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DEPARTMENT OF OBSTETRICS AND GYNECOLOGY

POST GRADUATE PROGRAM

INCIDENCE OF SURGICAL SITE INFECTIONS AND CONTRIBUTING FACTORS IN CESAREAN DELIVERIES AT WKUCSTH, WOLKITE, CENTRAL ETHIOPIA, 2025 G.C.

BY: MERKEBU ABERA (MD, YEAR IV OBSTETRICS AND GYNECOLOGY RESIDENT)

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Certification Sheet

We hereby certify that we have read and evaluated this Thesis titled "incidence of surgical site infections and contributing factors in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C. An institutional based prospective Study" prepared under our guidance prepared by Dr. Merkebu Abera. We recommend that the Thesis shall be submitted as fulfilling the requirements for the award of Certificate of Specialty in Obstetrics and gynecology.

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As members of the Board of Examiners of the Certificate of Specialty in Obstetrics and gynecology. Thesis open defense examination, we have read and evaluated this thesis prepared by Dr. Merkebu Abera, and examined the candidate. We hereby certify that; the thesis is accepted for fulfilling the requirements for the award of the Certificate of Specialty in Internal Medicine.

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DECLARATION

By my signature below, I declare and affirm that this specialty thesis entitled "The **incidence of surgical site infections and contributing factors in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C.**" is my original work in partial fulfillment for the requirement in **certificate of specialty in Obstetrics and gynecology program** and not submitted for any other educational program fulfillments or publications. All sources used here for review of the proposal and the thesis are duly acknowledged.

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List of abbreviation

AOR: Adjusted odds ratio

ARR: adjusted Relative Risk

CI: Confidence interval

CS: Cesarean section

COR: Crude odds ratio

DM: Diabetic Mellitus

HIV: Human immunodeficiency virus

OR: Odd ratio

PVE: per-vaginal examination

SSI: Surgical site infection

VD: Vaginal delivery

WHO: World health organization

WKU: Wolkite University

WKUCSTH: Wolkite University comprehensive specialized teaching hospital

Abstract

Background: Surgical site infection (SSI) is a significant post-cesarean complication affecting 3% to 15% of cases globally, resulting in substantial physical and financial burdens. Despite advancements, SSI rates remain high in low- and middle-income countries, with studies showing a pooled incidence of 12.32% in Ethiopia. This study aims to assess the incidence of and factors contributing with SSI among cesarean deliveries at Wolkite University Comprehensive Specialized Teaching Hospital (WKUCSTH).

Objective: To assess the incidence of surgical site infections and contributing factors in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C.

Method: A facility based single armed prospective study design was carried out on patients who have undergone cesarean section delivery in WUCSTH from October 1 to December 13/2025.and each Patient was followed for 30 days. Data was collected using a standardized checklist. The Statistical Package for Social Sciences (SPSS) version 23 was used for data analysis. Binary and multi-logistic regression model with a significance threshold of P-value < 0.25 and< 0.05 respectively has been used to identify the factors contributing with the outcome variable.

Results: The incidence of surgical site infection was 16.7% ((95%CI: 13.2, 19.7)). A prolonged labor exceeding 24 hours (ARR = 2.7; 95% CI: 2.43,8.91), obstructed labor (ARR = 19.2; 95% CI: 2.01,10.23), having five or more per vaginal examinations prior to cesarean delivery (AR = 5.2; 95% CI: 1.39, 9.12), and prolonged premature rupture of membranes before cesarean delivery (ARR = 2.32; 95% CI: 1.62,7.32) and number of less than 3 dose postoperative antibiotics (ARR=6.20; 95%CL:2,40,13.33) were statistically significantly contributing with surgical site infection.

Conclusion: The incidence of surgical site infection was high. Prolonged labor, obstructed labor, frequent per vaginal examinations, number of postoperative antibiotics doses and prolonged premature rupture of membranes were predictors of SSI. Strengthening intrapartum care and minimizing modifiable risk factors may reduce postoperative infections.

Key words: surgical site infection, contributing factors, cesarean section.

CHAPTER 1: INTRODUCTION

1.1. Background

Cesarean section (CS) is a surgical operation used to help deliver the baby using an incision created in the mother's abdomen and uterus. It should ideally be used when a typical vaginal delivery (VD) could endanger the woman, the unborn child, or both. Global CS rates have risen dramatically, from about 7% in 1990 to 21% today, above the WHO's recommended acceptable CS rate of 10% to 15 % (1).

The current decade is predicted to see these patterns continuing to rise, with misuse and unmet demands coexisting at a projected global rate of 29% by 2030.

Thus, if the surgeries are performed without a medical indication and, in certain situations, there are concurrent unmet demands, the women and children are exposed to needless short- and long-term complications (1). One of the short-term issues linked to cesarean sections is surgical site infection (SSI) (3).

A surgical site infection (SSI) is an infection that develops within 30 days following surgery and affects the skin, subcutaneous tissue, and deep soft tissue surrounding the incision or organ/space (4). Following the discovery of CS, a wide variety of SSI rates were reported worldwide; depending on the techniques employed to detect infections, these rates have been reported to range from 3 to 15% (5).

In total, 180 eligible studies (207 datasets) involving 2,188,242 participants from 58 countries were included in this review. The pooled global incidence of post-CS SSIs was 5.63% [95% confidence interval (CI) 5.18-6.11%]. The highest and lowest incidence rates for post-CS SSIs were estimated for the African (11.91%, 95% CI 9.67-14.34%) and North American (3.87%, 95% CI 3.02-4.83%) regions, respectively. The incidence was significantly higher in countries with lower income and human development index levels. The pooled incidence estimates have increased steadily over time, with the highest incidence rate during the coronavirus disease 2019 pandemic (2019-2023). Staphylococcus aureus and Escherichia coli were the most prevalent pathogens. Several risk factors were identified (19).

Facility-based studies conducted in Ethiopia indicated that the incidence of SSI is approximately 11% of the women who had CS delivery (7, 8). Even with advancements in surgical technique, operating room ventilation, sterilization techniques, and the availability of antimicrobial

prophylaxis, SSI after cesarean delivery continues to be a major contributor to maternal illness, prolonged hospital stays, higher medical expenses, and maternal mortality (3, 9–11).

There are few scientific publications have documented that the incidence of SSI and contributing factor following CS delivery is influenced by several factors, including wound class, maternal age, hypertensive disorders, types of CS procedures, number of vaginal examinations, high volume of blood loss during surgery, diabetes, maternal weight, surgical techniques, and premature membrane rupture (3, 8–12).

The majority of studies provide valuable information about the prevalence of SSI. However, because they were conducted in different countries and sociodemographic even in our country with settings that varied widely in operating rooms, the availability of trained personnel, study designs with limitations, variables, and the evidence from these studies cannot be applied generally.

Despite the increasing number of CS procedures performed at Wolkite University comprehensive Teaching and Referral Hospital, no study has been conducted on the incidence of SSI and contributing factors after CS delivery. Consequently, identifying the variables that predict SSI helps to create the best possible environment and maximally reduce SSI and its consequences. For post-CS SSI in this clinical setting and other situations with similar difficulties, the results of this study will also provide an evidence-based prevention strategy as well.

1.2. Statement of the problem

Surgical site infection (SSI) remains one of the most serious postoperative complications affecting women after cesarean section, contributing to maternal morbidity, extended hospitalization, and increased healthcare costs. Globally, SSIs complicate approximately 2–5% of clean surgeries in high-income settings; however, rates are consistently higher in low- and middle-income countries. In Ethiopia, maternity surgeries such as CS, which inherently involve the uterine cavity and are classified as clean-contaminated, carry a heightened risk of infection.

In Ethiopia, the estimated pooled incidence of SSI following cesarean section has been reported as approximately 9.72% according to a meta-analysis (Temesgen Getaneh). More recently, a systematic review indicated a pooled incidence of around 12.32% among women who delivered via CS in Ethiopia (Temesgen Gebeyehu Wondmeneh). These statistics suggest that more than

one in every ten women undergoing CS in Ethiopia may develop an SSI. This issue is particularly concerning at tertiary referral facilities such as Wolkite University comprehensive Specialized teaching Hospital, where the volume and complexity of obstetric surgeries may be high, and where localized data are not yet comprehensively described.

Several obstetric, patient, and health-service-related factors have been consistently contributing with an increased risk of SSI following cesarean delivery in Ethiopia. These include prolonged ruptured membranes (especially > 12 hours), prolonged labor(>24hours), presence of chorioamnionitis, vertical or midline incisions, postoperative anemia (Hb < 11 g/dL), emergency procedures, general anesthesia, rural residence, and other underlying obstetric complications. These consistent associations suggest that SSI following CS is modifiable and closely linked to both maternal and surgical care factors.

Despite the acknowledgment of this burden and the identification of contributory risk factors, there remains a deficiency of up-to-date, facility-specific evidence at many regional hospitals in Ethiopia. Specifically, the magnitude and determinants of SSI after cesarean delivery at Wolkite University comprehensive Specialized teaching Hospital in Central Ethiopia remain undetermined. Without current data, the hospital is unable to tailor targeted infection prevention and control (IPC) strategies or allocate resources effectively to address this complication. Furthermore, local variations in patient demographics, surgical practices, postoperative care protocols, and adherence to antibiotic prophylaxis may obscure important facility-level differences that national averages do not capture.

