Kwame Nkrumah University of Science and Technology, Kumasi

COLLEGE OF HEALTH SCIENCES

SCHOOL OF MEDICAL SCIENCES

DEPARTMENT OF CLINICAL MICROBIOLOGY

Surgical Site Infection after Caesarean Section delivery at Komfo Anokye Teaching Hospital, Kumasi, Ghana

BY

GEORGE NSIAH – AFRIYIE

OCTOBER 2016

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI.

COLLEGE OF HEALTH SCIENCE

SCHOOL OF MEDICAL SCIENCE

DEPARTMENT OF CLINICAL MICROBIOLOGY

SURGICAL SITE INFECTION AFTER CAESAREAN SECTION DELIVERY AT KOMFO ANOKYE TEACHING HOSPITAL, KUMASI, GHANA

BY

GEORGE NSIAH – AFRIYIE

OCTOBER 2016

SURGICAL SITE INFECTION AFTER CAESAREAN SECTION DELIVERY AT KOMFO ANOKYE TEACHING HOSPITAL, KUMASI, GHANA

BY

GEORGE NSIAH – AFRIYIE

A THESIS SUBMITTED IN PARTIAL FULFILMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF PHILOSOPHY IN CLINICAL MICROBIOLOGY

In the

Department of Clinical Microbiology

School of Medical Science

College of Health Science

KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY,

KUMASI.

OCTOBER 2016

DECLARATION

The experimental work described in this thesis was carried out at the Department of Clinical Microbiology, KNUST. Any assistance obtained has been duly acknowledged. This work has not been submitted for any other degree.

CANDIDATE ………………………….. …………………………

George Nsiah - Afriyie Signature Date

(PG 2435514)

Certified by:

SUPERVISOR

Dr. Alex Owusu – Ofori …………………………… …………………………

Signature Date

Certified by:

HEAD OF DEPARTMENT

Dr. T. B. Kwoffie …………………………… …………………………

Signature Date:

ABSTRACT

Introduction: Surgical Site infection (SSI) is one of the health problems that are caused by the invasion of pathogenic organisms. Information on local pathogens and sensitivity to antimicrobial agents is crucial for successful treatment of wounds.

Objectives: The objectives of this study was to determine the prevalence of SSI after caesarean section delivery, identify the type and frequencies of bacteria causing these infections and determine the antibiotic susceptibility pattern of pathogens involved with these infections at Komfo Anokye Teaching Hospital (KATH).

Methods: A cross sectional study was conducted among women with Caesarean Section delivery at KATH, from June to December, 2015. Wound swab was collected from 40 clinically infected wounds using sterile cotton swabs and processed for bacterial isolation and susceptibility testing to antimicrobial agents following standard bacteriological techniques. Biochemical tests were done to identify the species of the organisms. Sensitivity testing was done using Kirby- Bauer disk diffusion method. Structured questionnaire were administered to harness socio demographic, surgical and antibiotic data of women.

Results: The overall prevalence of SSI after Caesarean Section delivery in KATH within the study period was 9.67%. No anaerobic bacteria were isolated. The common bacteria that caused SSI after Caesarean Section at KATH was *Klebsiella pneumoniae* (36.25%) (n=21), followed by *Pseudomonas aeruginosa* (22.4%) (n=13). The least isolated bacteria were *Proteus vulgaris* (1.7%) (n=1) and *Acinetobacter baumanii* (1.7%) (n=1). Gentamicin, ciprofloxacillin and amikacin showed greater sensitivity on isolates than other antibiotics such as cefuroxime, levofloxacin and ceftriaxone. All the isolated bacteria showed high frequency of resistance to ampicillin, penicillin and tetracycline. Significant risk factors causing SSI after Caesarean Section delivery in this study was interrupted skin closure technique, emergency C/S, 2 or more vaginal examination before C/S and patient to whom antibiotic prophylaxis was not given. **Conclusion:** The prevalence rate of SSI after caesarean section delivery in this study was 9.67%, with *Klebsiella pneumoniae* being the most common bacteria isolate. Gentamicin, ciprofloxacin and amikacin should be used judiciously to treat wound infections. Empirical prescription of ampicillin, tetracycline and levofloxacin at the O & G Directorate for treating SSI should consider the resistant pattern of bacteria in this study. Infection reducing strategies should target women at high risk of developing SSIs such as those for emergency C/S, and women with more than 2 vaginal examinations before C/S.

