STUDY TITLE: RISK FACTORS, INDICATIONS AND OUTCOMES OF POST CESAREAN SECTION READMISSION AT KNH: A CASE-CONTROL STUDY

Principal Investigator:
Dr. Sheila Jepkoech Kipkore
H58/7073/2017
Department of obstetrics and Gynaecology

Dissertation submitted in partial fulfillment of the requirements for the award of the degree of Master of Medicine in Department of Obstetrics and Gynaecology, Faculty of Health Sciences, University of Nairobi.

2022

DECLARATION

This research is undertaken in partial fulfillment of the Masters of Medicine in Obstetrics and Gynecology and is my original work and has not been undertaken and presented for a degree in any other University.

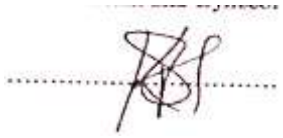
Signature:  **Date: 03/08/2022**

Dr. Sheila Jepkoech Kipkore

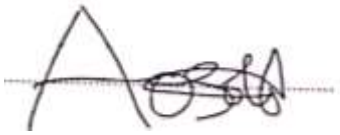
SUPERVISORS' APPROVALS

The dissertation has been submitted with the approval of the following supervisors:

Dr. Diana Ondieki, MBChB, Mmed (Obs/Gyn) MSc
Lecturer, Department of Obstetrics and Gynecology, Faculty of Health Sciences, University of Nairobi, Consultant Obstetrician Gynaecologist, Kenyatta N. Hospital.

Signature:  **Date: 06.08.022**

Dr. Alfred Osoti, MBChB, Mmed (Obs/Gyn), MP, PhD
Senior Lecturer, Department of Obstetrics and Gynaecology, Faculty of Health Sciences, University of Nairobi. Consultant Obstetrician and Gynecologist, Kenyatta N. Hospital.

Signature:  **Date: 7th August 2022**

Professor Omondi Ogutu, MBChB, Mmed(Obs/Gyn), PDGRM, FCOG (ECSA)
Associate Professor, Department of Obstetrics & Gynaecology, Faculty of Health Sciences, University of Nairobi.

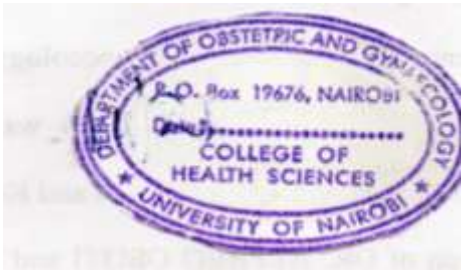
Signature:  **Date: 5th Aug 2022**

DEPARTMENTAL APPROVAL

This is to certify that this dissertation is an original work and is being submitted by Dr. Sheila Jepkoech Kipkore, a master of medicine student in the Department of Obstetrics and Gynaecology.

Professor Eunice J. Cheserem, MBChB, Mmed, (Obs/Gyn), PDGRM, Fell. Gyn/Onc
Associate Professor,Department of Obstetrics & Gynaecology, Faculty of Health Sciences
Chairperson,Department of Obstetrics and Gynaecology, University of Nairobi.

Signature:  **Date: 7/08/2022**



LIST OF ABBREVIATIONS

AOR	Adjusted Odds Ratio
ACOG	American College of Obstetricians and Gynecologist
BMI	Body Mass Index
BOOST	Better Outcomes by Optimizing Safe Transitions
CS	Cesarean Section
CTI	Care transition intervention
DVT	Deep venous thrombosis
HRRP	Hospital readmission reduction strategies
HDP	Hypertensive disease in pregnancy
ICU	Intensive care unit
KNH	Kenyatta National Hospital
LMIC	Low and middle-income country
OR	Odds ratio
PPH	Postpartum Hemorrhage
PE	Pulmonary embolism
RED	Re-engineered discharge
SSI	Surgical site infection

STAT	Software for statistics and scientific data
VTE	Venous thromboembolism
WHO	World Health Organization

OPERATIONAL DEFINITIONS

Readmission after cesarean section: Admission of a patient who had been discharged from a hospital within a specified time interval (within 6 weeks' post-cesarean section)

Postpartum period: A period within 42 days (6 weeks) post-delivery

Anemia: Hemoglobin concentration less than 11 g/dL in venous blood (WHO2010).

Hypertension: Systolic blood pressure (SBP) greater than or equal to 140mmHg or diastolic blood pressure (DBP) greater than or equal to 90 mmHg or higher, on two occasions at least 6 hours apart (Chobanian et.al 2003)(1)

Gestational hypertension: Systolic blood pressure (SBP) greater than or equal to 140mmHg or diastolic blood pressure (DBP) greater than or equal to 90 mmHg or higher, on two occasions at least 6 hours apart (Chobanian et.al 2003), without proteinuria or severe features develops after 20 weeks of gestation and blood pressure levels return to normal in the postpartum period (ACOG)(2)

Preeclampsia: Presence of (1) a systolic blood pressure (SBP) greater than or equal to 140mm Hg or diastolic blood pressure (DBP) greater than or equal to 90 mm Hg or higher, on two occasions at least 4 hours apart in a previously normotensive patient and proteinuria after 20 weeks of gestation up to 6 weeks post-delivery with proteinuria (ACOG)(2)

Eclampsia: The convulsion manifestation of the hypertensive disease in pregnancy. New New-onset tonic-colonic, focal or multifocal seizures in absence of other causative conditions such as epilepsy, cerebral arterial ischemia, infarction, intracranial hemorrhage, or drug use (ACOG)(2)

Diabetes mellitus: A chronic metabolic disorder due to either insulin deficiency (relative or absolute) or due to peripheral tissue resistance to the action of insulin(WHO 2006)(3).

Gestational diabetes mellitus: A carbohydrate intolerance of variable severity with onset or first recognition at pregnancy, presenting late in the second trimester or during the third trimester(Kerner et.al 2014)(4).

Surgical site infection: An infection that occurs after surgery in the part of the body where the surgery took place. Surgical site infections can be superficial infections involving the skin only. Other surgical site infections are more serious and can involve internal organs(Horan et.al 1992)(5).

Puerperal sepsis: Infection of the genital tract occurring at any time between the onset of rupture of membranes or labour and the 42nd day postpartum in which two or more of the following are present: pelvic pain, fever, abnormal vaginal discharge, abnormal smell/foul odor discharge or delay in uterine involution(WHO 2015)(6).

Venous thromboembolism (VTE): A condition in which a blood clot forms most often in the deep veins of the leg, groin, or arm (known as deep vein thrombosis, DVT) and travels in the circulation, lodging in the lungs (known as pulmonary embolism, PE) (Phillippe et.al 2017)(7).

LIST OF FIGURES

LIST OF TABLES

TABLE OF CONTENTS

Abstract

Background: Cesarean section (CS) is one of the most common major surgical procedures in Obstetrics. It is an effective lifesaving procedure in preventing maternal and perinatal mortality and morbidity when medically indicated(8). The rate of CS has been on a rising trend globally(9). Readmission rate is a recognized metric used to measure the quality of healthcare in surgical and medical specialties; the primary goal of this evaluation is to prevent morbidity. Women who deliver through CS are at a higher risk of readmission than those who have had spontaneous or assisted vaginal delivery (13)(14)(15). No studies in sub-Saharan Africa including Kenya have evaluated the risk factors for readmission after cesarean section (CS) which is essential in designing effective readmission prevention interventions.

Objective: To determine the risk factors, indications, and outcomes of post-CS readmission at Kenyatta National Hospital (KNH), from January 2014 to December 2019.

Methodology: This was an unmatched case-control study in which 107 records of post-CS patients readmitted within 6 weeks postpartum (cases) and 213 records of post-cesarean section patients who were not readmitted (controls), in a ratio of 2 controls to 1 case, after cesarean sections performed at KNH from January 2014 to December 2019. The socio-demographic, intrapartum, postpartum factor and comorbidities were summarized as frequencies or means and compared using Chi-square or student t-test for categorical data and continuous data respectively. Univariate and multivariable logistic regression adjusted for confounding factors were conducted to determine crude and adjusted odds ratios (aOR) and their 95% confidence intervals. Statistical significance was based on a p-value < 0.05. The indications for readmission and outcomes were tabulated and presented as frequencies (percentages) for the cases. The data was analyzed using the STATA version15.

Results: Between January 2014-December 2019, 25,449 patients underwent CS at KNH. Of these, records of 107 out of 166 cases and 213 out of 334 controls were eligible. The main risk factors for readmission post CS in KNH were unemployment (aOR 1.87, 95% CI [1.00 - 3.49], P<0.05), referral from another facility for CS at KNH (aOR 2.23, 95% CI [1.14 - 4.33 P<0.05]), induction of labour (aOR4.27, 95% CI [1.94 - 23.34], P<0.05) and intraoperative hemorrhage (aOR11. 50, 95% CI [1.19 - 111.18], P<0.05). The most common indication for readmission was

due to surgical site infections (72.89%). Fifty-eight percent of the readmitted patients were managed conservatively post-CS while 42.1% had surgical interventions. The median length of stay post-discharge was 3 days. All readmitted patients were discharged home.

Conclusion: Main risk factors for post-CS readmission were patients who had been managed at peripheral facilities then referred to KNH for CS, and induction of labour. The most common indication for readmission was due to surgical site infections (72.89%). The average length of stay during readmission was 3 days. Fifty-eight percent of patients were managed conservatively while 42.1% of the readmitted patients required surgical intervention. All patients were discharged home.

Recommendations: To reduce readmission post-CS, infection reduction and surveillance should be instituted especially among those with risk factors which include the unemployed, referrals to KNH for CS, and induction of labour.

Keywords: readmission, cesarean section, postpartum.

1.0 INTRODUCTION

1.1 Background

Cesarean section (CS) is one of the most common major surgical procedures in Obstetrics. It is an effective lifesaving procedure in preventing maternal and perinatal mortality and morbidity when medically indicated(8). The rate of CS has been on a rising trend globally(9). The global CS rate in 2000 was at 12.1% and in 2015 it had risen to 21.1 % a rise of 3.7% annually(10). This rise has been attributed mainly due to an increase in the proportions of births at health facilities and also an increase in the use of CS by these facilities(10).

There are still great disparities in CS rates among countries, with high-income countries having higher rates compared to low-income countries (LIC). Countries with high socioeconomic status, higher level of education- secondary level, urbanization, greater physician density, and low fertility index tend to have higher CS deliveries per population(10). In LIC there is low a CS rate even when it is medically indicated due to poor accessibility and availability of healthcare services, poor infrastructure in health facilities, and financial constraints that cause catastrophic health spending leading to an increase in poverty level(11).

There is no consensus on the recommended CS rate per population but the World Health Organization (WHO) 1985 had proposed an ideal rate of between 10%-15%(12). It states that when the cesarean rate rises towards 10% across a population, the number of maternal and newborn deaths decreases. There is no evidence that a CS rate above 10% improves mortality rates. This ideal CS rate remains contentious but each case must be well assessed for the need of the procedure.

.

Women who deliver through CS have a higher risk of short term complications such as admission to intensive care unit (ICU), blood transfusion, and surgical interventions like hysterectomy, and in patients where hysterectomy is not, done there is an increased risk of adverse events in the next pregnancies(11).

Women who deliver through CS are at a higher risk of readmission than those who have had spontaneous or assisted vaginal delivery (13)(14)(15). The most common indications for readmission post-CS are hypertensive disorder (9.3%), surgical site infection (SSI) or dehiscence (8.3%), psychiatric disease(7.7%), and uterine infection (7.2%)(13).

Readmission rate is a recognized metric used to measure the quality of healthcare in surgical and medical specialties, the primary goal of this evaluation is to prevent morbidity. Identifying and preventing avoidable hospital readmission leads to improved quality of care, reduces the cost of healthcare both to the patient and the institution, and improves outcomes.

According to the Kenya health demographic survey (KDHS)2014, Kenya's national CS rate in 2014 was at 8.9% with Nairobi having the highest CS rate at 20.7%(16). The rate of CS deliveries at Kenyatta National Hospital was at 30% according to Juma et.al in 2015 (17). This figure has since increased up to 44% in 2019 based on KNH monthly morbidity and mortality meetings in 2019. This rise can be attributed to the introduction of the free maternity program in 2013 and later the Linda Mama initiative of 2016 by the government, increasing accessibility of healthcare services to pregnant women and therefore increasing the number of women delivered by skilled birth attendants.

There is no institutional data at KNH, local or regional data on risk factors and indications among patients readmitted in the postpartum period post cesarean section. This information will aid in stratifying antenatal patients as high or low risk and institute measures to prevent their readmission post-CS and also provide a framework for the discharge of patients. It is against this background that the researcher had sought to examine the risk factors indications and outcomes among patients readmitted during the postpartum period post cesarean section done at KNH.