Consequently, conducting a focused study at Wolkite University comprehensive Specialized teaching Hospital to determine the incidence of SSI among cesarean deliveries in 2025 G.C. and to identify the contributing factors is imperative. Such evidence will inform targeted interventions aimed at optimizing peri-operative care (e.g., antibiotic timing and selection, type of skin incision, postoperative hemoglobin optimization), strengthening post-discharge follow-up surveillance (noting that many SSIs develop after discharge), and adjusting obstetric management protocols within the local context. Ultimately, this will contribute to reducing maternal morbidity, improving surgical outcomes, and supporting the hospital's quality improvement initiatives.

1.3. Significance of the study

This study on the incidence of surgical site infections and contributing factors in cesarean deliveries at WKUCSTH, is of significant importance, as it addresses a major cause of maternal morbidity, prolonged hospitalization, and increased healthcare costs. Understanding the magnitude and determinants of SSIs in this context is essential for improving surgical outcomes, ensuring safer deliveries, and enhancing the quality of maternal health services.

The findings of this study will provide valuable information for health professionals, administrators, program managers, policymakers, and future researchers regarding post-cesarean section SSIs and their contributing factors. It will also inform the planning and implementation of effective strategies to enhance professional knowledge and practices related to infection prevention and the management of SSI risk factors. Through such informed actions, patients, their families, and the broader community will benefit from improved maternal health outcomes and reduced infection-related complications.

Furthermore, this study will contribute important evidence to guide hospital management and national health authorities in developing targeted interventions, such as strengthening perioperative infection control protocols, promoting rational antibiotic use, and improving postoperative follow-up care. In the long term, the results will support efforts to reduce the burden of post-cesarean infections, thereby advancing Ethiopia's commitment to achieving national and global goals for maternal health and the reduction of preventable morbidity and mortality.

CHAPTER 2: LITERATURE REVIEW

2.1: Incidence of Surgical Site Infection among CS Deliveries

The global SSI rates were reported worldwide; depending on the techniques employed to detect infections, these rates have been reported to range from 3 to 15% (5). A systemic review and meta-analysis done in 2023 indicates the pooled global incidence of post-CS SSIs is 5.63%. The highest and lowest incidence rates for post-CS SSIs were estimated for the African 11.91% and North American 3.87% regions, respectively (6).

A retrospective case-control study done at a tertiary hospital in Kenya shows the rate of surgical site infection after cesarean section among 1262 study participants is 2.1%(2).

A prospective cohort study done in Tanzania involving 345 pregnant women who underwent a CS between October 2011 and February 2012 at Buganda Medical Centre shows the overall cumulative incidence of SSI was 10.9% with an incidence rate of 37.5 per 10,000 people/day (95% CI, 26.8-52.4)(3).

Another retrospective cohort study done in Saudi Arabia on 1584 cesarean sections conducted over five years from 2018 to 2022 G.C revealed an overall SSI rate of 4.7%(4).

A systematic review and meta-analysis done in 2023 encompassing 19 studies across Ethiopia reported a pooled estimate of SSI in Ethiopia was 11.13% (95%CI, 9.29–12.97% among women undergoing cesarean sections(5).

A prospective cohort study was conducted among 520 pregnant women who had a caesarean section between March 28, 2019 and August 31, 2019 at Debre Markos Referral Hospital (DMRH).The study shows the overall cumulative incidence of surgical site infection was 25.4% with an incidence of 11.7 (95% CI:9.8,13.9) per 1000 person/days(7).

2.2 : Risk Factor contributing with Surgical Site Infection Among CS Deliveries

2.2.1: Patient Related Risk Factors

Maternal age, Obesity, earlier cesarean delivery, prolonged labor, pre-existing Diabetes Mellitus (DM), Human Immuno-Deficiency Virus (HIV), anemia, and recurrent pregnancy loss can be listed as some of client related risk factors(4,6,8,9).

An institution based cross sectional study conducted from May to December 2017 in northwest Ethiopia indicates the proportion of surgical site infection among cesarean deliveries was about 8% (95%Cl: 5.4, 11.6). Pregnancy induced hypertension (AOR = 4.75, 95%CI: 1.62, 13.92), chorioamnionitis (AOR = 4.37, 95%CI: 1.53, 12.50), midline skin incision (AOR = 5.19, 95% CI: 1.87, 14.37 and post-operative hemoglobin less than 11 g/deciliter (AOR = 5.28, 95%CI:1.97, 14.18) were significantly contributing with surgical site infection(6).

Some studies suggest maternal age itself is not a direct risk factor when controlling for comorbidities. Conversely a 2023 Scandinavian registry study reported a persistent 1.5x higher surgical site infection risk in women greater than 40 years, independent of other variables. Similarly a hospital based prospective study done in Ethiopia indicates every one year increment in age leads to 1.5 times greater risk ((AOR 1.504, 95% CI: (1.170–1.933))) to develop SSI(8). Systemic review and meta-analysis done in Ethiopia in 2024 reported that cesarean-delivered women who had post-operative Hgb levels less than 11 mg/dl during cesarean-section had a nearly 3 times higher risk of developing surgical site infection than women who had post-operative Hgb levels higher than 11 mg/dl (AOR = 3.25, 95% CI: 1.54–4.96), with the absence of heterogeneity(10).

Different studies showed different associations between pre- existing maternal medical condition, such as DM, HIV, previous CS, and HTN. A prospective Cohort study done in 2020 in Debre-Markos referral hospital indicates the incidence of SSI following CS among HIV positive women is 39% higher compared to HIV negative women(AHR=1.39,95% CI: 1.21, 2.57)(7). Women with diabetic mellitus (OR=10.76(95%CI=1.14–101.70), p=0.038;) were found to be prone to SSI following CD in a study done in Saud Arabia in 2024(4).

A case control study done in 2022 in Tribhuvan University Teaching Hospital shows women who were overweight with adjusted OR 4.11(1.74-9.71) and p value of 0.001 and were in obese

nutritional status with adjusted OR 15.72(95%CI4.60-53.67) and p value of <0.001 had higher chances of developing SSI than normal and underweight ones(11).

2.3 : Pregnancy/Intrapartum Related Factors

Pregnancy and labor related conditions may increase the incidence of SSI following cesarean section. During pregnancy and delivery, some of the circumstances that can increase SSI include premature rupture of membrane, repeated number of vaginal examination during pregnancy, length of labor before CD and chorioamnionitis(3,6,8,11–13).

Most of research indicates that premature rupture of membranes constituted a high-risk factor for SSI after CD. Its risks found to be (OR=2.7; 95% CI=1.3-5.8; p=0.011), (AOR=3.75, 95%CI: (1.85–16.6, P=0.03), (OR 8.38(1.48-47.35) at p value 0.016), (AOR = 1.91, 95% CI: 1.18, 3.09) in studies performed in Tanzania, Easter Ethiopia, Nepal and Harar respectively(3,9,11,14).

Pregnancy complicated by chorioamnionitis were also contributing with increased rate of SSI after CD with (AOR=4.37, 95%CI: 1.53, 12.50), and (AOR = 4.13, 95% CI: 1.45–6.8) in a study done in Debre-Tabor general hospital and a systematic review and meta-analysis done in 2024 which includes 23 articles in Ethiopia respectively(6,10). A retrospective case control study conducted in Peruvian hospital indicates 5 and more vaginal examination (OR: 2.71, 95% CI: 1.07-6.82) had an increased risk of causing SSI(12). The study in Tanzania also shows 3 or more vaginal examination (HR = 2.6; 95% CI, 1.3-5.3; p=0.008) increases the risk of SSI(3).

A prospective cohort study done in eastern Ethiopia shows mothers who were in labor for more than 24h before CS were 4.04 times more likely to develop SSIs than those who were in labor for less than 24h (AOR=4.04; 95%CI: 1.52–10.79, P=0.004)(14) . Similarly prolonged duration of labor was found to increase the chance of developing SSI following CD in Study done in Tanzania (HR=3.0; 95% CI=1.5-6.0; p=0.002), and Mekelle [(AOR = 6.064, 95%CI: (1.676–21.949, p = 0.006)](3,13).

2.4 Procedure Related Risk Factors

Preoperative preparation and conditions surrounding the surgery also affects the incidence of SSI after CD. These includes hair removal, anti-septic skin preparation, experience of surgeon, duration of surgery, timing of the surgery and types of surgery affect the incidence of SSI(5,6,9,14,15).

Regarding the duration of surgery there is a controversial finding on the incidence of SSI after CD. Study done in Tanzania, Saud Arabia and Addis Ababa found rates of SSI were significantly

higher among patients whose surgical duration is greater than one hour (HR = 2.4; 95% CI = 1.1-5.0; p = 0.020), (OR = 3.54 (95% CI = 1.49–7.17), p = 0.002) and ((AOR - 1.108, 95% CI: (1.025–1.197)) respectively(3,4,8). Conversely study done in Nepal and Jimma indicates there is no association between incidence of SSI and surgery duration(11,15).

