70)
Sex	Male	132(28.21)
	Female	336 (71.79)
Occupation	Farmer	178 (38)
	Gov't employee	68 (14.52)
	House Holds	72 (15.38)
	NGO	19 (4.05)
	Merchants	105(22.43)
	Daily laborer	9 (1.92)
	Student	17 (3.63)
	Can't write and read	76(16.24)
	Primary school	184 (39.32)
Educational Status	Secondary school	104(22.22)
	College and above	104(22.22)
Residence	Urban	214(45.7)
	Rural	254(54.3)
Marital status	Single	54(11.54)
	Married	399(85.26)
	Widowed	8(1.71)
	Divorced	7(1.50)

*:-waaqeffataa, Adventist, Catholic

Social drug-related factors

Concerning behavioral characteristics, 460 (99.57%) participants had never smoked, 442 (94.44%) drank alcohol, and 441 (94.23%) had never chewed khat. Among those who developed SSI, 2 (0.43%), 9 (1.92%), and 2 (0.43%) belonged to alcohol, khat, and cigarette smoke, respectively (**Table 4**).

Table 3:Table of social drug-related factors patients of underwent surgery at tertiary hospitals in Nekemte Town, Oromia, from February27to April 22, 2025

Variables	Category	Total	Status	
		N (%)	Event n (%)	Censored n (%)
Alcohol use	Yes	26(5.56)	2(0.43)	24(5.12)
	No	442(94.44)	92(19.67)	350(74.78)
Khat chewing	Yes	27 (5.77)	9(1.92)	18(3.84)
	No	441(94.23)	85(18.16)	356(76.06)
Cigarette smoking	Yes	8(1.71)	2(0.43)	6(1.28)
	No	460(97.86)	92(19.67)	368(78.19)

Patient and surgical wound-related factors

In our study, only 78 (16.67%) patients received a preoperative blood transfusion. Among patients who had developed SSI, 38 (8.12%) had a clean-contaminated wound class, 55 (11.75%) had a contaminated wound class, and the largest number of participants belonged to ASA score II, 369 (79.70%), and ASA score III, 96 (19.44%). Among patients who developed SSI, 25 (26.59%) belonged to ASA score II, and 66 (70.21%) belonged to ASA score III. Among 468 study participants, 204 (43.59%) underwent CS. About 115 (24.60%) of them underwent surgery because of labor > 24 hrs and 93 (19.87%) because of rupture of membrane > 12 hrs (**Table 5**).

Table 4:Patients and surgical wound-related factors among patients who underwent surgery at tertiary hospitals in the Nekemte Town Oromia region, from February 27 to April 22, 2025

Variables	Category	Total	Status	
		n (%)	Event n (%)	Censored n(%)
Blood Transfusion	Yes	78(16.7)	36(7.69)	42(8.97)
	No	390(83.3)	58(12.39)	332(70.94)
Blood lost during procedure	<500ml	417(89.10)	69(14.74)	348(74.76)
	500ml-1000ml	51(10.90)	25(5.34)	26(5.56)
Surgical Wound Class	Clean	43(9.19)	1(0.21%)	42(8.97)
	Cleancontaminated	336(71.79)	38(8.12%)	298(63.67)
	Contaminated	89(18.80)	55(11.75%)	33(7.05%)
ASA Score	II	365(77.99)	23(4.91)	344(73.50)
	III	97(20.73)	67(14.31)	30(6.41)
	IV	6(1.28)	4(0.85)	2(0.43)
Gestational age(n=204)	Preterm	34(7.26)	5(1.07)	29(6.19)
	Term	89(19.02)	9(1.92)	80(17.09)
	Post-term	81(17.30)	6(1.28)	75(16.02)
ANC follow up(n=204)	Yes	189(40.38)	16(3.41)	173(36.96)
	No	15(3.20)	4(0.85)	11(2.35)
Labour>24hrs(n=204)	Yes	115(24.80)	3(0.64)	112(24.14)
	No	89(19.02)	17(3.63)	72(15.38)
Rupture of membre>12hrs(n=204)	Yes	93(19.87)	14(2.99)	79(16.88)
	No	111(23.93)	6(1.28)	105(22.45)
Types of the procedure	Surgic/ Emergence	147 (31.41)	46(9.83)	101(21.58)
	Surgical Elective	86 (18.16)	21(4.49)	65(13.67)
	Gyn Emergence	2 (0.43)	1(0.21)	1(0.21)
	Gyn elective	29(6.19)	7(1.28)	23(4.91)
	Obstetrics/emergen	185 (39.53)	18(3.85)	167(35.68)
	Obstetrics elective	19 (4.08)	1(0.21)	18(3.85)

ANC: antenatal care, ASA: American Society of Anesthesiologists

Regarding those who developed SSI, the most incident SSI types were superficial SSI 54 (54%), deep soft tissue SSI 38 (40.4%), and organ/space SSI 2 (0.42%). Among those who developed SSI, 65 (14.10%) of the incidents developed at the hospital, whereas 29 (5.98%) developed at patients' homes after they were discharged. Of the 9(1.92%) who had readmission, 27 (5.77%) had reoperation, and the median length of hospital stay was 2 days, with 4.27% of the procedures taking 3 hours and above to finish. The maximum pre-procedure hospital stay was one day for 186 (39.74%) patients. Reoperation after discharge for SSI was done for 27 (5.77%), while readmission after discharge for SSI was done for 9(1.97%) (**Table 6**).