2.0LITERATURE REVIEW

2.1Overview of the Chapter

This section incorporates literature review on risk factors and indications among women readmitted in the postpartum period after cesarean section and various strategies that have been instituted to reduce hospital readmission. The themes in this section are informed by the study objectives.

2.2 Risk Factors for Post Cesarean Section Readmissions

Readmission after CS is associated with maternal sociodemographic factors and antepartum factors, intrapartum and postpartum related factors as risk factors to readmission.

2.2.1 Social demographic and antepartum factors

Demographic factors include maternal age, body mass index (BMI), level of education, and marital status. Creanga et.al in 2015 found that maternal age has a significant influence on maternal morbidity. Those mothers who delivered above 35 years were at a higher risk of developing severe morbidity, 35-39 years with a relative risk of 1.9 (1.8-1.9) and the highest at 4.8 (4.2-5.6) relative risk between 45 and 49 years(18). Pallasmaa et.al in 2010, in a multicenter cohort study, found that women aged ≥35 years had 1.2 times higher odds of developing severe complications, hemorrhage, intraoperative complications, and re-operations than women aged 20–34.9 years (OR 1.2, 95% CI (1.0–1.5))(19).

Obesity has been associated with operative and postoperative complications and comorbidities. Peiront et.al in 2014 the mechanism associated with postoperative complications in those with higher body mass index (BMI) is postulated to be due to poor vascularity of the excess adipose tissue and prolonged pro-inflammatory phase affecting normal wound healing process(20). This predisposes to complications such as surgical site infections and fascial dehiscence stated in the

studies by Peiront et.al 2014 and Wolch et.al 2012 found it to be an independent risk factor for surgical site infection were overweight women (BMI 25–30 kg/m2) are at odds of 1.6 times greater and obese women (BMI > 30)2.4 times more at risk of developing SSI than normal-weight women BMI (18.5–25) (20)(21). A study by Kawakita et.al 2015 involving 3805 women who delivered through the caesarian section, found that the BMI at admission influenced the readmission rates, with an adjusted odds ratio (aOR) of 1.05; 95%CI 1.01-1.10(22).

Antenatal care has a profound impact on the continued outcome of the pregnancy and deliveries. The World Health Organization (WHO) considers maternal child care as a process that should start before pregnancy, continue during the pregnancy, and after delivery(23). The level of quality of care the mother receives during the antepartum period influences the risks for postpartum readmission(24). The quality of care the mother receives during the antenatal visits such as healthy nutrition; assessment and effective management of complications; maternal screening and immunization, and the preparation put towards cesarean section do influence the risks of postpartum readmissions(25).

Pallasmaa et.al 2010 found that gestational age of 30–36 weeks at delivery was associated with a higher risk of all complications (OR 1.31, CI 1.00–1.70) and severe complications (OR 1.8, CI 1.28–2.55) than delivery at gestational age >37 weeks. The risk of complications was even higher when CS was performed before 30 gestational weeks(19).

Simone et.al in 2003 found that 64.5% of HIV positive mothers developed complications such as mild anemia, mild fever, urinary tract infection, and pneumonia, and those with CD 4 counts more than 500×106 CD4+ lymphocytes which was protective (26) all found to be risk factors for readmission post-CS.

Comorbidities in the antepartum period such as hypertension, diabetes, and anemia in pregnancy have been associated with post-CS readmission.

Hypertension in pregnancy is part of the top two leading causes of direct obstetric deaths accounting for 14% (343 000, 11.1–17.4) of the deaths after hemorrhage. Hypertension in pregnancy accounted for 27.1% (661 000, 19·9–36·2) of maternal death in a study by Say et.al 2014 on “global causes of maternal death”(27). In 2016, Ye Chun et.al found that patients with

hypertensive disorders of pregnancy(HDP) recorded higher CS rates than those without hypertension at 53.36%, OR of 2.92 and 95% CI 2.74,3.10 (P<0.001)(28). In the same study, those with HDP were more likely to have complications such as postpartum hemorrhage (PPH) at a rate of 6.44% in those with HDP and 3.59% in those without HDP(28). In a case-control study, Hirshberg et.al found that 25 out of 440 patients who were readmitted during the postpartum period had hypertension which was diagnosed during the antenatal period (29).

Cunningham et.al in 2014, reported that patients with pre-gestational diabetes mellitus were at an increased risk of complications such as miscarriage, fetal anomalies, fetal growth abnormalities, intrauterine fetal demise, gestational hypertension, preeclampsia, birth injury, and operative delivery(30). In this study, 951570 California birth records were assessed for the years 1999 through 2003 about 6.6% of those diagnosed with gestational diabetes mellitus were readmitted after delivery as well as 18.5% of those with preexisting diabetes (30). In this study, the incidence of wound infection was found to be at 18.4% (34/185) in diabetic women and 5.8% (10/174) in control patients for an unadjusted OR 3.7 (95% CI, 1.8-7.7, P>0.05). Notably, those with pre-gestational diabetes were found to be at 2.5 times higher risk of wound infection., according to Takoudes et.al 2004 (31). In 1986 Diamond et.al on the occurrence of endometritis and wound complications post CS was also higher in diabetic women compared to non-diabetic women, the study found that it occurred in 25% of diabetic women and only 6% of non-diabetic women(32). This susceptibility to infection has been associated with cellular changes such as dysfunction in the white blood cells and the metabolic abnormalities leading to inadequate migration of neutrophils and macrophages to the wound site and reduced chemotaxis stated by Delamaire et.al 1997(33).

WHO defines anemia in pregnancy as a hemoglobin concentration less than 11g/dL in venous blood. The global prevalence among pregnant women was 38.2% (95% CI: 33.5—42.60) (34). Pregnant women with the lowest mean blood hemoglobin concentrations and the highest prevalence of anemia across population groups had a prevalence of anemia at 38.9% to 48.7% in regions like South-East Asia, Eastern Mediterranean, and African Regions(34). The main cause of anemia according to “global prevalence of anemia” by WHO 2011 was iron deficiency. (34)

A study by White et.al 2017 found that the risk of postoperative complications increases with the severity of anemia whereas patients with severe anemia have an 8.58 [3.65, 19.49] higher odds of experiencing surgical complications ($p<0.001$) compared to those who are not anemic. Complications reported were ICU admissions (odds ratio 33.13[9.57, 110.39],$p<0.001$), surgical site infection (7.29[1.98, 21.45],$p<0.001$), and hospital readmission (7.48[1.79, 25.78],$p<0.001$). (35) The most likely indications for readmission for those with anemia is due to surgical site infection, bleeding, or hematoma formation requiring intervention, and wound dehiscence not associated with infection(35).

2.2.2 Intrapartum risk factor for post-CS readmission

The intrapartum phase for mothers undergoing CS section may be short or prolonged due to delivery complications. Intrapartum factors have been classified as obstetric and surgical factors for this study. Obstetric factors associated with readmission are; the presence of chorioamnionitis, premature rupture of membranes, duration of rupture of membranes, the onset of labour (spontaneous vs. induced), and phase of labour. The surgical factors include the number of cesarean section scars, indication for CS, Nature of CS, prophylactic antibiotics before surgery, abdominal skin incision type length of CS, intra-operation complications.
The presence of chorioamnionitis even after treatment still increases the risk of developing infection post-delivery. In a study by Dotters et.al 2015 where 213 women with chorioamnionitis had CS, 22.5%(48) of the patients developed postoperative infections within the postpartum period, 16 developed endometritis, 8 had urinary tract infections (UTI), 32 (15%) patients were diagnosed with SSI and of this number 8 patients had more than 1 diagnosis(36). Prolonged rupture of membranes and premature rupture of membranes increases the risk of postpartum readmission. A study by La Rosa et.al 2019 reported that prolonged ruptured membranes > 18 hours was a significant risk factor for readmission in the postpartum period after CS with 1.9 times higher odds for readmission (aOR: 1.9, 95% CI:1.3–2.8)(37)(38).

According to Smail (2014), a Cochrane database of systemic review administration of prophylactic antibiotics before elective or emergency CS has been shown to lower the incidence of post-CS wound infection(RR 0.40; 95% CI), endometritis (RR 0.38; 95% CI 0.34 to 0.42) and serious infectious morbidity (RR 0.31; 95% CI 0.20 to 0.49.)(39). The guideline

recommendation for prophylactic antibiotic use in KNH was developed in 2017 and includes the use of cefazolin intravenously 15 to 60 minutes before skin incision and for those with penicillin allergy: clindamycin or erythromycin is given intravenously.

The nature of the surgery also predisposes to the risk of readmission, patients who undergo emergency CS were found to be at a higher risk of surgical site infection and puerperal febrile illness compared to those who underwent elective CS(40)(41). A metanalysis by Yang et.al 2017 also reported higher incidence of infection, fever, UTI, wound dehiscence, DIC, and reoperation of emergency CS were higher than those who had of elective CS (RR=0.44, 95% CI[0.37-0.5],P<0.00001; RR=0.29, 95% CI [0.19-0.45],P<0.00001; RR=0.31, 95% CI [0.23-0.41], P<0.00001; RR=0.67, 95% CI [0.48-0.95],P<0.02;RR=0.34, 95% CI [0.17-0.6],P<0.001; RR=0.44,95% CI [0.21- 0.93],P<0.03, respectively (42).
The time taken for a CS operation was a significant indicator for readmission with those taking more than 60 minutes having a high risk [aOR: 1.5, 95% CI[1.0–2.3], (22)(43). A study done by Vasla et al 2016 found that emergency CS had a 9 times higher risk of having intrapartum complications than those who had an elective CS (OR=9.0, P<0.05).

One other factor that has been attributed to influencing the degree of readmission is the type of skin incision, the low transverse incision, or the sub umbilical incision. The low transverse incision is often preferred because of accelerated wound healing ($p = 0.048$), reduced length of scarring ($p < 0.001$), and improved tolerance to pain ($p < 0.001$) (44). A study by Gelaw et.al 2017 reported that sub-umbilical incision is associated with the development of SSI at 5.7 higher odds (aOR5.733; 95%Cl [2.05-16.00]) Pfannenstiel due to poor wound apposition. (38)
The surgical technique employed can also determine the outcome of the mother, thus, influencing the length of stay in the hospitals, risk of infections, and risk of readmissions (45). In a study assessing the relationship between an epidural or general anesthesia and risk of maternal or neonatal outcome, evidence indicated that there is no statistical significance indicating either as superior to the other (46).

2.2.3 Postpartum risk factors for CS readmission

In a study by L Rosa et.al 2019 involving 2013 women, the risk of readmission post-delivery was elevated among those diagnosed with postpartum fever (aOR: 4.6, 95% CI: 3.0–7.0)(37).
Duration of urinary catheterization has a significant potential to cause catheter-related urinary tract infections. The best practice evidence indicates that the catheter should be removed at the end of surgery and if it has to be left only for 24–72 hours, as soon as the mother can ambulate. (47) In a cohort study by Gundersen T.D et.al in 2018 assessing the prevalence of urinary tract infection based on the mode of delivery, indicated that patients who had caesarian section had a statistically significant increased risk of postpartum urinary tract infection in comparison to those who had vaginal deliveries (OR 1.33, 95% CI [1.27-1.4])(48).

The length of stay in the hospitals is also a major risk factor for readmission. The time of discharge from the hospitals may also have a considerable influence on the readmission rate based on the degree of recovery. Discharge from hospital too early before full recovery or prolonged stay in the hospital is likely to lead to increased risks for readmission according to Campbell et.al in 2016(49).

2.3 Major indications for post cesarean section readmissions

A study by Lydon-Rochelle et.al found that the indications for readmission post CS were SSI (RR = 30.2; 95% CI, [18.8-47.4])), thromboembolic conditions (RR = 2.5; 95% CI[1.5-3.5]) cardiopulmonary conditions (RR = 2.4;95% CI[1.8-.4]),uterine infection (RR = 2.0; 95% CI[1.7-2.4]), appendicitis (RR = 1.8; 95% CI[1.3-3.0]), gallbladder disease (RR = 1.5; 95%CI[1.3-1.9]) and genitourinary tract conditions (RR = 1.5; 95% CI[1.2-2.0])(14).A study by La Rosa et.al 2019 reported that infectious causes(75.2%) and hypertensive(8.2%) complications were the most common indication for readmission.

2.3.1 Incision site-related complications and other acute infections

In a study that assessed a total of 1,392,622 deliveries in the United States with the rate of readmission within post 30 days of delivery being 136/10,000, the leading cause of readmission

irrespective of the site of care was wound infection (n = 1733, 9.1%) (50). These findings were in line with the results of a study conducted in an Irish maternity hospital involving 8580 mothers of which 2470 had given birth through the caesarian section(51). In this Irish study, the most common reason for readmission was infection to the incision site. The risk of surgical site infections(SSI) was found to be influenced by the immunity level of the mother, aseptic wound care technique, hygiene of the hospital, comorbidity factors, and demographic characteristics of the mother (52) (51)(53).