A study in Debra-Tabor and Easter Ethiopia shows Mothers who had midline abdominal incisions were more likely to develop SSIs as compared with Pfannenstiel abdominal incision with odds ratio of (AOR = 5.19, 95% CI: 1.87, 14.37) and(AOR = 3.76,95% CI: 1.47–9.58, P= 0.001) respectively)(6,14).

A systematic review and meta-analysis done in 2024 which includes 23 articles in Ethiopia and a hospital-based analytic cross-sectional study in Harar were observed in women who received a general anesthesia (AOR = 1.99, 95% CI: 1.22–2.75) and (AOR = 2.02, 95% CI: 1.34, 3.02) were independent risk factors for surgical site infections respectively(5,9). Study in Harar shows there is strong association with incidence of SSI following CD among women who had blood transfusion (AOR = 4.10, 95% CI: 2.61, 6.44) and had hospital stay over seven days (AOR = 2.42, 95% CI: 1.61, 3.64)(9). Study in Mekelle indicates those women who had blood loss less than1000 ml were almost 90% [(AOR = 0.097, 95% CI:(0.017–0.569, p = 0.01)] less likely to have post C/S infection than those women who had blood loss greater than 1000 ml(13).

2.5 Conceptual frame work

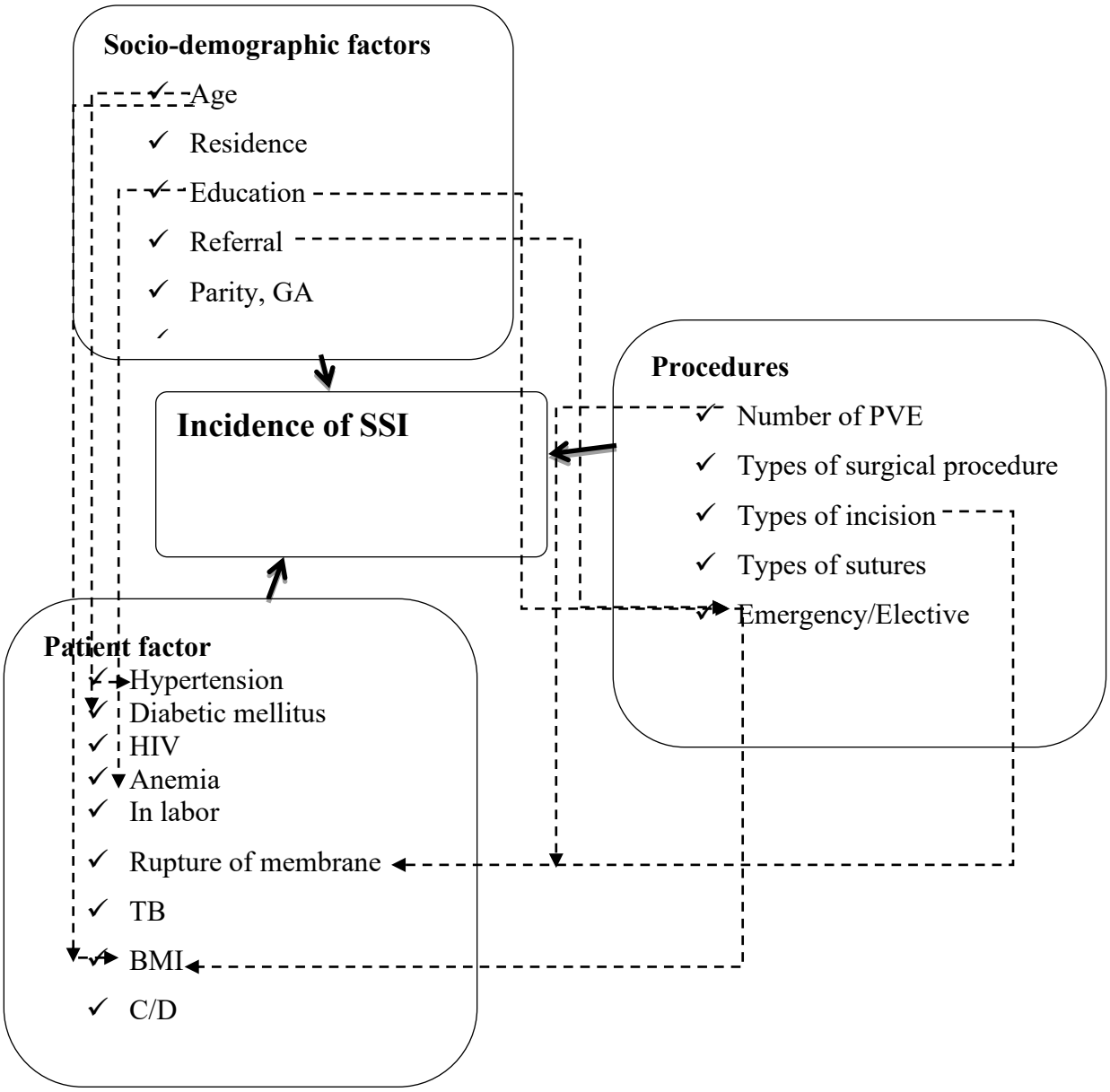

Figure 1. conceptual framework showing how variables are interrelated(6–9,12,15,16).

CHAPTER 3: OBJECTIVE

3.1 : General Objective

To assess incidence of surgical site infections and contributing factors in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C.

3.1.1: Specific Objective

To determine incidence of surgical site infections in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C.

To identify the contributing factors in cesarean deliveries at WKUCSTH, wolkite, central Ethiopia, 2025 G.C.

CHAPTER 4: METHODs

4.1: Study Area and Period

The study was conducted at the Wolkite University comprehensive specialized referral and teaching hospital; which is the first and the only referral and teaching hospital in Gurage zone, Central Ethiopia region. The Hospital is located at Gubreye sub-city, of the Gubreye-Butajira road 14km away from Wolkite town, which is 158km southwest away from capital city, Addis Ababa, at an altitude between 1910 meter and 1935 meter above sea level and it has sunny weather. It is expected to provide health service for more than four million people living in the region, neighboring districts of the Oromia region. It was inaugurated on July 29/2011 E.C.(data from hospital quality team).The hospital has around 226 health care professionals and 307 admin staff, 350 beds, 1 beds of maternal intensive care unit, pharmacies and clinical lab facilities .Under the Department of Gynecology man power we have 52(of this 2 subspecialist,5specialist,20 residents[year4=4,yera3=6,year2=5,year1=4],Gp=2,midwife23{3diploma,16 degree,4 masters}) and obstetrics,gyneacology emergency,gyneacology outpatient unit,gyneacology referral clinics, MCH, ANC follow up unit,labor ward and post-natal care unit, high risk and maternity unity,gyneacology ward unit,operation room and ICU(Source: WKUCSTH HMIS).

4.2: Study Setting, Design and Period

A facility-based single armed prospective study was employed in WUCSTH from October 1 to December 13/2025, Wolkite in Central Ethiopia.

4.3: Study population and their eligibility criteria.

4.3.1: Source Population

All postpartum mothers who undergone cesarean section at WUCSTH during study period.

4.3.2: Study Population

All women who fulfill inclusion criteria undergo Cesarean section at WUCSTH for whom Consecutive sampling done during study period.

4.4: Eligibility Criteria

4.4.1: Inclusion Criteria

1. All women who undergo CD delivery at WKUCSTH during the study period.

2.Provide consent to participate and the prospective follow-up.

3.Are available and willing to be followed for 30 days post-cesarean delivery (in-person or phone follow-up).

4.4.2. Exclusion criteria

1.They undergo cesarean delivery but are discharged or transferred immediately to another facility before postoperative assessment begins.

2.They have pre-existing wound infection or systemic infection prior to cesarean delivery.

3.They have incomplete baseline information required for the cohort (e.g., missing operative details).

4.They are lost to follow-up before 48 hours post-surgery (minimum time for early SSI detection).

5.severly ill or dead

4.5. Sample Size Determination

The sample size is determined by using the formula for estimating single population and double population proportion to take the largest sample among the result. First, using the formula for single population proportion, the sample size is calculated as follows considering the assumptions: Study conducted in Debre Markos Referral Hospital with incidence rate of 11.7% was used to calculate sample size. Level of significance 5% (α = 0.05), Z α/ 2 = 1.96 and margin of error 5% (d = 0.05). The sample size was calculated as follows:

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

Where;

Z = (Standard value for 95% confidence interval) = 1.96

CI = (Confidence interval) = 95%, D = (Marginal error) = 0.05

P = (Single population proportion) = 11.7%, n = 159(Consecutive sampling was employed).

4.5.1. Sample Size for The Second Objective

Second, the sample size for the second objective was determined using double population proportion formula with the assumptions of two-sided significance level of 95%, margin of error of 5% and power of 80% and the ratio of exposed to unexposed 1:1 using Epi Info Version 7 software.