Table 5:Procedure-related factors of SSI patients who underwent general surgery at tertiary hospitals in Nekemte town from February 27 to April 22, 2025

Variables	Categories	Total	Status
		N (%)	Event n (%)
Pre-procedure hospital stay(in days)	0	160(34.19)	44(9.40)
	1	186(39.74)	29(6.2)
	2	102(21.79)	16(3.42)
	3	14(2.99)	2(0.43)
	4	6(1.28)	3(0.64)
Length of procedure in hrs	1hr	306(65.38)	46(9.83)
	1:30hr	40(8.55)	10(2.13)
	2hr	100(21.37)	26(5.56)
	2:30	2(0.43)	2(0.43)
	3hr	20(4.27)	10(2.13)
A place where SSI detected	Initial stay(hospital)		65(14.10)
	Post discharge(home)		29(5.98)
Types of SSI identified	Superficial incision	54(57.45)	54(57.45)
	Deep tissue incision	38(40.43)	38(40.43)
	Organ /space	2(0.42%)	2(2.13)
Readmission after discharge for SSI	Yes	9(1.92)	9(1.92)
	No	29(6.2)	28(5.98)
Reoperation after discharge for SSI	Yes	27(5.77)	27(5.77)
	No	67(14.32)	67(14.32)

Primary Diagnosis Factors

Among the 468 surgical procedures above, two-thirds of the procedures, 334 (71.37%), were emergency cases. Of all surgical procedures, cesarean section surgery accounted for 204 (43.59%), followed by appendectomy procedures 75 (16.03%), trauma surgery 37 (7.91%), malignancy/cancer including breast surgery 35 (7.48%), and 31 (7.05%) gynecological cases (fig. 2).

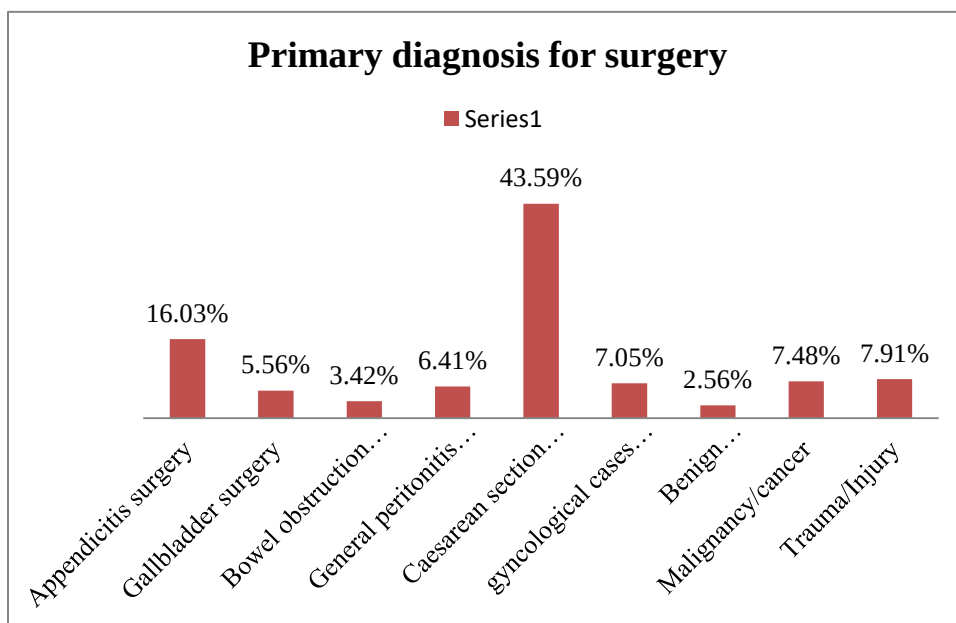


Figure 2:Primary diagnosis of patients who underwent surgery

Regarding comorbidity, 39 (8.33%) participants had hypertension, while 10 (2.14%) participants had diabetes mellitus, and about 88% of patients had no comorbidity problem. Among a total of 57 (12.18%), those with <7 gm/dl Hgb were 158 (33.76%) and those with WBC >12000 cells/ μm (Table 7).

Table 7: Baseline clinical profiles of SSI patients admitted for Surgery at Nekemte Town Tertiary Hospitals from February 27 to April 22, 2025

Variables	Category	Total	Status	
		N (%)	Event n (%)	Censored n (%)
Comorbidity	Yes	68(14.53)	24(5.12)	44(9.40)
	No	400(85.47)	44(9.40)	356(76.07)
Comorbidity type	HTN	39(8.33)	12(2.56)	27(5.77)
	DM	10 (2.13)	8(1.71)	2(0.43)
	HIV/AIDS	6 (1.28)	3(0.64)	3(0.64)
	Psychiatric disorder	5(2.13)	1(0.21)	4(0.85)
	Other*	3(0.64)	0	3(0.64)
Hemoglobin level	<7gm/dl	57(12.18)	36(7.69)	21(4.49)
	≥7gm/dl	411(87.82)	58(12.39)	353(75.43)
WBC level	>12000cells/μm	158(33.76)	61(13.03)	97(20.73)
	4500-12000cells/μm	310(66.24)	33(7.05)	277(59.19)

**Respiratory infection, renal infections*

Surgical Antimicrobial Prophylaxis Use patterns

Regarding Surgical Antimicrobial Prophylaxis (SAP), drugs were administered to 462 patients (98.71%), with 429 (92.85%) receiving it within 30 minutes of pre-incision. 308 (66.67%) participants received SAP for 1 day, while 154 (32.76%) received it for more than 1 day. A second intraoperative SAP dose was given to 163 (34.83%) patients, and neither additional medications were reinitiated nor discontinued. The most frequently administered prophylactic drug was ceftriaxone only (263, 56.20%), and the 2nd most frequent drug was a combination of ceftriaxone and metronidazole (111, 23.72%) (**Table 8**).