The number of previous caesarean sections is also a risk factor for incision site complications(53). Equally, obesity and maternal age below 20 years were significant risk factors of incision site infection(21).

Acute infection such as endometritis occurs in 2-16% of CS according to Fitzwater et.al 2014(54). It is an infection of the decidua with a polymicrobial profile. Patients present with fever > 38^0C, fundal tenderness, and purulent vaginal discharge. The independent risk factors for endometritis are CS performed during labour and those who had prolonged rupture of membranes >12 hours before CS.

In a study assessing the prevalence of urinary tract infection based on the mode of delivery, the caesarean section had a significantly higher risk of postpartum urinary tract infection compared to vaginal deliveries(48). An independent risk factor was the length of urethral catheterization >72houpost-CS CS (47).

Other acute infections also contribute to a significant proportion of post-CS readmissions. In a study assessing the incidence of non-urogenital infection among 222,751 deliveries of which 2,655 were postpartum readmissions, the leading non-urogenital infections among the readmitted cases were pneumonia (84%), cholecystitis (46%), or appendicitis (43%)(55). Most of the readmissions were secondary to cesarean section (55.7%) compared to spontaneous vaginal delivery (44.3%)(55).

2.3.2 Other indications of postpartum readmissions

Patients are readmitted following a late diagnosis of bladder injuries, which were rated at 0.13% in a study involving 56,000 caesarian section deliveries in Turkey(56). In Ireland, in which

records were evaluated from 2005 through 2008, the major indications of readmissions included CS complications and postpartum hemorrhage(57).

Venous thromboembolism (VTE) is a direct cause of maternal morbidity presenting as deep venous thrombosis (DVT) and pulmonary embolism (PE). Puperium is a hypercoagulable state and has been reported to have a 4-5 times higher risk of VTE than women of the reproductive age(58). The highest risk is the third trimester up to 6 weeks post-delivery(58)(59). Independent postnatal risk factors were cesarean section and preeclampsia(59).

2.4 Management and outcome of readmitted patients

Surgical site infection (SSI) is reported in 3-7% of CS deliveries(60)(61).The most common organism cultured from CS wounds is *Staphylococcus aureus* (61)(62). Other organisms found are *Staphylococcus spp Escherichia, Klebsiella spp, Enterobacter aerogenes* (61). Gram positives bacteria are sensitive to a penicillin (ampicillin, amoxicillin-clavulanate), aminoglycosides, quinolones (ciprofloxacin), glycopeptides (vancomycin) trimethoprim/sulfamethoxazole. For the gram-negative bacteria, they are sensitive to aenicillin (ampicillin amoxicillin-clavulanate), cephalosporins (cephazolin, ceftazidime, ceftriaxone), a carbapenem (meropenem, imipenem, ertapenem), quinolone (ciprofloxacin), trimethoprim/sulfamethoxazole(63)

For superficial wound infections treatment with oral antibiotics is adequate(63) (54). Empirical treatments combinations are clindamycin with an aminoglycoside or aztreonam, extended-spectrum penicillins (eg, piperacillin/tazobactam), and carbapenems. (54) In cases of deep wound infection or those with purulent discharge wound debridement is recommended to remove necrotic tissue and debris this is achieved with sharp debridement(64).

Wound dressing can be done using wet to dry gauze that debrides the necrotic tissue during dressing change. Other forms of dressings used are films hydrogel, foam, hydrocolloids, alginates, and hydro-fibers. There is no difference in the rate of wound healing based on t different types of dressing used. (65) Infected wounds can heal by secondary intention.

Delayed closure can be used for infected wounds a systematic review study (66) showed that with re-closure of 81-100% of the wounds heal and the healing was much faster compared to

those healing with secondary intention. Those wounds that failed with closure had recurrent abscess formation.

Necrotizing fasciitis is a progressive inflammatory infection of fascia with secondary necrosis of the subcutaneous tissue. It is a polymicrobial infection with *Clostridium* and group Ab-hemolytic *Streptococcus*. Management is with early aggressive surgical debridement and broad-spectrum antibiotic. Re-exploration of the wound after 24 hours – 36 hours then daily until all necrotic tissue is debrided. Empiric treatment includes vancomycin, linezolid, or daptomycin combined with either, piperacillin-tazobactam, carbapenem, ceftriaxone, metronidazole, or fluoroquinolone and metronidazole(67).

Postpartum endometritis is treated using antibiotics such as clindamycin in combination with gentamicin(68). Heparin or warfarin can be used in the treatment of venous thromboembolism in the postpartum period is safe even for lactating mothers.

Bladder and urethral injuries require Ureteroneocystostomy

2.5 Summary and research Gap

In summary, there is profound evidence on the need to cut down on the rate of readmissions, not only in postnatal wards but in the hospitals in general. Readmissions post-CS poses a significant risk to the patient and healthcare system by increasing the cost of care, hospital congestion, increasing risk of staff burnout, and reduces the level of satisfaction for both the caregivers and the patients. In this connection, the need to reduce the rates of readmission has been supported by substantial facts and statistics.

There is a gap in terms of the availability of data and evidence on the risk factors and indications of readmission among postnatal mothers who have delivered through a caesarean section at KNH and locally. Studies available on risk factors for readmission post-CS are from high-income countries and may not adequately reflect the situation in the LMIC setting to inform readmission reduction interventions and the associated burden on the patient and healthcare system. Therefore, understanding the risk factors and the indications of readmission after CS at KNH is critical towards stratification of patients into high risk and low risk for readmission and

establishing evidence-based interventions for improving patients' outcomes and reducing readmissions at the country's biggest referral hospital.

3.0 Statement of the problem

On a global scale, the rate of caesarian sections has been on the rise. Some of the factors that are attributed to the increase in the number of CS deliveries include advocacy to abolish trial of scar, avoid instrumental assisted delivery, consider all breech presentation for CS, early detection of fetal jeopardy in vaginal deliveries, prevention of mother to child HIV transmission, and an increased demand for CS deliveries. (11)

Locally according to findings reported by Juma et al 2015(17) the rate of CS deliveries at the Kenyatta National Hospital was at 33%, but currently, it's as high as 44% in 2019 based on monthly maternal mortality meetings 2020. Patients undergoing CS are 26 times more at risk of having maternal mortality/morbidity(11). Therefore, mothers who delivered through CS are more likely to be readmitted due to post-surgical complications. In a study conducted in the US by Clapp et al (13), the findings indicated that the readmission rate for postpartum patients increased from 1.72% in 2004 to 2.16% in 2011.

The cost of readmission is a burden to both the patient and the healthcare system. A study by Olsen et.al 2010 on "Attributable Costs of Surgical Site Infection and endometritis after low transverse cesarean delivery" found that the estimated crude costs associated SSI (*n*=80) $10,317 (4,703–140,478)and endometritis(*n* =121) $11,141 (4,248–57,263) and or patients with no SSI or endometritis(*n*=1,415) $6,829 (1,642–277,573)(69). Attributable total hospital costs estimated for SSI is $3,529 and $3,956 for endometritis. For patients with SSI room and board costs contributed significantly to the increase in cost accounting for 48%of the total cost and only 29% for patients with endometriosis(69). Patients with endometritis had pharmacy expenses making up 47% of the total cost as compared to 32% for SSI(69).

The rising number of cesarean sections in KNH means that the hospital is likely to have an increase in the rate of postpartum readmission, yet such cannot be substantiated as there is no study - as far as the researcher is aware - that has assessed the link between CS deliveries and

risk factors associated with readmissions post-delivery in KNH. Without such evidence, the hospital may fall short of instituting feasible and effective measures required to reduce postpartum readmissions for CS deliveries.

4.0 Study justification

The purpose of this study was to determine the risk factors, indications, and outcomes of patients readmitted after CS was performed at KNH. Readmission is part of the metric currently used to determine patient safety and quality of care in hospital settings in both surgical and medical specialties. Readmission to hospital has been cited to cause an increase in morbidity and mortality to the patient and also an added cost to both the patient and hospital.

There has been an increase in the number of women delivering through CS both globally and locally. In Kenya, this can be attributed to the increase in access to healthcare for pregnant women aided by the various Kenyan government initiatives. The CS rate in KNH has been on a rising trend. While CS is a lifesaving procedure both for the mother and baby when medically indicated, women who deliver through CS are at higher risk of short-term and long-term complications(11). They are therefore at risk of having readmission in the postpartum period as compared to those who deliver vaginally(11).

Studies from high-income countries have identified high BMI, medical comorbidities such as gestational diabetes, pre-gestational diabetes, chronic hypertension, prolonged rupture of membranes > 18hours, and longer surgery duration as risk factors for readmission after cesarean section (14). No studies have been done in sub-Saharan Africa specifically Kenya based on our search on Pubmed to determine the risk factors for readmission after CS. Understanding the underlying causes of readmission is essential in designing effective readmission prevention interventions.

The data collected from this study will identify the characteristics of patients who are at risk of readmission post-CS in KNH. This will inform the patient safety team in the hospital on gaps in the care of patients which would otherwise be missed or can be improved on leading to improved quality care, patient satisfaction, and outcomes among patients delivering through CS. In doing

so stratification of patients as high risk or low risk can be done and tailored management can be instituted during discharge to prevent avoidable readmission.

The data from the study will also aid in the formulation of a comprehensive discharge summary with more information to aid patient self-care post discharge reducing postpartum complications and identifying danger signs early to seek care. This will also improve and standardize the health worker's ability to educate the patient on danger signs and self-care in the postpartum period during discharge.

5.0 Conceptual framework

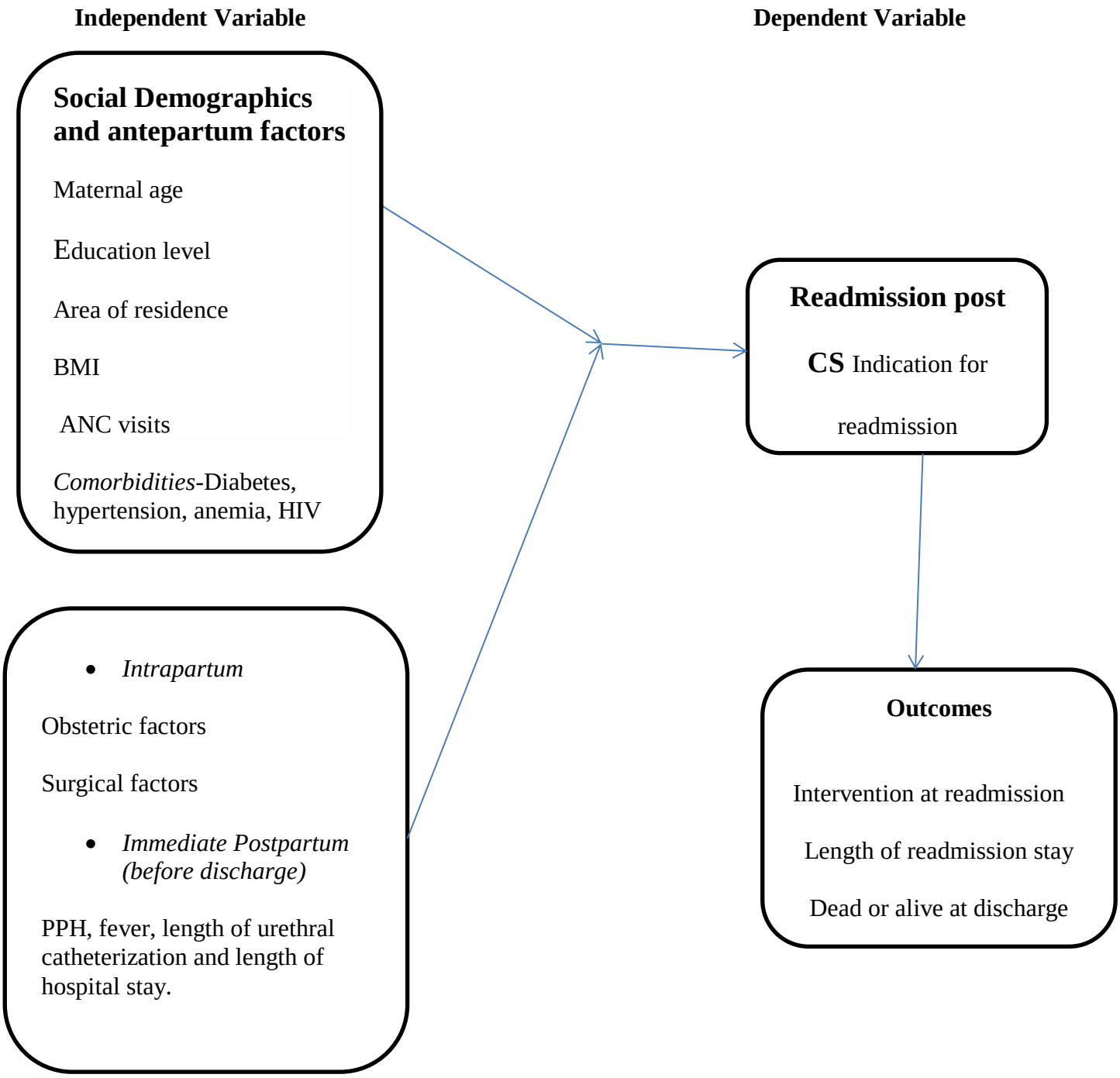


Figure 1conceptual framework

This study examined the relationship between the presence of the risk factors (independent variables) among patients who delivered via CS performed at KNH and admission after discharge from the hospital. The risk factors have been classified into socio-demographic factors, intrapartum and postpartum factors. The dependent variable is readmission post-discharge. Indications for readmissions post-CS include infections such as SSI and puerperal sepsis, secondary PPH, VTE, and medical conditions. The outcomes of this study are the length of stay during readmission, interventions at readmission, and the patients' status at discharge.