Table 1. sample size calculation for factors contributing with SSI in WKUCSTH, central Ethiopia

Factors considered	Assumptions	**Sample size**	**reference**
Rupture of membrane	Adjusted Odds Ratio = 1.53 % of exposed with outcome = 37 Power = 80% Confidence level =95%	**40**	**(6)**
Frequency of vaginal examination	Adjusted Odds Ratio = 4.77 % of exposed with outcome = 54 Power = 80% Confidence level =95%	**28**	**(14)**
Type of skin incision	Adjusted Odds Ratio = 0.046 % of exposed with outcome =22 Power = 80% Confidence level =95%	**64**	**(8,9)**
Diabetes Mellitus	Adjusted Odds Ratio = 1.83 % of exposed with outcome = 83 Power = 80% Confidence level =95%	**12**	**(4)**

The largest sample size is determined by using the formula found to be(n=159) for this study.

4.5.2. Sampling Technique and Procedure

4.5.3: Sampling Technique

Non-randomized Consecutive sampling was employed to recruit postpartum mothers who underwent cesarean section at WKUCSTH and met the inclusion criteria during study period.

4.6. Data Collection Procedure

Informed consent was obtained from all participants after a comprehensive explanation of the study's nature, purpose, methods, potential benefits, and risks. Privacy and confidentiality were maintained by assigning a unique code to each participant. Voluntary participation was ensured, and participants were informed of their right to withdraw at any time without impact on their access to care. Consecutive sampling was employed to recruit postpartum mothers who underwent cesarean section at WKUCSTH and met the inclusion criteria during study period.

Data were gathered through a review of medical records to identify SSI risk factors, comorbidities, and intraoperative information. Additionally, the operating surgeons were interviewed regarding hand preparation techniques. Post-discharge, mothers were counseled on recognizing SSI symptoms, report and were interviewed via telephone on a weekly basis for 30 days to monitor for SSI, with scheduled follow-ups on the 3rd day post-discharge, and subsequently during weeks 1–4. To ensure successful follow-up, at least two contact numbers were documented. Patients not reachable by telephone for 6 days despite attempts via alternative phone numbers, local health facilities, or extension workers were classified as "missed follow-up." If an SSI was suspected, the patient was evaluated, and management was provided by the surgeon and service unit team.

4.7. Data Collection Tool

A structured data extraction form was developed from a previous similar study to fit the study setting. After expert review and translation into Amharic, the tool was used to collect data on maternal sociodemographic, obstetric conditions, and operative details. Specifically, the tool recorded age, parity, BMI, coexisting morbidities, peripartum conditions (PROM, vaginal exams), and surgical factors, including operative duration, anesthesia type, and prophylactic antibiotic administration.

4.8. Data Quality Control

A team consisting of two degree-level midwives and two year-two residents, overseen by a master-level midwife supervisor, was trained for one day on the research objectives, data collection procedures, and the specific tools used. The data collection tool was adapted from a comparable study, modified to fit the local context, and translated into Amharic by experts. To ensure validity, the tool was pretested on 5% of a similar population at Gunchure Hospital, and necessary adjustments were made. Throughout the study, investigators and the supervisor monitored data collection, performing daily checks for completeness, accuracy, and consistency. Data were entered in duplicate, validated, and rigorously cross-checked prior to analysis.

4.9. Data Processing and Analysis

Data were coded, entered, and cleaned using Epi-Data version 4.2 and subsequently exported to SPSS version 23 for analysis. Descriptive statistics were computed to determine the proportion

of Cesarean Section Surgical Site Infections (CD SSI). To identify statistical associations, variables with a p-value <0.25

in the bivariate analysis were entered into a multivariable logistic regression model. The strength of the association was assessed using odds ratios (OR) with a 95% confidence interval (CI), and a p-value <0.05 was considered statistically significant. Hosmer and Lem show's test used to determine the model fitness (x2:15.2, p-value-0.71).

4.10. Study Variables

4.10.1. Dependent Variable

Incidence of surgical site infection

4.10.2. Independent Variable

The independent variables were socio-demographic variables like maternal age, marital status, residence, maternal educational status, occupational status, religion, and antenatal care.

Relevant maternal medical history like diabetes mellitus, renal disease, anemia, HIV, bronchial asthma, previous history of CS, and hypertensive disorder were captured.

Surgical intervention related variables were considered such as types of CS (elective or emergency), types of incision (vertical, horizontal), types of skin suturing (interrupted, sub-cuticle), premature rupture of membranes, number of per-vaginal examination, blood loss, duration of procedures, anesthetic techniques (general, epidural), indication for CS, gestational age, blood transfusion, and/or antibiotic used.

4.11. Operational Definition

Surgical site infection: A surgical site infection (SSI) is an infection that develops within 30 days following surgery and affects the skin, subcutaneous tissue, and deep soft tissue surrounding the incision or organ/space(5). SSI diagnosis criteria adhere to CDC guidelines (17),

(I) Surgical site infection (SSI): the Centers for Disease Control and Prevention (CDC) define surgical site infection (SSI) as an infection following surgery at the part of the body where the surgery was conducted

(II) Superficial SSI: infection occurs within 30 days after the operation and only involves skin and subcutaneous tissue at the region of incision and at least one of the following conditions occurs:

a) Purulent drainage with or without laboratory confirmation, from the superficial incision.
b) Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.
c) At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture negative.
d) Diagnosis of superficial incisional SSI made by a surgeon or attending physician.

(III) Deep incisional SSI: infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g., fascia and muscle) of the incision and at least one of the following:

1) Purulent drainage from the deep incision but not from the organ/space component of the surgical site
2) A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C) after 24hrs and exclude other causes, localized pain, or tenderness, unless incision is culture negative.
3) An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
4) Diagnosis of deep incisional SSI made by a surgeon or attending physician.

(IV) Organ space SSI: infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs) operation and at least one of the following:

i. Purulent drainage from a drain that is placed through a stab wound into the organ/space
ii. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space
iii. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.
iv. Diagnosis of organ/space SSI made.

CDC Surgical Wound Classification Definitions

- Class I – Clean: Operative wounds that are uninfected, do not show inflammation, and do not involve entering the respiratory, alimentary, genital, or urinary tracts.
- Class II – Clean-Contaminated: Operative wounds that involve entering the respiratory, alimentary, genital, or urinary tracts under controlled, aseptic conditions.
- Class III – Contaminated: Open, fresh, accidental wounds, or procedures with major breaks in sterile technique or gross spillage from the gastrointestinal tract.
- Class IV – Dirty-Infected: Old traumatic wounds with retained devitalized tissue or those involving existing clinical infection, such as purulence.

Prolonged rupture of membranes (PROM): - is defined as the rupture of amniotic membranes that persists for more than 12 hours prior to the onset of labor or delivery (Obstetrics guideline 2021 by FMOH).

Prolonged labor- labor last >24 hours after true labor diagnosed delivery (Obstetrics guideline 2021 by FMOH).

4.12: Ethical Consideration

Ethical clearance has been obtained from the Ethical review committee of institute of health sciences and medicine of Wolkite University and then supportive letter has been taken from this committee to Chief clinical director of WKUCSTH where he directed for cooperating and facilitating to labor ward head, ward midwives head, Operation room head and medical record room head for legality issues. Participants were asked for their willingness to participate and give consent in the study after explaining all the objective, risks and benefits of involving in the study. All the information retrieved has been kept in a way that could not interfere with personal Confidentiality has been kept(coding).

4.13. Dissemination Result

The result of this study will be submitted to Wolkite University, school of medicine, department of Gynecology and obstetrics and other concerned bodies. It will be presented on symposiums to the scientific community and finally effort will be made to publish on international scientific journals.

CHAPTER 5: RESULTS

Between October 1 to December 13/2025, 2025, a 30-day prospective telephone follow-up was conducted to monitor for Surgical Site Infection (SSI) symptoms among 159 mothers who undergo Cesarean Delivery (CD) at WKUCSTH. The follow-up was completed by 156 participants (98.1%), with 3 mothers lost to follow-up.

5.1: Sociodemographic and baseline characteristics of the study participants

A total of 159 mothers who underwent cesarean delivery 156 completed 30days follow-ups The majority of participants were between the age of 20 - 29 years (113, 72.4%), followed by those aged 30 - 39 years (31, 19.9%), while mothers aged <20 years and those ≥40 years accounted for smaller percentages of 5.1% (8 participants) and 2.6% (4 participants) respectively of the study population. Most participants were rural residents, 99 (63.5%). Almost two-third (66.7%) of study participants were referred from other institutions. Regarding BMI status, 54 (34.6%) of the participants were normal, followed by (28.2%) were underweight., 54 (34.6%) of the participants were normal, followed by 44 (28.2%) who were underweight (Table 2).

Table 2. Socio-demographic and obstetric characteristics of study participants who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n = 156).