DEDICATION

This work is dedicated to my late father; Mr. Georges Nsiah – Afriyie (Action man), my professional mentor; Mr. Awuley Nii Lartey, my wife; Gloria and son; Kingsford.

ACKNOWLEDGEMENT

Indeed, this research work would have not been possible without the divine help from God Almighty. Thank you LORD for the abundant grace!

My sincere thanks go to my supervisor, Dr. Alex Owusu - Ofori, Lecturer at the Department of Clinical Microbiology of KNUST and Head of Microbiology Department of Komfo Anokye Teaching Hospital (KATH) who reviewed every section of this work with tenacity and patience and offered useful contributions and suggestions to the organization of this thesis. I am most grateful.

Worthy of mention is Dr. Roderick F. L Reindolf who provided financial support to this work. God richly bless you. I also show my profound appreciation to Newmont Ahafo Development Foundation (NADeF) and Mr. Philip Aboagye (Director of Medicare College of Applied Sciences) for their financial support for my master's programme.

My sincere gratitude also goes to my mum; Angelina Obiri- Yeboah, my siblings; Nelson and Rita for their support and encouragement.

I also thank Mr. Thomas Gyampomah and the staff of the Department of Clinical Microbiology, Bacteriology unit, KATH, especially Mr. Ishmael Tetteh for their assistance and support. To the Nurses at the A1 Dressing Room of KATH (Mrs. Rebecca Nyame and Victoria Krowa), I say a big thank you for the immense contribution you made to the success of this work. Also, to Tweneboah Kodua Kenneth, Micheal, Eric and Harry who spent their precious time to assist in the collection of qualitative data from patients, God bless you all.

Last but not the least; my sincere appreciation is shown to Mr. Robert Nii Awuley Lartey and students of Medicare College who helped in diverse ways in the laboratory work of this study.

May God reward all who helped to bring this work to its successful completion.

TABLE OF CONTENT

CONTENT **PAGE**

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BD – Becton Dickson and Company

C/S – Caesarean Section

CI – Confidence Interval

CLSI – Clinical and Laboratory Standard Institute

CNS – Coagulase Negative *Staphylococcus aureus*

CPD – Cephalopelvic Disproportion

ECDC – European Center for Disease Prevention and Control

HIV – Human Immuno – deficiency Virus

KATH – Komfo Anokye Teaching Hospital

KNUST – Kwame Nkrumah University of Science and Technology

MRSA – Meticillin Resistant *Staphylococcus aureus*

NICE – National Institute for Health and Care Excellence

O & G – Obstetrics and Gynaecology

OR – Odds Ratio

SHS – Senior High School

SPSS – Statistical Package for Social Sciences

SSI – Surgical Site Infection

SSIs- Surgical site infections

TSI – Triple Sugar Iron agar

USA – United States of America

WHO – World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Surgery is a key component of health care delivery. Annually, about two hundred and thirty four (234) million surgeries are carried out in the world (Borchard *et al*., 2012). Complications associated with surgeries are common, occurring in 3 to 16% of all surgical procedures. It is estimated that about one (1) million patients pass away and seven (7) million patients obtain injuries as a result of surgical related complications annually (WHO, 2008).

A surgical site infection (SSI) is an infection that develops at the site of incision within one (1) month after surgery. It is one of the setbacks that occur after a surgical procedure is carried out on a patient (Seltzer *et al*., 2002). SSI is a major source of morbidity in patients who undergo surgery. There are about five hundred thousand (500,000) surgical site infections (SSIs) annually, from about twenty seven (27) million surgeries in United States. Each year, SSIs accounts for one quarter (1 / 4) of the estimated two (2) million nosocomial infections (Nichols, 2011). Signs and symptoms of SSI include purulent discharge from the wound or around the incision site, increased pain, pyrexia, and dehiscence at the incision site (Swenne, 2006). Generally, it has been observed that chances of a patient getting infected after surgical operation largely depends on the hospital in which the operation was carried out. It may also be as a result of poor surgical management and other aspects of quality health care (Gibbons *et al*., 2012). Although surgeries are ideally performed in a sterile environment, the risk of infection always exists (Nasreen & Perveen, 2013).