6.0 Research question

What are the risk factors, indications, and outcomes of readmission after cesarean sections performed at Kenyatta National Hospital?

7.0 Objectives

7.1 Broad objective

To determine the risk factors, indications, and outcomes of readmission after cesarean sections performed at Kenyatta National Hospital.

7.2 Specific objectives

7.2. 1 Primary objective

I. To determine the social demographic and antepartum, intrapartum, and postpartum factors associated with readmission after cesarean sections performed at KNH.
II. To determine the indications for readmission after cesarean sections performed at KNH.

7.2.2 Secondary objective

I. To describe the outcomes of readmissions after CS performed at KNH.

8.0 METHODOLOGY

8.1Research Design

This was an unmatched case-control study in which 107 records of post cesarean section patients readmitted (cases) and 213 records of post cesarean section patients who were not readmitted (controls) within 6 weeks postpartum between January 2014 and December 2019 were evaluated for risk factors, indications, and outcomes of post cesarean section readmission.

8.2 Study Setting

The setting of this study was Kenyatta National Hospital (KNH), the largest referral hospital in Kenya. It is a well-equipped facility with a comprehensive reproductive health unit including access to an intensive care unit (ICU) and renal unit. The study period was from December 2019 moving backward until the sample size was reached in January 2014. KNH has a high number of CS as indicated by Akech et.al with over 5000 CS each year(70). KNH is the appropriate setting for examining our population, considering the high probability those patients who had a CS at this facility and experience complications are more are likely to return to the facility for readmission

8.3 Study Population

The sample population comprised of patients readmitted after CS performed in KNH as the cases and the controls were patients not readmitted after CS performed in KNH as per the inclusion and exclusion criteria below.

8.4 Inclusion and exclusion criteria

8.4.1 Inclusion criteria

I. Women who were admitted to post-discharge up to 6 weeks after CS performed at KNH as case population.

II. Women who had cesarean section performed at KNH and were not admitted post-discharge as controls

8.4.2 Exclusion

I. Readmitted patients whose CS was not performed at KNH.
II. Women who had a CS performed at KNH, developed complications post-discharge had an unscheduled visit to outpatient facilities, or had readmission to other health facilities.
III. Women admitted after 6 weeks post CS at KNH.

8.5 Study Variables

8.5.1 Risk factors for readmission

Patient records were reviewed for socio-demographic characteristics for (a) Age, (b) education level classified as primary, secondary, and tertiary level, (c) county of residence, d) parity defined as the number of times the mother has given birth (e) BMI at delivery which was calculated as the weight (kg) divided by the square of the height (m) and will be categorized with cut-off points of<18.49kg/m2(underweight), 18.50–24.99kg/m2(normal-weight), 25.00–29.99 kg/m (overweight), and 30 kg/m2 (obese), (f) gestational age at delivery (based on last menstrual period and when available the first-trimester ultrasound), (g) number of ANC visit during the pregnancy.

Antepartum comorbidities such as anemia, diabetes grouped as gestational or known DM, and hypertension classified as pre-eclampsia, eclampsia, and chronic hypertension.

Intrapartum factors were reviewed as obstetric factors and surgery-related factors; obstetric factors; (a) presence of chorioamnionitis, (b) premature rupture of membranes (ROM before the onset of labour), (c) duration of rupture of membranes, (d) onset of labour spontaneous vs. induced, (e) phase of labour during surgery, not in labour, latent phase of labour defined as dilation > 4cm, and active phase of labor defined as cervical dilation $\geq$4 cm up to delivery. Surgery related factors; (a) Number of previous CS scars, (b) nature of surgery (emergency or

elective CS) (C) length of CS in minutes < 60 minute, >60 minutes, (d)surgeon- consultant or resident (e)type of skin incision- vertical or horizontal (f)prophylactic antibiotics given before surgery, (g)intra-operation complications.

Postpartum factors include (a) PPH blood loss >1000ml (b) febrile illness temperature reading above 38^{0C}, (c) length of urethral catheterization, intra-operatively (in and out catheterization) < 48hourshours or >48 hours, (d) length of hospital stay in days.

8.5.2 Indications for readmission

This are the primary indication of readmission based on ICD 10 and they included (a)SSI, (b)puerperal sepsis, (c) secondary PPH, (d) VTE, (e) anemia, (f) medical conditions including cardiac conditions, asthma, pneumonia, and peptic ulcer diseases,

8.5.3 Outcomes of readmission.

Outcomes of these patients were also assessed as the average length of stay before readmission, management during readmission which includes conservative management or surgical intervention, and status post discharged described as alive or dead

8.6 Sample size determination and formula

The Sample size was calculated using the difference in proportions - Fleiss JL (with cc) formula (Statcalc info TM) as outlined below. The proportion of controls and odds ratio were derived from secondary analysis of data on incidence and risk factors for readmission by La Rosa et.al 2019. (37) The following assumptions were considered during the calculation:

$$n = \left(\frac{r+1}{r}\right)\frac{(\bar{p})(1-\bar{p})(Z_{\beta}+Z_{\alpha/2})^2}{(p_1-p_2)^2}$$

n = sample size per arm

r = ratio of controls to cases, 2:1 in this case, taken to maintain the power of the study at 80% and also to be able to conduct multivariate analysis of the different variables

P1= Proportion of women who were readmitted to KNH post-discharge up to 6 weeks after a CS done at KNH, the cases 34.62%

P2= Proportion of women who were not readmitted post-discharge up to 6 weeks after a CS done at KNH as controls 19.4%

Ṕ = measure of variability, taken as 34.62+19.4/2=27.01

Zβ= Value corresponding to the power of the study, in this case, 80% = 0.80

Zα = Value corresponding to the normal standard deviate at 95, in this case, = 1.96, with 0a .05 level of significance

P1- P2 = effect size (difference in proportions)

Odds ratio to be detected of 2.2 (La Rosa et.al 2019)

Applying this in the Statcalc epi info software gives a value of 320 as the sample size with 107 as cases and 213 as controls as shown below:

Table 1:Stalc epi info software

Sample Size for Unmatched Case Control Study		
Two-sided confidence level	95	(1-alpha) usually 95%
Power(% chance of detecting)	80	Usually 80%
Ratio of Controls to Cases	2	For equal samples, use 1.0
Percent of controls exposed	19.4	Between 0.0 and 99.99
Please fill in one of the following. The other will be calculated.		
Odds ratio	2.2	
Percent of cases with exposure	34.62	Between 0.0 and 99.99

Table 2: Sample size calculation results

Sample Size for Unmatched Case-Control Study

For:

Two-sided confidence level(1-alpha)	95
Power(% chance of detecting)	80
Ratio of Controls to Cases	2
Hypothetical proportion of controls with exposure	19.4
Hypothetical proportion of cases with exposure:	34.62
Least extreme Odds Ratio to be detected:	2.20

	Kelsey	Fleiss	Fleiss with CC
Sample Size - Cases	94	97	107
Sample Size - Controls	188	194	213
Total sample size:	282	291	320

References

Kelsey et al., Methods in Observational Epidemiology 2nd Edition, Table 12-15
Fleiss, Statistical Methods for Rates and Proportions, formulas 3.18 &3.19

CC = continuity correction
Results are rounded up to the nearest integer.

8.7 Sampling procedure

The researcher used consecutive sampling to select the cases from the records. For each case selected, controls were selected consecutively as patients who had a CS done the same period day as the case. The controls selected were called and verbal consent was obtained, once given questions were asked to confirm eligibility. The first 2 respondents to meet these criteria had their records used as controls for the study. All those who declined consent did not pick up the phone call, or did not meet the criteria were excluded from the study.

8.7 Study Procedures

8.7.1 Data Collection Method and Management

The data for this study was collected from patients' files using a data retrieval form (Appendix 1). Unit data was collected from the theater department of the hospital, casualty, and ward 1D, and files were retrieved from the central registry, the patient health records at KNH using the patient's unique identifying numbers. Due to the small numbers of patients being readmitted the study duration was from December 2019 going back until the sample size number was reached. The information collected for the study comprised all relevant information on the independent and dependent variables. Information from the patients' file was kept in a private laptop and encrypted to ensure that ethical issue of privacy and confidentiality was observed. This included assigning a study number identity for all eligible patients and used henceforth.

8.7.2Training Procedures

The study team comprised the PI and two research assistants. The research assistants underwent training on the collection of data, confidentiality, and techniques for extracting retrospective data accurately first by observing then collection under supervision. There was supervision during data collection by the researcher and supervisors.

8.8 Quality control and assurance

Quality control and assurance procedures were conducted continuously throughout the study period to maximize the validity and reliability of the findings. Pre-testing of study instruments was carried out to correct for bias, misinterpretation of the questions, and ambiguity. The validity of the study was ascertained by ensuring that the data collection instruments reflect the objectives of the study. The research instrument was approved by the University supervisors.

During the data collection phase, the trained research assistants worked closely with the researcher to ensure questionnaire completeness and all the relevant information is collected. The

trained research assistants were supervised by the principal researcher throughout the study period. EpiData software was used during data entry to store the data, get rid of inconsistencies, and ease data cleaning.

8.9 Data analysis

Data was analyzed using STATA 15. Before analysis, all the variables were checked for outliers, inconsistencies, missing data, and distribution. Visual inspection of all continuous variables using scatter plots, box plots, or histograms was done to identify outliers and the distribution of the data. Some of the values in the categorical variables were grouped especially where the subgroups had small numbers.

Descriptive analysis was carried out to describe the population through means (standard deviations) or medians (interquartile range) and frequencies (percentages) and presented in the tables shown in the results section. Chi-square for categorical data and student T for non-categorical data, were used to test for statistical significance. Wilcoxon rank-sum test was for non-normally distributed continuous variables while Fishers' exact test was used where frequencies were small.

Inferential univariate analysis was carried out to determine whether the observed differences between the cases and the controls were due to chance.

Simple logistic regression was used to compare the association between participant characteristics and readmission (case/control), crude odds ratio with 95% confidence intervals have been presented. Each of the covariates was checked for association with readmission and significant risk factors were then selected for the multivariate model.

Multiple logistic regression analysis was carried out to determine the factors affecting the readmission. Likelihood ratio test was used to determine statistical significance and confidence intervals for adjusted odds ratios have been presented.

Objective 1 – the sociodemographic, intrapartum, and postpartum factors and comorbidities were compared for the cases and controls. Chi-square/fishers exact and student t-test/Wilcoxon rank-sum test were used to test for statistical significance. Univariate and multivariate logistic regression was also carried out to determine significant associations. Odds ratios and their 95% confidence intervals have been presented.

Objective 2: The indications for readmission after CS were tabulated and presented as frequencies (percentages) for the cases.

Objective 3: The outcomes of readmitted patients included the average stay during readmission and interventions carried out at readmission have been tabulated in the results section.

8.9 Ethical issues in research

The researcher received permission from the Kenyatta National Hospital and University of Nairobi the research committee at the institution of study [University of Nairobi]-P143/03/2020. Before commencing the study, permission was sought from KNH Department of Obstetrics and Gynecology. The researcher took verbal consent for the control group only before proceeding with the telephone conversation to determine if they meet the eligibility criteria. Cases were identified from the records using the ICD-10 readmission codes.

8.10 Study Limitations and how they were minimized

Patients who were readmitted to other hospitals are not accounted for in this study.

Missing data from patient files was a limitation to the study as it was a retrospective study. This was minimized by the use of files with complete data or complete on key variables.