Study Variable	Frequency	Percent
Age in years		
< 20	8	5.1
20–29	113	72.4
30–39	31	19.9
≥ 40	4	2.6
Residency		
Urban	57	36.5
Rural	99	63.5
Referral status		
No	52	33.3
Yes	104	66.7
BMI		
Underweight	44	28.2
Normal	54	34.6
Overweight	27	17.3
Obese	31	19.9

Keynote: Underweight [BMI <18.5], Normal [BMI ≥18.5 and <25], Overweight [BMI ≥25 and <30], Obese [BMI ≥30]

5.2: Obstetric and medical characteristics of the study participants

Majority of study participants, 129, (82.7%) were multigravida. Less than two-third (62.2%) of the mothers were Primiparous. 41 (26.3%) mothers had previous history of cesarean delivery. Regarding to gestation of cesarean delivery, the majority of cesarean deliveries occurred at term gestation, 99 (63.5%), followed by 19 (21.1%) who were post term. Regarding obstetrics factors, 74(47.5 %) of mothers were in labor for less than 24 hours, while 42(26.9%) experienced labor lasting more than 24 hours. 109 (69.9 %) of the mothers underwent 1-4 per-vaginal examinations, and additionally 13.5% had five or more per-vaginal examinations. Prolonged rupture of membranes was diagnosed in 23 (14.7 %) mothers. (Table 3).

Table 3. Obstetric characteristics of study participants who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n=156).

Study Variable	frequency	Percent
Gravidity		
Primigravida	17	10.9
Multigravida (2–4)	129	82.7
Grand multigravida (≥5)	10	6.4
Parity		
Nulliparous	24	15.4
Primiparous	97	62.2
Multiparous (2–4)	35	22.4
Gestational age		
37–40 weeks	99	63.5
<37 weeks	24	15.4
>40 weeks	33	21.1
Previous history of cesarean delivery		
No	115	73.7
Yes	41	26.3
Duration of labor		
No labor	40	25.6
<24 hours	74	47.5
> 24 hours	42	26.9
Number of per vaginal examination (interview and chart review)		
No exam	26	16.6
1–4	109	69.9
≥5	21	13.5
Duration of ROM		
No rupture	19	12.2
< 12 hours	118	75.6
>12 hours	19	12.2
Prolonged PROM		
No	118	75.6
Yes	23	14.7
Presence of obstructed labor		
No	148	94.9
Yes	8	5.1

5.3: Underlying medical characteristics of the study participant

Regarding comorbidities, 51 (32.7%) of the participants had at least one underlying comorbidity. Among those comorbidities, 41 (26.3%) accounted for hypertension, 8 (5.1%) for diabetes mellitus, 5 (3.2%) for cardiac disease, 5 (3.2%) for HIV infection, and 2 (1.3%) had a history of tuberculosis. Among mothers with HIV, all 5 were on ART, and among the two mothers who had a history of TB diagnosis, both had received anti-TB treatment before their pregnancy (Table 4).

Table 4. Underlying medical characteristics of the study participant who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n = 156).

Study Variable	Frequency	Percent
Comorbidity		
No	105	67.3
Yes	51	32.7
DM		
No	148	94.9
Yes	8	5.1
Yes Overt	5	3.2
Yes Gestational	3	1.9
HTN		
No	115	73.7
Yes	41	26.3
Yes, before pregnancy (chronic HTN)	18	11.5
Yes, during pregnancy (Variants of PIH)	23	14.7
Preeclampsia with severity	8	5.1
Gestational HTN	7	4.5
Chronic HTN superimposed Preeclampsia	5	3.2
Atypical preeclampsia	3	1.9
Cardiac disease		
No	151	96.8
Yes	5	3.2
Yes, before pregnancy	4	2.6
Yes, during pregnancy	1	0.6
HIV		
Negative	151	96.8
Positive	5	3.2
Positive before pregnancy	5	3.2
Positive during pregnancy	0	0
1st. Triminister	0	0
2nd. Triminister	0	0
3rd. triminister	0	0
If HIV positive, on ART		
No	0	0

Yes	5	3.2
TB		
No	154	98.7
Yes	2	1.3
Yes, before pregnancy	2	1.3
Yes, during pregnancy	0	0
any course of anti -TB		
No	0	0
Yes, before pregnancy	2	1.3

Keynote: DM: diabetes mellitus, GDM: Gestational diabetes mellitus, TB: Tuberculosis, ART: antiretroviral therapy, HTN: Hypertension

5.4: Perioperative characteristics of the study participants

Before the cesarean section preoperative antibiotic was given to almost all mothers (98.1%) mothers, with ceftriaxone 1gm stat being the primary antibiotic given. The prophylactic antibiotic was given within 15–30 minutes before skin incision in 121 (77.6%) cases. Plain soap and water were the most commonly used hand preparation method, 78(50 %) was with plain soap and water, whereas 32 (20.5%) used antimicrobial soap and water. Skin preparation was mainly performed using povidone iodine 150(96.2%). The most common indication for cesarean delivery was NRFHRP in 70 (44.9%) participants, followed by CPD in 34 (21.8%), and arrest of labor in 30 (19.2%) Preoperatively, 11 (7.1%) mothers had surgical area shaving of which was performed at home as well as in the ward equally (Table 5).

Table 5. Preoperative characteristics of the study participants who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n = 156).

Study Variable	Frequency	Percent
Antibiotic prophylaxis		
Yes	153	98.1
No	3	1.9
Prophylactic antibiotic given		
Ceftriaxone 1gm	153	98.1
Prophylaxis interval before skin incision		
15–30 min	121	77.6
<15 min	7	4.5
30–45 min	12	7.7
45–60 min	8	5.1
>1 hour	5	3.2
Type of solution used for Hand preparation (Surgeon interview)		
Alcohol	46	29.5
Plain soap & water	78	50.0
Antimicrobial soap & water	32	20.5

Type of antiseptic used for skin preparation		
2% Chlorohexidine/Alcohol	6	3.8
Aqueous butadiene (Povidone iodine)	150	96.2
Indication for CS		
NRFHRP	70	44.9
CPD	34	21.8
Arrest of labor	30	19.2
Malpresentation	15	9.6
Previous CS (no eligible for TOLAC)	7	4.5

Keynote: Prolonged PROM>12 hours, Prolonged labor >24 hours lapse after true labor established

5.5: Intraoperative characteristics of the study participants

The majority of cesarean sections were performed as emergency procedures, accounting for 137 (87.8%) of cases, while only 19 (12.2%) where elective CS. Spinal anesthesia was predominantly used, administered in 143 (91.7%) procedures, while 13 (8.3%) received general anesthesia. Almost all surgeries involved a transverse skin incision (153, 98.1%), with only 3 (1.9%) vertical incisions. For the majority of deliveries, the duration of operation was 30–60 minutes (85.9%). continuous subcuticular skin closure was used in 144 (92.3%) participants, and interrupted closure in 12 (7.7%). Most wounds were classified as Class II (clean-contaminated) in 137 (87.8%). The majority of operations were performed by residents (150, 96.2%), with only 6 (3.8%) surgeries being done by specialists (Table 6).

Table 6. Intraoperative characteristics of the study participants who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n = 156).

Study Variable	Frequency	Percent
Type of operation		
Elective	19	12.2
Emergency	137	87.8
Type of Anesthesia		
Spinal	143	91.7
General	13	8.3
Epidural	0	0
Type of Skin incision		
Transverse	145	93
Vertical	11	7
Duration of operation		
<30 min	6	3.8
30–60 min	134	85.9
>60 min	16	10.3
Type of skin closure		
Continuous subcuticular	154	98.7
Interrupted	2	1.3
Wound class		
Class I	19	12.2
Class II	137	87.8
Class III	0	0

Class IV	0	0
Level of training of operating surgeon		
Specialist	6	3.8
Resident (year 1-year 4)	150	96.2
Year 1	0	0
Year 2	50	32
Year 3	68	43.6
Year 4	32	20.5

5.6: Postoperative characteristics of the study participants

Postpartum hemorrhage was only diagnosed in 6 (3.8%) mothers. Most mothers completed three doses of antibiotics postoperatively (140, 89.7%), whereas 16 (10.3%) received fewer than three doses. Postoperative fever was documented in 26 (16.7%) participants. Postoperative vital sign derangement, specifically tachycardia, was observed in 39 (25.0%) mothers. The majority had a postoperative hospital stay of ≤3 days (127, 81.4%). The total hospital stay was ≤4 days for 127 (81.4%) participants (Table 7).

Table 7. Postoperative characteristics of the study participants who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n=156)**.**

Study Variable	**Frequency**	**Percent**
Postpartum hemorrhage		
No	150	96.2
Yes	6	3.8
Doses of postoperative antibiotics		
3 doses completed	140	89.7
<3 doses	16	10.3
2 doses	9	5.8
1 dose	7	4.5
Postoperative Fever record postoperatively		
No	130	83.3
Yes	26	16.7
Postoperative V/S derangement (specifically tachycardia)		
No	117	75.0
Yes	39	25.0
Postoperative length of hospital stays		
≤3 days	127	81.4
>3 days	29	18.6
Total length of hospital stays		
≤4 days	127	81.4
>4 days	29	18.6
Suture removal (in postoperative days)		
Use only absorbable	156	100
Use non absorbable	0	0

5.7: Incidence and characteristics of surgical site infection

The overall incidence of surgical site infection among mothers who delivered via cesarean section was 26(16.7% at (95%CI: 13.2, 19.7) (Figure 2).