Table 8: Surgical Antimicrobial Prophylaxis use Pattern and Prophylactic drugs used in surgical patients

Variables	Category	Total N (%)
SAP given	Yes	462(98.71%)
	No	6(0.85)
Time to SAP given	≤30 minutes	429(92.85)
	>30minutes	33(7.14)
2 nd dose of SAP intraoperative	Yes	163(34.63)
	No	305(65.17)
Duration SAP given	≤1 days	308(66.67)
	>1days	154(32.76)
Prophylactic drugs	ceftriaxone only	263 (56.20)
	ceftriaxone +Ampicillin	83(17.74)
	ceftriaxone +metronidazole	111(23.72)
	Other medication*	11(2.35)

SAP : Surgical Antimicrobial Prophylaxis ,*Ceftriaxone+gentamicin, ceftriaxone+Vancomycin

Incidence of SSI

Among 468 patients, 94 (20.1%) developed SSI, while 374 patients (79.9%) were censored until the end of the follow-up period. Out of censored participants, 16 (3.43%) were censored before the 30th POD because they either failed to answer their phones (lost to follow-up) or their phones stopped working after three days of the trial. A total of 11630 person-days have been spent on follow-up of the patients. The incidence density of SSI in this study was 8.08 (95% CI: 6.60 – 9.89) per 1000 person-days of observations (**fig. 3**).

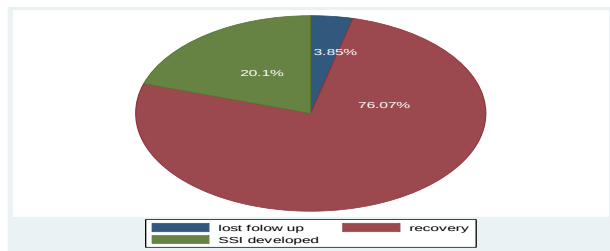


Figure 3: Status of Respondents on follow up

Time to SSI from date of surgery to 30th POD

In the findings of this study, the overall Kaplan–Meier estimate, the likelihood of time to SSI, is highest during the first five postoperative days and subsequently decreases as follow-up increases. This study’s significant incidence of censoring made it impossible to ascertain the median survival time since the number of censored patients was large.

The majority of SSIs were developed within the first 3 to 7 days following surgery. Five days was the median period for SSI development in this study. A hundred percent (100%) probability of SSI was observed during the first five days, and at the end of 5 days, an 87.18% probability of SSI with a standard error of 0.0155 (95% CI: 0.8380 - 0.8990) was observed; however, no significant change was observed after 16 postoperative days of follow-up. The probability of cumulative SSI was 20.09% at the end of the 15th day of stay, with a standard error of 0.0185 (95% CI: 0.1673-0.2401). From the 16th to the 30th day, there was a slight change in SSI occurrences, and the graph became straight, indicating that the percentage of postoperative surgical patients who developed SSI stayed constant, indicating relatively few SSI cases. The cumulative probability of SSI for surgical patients at the 30-day mark after surgery was 75.85%, with a standard error of 0.0198 (95% CI: 0.7171–0.7948).

The Kaplan-Meier with Cochran-Mantel-Haenszel log-rank test was used to test the equality of survival curves of time variables (**Fig 3**).

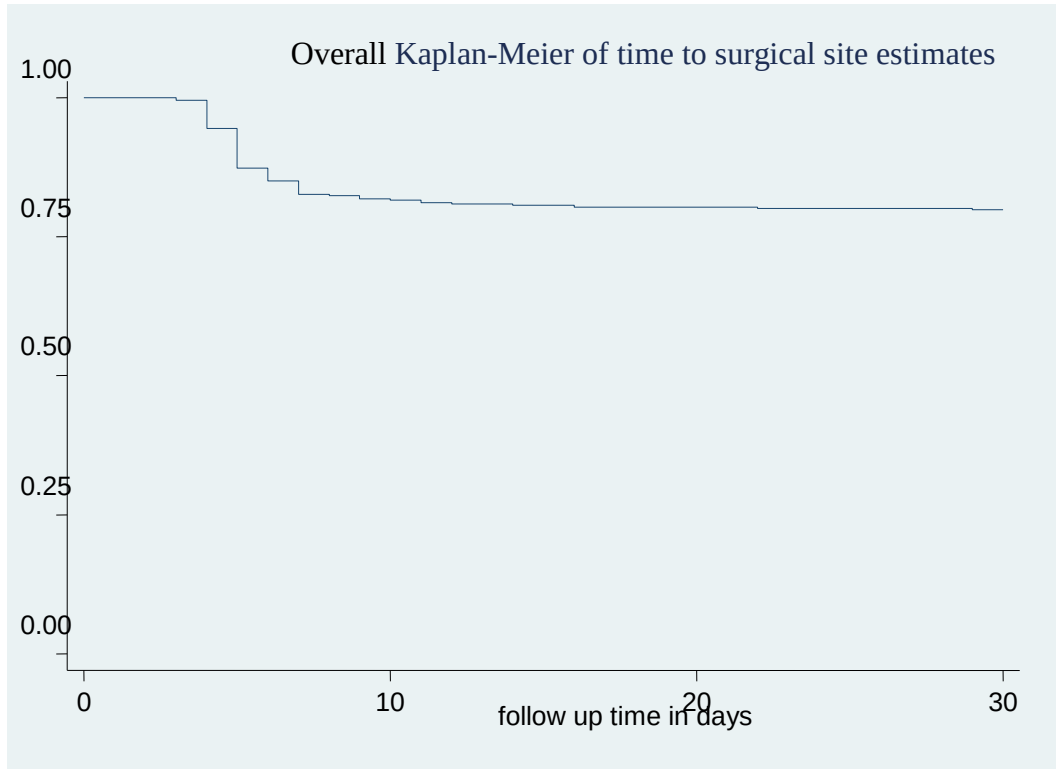


Fig: 3 The overall KM time to SSI estimate

The Cox-Snell residual and Nelson—Aalen cumulative hazard graph showed the overall model fitness of the data in the proportional hazards regression model. The hazard function closely follows the 45° line and begins to deviate as the number of censored patients increases, suggesting that residuals have a standard censored exponential distribution with the hazard ratio (Fig. 5).