There was potential inaccurate reporting of the patients' diagnosis. That was minimized by the researcher and research assistant by verifying the information from the file to the best of their ability.

We were unable to assess files of patients who had died post readmission due to poor filing system.

8.11 Study results Dissemination and Closure

The final results of the study were presented at Department of Obstetrics and Gynecology for inputs from the faculty and as part of the fulfillment of the master's Obstetrics and Gynecology. Following the revisions by both the internal and external examiners, the findings will be disseminated to KNH management and later published into a thesis for filing in the University of Nairobi Library services. The findings will then be summarized into papers and sent out to a reputable journal for publication and wider dissemination. The findings will also be presented at conferences and continuous medical education (CME) events.

4.0: RESULTS

During the study period (January 2014 - December 2019), there were 25,449 records of patients who underwent cesarean section at Kenyatta National Hospital. Of these, 107 out of 166 readmissions (cases) and 213 out of 334 non-readmissions (controls) were identified as eligible (figure 2). Of the ineligible records, 59 readmissions and 111 of non-readmissions had incomplete data such as missing initial theater notes or admission history notes.

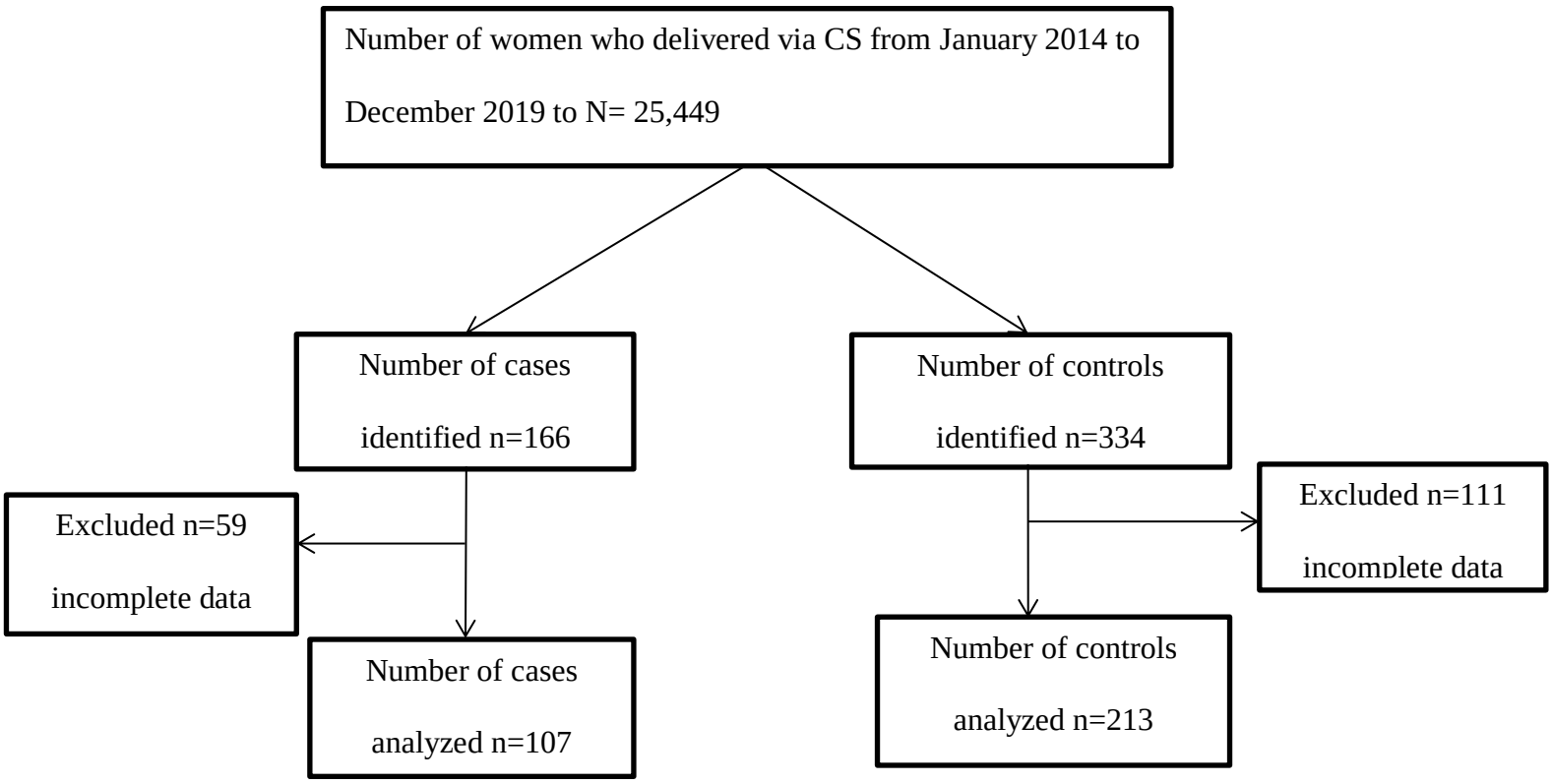


Figure 3: Study flow of records of eligible cases and controls among patients delivered by caesarean section at KNH from January 2014-December 2019

4.2 Risk factors for readmission post-CS KNH

The socio-demographic factors and clinical characteristics between cases and controls are compared in Table 3 below. The mean (±standard deviation) age for cases was statistically significant was lower than controls at 26 (± 6) versus 29 (± 6) years (P<0.05). In addition, the

readmitted cases had a higher unemployment level (64.5%) compared to the non-readmitted controls (44.1%), P<0.05). Notably, a higher number of cases were referred from other facilities for cesarean section at KNH compared to the control group (43.0% vs. 22.5%, P<0.05). Also, the readmitted cases had higher numbers with moderate to severe anemia compared to the group not readmitted (6.5% VS. 2.3%, OR 2.42 95%, P<0.05). The readmitted group had more primigravida compared to the group not readmitted (39.3% vs. 21.6%, P<0.05) and a higher number of grand multiparous than the group not readmitted (7.5%vs.6.1%, P<0.05). The readmitted patients had more numbers with no previous CS scars (72.9% vs. 42.2%, P<0.05) which was statistically significant. Social demographic and clinical characteristics such as marital status, education level, number of ANC visits, HIV status, and presence of comorbidities were not found to be statistically significant risk factors for post-CS readmission.

Table 3: Social demographic and antepartum characteristics of the study participants.

Participant characteristics		Re-admitted (case n=107)	Not readmitted (control n=213)	P value
Age categories	<19years	11(10%)	8(4%)	0.009
	20-35years	87(81%)	166(78%)	
	>35 year	9(8%)	39(18%)	
Marital status	Married	87 (81.3%)	182 (85.5%)	0.34
	Single	20 (18.9%)	31 (14.6%)	
Education level	Primary	39 (36.5%)	50 (23.5%)	0.02
	Secondary	46 (43.0%)	96 (45.0%)	
	Tertiary	22 (20.5%)	67 (31.5%)	
Occupation	Employed	38 (35.5%)	119 (55.9%)	0.001
	Unemployed	69 (64.5%)	94 (44.1%)	
Referral status	No	61 (57.0%)	165 (77.5%)	0.001
	Yes	46 (43.0%)	48 (22.5%)	
ANC Visits	<4 visits	43 (40.9%)	65 (31.1%)	0.083
	>4 visits	62 (59.1%)	144 (68.9%)	
Hemoglobin level at admission	Normal ≥11	76 (71.0%)	131 (61.5%)	0.001
	Mild (9-10.9)	19 (17.8%)	38 (17.8%)	
	Moderate/severe (<8.9)	7 (6.5%)	5 (2.3%)	
	Not reported	5 (4.7%)	39 (18.3%)	
HIV status	Negative	105 (98.1%)	203 (95.3%)	0.178
	Positive	2 (1.9%)	10 (4.7%)	
Comorbidities	No	Comorbidities	194 (91.1%)	0.352
	Yes	1 (0.9%)	2 (0.9%)	
Gestation at CS	Less than 37 weeks	27 (25%)	43 (920%)	0.187
	357weeks or more	80 (75%)	170 (80%)	
Parity	Primigravida	42 (39.3%)	46(21.6%)	0.001
	Para 1-4	54 (50.5%)	154 (72.3%)	
	Para 5 and above	11 (10.3%)	13 (6.1%)	
Number of previous CS	No scar	78 (72.9%)	90 (42.2%)	0.001
	1 C/S	19 (17.8%)	79 (37.1%)	
	≥2	10 (9.3%)	44 (20.7%)	

Abbreviation 1: ANC Antenatal clinic, CS cesarean section.

Table 4 below presents a comparison between intrapartum factors in the case and control groups. The readmitted patients had a higher number of women in the active phase of labour compared to the group not readmitted (64.4% vs. 32.1%, P<0.05). The readmitted group had more women who had induction of labour compared to the group not readmitted (9.3% vs.1.9%, P<0.05). Patients who had chorioamnionitis at the time of cesarean section were readmitted (3.3%, P<0.05). The majority of the women had an emergency CS in both groups but there was a higher number of patients in the readmitted group who underwent an emergency CS compared to the group not readmitted (97.2% vs. 86.9%, P<0.05). Obstetric Intrapartum factors such as premature rupture membranes was not statistically significant. The surgeon, administration of prophylactic antibiotics, type of skin incision, duration of surgery, and intraoperative complications were not statistically significant surgical intrapartum risk factors for readmission.

Table 4: A Comparison of Intrapartum characteristics of the study participants

Patient Characteristics	Re-admitted	Not re-admitted	P-value

		(Case n=107)	(Controls n=213)	
Phase of labour	Not in labour	26 (24.3%)	70 (32.9%)	0.001
	Latent	11 (10.3%)	66 (31.0%)	
	Active	69 (64.4%)	69 (32.1%)	
Onset of Labour	Not in labour	10 (9.3%)	4 (1.9%)	0.004
	Induced	26 (24.3%)	70 (32.9%)	
	Spontaneous	71 (66.4%)	139 (65.3%)	
Chorioamnionitis	No	103 (96.3%)	213 (100.0%)	0.005
	Yes	4 (3.3%)	0	
Premature rupture of membranes	No	103 (96.3%)	207 (97.2%)	0.655
	Yes	4 (3.7%)	6 (2.8%)	
Nature of CS	Elective	3 (2.8%)	28 (13.2%)	0.003
	Emergency	104 (97.2%)	185 (86.9%)	
Surgeon	Consultant	2 (1.9%)	13 (6.1%)	0.09
	Resident	105 (98.1%)	200 (93.9%)	
Prophylactic antibiotics	Not given	14 (13.1%)	21 (9.9%)	0.08
	Given	89 (86.9%)	179 (90.1%)	
Type of abdominal Skin incision	Horizontal	99(91.6%)	179(84.0%)	0.062
	Vertical	9(8.4%)	34(16.0%)	
Duration of CS	< 60min	66 (61.7%)	138 (64.8%)	0.586
	>60 min	41 (38.3%)	75 (35.2%)	
Intra-op complications	None	97 (90.7%)	207 (97.2%)	0.011
	PPH (EBL> 1000ml)	10 (9.3%)	6 (2.8%)	

Abbreviation 2: CS cesarean section, PPH postpartum hemorrhage.

Table 5 below compares the postpartum factors between the readmitted and the group not readmitted. The readmitted group a had higher number of patients who developed PPH post-delivery compared to the non-readmitted group (4.7% vs.0.9%, OR 1.59, 95% CI [0.42 to 6.05]) P<0.05). There was a higher number of patients who had urethral catheterization >48hrs than in the non-readmitted group (2.8% vs. 1.0% OR 0.75, 95% CI [0.09-6.47] P<0.05). Febrile illness and length of stay were not statistically significant postpartum risk factors. The mean length of

stay for the readmitted group was 3(2-15) days and in the group not readmitted was 3(2-12) but this finding was not statistically significant

Table 5 Postpartum factors of the study participants..

Patient Characteristics		**Re-admitted (Case n=107)**	**Not-readmitted (Control n=213)**	**P value**
PPH	No	102 (95.3%)	211 (99.1%)	0.04
	Yes	5 (4.7%)	2 (0.9%)	
Febrile illness	No	107 (100.0%)	212 (99.5%)	0.67
	Yes	0 (0.0%)	1 (0.5%)	
Duration of urethral catheterization	None	5 (4.7%)	6 (2.9%)	0.03
	Intra-op	91 (85.1%)	196 (94.2%)	
	24 -48hours	8 (7.5%)	4 (1.9%)	
	>48 hours	3 (2.8%)	2 (1.0%)	
Length of hospital stay	Less than 3 days	12(11.2%)	21(9.9%)	0.276
	3-5 days	84(78.5%)	180(84.5%)	
	> 5 days	11(10.3%)	12(5.6%)	

Abbreviation 3: PPH postpartum hemorrhage

Table 6 below displays the adjusted odds ratio and 95% confidence interval (CI) for the multivariate logistic regression output that models the predictor of socio-demographic factors associated with post-CS readmission at KNH. Patients are more likely to be readmitted if they were unemployed (aOR 1.87, 95% CI [1.00-3.49]), referred from another facility for CS at KNH aOR2. 2.23 95% CI [1.14-4.330]). Insignificant risk factors after multiple regressions were moderate to severe anemia (aOR 1.66, 95% CI [0.33-10.30]) and high parity (aOR2.71, 95 %CI [0.67-10.97]).