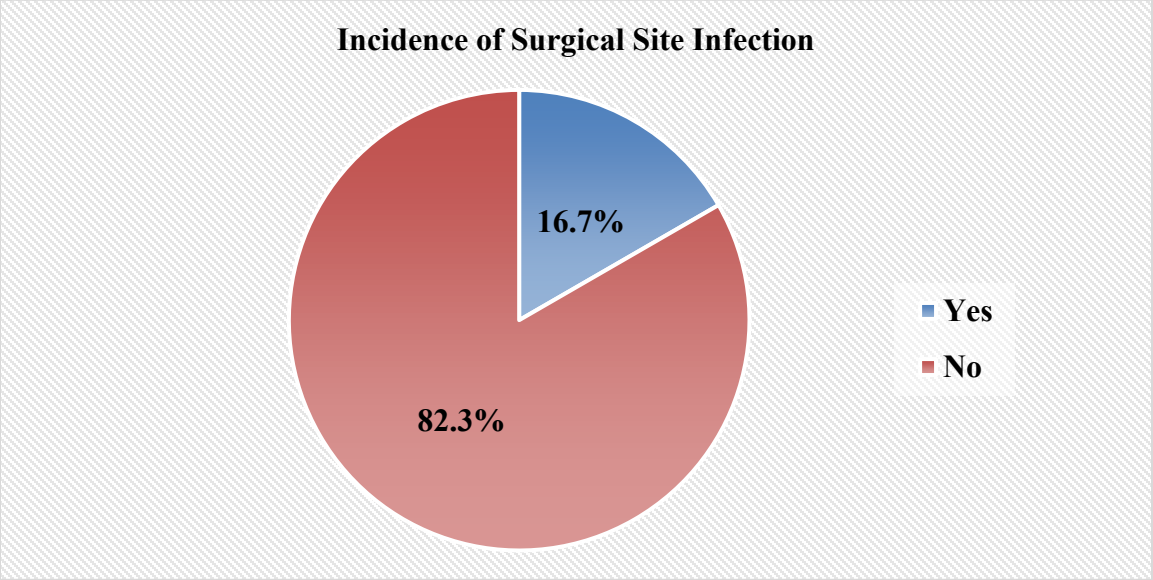

Figure 2. The incidence of surgical site infection among the study participants

Among SSI cases, majority of the case, 25 (96.1%) were superficial Surgical site infections. Most SSIs were diagnosed after hospital discharge, 25 (96.2%), and 17(65.4%) of symptoms commonly developed during the second postoperative week. All mothers with SSI presented had a history of fever and purulent wound discharge, while 76.9% reported pain or tenderness at the incision site. Wound dehiscence occurred in 1 (3.8%) case. The majority of SSIs, 21 (80.8%), were managed on an outpatient basis (Table 8).

Table 8. SSI related characteristics who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia **(n=156).**

Study Variable	Frequency	Percent
Type SSI		
Superficial	25	96
Deep	1	4
Organ/Space	0	0
Diagnosis of SSI made before or after discharge		
Before discharge	1	3.8
Post discharge (Outpatient)	25	96.2
If SSI developed, time of onset of symptoms of SSI started		
Before discharge (3rd day)	1	3.8

Day 4–10 (post discharge)	8	30.8
Day 11–17 (post discharge)	17	65.4
SSI signs & symptoms		
Fever	17	65.4
Pain or tenderness at wound/incision site	20	76.9
Purulent discharge at wound/incision site	26	100.0
Wound dehiscence	1	3.8
Localized swelling	17	65.4
Redness of the skin	20	76.9
Hotness of skin	15	57.7
How was the SSI managed		
Outpatient management	21	80.8
wound care at nearby health facility.	9	34.6
Wound care at our side at our side at emergency	7	27
Observed and resolved	5	19.2
Inpatient management	5	19.2
Treated with antibiotics and wound care	3	11.5
Only wound care only for 2 cases.	2	7.7

5.8: Factors contributing with Surgical Site Infection

In the bivariate logistic regression analysis, several variables were found to be potentially contributing with the development of surgical site infection (SSI) and were selected for inclusion in the multivariable analysis. Gestational age greater than 40 weeks, prolonged labor lasting more than 24 hours, obstructed labor, prolonged premature rupture of membranes before cesarean delivery, having 1–4 per vaginal examinations prior to cesarean delivery, five or more per vaginal examinations, Use of plain soap and water for hand preparation and receiving fewer than three doses of postoperative antibiotics.

All variables with p-values less than 0.25 in the bivariate analysis were subsequently entered into the multivariable logistic regression model to identify independent predictors of surgical site infection (Table 9).

The bivariate logistic regression of developing SSI among the participant who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n=156).

Study Variable	**SSI**		**p-value**	**COR with 95%CI**
	No	**Yes**		
Gestational age				
37–40 weeks	82	17		1
<37 weeks	22	2	0.280	0.43 (0.20, 7.89)

>40 weeks	26	7	**0.046**	**1.32 (1.01, 2.59)**
Duration of labor				
No labor	36	4		1
<24 hours	63	11	0.893	1.57 (0.23, 5.49)
> 24 hours	32	10	**0.011**	**2.81 (1.21, 11.78)**
Presence of obstructed labor				
No	128	20	1	
Yes	2	6	**0.001**	**19.20 (3.62, 101.815)**
Number of per vaginal examination before cesarean delivery				
No exam	23	3	1	
1–4	92	17	**0.006**	**1.41 (1.32, 5.18)**
≥5	8	13	**0.021**	**12.45 (1.89, 20.92)**
Prolonged PROM diagnosed before cesarean delivery				
No	115	18		1
Yes	15	8	**< 0.001**	**3.41 (1.82, 6.71)**
Type of solution used for Hand preparation				
Alcohol	39	7		1
Plain soap & water	62	16	**0.033**	**1.44 (1.06, 3.77)**
Antimicrobial soap & water	29	3	0.753	0.57 (0.03, 0.63) _
Doses of postoperative antibiotics				
3 doses completed	123	17		1
<3 doses	7	9	**<0.001**	**9.30(2.34, 19.83)**

5.9: Multivariate analysis of associations

In the multivariable logistic regression analysis, several factors remained statistically significantly associated with the surgical site infection (SSI) after adjusting for potential confounders. Prolonged duration of labor is significantly associated with surgical site infections (SSI). Women who experience prolonged labor are 2.7 times more likely to develop SSI compared to those who do not go through labor at all [ARR = 2.7; 95% CI: 2.43, 8.91; p = 0.021]. Obstructed labor also significantly associated with surgical site infections (SSI). Women who experience Obstructed labor are 19.2 times more likely to develop SSI compared to those who do not go through labor at all [ARR = 19.2; 95% CI: 3.62, 101.81; p = 0.021]. In addition, undergoing five or more per vaginal examinations prior to cesarean delivery was significantly associated with SSI. Women who undergoing five or more per vaginal examinations are 5.2 times more likely to develop SSI compared to those who do not undergoing per vaginal examinations at all [ARR = 5.2; 95% CI: 1.39, 9.12; p < 0.001]. Prolonged premature rupture of membranes before cesarean delivery also remained significantly associated with SSI. Women who experience Prolonged

premature rupture of membranes before cesarean delivery are 2.32 times more likely to develop SSI compared to those who do not have premature rupture of membranes at all [ARR = 2.32; 95% CI: 1.62, 7.32; p = 0.032]. Those who received less than 3 doses of postoperative antibiotics were statistically significantly associated with SSI. Women who received less than 3 doses of postoperative antibiotics are 6.2 times more likely to develop SSI compared to those who do not receive at all [ARR = 6.20; 95% CI: 2.40, 13.33] (Table 10).

Table 9. The multivariable logistic regression of developing SSI among the participant who gave birth through CD from October 1 to December 13/2025 in WKUCSTH, Ethiopia (n=156).

Variable	SSI		COR with 95%CI	p-value	ARR with 95%CI	p-value
	Yes	No				
Gestational age						
37–40 weeks	17	82	1		1	1
<37 weeks	2	22	0.43(0.20,7.89)	0.280	0.21(0.61,3.91)	0.531
>40 weeks	7	26	**1.32(1.01,2.59)**	0.046	1.12(0.21,5.61)	0.646
Duration of labor						
No labor	4	36	1		1	1
<24 hours	11	63	1.57(0.23,5.49)	0.893	1.32(0.67,7.29)	0.923
> 24 hours	10	32	**2.81(1.21,11.78)**	0.011	2.7 (2.43, 8.91)	0.021
Presence of obstructed labor						
No	18	128		1		1
Yes	6	2	**19.20(3.62,101.815)**	0.001	19.20(3.62,101.815)	0.021
Number of per vaginal examination before cesarean delivery						
No exam	3	23		1		1
1–4	17	92	**1.41 (1.32, 5.18)**	0.006	1.2 (0.22, 8.24)	0.562
≥5	13	8	**12.45 (1.89, 20.92)**	0.021	5.2 (1.39, 9.12)	0.001
Prolonged PROM diagnosed before cesarean delivery						
No	18	115	1			1
Yes	8	15	**3.41 (1.82, 6.71)**	<0.001	2.32 (1.62, 7.32)	0.032
Type of solution used for Hand preparation						

Alcohol	7	39	1			1
Plain soap & water	16	62	**1.44 (1.06, 3.77)**	0.033	0.7 (0.06, 3.27)	0.081
Antimicrobial soap & water	3	29	0.57 (0.03, 0.63)	0.753	0.21 (0.34, 1.33)	0.864
Doses of postoperative antibiotics						
3 doses completed	17	123	1			1
<3doses	9	7	**9.30(2.34, 19.83)**	<0.001	6.20 (2.40, 13.33)	0.004

CHAPTER 6: DISCUSSION

This study aimed to assess incidence and risks contributing with post CD surgical site infection among mothers who give birth by CD in Wolkite University Comprehensive Teaching Hospital.