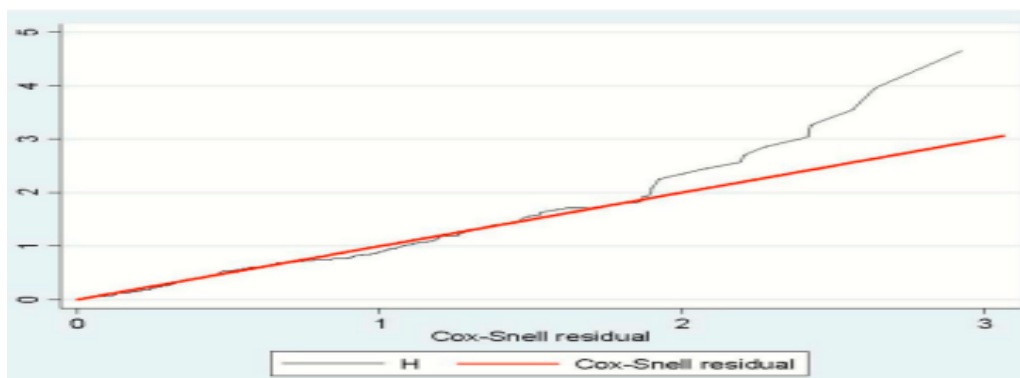


Fig 5:-Cox-Snell residual graph

Risk factors for the time to the development of SSI

The findings of the simple Cox regression analysis showed that 11 factors were linked to the incidence of SSI at a p-value of ≤ 0.05 . Following the control of confounders in multiple Cox regression analyses, the following factors were identified as independent risk factors for surgical site infection at any time t: lack of ANC follow-up, clean contaminated surgical wound, having of co-morbidity, >500ml of blood loss, delayed more than 30 minutes before skin incision of antimicrobial prophylaxis, and ASA score were statistically significant.

When all other factors were held constant, the results of the multiple regression analysis showed that pregnant women without ANC follow-up had a 6.26-fold higher risk of having SSI (AHR: 6.26, 95% CI: 0.88- 8.35) at all follow-up dates compared to those who did. Surgical patients with comorbidities are 6.34-fold more likely to develop SSI than those without comorbidities when all other factors are held constant (AHR: 6.34, 95% CI: 2.27-7.08). Underlying conditions impair wound healing and immune defenses, making patients more susceptible to infections.

The risk of developing SSI is 7.64 times higher for patients who received SAP more than 30 minutes before skin incision than for those who received SAP within 30 minutes before surgery (AHR: 7.64, 95% CI: 2.29-12.46). This finding highlights the critical importance of timing when administering SAP to reduce the risk of SSI. Ensuring that SAP is given within the recommended timeframe can significantly enhance patient outcomes and minimize complications associated with surgery.

Furthermore, patients with ASA score III have a 2.50-fold higher risk of having SSI compared to those with ASA score II (AHR: 2.50, 95% CI: 0.67-9.27). This indicates that the severity of a patient's physical status, as classified by the ASA scoring system, plays a significant role in the likelihood of developing SSI. Therefore, clinicians should consider these scores when assessing patient risks and planning for postoperative care.

Patients who have lost 500–1000 ml of blood have a 4.33-fold higher risk of developing SSI (AHR: 4.33, 95% CI: 0.32-8.37) than patients who have lost less than 500 ml of blood during the procedure. This increased risk underscores the importance of careful monitoring and

management of blood loss during surgical procedures. Proper strategies to minimize blood loss could potentially reduce the incidence of SSI in at-risk patients. Compared to patients with clean wounds, those with clean-contaminated wounds had a 0.205-fold likelihood of experiencing SSI events (AHR: 0.205, 95% CI: 0.64- 4.99).

Table 9: Bivariable and multivariable analysis to identify independent risk factors for the development of SSI among patients who underwent surgery at Tertiary Hospitals of Nekemte town, Ethiopia, 2025

Variables	Status		CHR(95%CI)	AHR(95%CI)	P value
	Event	Censored			
Sex					
Female	55	281	1	1	
Male	39	93	1.84(1.22-2.78)	3.82(0.341, 12.78)	0.975
Residence					
Urban	27	187	1	1	
Rural	67	187	2.24(1.43-3.50)	0.600 (0.133-2.71)	0.507
Marital status					
Single	19	35	1	1	
Married	69	330	0.44(0.27-0.74)	0.32(0.29-2.10)	0.24
Widowed	2	6	0.64(0.15-2.76)		
Divorced	4	3	1.86(0.63-5.47)		
ANC followup					
Yes	16	173	1	1	
No	4	11	3.55(1.18-10.62)	6.26 (0.88 -8.35)	0.012
Blood Transfusion					
No	58	332	1		
Yes	36	42	3.70(0.18- 4.30)	22.87 (2.48-21.88)	0.25
Surgical Wound Class					

Clean	0	43	1	1	
Clean	38	298	0.065(0.008-0.47)	0.205(0.64- 4.99)	0.031
Contaminated					
Contaminated	56	33	0.204(0.083-4.99)	4.73(0 .63 -5.32)	0.997
ASA Score					
II	23	342	1	1	
III	67	30	0.024(0.005-0.10)	2.50(0.67-9.27)	0.016
IV	4	2	0.36(0.08-1.48)	1.43(0.13 - 15.8)	0.77
Time to SAP					
<30minutes	72	363	1	1	
>30minutes	22	11	5.44(3.36-8.80)	7.64(2.29-12.46)	0.01
Comorbidity					
No	80	332	1	1	
Yes	14	42	1.88(1.12-3.15)	6.34(2.27-7.08)	0.023
Blood loss during operation					
<500ml	69	348	1	1	
500ml-1000ml	25	26	3.38(2.15-5.35)	4.33 (0.32-8.37)	0.046
Hgb level					
≥7mg/dl	58	353	1	1	
<7mg/dl	36	21	6.09(4.00-9.27)	0.42(0.026-0.68)	0.38

ANC- Antenatal care, ASA- American Society of Anesthesiologists: SAP- Antimicrobial prophylaxis, WBC: White Blood cell, Hgb: Haemoglobin, IESO: Integrated Emergency Surgical Officers

The survival function for occurrences of SSI was checked by Kaplan-Meier (log-rank test). A collinearity test was performed by VIF to check for collinearity between independent variables (**Table 11**). The Cox regression model assumption of proportional hazards was checked by testing covariates with time. Bivariate regression analysis was performed to identify candidate variables for multivariable regression. Variables with a p-value < 0.25 in bivariate Cox regression were considered as candidates for multivariable Coxregression.