Conversely factors decreasing risk for readmission included having an education, secondary education at aOR 0.55, 95% CI [0.26-1.17]) tertiary education aOR 0.57, 95% CI [0.23-1.35]) mild anemia aOR 0.84, 95% CI [0.36-1.95]).

Table 6 Adjusted OR of the Social-demographic risk factors associated with post-cesarean section in KNH from January 2014-December 2019.

Participant characteristics		UOR 95%CI	AOR (95%CI)	P-Value
Age	<19 years	Ref	Ref	
	20-35 years	0.38 (0.15- 0.98)	1.26 (0.33-4.80)	0.736
	>35 years	0.17 (0.55-3.42)	0.52 (0.09- 2.84)	0.449
Education level	Primary	Ref	Ref	
	Secondary	0.61 (0.36-1.06)	0.55 (0.26-1.17)	0.121
	Tertiary	0.42 (0.22-0.80)	0.57 (0.23-1.35)	0.202
Occupation	Employed	Ref	Ref	
	Unemployed	2.57 (1.58-4.18)	1.87 (1.00-3.49)	0.05
Referral	No	Ref	Ref	
	Yes	2.56 (1.55-4.22)	2.23 (1.14-4.33)	0.02
Parity	Primigravida	Ref	Ref	
	Para 1-4	0.38 (0.23-0.65)	0.97 (0.42-2.22)	0.938
	Para 5 and above	0.93 (0.37-2.29)	2.71 (0.67-10.97)	0.161
Hemoglobin level at admission	Normal ≥11g/dl	Ref	Ref	
	Mild (9-10.9g/dl)	0.86 (0.46-1.60)	0.84 (0.36-1.95)	0.672
	Moderate/severe (<8.9g/dl)	2.42 (0.74-7.87)	1.66 (0.33-10.30)	0.415

Table 7 below displays the adjusted odds ratio and 95% confidence interval (CI) for the multivariate logistic regression output that models the predictor of intrapartum risk factors associated with readmission post-CS at KNH. Patients are more likely to be readmitted if they had induction of labour (aOR4.27, 95% CI (1.94 to 23.34and had intraoperative PPH (aOR11.50, 95% CI [1.19-111.18]). Were in the active phase of labour at the time of CS (aOR2.52 [0.51-12.51]) and an emergency CS (aOR 3.50, 95% CI [0.90-13.55]) were not statistically significant

risk factors associated with readmission. The protective intrapartum factors was been in the latent phase of labour at the time of CS (aOR 0.79, 95% CI [0.15-4.07]).

Table 7:Adjusted OR of the Intrapartum risk factors associated with readmission post-cesarean section in KNH from January 2014-December 2019.

Participant characteristics		UOR 95%CI	AOR (95%CI)	P-Value
Number of previous CS scars	None	Ref		
	1-2	1.10 (0.45-2.68)	0.42 (0.02-7.51)	
	>3	0.42 (0.05-3.44)	0.68 (0.22-2.11)	
Phase of labour	Not in labour	Ref	Ref	
	Latent	0.45 (0.21-0.98)	0.79 (0.15-4.07)	0.020
	Active	2.69 (1.54-4.71)	2.52 (0.51-12.51)	0.994
Onset Labour	Not in labour	Ref	Ref	
	Induced	6.73 (1.94-23.35)	4.27 (1.94-23.34)	0.003
	Spontaneous	1.38 (0.81-2.34)	0.81 (0.09-2.34)	0.242
Nature of CS	Elective	Ref	Ref	
	Emergency	5.25 (1.56-17.68)	3.50 (0.90-13.55)	0.051
Intra-operative complications	None	Ref	Ref	0.247
	PPH	3.56 (1.26-10.07)	11.50 (1.19-111.18)	

Abbreviation 4:PPH postpartum hemorrhage.

Table 8 below displays the adjusted odds ratio and 95% confidence interval (CI) for the multivariate logistic regression output that models the predictor of post-partum risk factors associated with readmission post-CS at KNH. There were no postpartum risk factors associated with readmission.

Table 8 Adjusted OR of post-partum risk factors associated with readmission post-cesarean section in KNH from January 2014-December 2019.

Participant characteristics		UOR 95%CI	AOR (95%CI)	P-Value
PPH	No	Ref	Ref	0.020
	Yes	1.59 (0.42 -6.05)	0.09 (0.01 to 0.74)	
Catheter duration	None	Ref	Ref	
	Intra-op	0.41 (0.08-2.25)	0.23(0.02-2.11)	0.682
	24 to 48h	0.23 (0.06-0.79)	0.23 (0.03-0.67)	0.014
	More than 48h	0.75 (0.09-6.47)	1.99 (0.07-54.31)	0.145

Abbreviation 5: PPH postpartum hemorrhage.

4.2 Indication for readmission post-CS in KNH.

Figure 3 below illustrates the indications for readmission post-CS. Infections were the most common indications for readmission post-CS in KNH. SSI accounted for 72.89% of all infections, puerperal sepsis 15.8%, and peritonitis 0.93%of all readmissions. Burst abdomen accounted for 7.47% of all readmission, secondary PPH at 4.67%. Wound hematoma and hematometra accounted for 0.93% each. Medical conditions reported were pulmonary hypertension, pneumonia, and peptic ulcer disease representing 3.97% of all readmission.

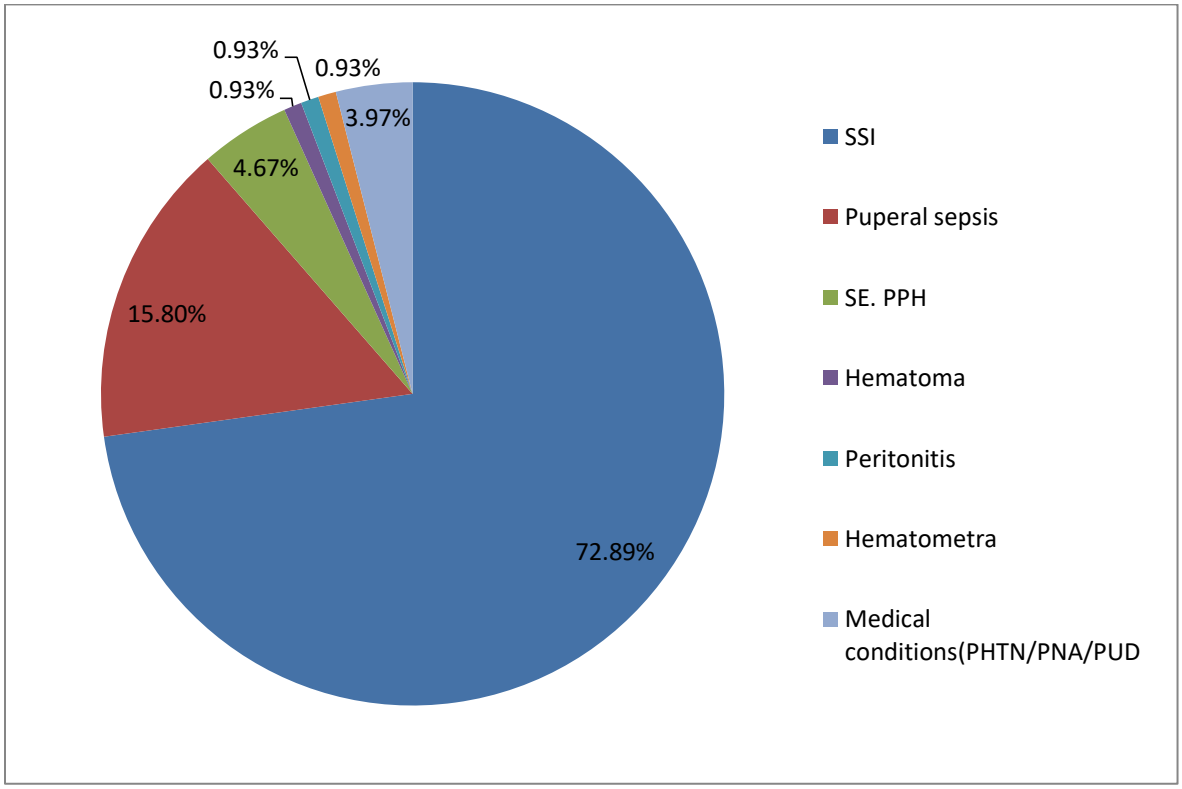


Figure 3: Indication for readmission after CS in KNH as percentages.

Table 9 below shows the classification of SSI for those readmitted with SSI as the primary diagnosis. Superficial SSI was the most common SSI at 33.4%, deep SSI at 26.,1,7% and organ space SSI at 5.6%.

Table 9 Classification of SSI among the readmitted participants post-CS at KNH from January 2014-December 2019.

Indication	Freq.	Percent (%)
superficial SSI	36	33.64
Deep SSI without dehiscence	28	26.17
Deep SSI with dehiscence	8	7.47
Organ space SSI	6	5.6

Abbreviation 6: SSI surgical site infection

4.3Outcome of readmission post-CS in KNH.

4.3.1 Duration of readmission post-CS in KNH.

The median duration of stay during readmission is 3 days. The duration of stay during readmission with each indication of readmission is as listed below in table 10.

Table 10 The average length of stay during readmission for each indication of readmission post-CSH from January 2014-December 2019.

Indication	Mean (SD)	Median (range)	Min	Max
Superficial SSI	3.64 (1.6)	3	2	9
Deep SSI without wound dehiscence	3.8 (2.4)	3	2	13
Deep SSI with wound dehiscence	3 (0.1)	3	3	3
Organ space SSI	3.3 (0.6)	3	3	4

Secondary PPH	3.3 (0.5)	3	3	4
Puerperal sepsis	3.8 (1.4)	3	2	8
Hematometra	3 (0.1)	3	3	3
medical (PHTN/PN	5.8 (6.2)	3	2	15

Abbreviation 7:SSI surgical site infection, PPH postpartum hemorrhage ,PHTN pulmonary hypertension.

4.3.2 Management among readmitted patients post CS in KNH

Table 12 below lists the outcome of readmitted patients. 57.9% of the readmitted patients had medical management. The most common surgical procedure done during readmission was wound debridement carried out on 31.8% of all surgical procedures. All patients readmitted were discharged home.

Table 11: Management among readmitted patients post CS in KNH from January 2014-December 2019.

Outcome		**Freq.**	**Percent**
No Surgery		62	57.9%
Type of Surgery performed	Ex-lap	7	6.5%
	Incision and drainage	5	4.7%
	Wound debridement and Primary wound closure	29	27.1%
	Wound debridement and Secondary wound closure	5	4.7%

All patients in this study who were readmitted post-CS at KNH were discharged from hospitals.

5.0 DISCUSSION

The study aimed to determine the risk factors associated with readmission post-CS at KNH and to describe the indications for readmission. Patients are more likely to be readmitted if they were unemployed with 1.87 higher odds of readmission post-CS, referred from another facility for CS at KNH are 2.23 higher odds of readmission, had induction of labour increases the odds of readmission by 4.27 higher odds of readmission post CS.

In this study patients who had been managed at peripheral facilities then referred to KNH for CS were at two-fold greater odds (aOR 2.14, 95% CI [1.21-3.77]) post-CS readmission than those who were primarily managed at KNH before the CS. These patients were more likely to be in the active phase of labour, had prolonged labour, have raptured membranes, and had many vaginal examinations before being referred and undergoing an emergency CS at KNH, therefore, having a higher risk of complications post-surgery. This could be due to delayed recognition of complications by the referring facility or delayed decision to refer Other studies have been conducted examining the outcome of mothers and the neonate but have not had a long-term follow-up of these patients.

In our study, those undergoing induction of labour had 4.27 higher odds of readmission (aOR4.27, 95% CI [1.94-23.34], $p< 0.05$). Allen et.al in 2005 found that women undergoing induction had more CS active phase of labour than those who had spontaneous labour (RR 2.11, 95% CI [1.99-2.23], $P<0.00$)(72), increases their risk of developing complications post-delivery.