In this study, the incidence of SSI was 16.7% [95%CI: 13.2-19.7]. In present study, prolonged labor, obstructed labor, prolonged premature rupture of membranes, frequent per vaginal examination, and number of postoperative antibiotics doses were factors contributing with surgical site infections.

The finding of this study showed post CD SSI was detected in twenty-six (16.7%) of the participants after getting discharged from the hospital completing due follow-up. From this one can appreciate the use of post discharge infection surveillance for immediate evaluation and improvement of CD service, since post CD in-patient stay is decreasing from time to time. The rate, however, might be overestimated due to small number of participants in study.

The finding was significantly higher compared to the results of studies done in a retrospective case-control study done at a tertiary hospital in Kenya, prospective cohort study done in Tanzania retrospective cohort study done in Saudi Arabia, and a systematic review and meta-analysis done in Ethiopia overall SSI rate of 2.1%,10.9% ,4.7% and 11.13% respectively (2,3,4,5).

These variations might be due to the difference in socio-economic status, health care delivery system, study design and distribution of risk factors among the studied group.

The overall incidence of SSI was 16.7%, which is higher than the pooled global incidence of post-cesarean SSIs reported in recent systematic reviews and meta-analyses, including the 2023 global estimate of 5.63%. It also exceeds pooled national estimates reported in Ethiopia, which range from approximately 9.7% to 12.3%. In comparison with studies done in some institution-based prospective studies conducted in tertiary and referral hospitals in Ethiopia, such as the study at Debre Markos Referral Hospital that reported an incidence of 25.4%. The relatively high incidence observed in this study may be explained by the high proportion of emergency cesarean sections, the large number of referrals from peripheral health facilities, and the frequent presence of intrapartum complications, all of which increase the risk of postoperative infection.

The result was lower compared to study conducted at Debre Markos Referral Hospital, 25.4% (7). The difference observed may be because of the high proportion of emergency cesarean

sections, the large number of referrals from peripheral health facilities, and the frequent presence of intrapartum complications, all of which increase the risk of postoperative infection.

The majority of SSIs identified in this study were superficial surgical site infections, and most cases were diagnosed after hospital discharge, predominantly during the second postoperative week. This finding is consistent with findings from studies conducted in Ethiopia and Tanzania, (3,5,6) where post-discharge SSIs accounted for a substantial proportion of cases. Early discharge practices, limited postnatal follow-up, and inadequate post-discharge surveillance systems may contribute to delayed diagnosis. These findings highlight the importance of strengthening post-discharge follow-up and educating mothers on early recognition of SSI symptoms.

Prolonged duration of labor exceeding 24 hours was significantly associated with an increased risk of SSI. This finding is similar with studies conducted in Ethiopia, Tanzania, and other low-income settings (1,3,5,6), which reported that prolonged labor significantly increases the likelihood of postoperative infection. For instance, a prospective cohort study in eastern Ethiopia reported that women who labored for more than 24 hours prior to cesarean delivery were more than four times more likely to develop SSI. Similar associations have been reported in Tanzania and Mekelle (3,13). The possible justification is prolonged labor increases exposure to ascending genital tract microorganisms, is often accompanied by repeated vaginal examinations, and is frequently associated with emergency surgical intervention, all of which contribute to bacterial contamination and impaired wound healing (3,6,8,11-13).

Obstructed labor was also identified as a strong independent predictor of SSI. Women who experienced obstructed labor were 4.4 times higher odds of developing SSI compared with those without obstructed labor. This finding aligns with existing literature from Ethiopia and other sub-Saharan African countries (1,5,6). The possible reasons are obstructed labor is commonly associated with prolonged labor duration, tissue edema, ischemia, and repeated instrumentation, which increase susceptibility to infection (3,6,8). Additionally, obstructed labor often necessitates urgent surgical intervention, which may limit optimal preoperative preparation and increase the risk of contamination (3,13).

Having five or more per vaginal examinations prior to cesarean delivery was independently associated with SSI. Women who underwent five or more vaginal examinations had more than threefold increased odds of developing SSI compared with those who had no vaginal

examinations. This finding is supported by studies conducted Tanzania, Peru, and Ethiopia (3,5,6,12) which indicated that frequent vaginal examinations significantly increase the risk of postoperative infection. The possible evidence is that repeated vaginal examinations facilitate ascending bacterial contamination, particularly in the presence of prolonged labor or ruptured membranes (3,4,13). This underscores the importance of adhering to evidence-based intrapartum practices that minimize unnecessary vaginal examinations (3,12).

Prolonged premature rupture of membranes prior to cesarean delivery also remained independently associated with SSI. This finding is consistent with numerous studies conducted in Ethiopia, Tanzania, Nepal, and Harar (3,5,6,11,14), which reported significantly higher odds of SSI among women with prolonged rupture of membranes. The evidence revealed that prolonged membrane rupture allows bacteria to ascend from the lower genital tract to the uterine cavity and surgical field, increasing the likelihood of postoperative wound infection (3,5,6,12). The persistence of this association after adjustment for confounders highlights the importance of timely obstetric decision-making and appropriate perioperative management in women with prolonged PROM.

Several factors that showed significant associations in the bivariate analysis did not remain statistically significant in the multivariable model. These included gestational age greater than 40 weeks, and type of hand preparation solution used by the surgical team. The loss of statistical significance after adjustment suggests that these factors may be confounded by intrapartum variables such as prolonged labor, obstructed labor, repeated vaginal examinations, number of postoperative antibiotics doses and PROM.

Overall, the findings of this study indicate that intrapartum obstetric factors play a more prominent role in the development of surgical site infection following cesarean delivery than sociodemographic or procedural factors in this setting. The high proportion of emergency cesarean sections, frequent labor complications, and delayed referrals observed among the study participants likely contributed to the elevated SSI incidence. These findings highlight critical areas for intervention, including strengthening labor monitoring, ensuring timely referral and decision-making, minimizing unnecessary vaginal examinations, and optimizing the management of prolonged labor and premature rupture of membranes. Addressing these factors may substantially reduce the burden of surgical site infection following cesarean delivery in similar resource-limited settings.

6.1: STRENGTH AND LIMITATION OF THE STUDY

6.1.1: STRENGTH OF THE STUDY

A primary strength of this research is its ability to identify post-discharge infections that often go undocumented in standard retrospective cohort designs. In the context of shorter hospital stays, our survey-based method ensured a robust capture of all CD SSIs, mitigating potential underreporting and providing a higher, more reliable incidence rate.

6.1.2: LIMITATION OF THE STUDY

While this study underscores the value of post-discharge surveillance in optimizing Cesarean Delivery (CD) services, several methodological constraints must be acknowledged. First, the reliance on patient charts for baseline data introduced a risk of information bias due to occasional incomplete or inaccurate clinical documentation. Second, the follow-up process was hindered by geographic and technical barriers; specifically, the rural residency of many participants, coupled with intermittent phone connectivity and local security concerns, led to participant attrition. Finally, the study's power may be limited by the non-randomizing technique, small sample size and the absence of a 10% non-response buffer in the initial calculation, which may affect the generalizability and statistical representation of certain variables

CHAPTER 7: CONCLUSION AND RECOMMENDETION

7.1: CONCLUSION

This study identified a high prevalence of surgical site infections (SSI) following cesarean delivery at Wolkite University Comprehensive Specialized Teaching Hospital. Key risk factors for SSI included prolonged labor exceeding 24 hours, obstructed labor, frequent vaginal examinations (≥5), sub-therapeutic postoperative antibiotic dosing, and prolonged premature rupture of membranes. These results indicate that intrapartum obstetric factors are the primary determinants of post-cesarean SSI in this clinical setting. To improve maternal surgical outcomes and reduce postoperative morbidity, it is imperative to implement strategic clinical improvements focused on timely labor management, minimizing unnecessary vaginal examinations, and optimizing care protocols for patients with premature rupture of membranes. For prolonged labor and premature rupture of membranes are imperative for reducing postoperative morbidity and enhancing better maternal surgical outcomes.

7.2: RECOMMENDATIONS

To National and Regional Authorities:

Refining perioperative guidelines by establishing routine SSI surveillance programs

To WKUCSTH

Establish Follow-up Protocols.

Strengthen Institutional Support to the catchment and nearby health facility to optimizing referral pathways.

To Midwifes and residents

strictly enforcing adherence to postoperative antibiotic regimens.