The organisms which often cause SSIs include *Pseudomonas aeruginosa, Klebsiella pneumoniae, Staphylococcus aureus, Enterococcus spp* and Coagulase - Negative *Staphylococci.*

Others include *Proteus species*, *Enterobacter species, Escherichia coli*, *Candida spp*., *Klebsiella oxytoca, Acinetobacter baumannii, Clostridium spp*. and *Bacteriodes species* (Hidron *et al*., 2009).

SSIs after Caesarean Section delivery are very common. They are a major cause of morbidity and socio - economic implications for the woman involved (Gould, 2007). They prolong hospital stay and increase medical expenses (Olsen *et al*., 2008).

About 15 to 80% of post Caesarean Section morbidities, especially those related to the wound occurs after initial discharge from the hospital (Tita *et al*., 2009).

In preventing SSIs, the appropriate use and timing of surgical antimicrobial prophylaxis is a significant intervention (Walenkamp, 2003; Humphreys and Cunney, 2008). It is known that, if the prophylaxis is given too soon, the antibiotic level will have fallen before the first incision. If the antibiotic is given too late, (i.e. less than 30 minutes before incision), blood and tissue antibiotic levels will be highest just after the period of greatest risk which is the initial phase of surgery (Carignan *et al*., 2008). When the surgical procedure is prolonged, prophylaxis is continued beyond one or two doses. Additional doses of antibiotic prophylaxis given post operatively are not needed because of the association between new resistant strains of bacteria and overuse of antibiotics (Consumers Association 2001, 2003; 2004a).

Methicillin - Resistant *Staphylococcus aureus* (MRSA) and multi-drug resistant *Enterococcus* strains are drug resistant microorganisms that have emerged due to excessive use of antibiotics. Such complicated situations have reemphasized the need to focus on infection prevention steps as essential component of preventive medicine (Sepkowitz, 1995). Caution is required as even one to two doses may have adverse effects. Again, the purpose of administering antibiotic prophylaxis to patients must be targeted at the bacteria most likely to cause infection at the incision site (Griffin, 2005).

1.2 Problem Statement

SSIs have a significant impact on patients. It results to increase in number of days spent in the hospital, overuse of antibiotics and high hospital bills (Ezechi *et al*., 2009). SSI is still encountered in health facilities where most modern equipment is used and standard operating procedures on preoperative preparation and antibiotic prophylaxis are enhanced (Yalcin *et al*., 1995).

In developing countries, infections associated with multiple drug resistant bacteria have become a serious problem owing to ineffective infection programs, crowded hospital environments and empirical prescription of antimicrobial drugs (Nasreen & Perveen, 2013).

1.3 Justification

SSI is common and has existed over centuries. After every major surgery, the chance of a patient developing infection at site of incision is estimated between 2 to 5 %. Patients that acquire these infections are at risk of death, possible re - admission to the hospital, or likely to stay in the hospital for longer periods than patients without infections (Shute, 2005).

In United States of America, 56 hospitals collaborated in the bid to improve their operations and ultimately reduce surgical infections to the barest minimum (Dellinger *et al*., 2005). If the hospitals in the developed countries have recognized the danger posed by SSIs and are putting measures to reduce its emergence, it would be proper for health institutions in Ghana to consider it.

In a prospective descriptive study of all the Caesarean Sections performed at the Obstetrics and Gynaecology (O & G) Directorate of KATH between May and July 1996, the wound infection rate was 15.14% with *Staphylococcus aureus* being the common bacterial isolate (Danso *et al*., 1998). In this research, there were no anaerobic cultures done.

Currently, prevalence of SSI after Caesarean Section delivery at O & G and the contribution of anaerobes to SSIs at KATH are unknown.

This research was designed to help determine the current prevalence of SSI after Caesarean Section delivery, local trends of common aerobic and anaerobic bacteria and their antibiotic susceptibility.

The outcome of the research will guide the management of KATH in devising recommendations regarding empirical use of antibiotics and pre – operative preparation of patients to reduce SSIs associated with Caesarean Sections.

1.4 Aim of research

To determine the burden of SSIs after Caesarean Sections at KATH.

1.5 Specific objectives of research

- To determine the prevalence of SSIs after Caesarean Section at KATH.
- To identify the type of pathogen causing SSIs after Caesarean Section at KATH.
- To determine the frequencies of pathogens that complicate SSIs after Caesarean Section at KATH.
- To determine the antibiotic susceptibility of pathogens involved in SSIs after Caesarean Section at KATH.