The most common indications for readmission post-CS were infectious etiology accounting for 82.15% of all indications for readmission. L Rosa et.al 2019 analyzed data and found that infections were the most common indication for readmission-CS at 77.6%, other studies have a range from 5%-85%. In our study, SSI and puerperal sepsis accounted for 65.42% and 15.8% of all indications for readmission. This is in line with a study by Bostanci et.al 2017 and La Rosa et.al 2019 reporting that obstetric wound infection was the most common indication for readmission.

The strengths of this study are the analysis of files of women who delivered within a certain period within a single department and the ability to create a control group that delivered at the same time and facility, therefore, treated similarly.

The weakness of the study is being retrospective and the bias of the population that was readmitted to our facility. It is possible that some of the patients who developed postpartum complications chose to go to a different hospital and therefore cannot be accounted for. Information on comorbidities and peripartum events were derived from ICD-10 diagnosis and procedure codes and are subject to the biases of both under and over-coding.
Prospective studies can be conducted at level 4 and 5 hospitals to inform policy.

Conclusion

The main risk factors for post CS readmission are patients who had been managed at peripheral facilities then referred to KNH for CS, and induction of labour. The most common indication for readmission wan as infection. The median length of stay during readmission was 3 days. 42.1% of readmitted patients required surgical intervention while 57.9% were managed conservatively. All readmitted patients were discharged home.

Recommendations

To reduce readmission post-CS infection reduction and surveillance should be instituted especially among those with risk factors which include; referrals to KNH for CS, and induction of labour, but these need prospective studies to establish causation.

REFERENCES

1. Chobanian A V., Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. Seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure. Hypertension. 2003;42(6) 1206-52.

2. Gestational Hypertension and Preeclampsia: ACOG Practice Bulletin, Number 222. Obstetrics and gynecology. 2020;135(6):e237–60.

3. WHO. World Health Organization: Definition and Diagnosis of Diabetes Mellitus and Intermediate Hyperglycemia. Geneva, World Health Org. WHO2. 2006;413(3):472–82.

4. Kerner W, Brückel J. Definition, classification and diagnosis of diabetes mellitus. Experimental and Clinical Endocrinology and Diabetes. 2014. p. 122(07):384-6.

5. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC Definitions of Nosocomial Surgical Site Infections, 1992: A Modification of CDC Definitions of Surgical Wound Infections. Infection Control and Hospital Epidemiology. 1992;13(10):606–8.

6. WHO. WHO recommendations for prevention and treatment of maternal peripartum infections. World Health Organization. 2015;

7. Phillippe HM. Overview of venous thromboembolism. The American journal of managed care. 2017.

8. Betran AP, Torloni MR, Zhang JJ, Gülmezoglu AM. WHO statement on caesarean section rates. BJOG: An International Journal of Obstetrics and Gynaecology. 2016. p. 3929(10155), 1341–8.

9. Cavallaro FL, Cresswell JA, França GV, Victora CG, Barros AJ, Ronsmans C. Trencesareansarean delivery by country and wealth quintile: cross-sectional surveys in southern Asia and sub-Saharan Africa. Bulletin of the World Health Organization [Internet]. 2013 Dec 1;91(12):914-922D. Available from: http://www.who.int/entity/bulletin/volumes/91/12/13-117598.pdf

10. Boerma T, Ronsmans C, Melesse DY, Barros AJD, Barros FC, Juan L, et al. Global epidemiology of use of and disparities in caesarean sections. The Lancet [Internet]. 2018 Oct;392(10155):1341–8. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0140673618319287

11. Wanyonyi S, Sequeira E, Obura T. Caesarian section rates and perinatal outcome at the Aga Khan University Hospital, Nairobi. East African Medical Journal. 2006;83(12):651–

8.

12. Villar J, Valladares E, Wojdyla D, Zavaleta N, Carroli G, Velazco A, et al. Caesarean delivery rates and pregnancy outcomes: 2005 WHO global survey on maternal and perinatal health in Latin America. Lancet [Internet]. 2006;367(9525):1819–29. Available from: https://doi.org/10.1016/S0140-6736(06)68704-7

13. Clapp MA, Little SE, Zheng J, Robinson JN. A multi-state analysis of postpartum readmissions in the United States. In: American Journal of Obstetrics and Gynecology [Internet]. 2016. p. 251(1),113e1-113e10. Available from: https://doi.org/10.1016/j.ajog.2016.01.174

14. Lydon-Rochelle M, Holt VL, Martin DP, Easterling TR. Association between method of delivery and maternal rehospitalization. Journal of the American Medical Association. 2000;283(18):2411.

15. Thompson JF, Roberts CL, Currie M, Ellwood DA. Prevalence and persistence of health problems after childbirth: Associations with parity and method of birth. Birth [Internet]. 2002;29(2):83–94. Available from: https://doi.org/10.1046/j.1523-536X.2002.00167.x

16. KNBS. 2014 Kenya Demographic and Health Survey (KDHS). Kenya National Bureau of Statistics. 2016;

17. Juma S, Nyambati V, Karama M, Githuku J, Gura Z. Factors associated with caesarean sections among mothers delivering at Mama Lucy Kibaki Hospital, Nairobi, Kenya between January and March, 205: a case-control study. Pan African Medical Journal [Internet]. 2017;28(1):7. Available from: http://www.panafrican-med-journal.com/content/series/28/1/7/full

18. Admon LK, Winkelman TNA, Zivin K, Terplan M, Mhyre JM, Dalton VK. Racial and Ethnic Disparities in the Incidence of Severe Maternal Morbidity in the United States, 2012–2015. Obstetrics & Gynecology [Internet]. 2018 Nov;1158–66. Available from: http://insights.ovid.com/crossref?an=00006250-201811000-00011

19. Pallasmaa N, Ekblad U, Aitokallio-Tallberg A, Uotila J, Raudaskoski T, Ulander VM, et al. Cesarean delivery in Finland: Maternal complications and obstetric risk factors. Acta Obstetricia et Gynecologica Scandinavica. 2010;89(7):896–902.

20. Pierpont YN, Dinh TP, Salas RE, Johnson EL, Wright TG, Robson MC, et al. Obesity and Surgical Wound Healing: A Current Review. In: ISRN Obesity. 2014. p. 1–13.

21. Wloch C, Wilson J, Lamagni T, Harrington P, Charlett A, Sheridan E. Risk factors for surgical site infection following caesarean section in England: results from a multicentre cohort study. BJOG: An International Journal of Obstetrics & Gynaecology [Internet]. 2012 Oct;119(11):1324–33. Available from: http://doi.wiley.com/10.1111/j.1471-0528.2012.03452.x

22. Kawakita T, Tefera E. Risk Factors for Readmission Due to Infection after Cesarean Delivery [26D]. Obstetrics & Gynecology. 2018;31(1):1–9.

23. WHO. WHO recommendations on health promotion interventions for maternal and newborn health. World Health Organization Offset Publication. 2015;

24. Austin MP, Priest SR, Sullivan EA. Antenatal psychosocial assessment for reducing perinatal mental health morbidity. Cochrane Database of Systematic Reviews. 2008.

25. Clapp MA, Little SE, Zheng J, Robinson JN, Kaimal AJ. The relative effects of patient and hospital factors on postpartum readmissions. Journal of Perinatology [Internet]. 2018 Jul 24;38(7):804–12. Available from: http://www.nature.com/articles/s41372-018-0125-8

26. Ferrero S, Bentivoglio G. Post-operative complications after cesarean section in HIV-infected women. Archives of Gynecology and Obstetrics [Internet]. 2003 Oct 30;268(4):268–73. Available from: http://link.springer.com/10.1007/s00404-002-0374-8

27. Say L, Chou D, Gemmill A, Tunçalp Ö, Moller A-B, Daniels J, et al. Global causes of maternal death: a WHO systematic analysis. The Lancet Global Health [Internet]. 2014 Jun;2(6):e323–33. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2214109X1470227X

28. Ye C, Ruan Y, Zou L, Li G, Li C, Chen Y, et al. The 2011 Survey on Hypertensive Disorders of Pregnancy (HDP) in China: Prevalence, Risk Factors, Complications, Pregnancy and Perinatal Outcomes. Obukhov AG, editor. PLoS ONE [Internet]. 2014 Jun 17;9(6):e100180. Available from: https://dx.plos.org/10.1371/journal.pone.0100180

29. Hirshberg A, Levine LD, Srinivas SK. Clinical factors associated with readmission for postpartum hypertension in women with pregnancy-related hypertension: a nested case control study. Journal of Perinatology [Internet]. 2016 May 14;36(5):405–9. Available from: http://www.nature.com/articles/jp2015209

30. FG Cunningham, KJ Leveno, SL Bloom, JC Hauth, DJ Rouse, Spong C. Chapter 3: Implantation, Embryogenesis, and Placental Development. In: Williams Obstetrics. 2009. p. 23.

31. Takoudes TC, Weitzen S, Slocum J, Malee M. Risk of cesarean wound complications in diabetic gestations. American Journal of Obstetrics and Gynecology [Internet]. 2004 Sep;191(3):958–63. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0002937804005472

32. Diamond MP, Entman SS, Salyer SL, Vaughn WK, Boehm FH. Increased risk of endometritis and wound infection after cesarean section in insulin-dependent diabetic women. American Journal of Obstetrics and Gynecology [Internet]. 1986 Aug;155(2):297–300. Available from: https://linkinghub.elsevier.com/retrieve/pii/0002937886908136

33. Delamaire M, Maugendre D, Moreno M, Le Goff M-C, Allannic H, Genetet B. Impaired Leucocyte Functions in Diabetic Patients. Diabetic Medicine [Internet]. 1997 Jan;14(1):29–34. Available from: http://doi.wiley.com/10.1002/%28SICI%291096-9136%28199701%2914%3A1%3C29%3A%3AAID-DIA300%3E3.0.CO%3B2-V

34. World Health Organization. The global prevalence of anaemia in 2011. WHO. 2015.

35. White MC, Longstaff L, Lai PS. Effect of Pre-operative Anaemia on Post-operative Complications in Low-Resource Settings. World Journal of Surgery [Internet]. 2017 Mar

11;41(3):644–9. Available from: http://link.springer.com/10.1007/s00268-016-3785-6

36. Dotters-Katz SK, Feldman C, Puechl A, Grotegut CA, Heine RP. Risk factors fopostoperativeve wound infection in the setting of chorioamnionitis and cesarean delivery. The Journal of Maternal-Fetal & Neonatal Medicine [Internet]. 2016 May 18;29(10):1541–5. Available from: http://www.tandfonline.com/doi/full/10.3109/14767058.2015.1058773

37. La Rosa M, Jauk V, Saade GR, Boggess K, Longo S, Clark EAS, et al. Incidence and Risk Factors for Hospital Readmission or Unexpected Visits in Women Undergoing Unscheduled Cesarean Delivery. American Journal of Perinatology [Internet]. 2019 Sep 15;36(11):1115–9. Available from: http://www.thieme-connect.de/DOI/DOI?10.1055/s-0039-1683391

38. Gelaw KA, Aweke AM, Astawesegn FH, Demissie BW, Zeleke LB. Surgical site infection and its associated factors following cesarean section: across-sectional study from a public hospital in Ethiopia. Patient Safety in Surgery [Internet]. 2017 Dec 12;11(1):18. Available from: http://pssjournal.biomedcentral.com/articles/10.1186/s13037-017-0131-3

39. Smaill FM, Grivell RM. Antibiotic prophylaxis versus no prophylaxis for preventing infection after cesarean section. Cochrane Database of Systematic Reviews.

40. Leth RA, Møller JK, Thomsen RW, Uldbjerg N, Nørgaard M. Risk of selected postpartum infections after cesarean section compared with vaginal birth: A five-year cohort study of 32,468 women. Acta Obstetricia et Gynecologica Scandinavica [Internet]. 2009 Jan;88(9):976–83. Available from: http://doi.wiley.com/10.1080/00016340903147405

41. Allen V. Maternal morbidity associated with cesarean delivery without labor compared with spontaneous onset of labor at term. Obstetrics & Gynecology [Internet]. 2003 Sep;102(3):477–82. Available from: http://linkinghub.elsevier.com/retrieve/pii/S0029784403005702

42. Yang XJ, Sun SS. Comparison of maternal and fetal complications in elective and emergency cesarean section: a systematic review and meta-analysis. Archives of

Gynecology and Obstetrics. 2017;

43. Jido T, Garba I. Surgical-site infection following cesarean section in Kano, Nigeria. Annals of Medical and Health Sciences Research [Internet]. 2012;2(1):33. Available from: http://www.amhsr.org/text.asp?2012/2/1/33/96934

44. Vejnović T, Costa S, Ignatov A. New Technique for Caesarean Section. Geburtshilfe und Frauenheilkunde [Internet]. 2012 Sep 27;72(09):840–5. Available from: http://www.thieme-connect.de/DOI/DOI?10.1055/s-0032-1315347

45. Dempsey A, Diamond KA, Bonney EA, Myers JE. Caesarean section: techniques and complications. Obstetrics, Gynaecology & Reproductive Medicine [Internet]. 2017 Feb;27(2):37–43. Available from: https://linkinghub.elsevier.com/retrieve/pii/S1751721417300155

46. Afolabi BB, Lesi AF, Merah NA. Regional versus general anaesthesia for caesarean section. In: Afolabi BB, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd; 2006. p. 7(1),1-7. Available from: http://doi.wiley.com/10.1002/14651858.CD004350.pub2

47. Acosta-Terriquez JE, Ramos-Martínez MA, Zamora-Aguilar LM, Murillo-Llanes J. Prevalence of urinary tract infection in hospitalized patients with preterm labor. Ginecologia y Obstetricia de Mexico. 2014;82(11):737–43.