A multivariable Cox regression was performed to identify independent predictors of the outcome variable. The adjusted hazard ratio was used as a measure of the strength of the association, and a p-value < 0.05 was considered to declare statistical significance (**Table 10**).

Table 10: Multivariable cox regression analysis of factors associated with the development of SSI among patients who underwent surgery at Tertiary Hospitals of Nekemte town, Ethiopia, from February 27 to April 22, 2025

Variables	Categories	AHR	P value	95% CI
residence	Urban(ref)			
	Rular	0.600	0.507	0.133-2.710
No staff in OR	1(ref)	1	1	1
	more than six	0.090	0.505	0.14-14.30
Labor >24hrs	No(ref)	1	1	1
	Yes	0.166	0.077	0.02-1.22
Rupture of membrane > 12 hours	No(ref)	1	1	1
	Yes	0.8743	0.941	0.21- 5.40
Surgical Wound class	Clean contaminated	0.205	0.031	0.64- 4.99
Blood loss during the procedure	>500ml	4.33	0.046	0.32-8.37
Blood transfusion	Yes	2.87	0.25	2.48- 21.88
Time to SAP	>30mins	7.64	0.01	2.29-12.46
ASA score	≥III	2.50	0.016	0.67-9.27
ANC visit	No	6.26	0.012	0.88-8.35
Comorbidity	Yes	6.34	0.023	2.27-7.08

The Cox-Snell residual and Nelson—Aalen cumulative hazard graph showed the overall model fitness of the data in the proportional hazards regression model. The hazard function closely follows the 45° line and begins to deviate as the number of censored patients increases,

suggesting that residuals have a standard censored exponential distribution with the hazard ratio (Fig. 5).

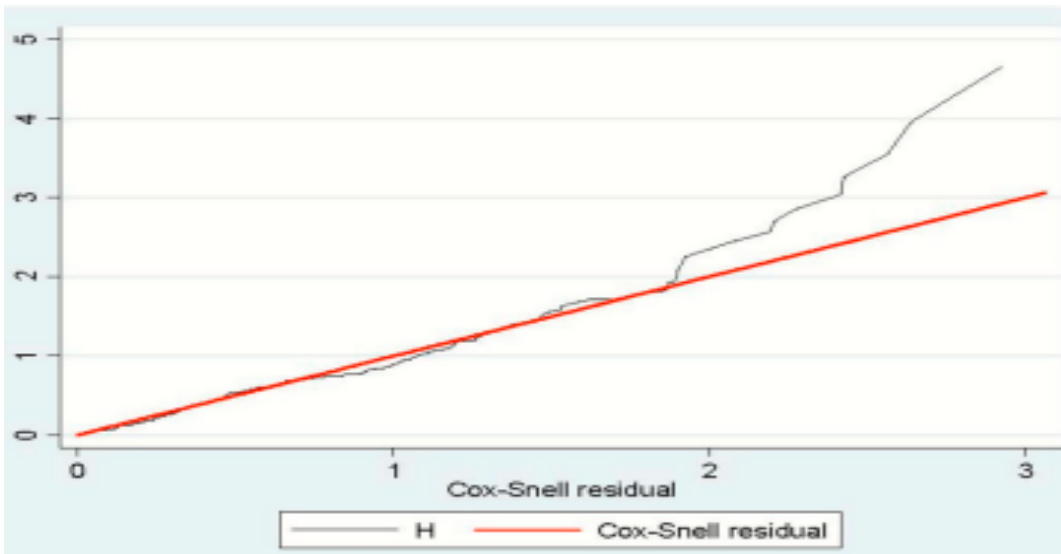


fig 5:-Cox-Snell residual graph

6. DISCUSSION

The most or second most frequent nosocomial infections are SSI, which are the leading causes of mortality and morbidity in the world. They result in higher rates of hospitalization, treatment costs, and morbidity and mortality following surgical procedures(2,14). Therefore, this study intended to assess the time to SSI development and risk factors for SSI and SAP use patterns in patients who underwent surgery at the tertiary hospitals in Nekemte Town. Of the participants in this study, 20.1% developed SSI. This result was consistent with earlier research conducted in Ethiopia at Hawassa University Referral Hospital (19.1%)(2), the Amhara region (21.1%)(19), St. Paul's Hospital Millennium Medical (23.3%),(53), Tikur Anbessa Tertiary Hospital 20.6%(28) and Atlanta Georgia 23% (15).

The results, however, were higher than those of a prior study conducted at Nekemte Comprehensive Specialized Hospital (8.9%)(27), Ayder Comprehensive Specialized Hospital in Tigray 11.7% (51), and Lemlem Karl Hospital in Ethiopia (6.8%). (30), Assella 9.4% (23), St. Paul's Hospital Millennium Medical(11.1)(63), Jimma University Tertiary Hospital (11.4%) (69), and Dessie Comprehensive Specialized Hospital(14.5%)(17), Ujjain, India 5% (44). The discrepancies may result from these studies being done on a particular surgery, a cesarean section alone. This might be due to the exclusion of Gynecology/obstetric surgery in the Indian study. The study's incidence finding was lower than earlier findings from Ethiopia (25.5%), Tanzania (25%), and Nigeria (27.56%) (46, 50, 55) respectively. The difference might be due to variations in study design, diagnostic facilities, and improved interventions over time in the current study.