To Researcher:

Future studies should utilize prospective designs with larger cohorts

CHAPTER 8: REFERENCES

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CHAPTER 9: APPENDIX

Appendix A: Information Sheet

Here, I the undersigned student, WKUCSTH, School of medicine and health science, post graduate studies program, am currently undertaking my proposal. For this study, you will be selected as a participant and before getting your consent of participation, you need to know all necessary information related to the study. Thus, this information will be detailed as:

Title of the Research proposal:

Incidence of surgical site infection and factors ass contributing factor in cesarean deliveries in WKUCSTH, Ethiopia.

Name of the Organization: Wolkite University, School of medicine and health science

Name of the Sponsor: Wolkite University.

Objective of the study: The aim of this study is to assess the incidence of SSI among cesarean deliveries and its contributing factors in WKUCSTH, 2025.

Significance of the study: the study will identify predictors of post cesarean delivery surgical site infection and guide stake holders to reduce incidence of SSI, work on prevention strategies, and reduce socio-economic impact. Findings from the study will provide important information for policy makers to develop strategies, guidelines and early prevention approach towards post cesarean delivery surgical site infection.

Participants to be included: all mothers who undergo cesarean delivery in WKUCSTH and are willing to participate in the study will be included.

Procedure: All mothers delivering by CD in WKUCSTH will be told about the objectives, benefits, and risks of the study. If they are willing to participate in the study, their charts will be reviewed for recorded maternal characteristics like sociodemographic, obstetrics, comorbidities, intrapartum, perioperative, and procedures. Then they will be followed for the development of SSI signs and symptoms during their hospital stay and counselled on sign and symptoms SSI to report immediately. Optional phone number was documented. After discharge, four phone calls, every week, will be held to those mothers and development of SSI syndrome will be requested.

Confidentiality: All information you give will be kept confidential and won't be accessible to any third party. Your name won't be registered on the questionnaire sheet so that you will not be identified.

Risks and Benefits of the study

Risks and /or Discomfort: The study will be conducted by taking necessary information from the medical chart and through a phone call. So, it will elicit any harm or discomfort on the client. The name and other identifying information will not be recorded and the information taken from the chart and the phone call will be kept strictly in confidential manner. The information retrieved will only be used for the study purpose and you will not be forced to respond to the information you do not need to.

Benefits: the research has no direct benefit or a payment for those participants who provide information about their CD wound condition. However, the study has indirect benefit for the participant and other clients with post cesarean delivery SSI, since, the study will identify potential predictors of SSI and the recommendation based on the finding will help stake holders and policy makers to work on the prevention approaches.

Appendix B: Consent Form

Client consent form to assess post- cesarean delivery surgical site infection and factors contributing with it in WKUCSTH, Ethiopia.

My name is _____ I am working in research team which is conducted in wolkite University for partial fulfillment of Specialty in obstetrics and gynecology. I am collecting data from mothers giving birth by cesarean delivery in WKUCSTH. The objective of the study is to assess the incidence of surgical site infection among cesarean deliveries and factors contributing with it in WKUCSTH.

If you are willing to participate in the study, I am going to provide you brief explanation about post-cesarean delivery surgical site infection syndrome and equip you with graphic and diagrammatic representation of the condition. I then expect you to communicate with me through cell phones for the development of the syndromes based on the guide provided within 30 days after surgery. I also will take notes from your medical records. Nevertheless, your name will not be written in this form and will never be used in connection with any of the information you will tell me. You do not have to participate in the study if you do not want to.

However, your willing participation will help us in determining level of and factors contributing with post-cesarean delivery surgical site infection. We would appreciate your keen interests in participating in this study. The interview will take about 20 minutes. Would you be willing to participate [indicate by ticking the appropriate responses]?

Yes _____, No_____.

Signature of the interviewer certifying that the informed consent has been read verbally by respondents-

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If you have any question with regards to this study, you can ask immediately the interviewer or the principal investigator (**Mobile Number: 0920312850**).

Appendix C: Data Collection Tool

Post-cesarean delivery surgical site infection data collection tool	
1	Participant code: ____Age: ____Weight: ___Kg. Height: _____cm. BMI: _____ Gravidity: _____ Parity: _____ Hospital; _____ Ward: _Kebele_____ Urban: _____Rural: _____ Date of admission: ___Participant contact number1: _____& 2nd contact number: _____ Is the client referred from another facility: □ Yes □ No □Referring facility: _____
2	Underlying conditions: Diabetes mellitus (DM) □ Yes, Overt DM □ Yes Gestational DM □ No Hypertension □No □Yes □Chronic HTN □Preeclampsia □Gestational HTN □ superimposed with preeclampsia □ atypical preeclampsia Cardiac disease □No □Yes before pregnancy □ Yes during pregnancy HIV status □ Negative □ Positive before pregnancy □ Positive during pregnancy then □1st Triminister□ 2nd triminister□ 3rd triminister If HIV positive, is client on ART □ Yes □ No Is patient having TB □ Yes before pregnancy □ Yes during pregnancy □ No Other, specify_____
3	Gestational age □ <37 weeks □ 37 – 40 weeks □ > 40 weeks □ Unknown date
4	Duration that client was in labor □ no labor □ < 24 hours □ > 24 hours □Not registered Number of vaginal examinations before CD: □ No vaginal examination □ < 5vaginal examinations □ ≥ 5 vaginal examinations
5	Length of time membranes ruptured prior to cesarean delivery
	No rupture □ >12 hours < 12 hours
6	Date of operation _____Time of operation _____ Duration of operation _____ Start time ____End time _____ Type of operation □ Elective □ Emergency Type of skin incision □ Transverse □ Vertical History Previous cesarean section □ Yes □ No Type of anesthesia provided □ General □ Local □ Spinal □ Epidural The operation is performed by □ Year 1 resident □year 2 resident □ year 3 resident □ year 4 resident□ Specialist

	Does antibiotic prophylaxis provide □ Yes □ No If yes, state type and dose of antibiotics given _____ Time prophylactic antibiotics is given □ Exact time If exact time is not available, tick the appropriate one: □ < 15 min. □ 15 – 30 min. □ 30 – 45 min. □ 45 – 60 min □ > 1 hour						
8	State solution used for surgeon's hand preparation (interview the surgeon): Plain soap and water □Antimicrobial soap and water □Other specify…… Antiseptic used for peri operative skin preparation □Aqueous butadiene (povidone iodine) □2%Chlohexidine/Alcohol □Other specify……						
9	Surgical wound classification for caesarean section Please tick one: □Class I: Clean Caesarean Section, elective, no pre-rupture of membranes or trial of labour						
	□Class II: Clean Contaminated Caesarean Section, emergency involving pre-rupture of membranes less than 12hours and /or trial of labor □Class III: Contaminated Rupture of membranes more than 24hours □Class IV: Dirty Purulent amniotic fluid						
10	Skin closure: □Interrupted sutures □ Continuous						
11	Post-partum hemorrhage □ Yes □ No						
12	Post operative Findings	Immediate post operative day		1st post operative day		2nd post operative day	
	Temperature						
	Pulse						
13	Post operation prophylaxis antibiotics	□ 1Dose □ 2Dose□ 3Dose □not registered					
	Standing dose post operative antibiotics in obstructed labor/intraamniotic infection and others specified-------	□ yes□ no					

14	State presence of any of the following infection symptoms during inpatient stay: Purulent drainage from the incision □ Yes □ No Wound dehiscence □ Yes □ No Presence of at least one of the following signs or symptoms of infection Pain or tenderness at operation site □Localized swelling □Redness □Fever (>38°C) □Hotness of skin
15.	□Date of onset of symptoms: …… Date patient discharged……

16. Post Discharge Surveillance schedule

Review Week 1: Post Discharge Day 4-10 Is patient experiencing any of the following infection symptoms: Pain/tenderness at operation site: □Yes □No Purulent discharge at wound site □Yes □No Wound dehiscence □Yes □No Localized swelling □Yes □No Redness □Yes □No Hotness of skin □Yes □No Date of onset of symptoms…… Outcome ……	**Review week 2: Post discharge Day 11 – 17** Is patient experiencing any of the following infection symptoms: Pain/tenderness at operation site: □Yes □No Purulent discharge at wound site □Yes □No Wound dehiscence □Yes □No Localized swelling □Yes □No Redness □Yes □No Hotness of skin □Yes □No Date of onset of symptoms…… Outcome ……
Review week 3: Post discharge Day 18 – 24 Is patient experiencing any of the following infection symptoms: Pain/tenderness at operation site: □Yes □No Purulent discharge at wound site □Yes □No Wound dehiscence □Yes □No Localized swelling □Yes □No Redness □Yes □No Hotness of skin □Yes □No Date of onset of symptoms…… Outcome ……	**Review week 4: Post discharge Day 25 – 30** Is patient experiencing any of the following infection symptoms: Pain/tenderness at operation site: □Yes □No Purulent discharge at wound site □Yes □No Wound dehiscence □Yes □No Localized swelling □Yes □No Redness □Yes □No Hotness of skin □Yes □No Date of onset of symptoms…… Outcome ……

17. SSI detected: □Yes □No
If Yes state when SSI was detected: □ Before discharge □Post discharge Date Type SSI detected: ……
Type of SSI: □Superficial □Deep □ Organ/Space

Comment:
……
……
Form completed by ---------- Signature---------- Date……