48. Gundersen T., Krebs L, Loekkegaard ECL, Rasmussen SC, Glavind J, Gundersen TD, et al. Postpartum urinary tract infection by mode of delivery: a Danish nationwide cohort study. BMJ open [Internet]. 2018;8(3):e018479. Available from: http://dx.doi.org/10.1136/bmjopen-2017-018479

49. Campbell OMR, Cegolon L, Macleod D, Benova L. Length of Stay After Childbirth in 92 Countries and Associated Factors in 30 Low- and Middle-Income Countries: Compilation of Reported Data and a Cross-sectional Analysis from Nationally Representative Surveys. Myers JE, editor. PLOS Medicine [Internet]. 2016 Mar 8;13(3):e1001972. Available from: https://dx.plos.org/10.1371/journal.pmed.1001972

50. Belfort MA, Clark SL, Saade GR, Kleja K, Dildy GA, Van Veen TR, et al. Hospital readmission after delivery: evidence for an increased incidence of nonurogenital infection in the immediate postpartum period. American Journal of Obstetrics and Gynecology [Internet]. 2010 Jan;202(1):35.e1-35.e7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0002937809009557

51. Panda S, Begley C, Daly D. Readmission following caesarean sec

tion: Outcomes for women in an Irish maternity hospital. British Journal of Midwifery [Internet]. 2016;24(5):322–8. Available from: https://doi.org/10.12968/bjom.2016.24.5.322

52. Ranjit A, Zogg C, Witkop C, Little S, Haider AH, Robinson JN. Do 30-Day Postpartum Readmissions Rates Vary by Site of Care for Vulnerable Patients? [9OP]. Obstetrics & Gynecology. 2017;129(5):4S.

53. Kaplanoglu M, Karateke A, Un B, Akgor U, Baloğlu A. Complications and outcomes of repeat cesarean section in adolescent women. International Journal of Clinical and Experimental Medicine. 2014;7(12):5621–8.

54. Fitzwater JL, Tita ATN. Prevention and management of cesarean wound infection. Obstetrics and Gynecology Clinics of North America. 2014. p. 41(4), 671–89.

55. M.A. B, S.L. C, G.R. S, K. K, G.A. DIII, T.R. VV, et al. Hospital readmission after delivery: Evidence for an increased incidence of nonurogenital infection in the immediate postpartum period. American journal of obstetrics and gynecology. 2010;202(1):35.e1-35.e7.

56. Gungorduk K, Asicioglu O, Celikkol O, Sudolmus S, Ark C. Iatrogenic bladder injuries during caesarean delivery: A case control study. Journal of Obstetrics and Gynaecology [Internet]. 2010 Oct 7;30(7):667–70. Available from: http://www.tandfonline.com/doi/full/10.3109/01443615.2010.486086

57. Ade-Conde JA, Alabi O, Higgins S, Visvalingam G. Maternal post natal hospital readmission-trends and association with mode of delivery. Irish Medical Journal. 2011.

58. POMP ER, LENSELINK AM, ROSENDAAL FR, DOGGEN CJM. Pregnancy, the postpartum period and prothrombotic defects: risk of venous thrombosis in the MEGA study. Journal of Thrombosis and Haemostasis [Internet]. 2008 Apr;6(4):632–7. Available from: http://doi.wiley.com/10.1111/j.1538-7836.2008.02921.x

59. Jacobsen AF, Skjeldestad FE, Sandset PM. Incidence and risk patterns of venous thromboembolism in pregnancy and puerperium—a register-based case-control study. American Journal of Obstetrics and Gynecology [Internet]. 2008 Feb;198(2):233.e1-233.e7. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0002937807010265

60. Schneid-Kofman N, Sheiner E, Levy A, Holcberg G. Risk factors for wound infection following cesarean deliveries. International Journal of Gynecology and Obstetrics. 2005;9(1):10–5.

61. G. ilhan, F.F. VA, A.H. E, A. K, A.F. GK, M. T. Risk factors and microbiology of wound infections following cesarean delivery: Experience of a single institution. Journal of Infection and Chemotherapy. 2016;22(10):667–70.

62. Mpogoro FJ, Mshana SE, Mirambo MM, Kidenya BR, Gumodoka B, Imirzalioglu C. Incidence and predictors of surgical site infections following caesarean sections at Bugando Medical Centre, Mwanza, Tanzania. Antimicrobial Resistance and Infection Control. 2014;31(1):1–0.

63. Kawakita T, Landy HJ. Surgical site infections after cesarean delivery: epidemiology, prevention and treatment. Maternal Health, Neonatology and Perinatology. 2017;31(1):1–9.

64. Stadelmann WK, Digenis AG, Tobin GR. Impediments to wound healing. American Journal of Surgery. 1998;176(2):39S-47S.

65. Vermeulen H, Ubbink DT, Goossens A, De Vos R, Legemate DA. Dressings and topical agents for surgical wounds healing by secondary intention. Cochrane Database of Systematic Reviews. 2009.

66. Wechter ME, Pearlman MD, Hartmann KE. Reclosure of the disrupted laparotomy wound: A systematic review. Obstetrics and Gynecology. 2005.

67. Stevens DL, Bisno AL, Chambers HF, Dellinger EP, Goldstein EJC, Gorbach SL, et al. Executive summary: Practice guidelines for the diagnosis and management of skin and soft tissue infections: 2014 update by the infectious diseases society of America. Clinical Infectious Diseases. 2014;

68. Mackeen AD, Packard RE, Ota E, Speer L. Antibiotic regimens for postpartum endometritis. Cochrane Database of Systematic Reviews.

69. Olsen MA, Butler AM, Willers DM, Gross GA, Hamilton BH, Fraser VJ. Attributable Costs of Surgical Site Infection and Endometritis after Low Transverse Cesarean Delivery. Infection Control & Hospital Epidemiology [Internet]. 2010 Mar 2;31(3):276–82. Available from: https://www.cambridge.org/core/product/identifier/S0195941700028915/type/journal_article

70. Akech JEO. Demand for Emergency Caesarean Delivery at Kenyatta National Hospital: Free Maternal Health Care Program. 2016.

71. Bianco A, Molè A, Nobile CGA, Di Giuseppe G, Pileggi C, Angelillo IF. Hospital Readmission Prevalence and Analysis of Those Potentially Avoidable in Southern Italy. PLoS ONE. 2012;27(11):e48263.

72. Allen VM, O'Connell CM, Farrell SA, Baskett TF. Economic implications of method of delivery. American Journal of Obstetrics and Gynecology. 2005;193(1):192–7.

73. Diana V, Tipandjan A. Emergency and elective caesarean sections: comparison of maternal and fetal outcomes in a suburban tertiary care hospital in Puducherry. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 2016;5(9):3060–5.

74. Tran TS, Jamulitrat S, Chongsuvivatwong V, Geater A. Risk factors for postcesarean

surgical site infection. Obstetrics and Gynecology. 2000;95(3):367–71.

APPENDIX

APPENDIX 1: DATA ENTRY FORM

STUDY TITLE: RISK FACTORS, INDICATIONS AND OUTCOMES OF POST CESAREAN READMISSION AT KNH: A CASE CONTROL STUDY

Date:

Risk Factors

Social demographic

Number assigned: _____

Case	
Control	

Maternal age: …... years

Education level:

None	
Primary	
Secondary	
Tertiary	

County of residence…….

Marital status

Single	
Married	

Divorced	
Widowed	

BMI at admission

Weight ……kg.

Height……...cm

Number of ANC visit…….

Comorbidities- *(tick appropriately)*

Yes	
No	

If yes- *(tick appropriate)*

- Diabetes,

Known diabetic	
Gesational diabetes	

- Hypertension

Chronic	
Preeclampsia	
Eclampsia	

- Aaemia HB at admission……g/dl

  Known Sickle cell disease patient--(tick appropriately)

  Yes

  No

- HIV status at delivery

Intrapartum Risk Factors

- **Obstetric Risk Factors**

Parity; ……

Gestation at delivery……weeks

Chorioamnionitis

Yes	
No	

Premature rapture of membranes

Yes	
No	

Duration of Rupture of membranes……Hours

Onset of labour spontaneous

Spontaneous	
Induced	

Duration of labour

- **Surgical Risk Factors**

Previous Mode of delivery

SVD	
CS	
N/A	

Number of CS scars …….

Indication for CS……

Carder of surgeon……

Nature of CS

Emergency	
Elective	

Type of abdominal skin incision

SUMI	
Pfannenstiel	

Length of CS……. minutes

Intra-op complication- *(tick appropriately if other state it)*

None

PPH,

DIC

Bladder injury

Gut injury

Hysterectomy done

Other……...

Estimated blood loss

Postpartum Risk Factors

PPH

Yes	
No	

Febrile illness

Yes	
No	

Duration of catheterization……hours

Length of Hospital stay post CS……...days

Indication for re-admission:

Diagnosis

OUTCOMES

Length of days before readmission…… days

Readmission vitals

BP……. mmhg

Pulse……beats per minute

Temp……^{0}C

Respiratory rate……breaths per minute

Intervention during readmission

Antibiotics administered--(tick appropriately)

Yes

No

Surgery--(tick appropriately)

Repeat ex-lap

Wound debridement

Hysterectomy

Incision and drainage

ICU admission

Blood transfusion (……units)

Length of readmission stay……...days

Outcome- *(tick appropriately)*

Discharged home

Mortality

APPENDIX 2: DUMMY TABLES

1. **Distribution of descriptive characteristics of women studied to assess risk factors associated with readmission post cesarean section at KNH**

Social Demographics

		n	[%]	Chi Square (λ)	P-value
Maternal Age Bracket	less than 19 years		[ ]		
	Between 20-34 years		[ ]		
	More than 35 years		[ ]		
Marital Status	Single		[ ]		
	Married		[ ]		
	Divorce		[ ]		
	Widow		[ ]		
level of Education	None		[ ]		
	Primary		[ ]		
	Secondary		[ ]		
	Tertiary		[ ]		
Parity	0		[ ]		
	1 -- 4		[ ]		
	➢ 5		[ ]		

Clinical information

Clinical information		**Frequency**	**[%]**	**Correlation with Readmission**
Number of ANC VISTS	None		[]	
	1 -- 4		[]	
	>4		[]	
Anemia (Hb at admission) mean				
Hypertension	Chronic hypertension		[ ]	
	Pre-eclampsia		[ ]	
	Eclampsia		[ ]	
Diabetes	Gestational DM			
	Known DM			
Chorioamnionitis	NO YES			
Premature rupture of membranes	NO YES			
Duration of rupture of membranes	<18hrs >18hrs			
Onset of labour	Spontenous			
	Induced			

Number of previous CS scars	None 1 >1			
Nature of CS	Emergency Elective			
Type of abdominal skin incision	Pfannenstiel SUMI			
Intra-operation complications	NONE YES			
PPH(proportions)				
Fever				
Length of urethral catheterization	<72 hours >72 hours			
Length of hospital stay	3 days 3-7 days >7days			

APPENDIX 3: STUDY BUDGET AND JUSTIFICAT

ITEM	Cost(ksh)
Supplies and material	3500
Research assistant	20000
Statistician	30000
Total	53500

supplies and materials are the stationary to be used data entry forms and pens required to collect the data. The data entry forms are photo copied at 3ksh per page (3*340*3) and pens cost 20ksh per pen (3*20) and other consumables.

The salary of the research assistant also includes transport and meals for the duration of data collection.

The analysis to be done by the statistician has been stated at 30,000ksh

APPENDIX 4: STUDY TIME LINE

	May 2019	June 2019	July 2019	Aug 2019	Sept 2019	Nov 2019	Dec 2019	Jan 2020	Feb 2020	March 2020	April 2020	May 2020	June 2020
Concept development													
Proposal development													
Ethical approval													
Data collection													
Data analysis													
Result presentation, dissemination and close out													