The incidence was higher in this study than in several high- and middle-income countries. For example, rates were 1.6% in Germany, 2.6% in the USA, 3.4% in Brazil, and 4.5% in China (11, 37, 39, and 67). The observed disparities may stem from multiple factors, including A lack of supplies and equipment needed to maintain strict aseptic conditions, Poor patient hygiene, which increases bacterial colonization of the skin, delayed patient presentation to the healthcare system, leading to contaminated wounds, and Overburdened emergency services due to population growth.

In our study, ASA score ≥ 3 , type of wound, time to antimicrobial prophylaxis, lack of ANC follow-up, volume of blood lost during operation, and co-morbidity were all found to have statistically significant associations with SSI.

The clean contaminated wound was a significant risk factor in this study; the likelihood of developing SSI was about 20.5%. This study, in line with a retrospective multicenter study conducted in six teaching hospitals in the southwest region of the Netherlands, found that the kind of surgery and the type of wound class were independent risk factors for the prevalence of SSIs(50,56).

There was a significant correlation between SSI and higher ASA scores. The likelihood of SSI events was 2.5 times higher for patients with an ASA score of ≥ 3 . These findings were in line with the study conducted in Jimma Medical Center and a specialized care hospital, in Rwanda(31,70). A possible reason for this could be that a higher ASA score makes the patient's overall clinical status worse, lengthens the surgical procedure, and increases the risk of infection.

The hazard rate of developing SSI for surgical patients with co-morbidity was 6.34 times higher than for patients who do not have co-morbidity. This is supported by previous findings in the literature, including in Ethiopia(28), the USA, India, and Pakistan(52,71,72).

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The risk of developing SSIs also increases with the amount of blood lost during the procedure means patients who had lost 500–1000 ml of blood have a 4.33 times higher risk of developing SSI than patients who have lost less than 500 ml of blood during the procedure this align with the study conducted in Jimma University Specialized Hospital's (JUSH) obstetric department which was 11.4%(73). Increased intraoperative blood loss is associated with prolonged surgery, higher transfusion needs, and immune suppression, all of which elevate SSI risk.

SSI was significantly affected by ANC follow-up; the results of the multiple Cox regression analysis showed that women without ANC follow-up had a 6.26-fold higher risk of having SSI at all follow-up dates, in line with the study conducted at Jimma University Specialized Hospitals (65,73). To identify problems early and provide basic emergency obstetric care or to refer patients promptly to reduce pregnancy complications, ANC follow-up should be improved in rural areas and experienced birth attendants should be available at all community

health facilities. Emergency obstetric care services should also be expanded to improve access to care and reduce delays.

Another independent risk factor was the timing of antimicrobial prophylaxis. Patients who did not receive Antimicrobials within the first 30 minutes before skin incision were 7.64 times more likely to develop SSIs compared to patients who received SAP them within the first 30 minutes before surgery.

Surgical Antimicrobial Prophylaxis (SAP) Use Patterns

In this study, nearly 32.97% of patients received Surgical Antimicrobial Prophylaxis(SAP) for more than 24 hours after surgery, while 67.03% received it for approximately 24 hours. This contradicts a previous study conducted eight years ago, which found that 75.8% of prophylactic antimicrobials were administered for more than 24 hours, and 52.3% were given preoperatively(66). This difference indicates improved use of infection prevention programs, treatment guidelines, and an increased number of qualified human resources.

The duration and timing of Surgical Antimicrobial Prophylaxis(SAP) are known risk factors for SSI, which aligns with the findings of this study. Patients who did not receive SAP within the first 30 minutes before incision were more likely to develop SSI(62). This was aligned with the current study, the patient did not receive SAP within the first 30 minutes developed SSI. The serum antimicrobial concentration will therefore not reach its therapeutic level to prevent bacterial contamination of the surgical site until the skin has been closed. Ceftriaxone (56.20%) followed by the combination of ceftriaxone with metronidazole (23.72%) was the predominantly used prophylactic antibiotic. This was consistent with the study conducted in Debre Berhan Comprehensive Specialized Hospital, Northeast and Finota Hospital Western Ethiopia respectively(74,75).

6.1. LIMITATIONS AND STRENGTHS OF THE STUDY

The strengths of this study were its prospective nature the study and, an acceptable Sample size were also employed, and the post-discharge follow-up of patients which is essential for the timing of SSI occurrences and severity of the infections. Furthermore, the study's multicenter design enhanced the results' generalizability, and lastly, the data gathering process was completely accurate and reliable because it was conducted by utilizing the Epi Data 4.6 version data collection tool.

This study has some limitations. The patients lost to follow-up during the study period could likely influence the calculated rate of SSI. In addition, using telephone call follow-up and interviews for post-discharge SSI diagnosis was a limitation. Furthermore, due to finances, the study was unable to study significant relationships between variables associated with healthcare providers, the type of anesthesia employed, sterilizing equipment, and the antiseptic solutions used for patient preparation. Also, microbiological isolation was not carried out in this study.

6.2. CONCLUSION

The incidence of SSI post-surgical procedures, including cesarean sections, was comparatively high. This exceeded the acceptable international range. Within the first 3 to 7 days following surgery, the majority of SSIs occurred. Five days was the median period for SSI development in this study. Significant risk factors of SSI in this study included ASA score ≥ 3 , type of wound, time to antimicrobial prophylaxis, lack of ANC follow-up, volume of blood lost during operation, and co-morbidity were all found to have statistically significant associations with SSI.

6.3. RECOMMENDATION

Based on the pre-operative, intra-operative, and post-operative phases, the study strongly suggests that hospitals consider implementing a comprehensive, independent, and systematic post-discharge follow-up program for surgical patients. This helps determine the true rate of SSI and facilitates early recovery, treatment initiation, and prevention of potentially fatal outcomes.

The findings will also guide policymakers and hospital administrators in allocating resources effectively, such as improving infection control protocols, enhancing surgical staff training, and

implementing patient education initiatives to lower SSI rates. Addressing the lack of localized data, this study will fill a significant gap in the literature and serve as a reference for future research in Ethiopia and other resource-constrained settings.

In summary, the study has the potential to revolutionize SSI prevention and management in tertiary hospitals in Nekemte Town, contributing to better healthcare outcomes both locally and in similar national contexts.

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ANNEX I: QUESTIONNAIRE

INFORMATION SHEET AND CONSENT FORM

WOLLEGA UNIVERSITY

INSTITUTE OF HEALTH SCIENCE

SCHOOL OF PHARMACY

DEPARTMENT OF CLINICAL PHARMACY

A questionnaire/checklist paper to assess the incidence, clinical outcomes, and risk factors of SSI among patients admitted to the surgical wards of Wollega University Comprehensive Tertiary Hospital (WUCSH) and Nekemte Comprehensive Tertiary Hospital (NCSH), western Ethiopia. A prospective cohort study design. Dear participants, this study aims to assess the incidence, clinical outcomes, and risk factors of SSI among patients admitted to the surgical wards of Wollega University Comprehensive Tertiary Hospital (WUCSH), western Ethiopia. Your correct and genuine answers to the questions can help the study achieve its goals. Based on such results and commitments from the researcher, the findings will be disseminated to different stakeholders, and the problem will be solved accordingly. I kindly request that you 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 there is no risk to you, and the confidentiality of the information you provide will be kept. For that reason, you don't need to write your name. It will take approximately 10 minutes to complete the questionnaire.

Participant: I am fully informed in the language I understand about the aim of the above-mentioned research. 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.....

Supervisors name.....signature.....date

8.1 Data Collection Tool

I Socio-demographic factors

1. Card number _____ 2. Phone no: _____,

Age(in years)	Gender	Marital status	
	Male : ☐ Female: ☐	Single ☐ Married: ☐	Divorced: ☐ Widowed: ☐
Residence	Educational status	Occupational status	
Urban: ☐ Rural: ☐	Cannot read & write: ☐ Primary school : ☐ Secondary school: ☐ College/University ☐	Farmer: ☐ Household: ☐ Daily laborer: ☐ Gov't employee: ☐ NGO worker: ☐ Merchant: ☐ Student= ☐	
Religion	Ethnicity		
Protestant ☐ Orthodox ☐ Muslim ☐ Others; specify_____	Oromo ☐ Amhara ☐ Tigre ☐ Other ☐		
Alcohol consumption	Khat chewing	Cigarette smoking	
Yes : ☐ No: ☐	Yes : ☐ No: ☐	Yes : ☐ No: ☐	

II. Disease-Related Profiles

1. Primary diagnosis (pathology):

A. Appendicitis B. Gallstone disease C. BPH D. Thyroid disorder E. Trauma or injury F. Small Bowel Obstruction G. Large Bowel Obstruction H. Caesarean Section I. Hysterectomy, K. Uterine Rupture. Others specify_____

2. Who did the operation? A. Senior physician B., residence physician(R4), C. IESO

3. Number of staff professionals in the operation room: A. more than six B. less than six

4. Urgency of surgery

A. Surgical Emergency ☐ B. Surgical Elective ☐

C Gyn Emergency ☐ D. Gyn Elective ☐

E.Obstrics Emergency ☐ F. Obstrics Elective ☐

5. If your answer is ‘E’ or ‘F’ for the question above, then answer the following accordingly

6. Gestation age: A. preterm, B. Term ☐ C. post-term ☐

7. Duration of labor ≥ 24 h? Yes: ☐ No: ☐

8. Duration of rupture of membrane ≥ 12 hrs? Yes: ☐ No: ☐

9. Does the patient's Antenatal care (ANC) follow up? Yes: ☐

10. Date of admission (pre-operation) __/__/__

11. Date of procedure (surgery) __/__/__

12. A. Start time. __ (min) B. End time __ (min)

13. ASA score: Category I: ☐ II: ☐ III: ☐ IV: ☐

14. Pre-procedure length of Hospital stays (days) _____

15. Post-procedure length of Hospital stays (days) _____

16. Wound class

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

17. Do you have any other diseases (morbidity)? Yes: ☐ No: ☐

18. If yes to any” Comorbidities “ (specify) _____

19. Amount of blood loss; A.<500ml : ☐ B. 500ml -1000ml : ☐ C.>1000ml: ☐

20. Did the patient receive blood transfusions? A. yes _____. B. No _____.

III. Medication-related factors

1. Were preoperative prophylactic antimicrobial agents given? Yes: ☐ No: ☐

2. If yes, time of administration before surgery A. < 30mins B. >30mins

3. If yes, to the Preoperative prophylactic antimicrobial agents above, did the patient get a second dose during the procedure? Yes: ☐ No: ☐

4. If yes, to the Preoperative prophylactic antimicrobial agents above, did the patient receive additional doses of the same antibiotic post-operation? Yes: ☐ No: ☐

5. If the same antibiotic, how many times were the doses administered continuously post-operation? A. less than 1 day, B. more than 1 day
6. If a new antibiotic or initiation of the discontinued former antibiotic, for what reason was it prescribed? _____
7. Which prophylactic drugs were prescribed A. ceftriaxone only
B. ceftriaxone +Ampicillin C . Ceftriaxone +Metronidazole D.Other medication

IV.Laboratory results

1. Pre-operation level of hemoglobin, 1. <7gm/dl 2. >7gm/dl
2. Pre-operation level of WBC, 1. 4500-12000cells/ μ m 2. >12000cells/ μ m

V. Procedure Related Factors

1. Was a postoperative SSI identified within 30 days of the procedure? Yes: ☐ No: ☐
2. Types of SSI identified: A. Superficial SSI, ☐ Deep incisional SSI, ☐ Organ/Space SSI ☐
3. If yes, in what setting was the post-operative SSI identified?
A. Initial stays: ☐ B. Re-admission: ☐ C. Post-discharge (outpatient): ☐
4. If yes, to the question above, in what follow-up method was SSI detected?
A. Clinic review ☐ B. Physician diagnosis: C. Discharge appointment: ☐ ☐
5. Date of SSI diagnosis ; _____ dd/mm/yy
6. Did the patient return to the OR to treat a SSI after the initial procedure?
Yes: ☐ NO: ☐
7. If yes, date of the procedure ____/____/____
8. Has the patient been readmitted after being discharged from the hospital? Yes: ☐
No: ☐
9. If yes, when was the readmission? Date ____/____/____
10. Expected Outcome status: A. died, B. Censored, C.SSI developed
11. If the patient had died, when would the death have occurred? Date ____/____/____

THANK YOU FOR PARTICIPATING

ANNEX II: CONSENT

Greetings: Good morning/afternoon. My name is_____ I am working on behalf of research conducted by Kuleni Ejeta, who is a student at Wollega University. I would like to ask a few questions that take around 10 minutes. Your responses that you are going to give are very.

important to assess the time to develop, incidence, and risk factors of the surgical site Infections and Surgical Antimicrobial Prophylaxis use patterns. You are selected to be the participant in this study if you consent after you have understood the following.

Information sheet.

Title of the study: Incidence, Risk Factors, and Time to Development of SSIs

The objective of the study: To assess the time to develop, incidence, and risk factors of SSIs in surgical patients.

Procedure of the study: You will be undergoing an 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 interviews

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 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 questions, please feel free to ask me. In case you have any later on, you can contact the principal investigator, Mss KuleniEjeta, on the telephone number**0917674264**

Right of participants: You have the full right to participate or not to participate in the study. You can ask any questions that are unclear to you, jump out of any questions that you don't want to answer, and end the interview.

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

Participantssignature.....

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

Afaan Oromoo version of informed consent:

Odeeffannoohirmaattotaafkennamu

Akkam bultan/ooltan? Maqaan Koo_____jedhama

Yuunivarsiitii Wallaggaa irraa kanan dhufe yoo ta’u; qorannoo mata dureen isaa hubaatii fi sababoota jaarimiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabatan qorachuu jedhurratti **B/stuuKuulanii Ejjetaa** bakkabu’eenhojjachaa jira.

Gaafilee muraasa kandaqiiqaa kudhan caalaa hinfudhanne isin gaaafadha.

Deebiin isin naaf laattan waa’ee hubaatii fi sababoota jaarimiilee iddoo yaala baqaqsanii hodhuu wajjiin walqabatan adda baafachuuf baayyee barbaachisaadha.

Kanaaf kaayyoo fi barbaachisummaa qorannoo

kana erga hubattanii booda waliigaluu keenya mallattoo keessanin mirkaneessuun garagaafilee ttidarbina.

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

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

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

Miidhaa qorannoo: Qorannoo kana keessatti hirmaachuun keessan miidhaanis irraga hutokkollee hinjiru.

Mirga Himaattotaa: Qorannoo kanarratti hirmaachuuf ista’e, dhiisuuf mirgaguutu qabdu.

Gaafii faisiniif hintaaneyoo jiraate gaafachuuf mirga qabdu, gaafii deebisuun barbaanne deebisuudhiisu akka sumas gaafilee jidduudhaan addaankutuuf mirgaguutu qabdu.

Iccii tiie guu: yeroogaafii fi deebii akka sumas odeeffannoosin irraa gannes icciti innieegna.

Gaafilee irratti maqaakeessan ibsuun hin barbaachisu. bu’aan qoranichaas akka waliigalitti maleedhuun faan hin ibsamu.

Bakka bu’iinsa:

hirmaannaakeessanii faayye galatooma, yeroon uffaattanii fi wanti isiniif laadhu hinjiru

Yoogaaffii qabaattansoda tokkomalee abbaa qorannichaalak. **0917674264**

bilbilaangaafachuun dandeessu.

Mallattoohirmaataa:

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

GALATOOMAA!

Annex III:

. ltable time, survival failure

Interval		Beg. Total	Deaths	Lost	Survival	Std. Error	[95% Conf. Int.]	
3	4	468	2	0	0.9957	0.0030	0.9830	0.9989
4	5	466	25	0	0.9423	0.0108	0.9170	0.9601
5	6	441	33	0	0.8718	0.0155	0.8380	0.8990
6	7	408	11	0	0.8483	0.0166	0.8125	0.8778
7	8	397	12	0	0.8226	0.0177	0.7849	0.8544
8	9	385	1	0	0.8205	0.0177	0.7826	0.8524
9	10	384	4	0	0.8120	0.0181	0.7735	0.8445
10	11	380	1	0	0.8098	0.0181	0.7713	0.8426
11	12	379	3	0	0.8034	0.0184	0.7644	0.8366
12	13	376	1	0	0.8013	0.0184	0.7622	0.8347
14	15	375	1	0	0.7991	0.0185	0.7599	0.8327
16	17	374	2	0	0.7949	0.0187	0.7554	0.8287
19	20	372	2	0	0.7906	0.0188	0.7509	0.8248
20	21	370	3	0	0.7842	0.0190	0.7441	0.8188
21	22	367	1	0	0.7821	0.0191	0.7418	0.8168
22	23	366	2	0	0.7778	0.0192	0.7373	0.8128
25	26	364	1	0	0.7756	0.0193	0.7351	0.8108
27	28	363	3	0	0.7692	0.0195	0.7283	0.8048
29	30	360	5	0	0.7585	0.0198	0.7171	0.7948
30	31	355	355	0	0.0000	.	.	.

Table 11: To check the multicollinearity of the data, VIF

Variables	VIF	1/VIF
Blood transfusion	2.21	0.453
No_of_staff	1.96	0.510
Blood loss during a procedure	1.53	0.653
Rupture of membrane >12hrs	1.46	0.683
ASA	1.42	0.754
Comorbid	1.32	0.758
time_to_SAP	1.33	0.703
Labor >12hrs	1.30	0.768
Residence	1.22	0.816
ANC	1.17	0.853
wound (contaminated)	1.07	0.935
Mean VIF	1.57	