1.6 Research questions

The main research questions that were derived from the objectives set were:

a. What is the prevalence of SSIs after Caesarean Section at the Obstetrics and Gynaecology Directorate of KATH within the study period?

b. What are the common organisms associated with SSIs after Caesarean Section at the Obstetrics and Gynaecology Directorate of KATH within the study period?

c. Are anaerobic organisms associated with SSIs after Caesarean Section at the Obstetrics and Gynaecology Directorate of KATH within the study period?

d. What was the antibiotic susceptibility pattern associated with SSIs after Caesarean Section at the Obstetrics and Gynaecology Directorate of KATH within the study period?

CHAPTER TWO

LITERATURE REVIEW

2.1 Surgical site infections

Surgical Site Infections (SSIs) are among the encountered complications of surgery. Although several advances have been made in asepsis and surgical procedures over the last century, morbidities are still relatively frequent complications (Gibbons *et al*., 2012).

A Surgical Site Infection (SSI) is defined as presence of pain at a surgically created wound. It is characterized by indurations, local tenderness and presence of purulent discharge at wound site or erythema (Ussiri *et al.*, 2004).

Surgical site infection is one of the health related problems caused by the invasion of pathogenic organisms in different parts of the body.

2.2 Surgical site infection rates

Globally, the rate of SSI ranges from 2.5% to 41.9% (Brown *et al.*, 2007). In the United Kingdom, a study conducted on SSI reported that 8.2% of surgery patients developed healthcare associated infections whilst 4.65% of these patients developed SSIs (Hospital Infection Society and Tissue Viability Nurses Association, 2007). A similar study carried out in India reported 8.95% SSI rate (Lilani *et al*., 2005).

In Africa, an observational study that was carried out in Tanzania on all surgical disciplines reported 24% SSI rate (Fehr *et al.*, 2006). Also, in a prospective surveillance of SSI in Egypt, the overall SSI rate was 9.23% (Wassef *et al*., 2012). Similarly, in a study on SSI following caesarean section in Nigeria, SSI complicated up to 9.1% of Caesarean Sections (Jido & Garba, 2012).

In Ghana, in a retrospective cross sectional study of wound infection carried out in a Tertiary Care Hospital in Northern Region, 32.3% SSI rate was recorded among 1,096 hospitalized patients (Apanga *et al*, 2013). Another study on Surgical Site Infection after Cesarean Delivery at Apam Catholic Hospital in Central Region, showed 7.6% infection rate (Atia, 2013) whilst the overall prevalence of SSIs was 40% in a study carried out on surgical site infections after abdominal surgery at KATH (Ofosua, 2014).

2.3 Caesarean Section (C / S) delivery

A common surgical procedure in Obstetric practice is Caesarean Section (Ezechi *et al*., 2009). It is performed when a mother or baby's health would be jeopardized by vaginal delivery. In some cases, C/S is also performed upon request by patients for childbirths that could otherwise have been done through the vagina (Finger, 2003). Surgical site infection (SSI) complicates up to 8.9% Caesarean Sections worldwide (Opoien *et al*., 2007).

Caesarean Section (C/S) involves making an incision in the abdomen to allow for the delivery of an infant from the uterus (Dodd & Reid, 2006). A Caesarean Section can be emergency or elective (Seltzer *et al*., 2002).

In emergency Caesarean Section, the surgery is done in the short possible time. Usually, the decision-to-delivery time is within 30 minutes. Possible indications of emergency C/S include cord prolapse, antepartum haemorrhage and fetal distress in the first stage (NICE Pathway, 2015).

In elective Caesarean Section, however, decision-to-delivery time is usually within 75 minutes. Indications may include transverse lie in labour and failure to progress. The timing is dependent on the type of indication (NICE Pathway, 2015).

Caesarean Section rates among total deliveries have been rising steadily due to a higher number of sections due to fetal distress. It is also used for multiple and breech pregnancies. However, the most contributory factor to the current rise in Caesarean Section rates comes from repeat elective Caesarean Section (NICE Clinical Guideline, 2011).

The rate of Caesarean Section in the United States is around 33% and range from 23% to 40% depending on the State in consideration (Safe Prevention of the Primary Caesarean Delivery, 2014). Caesarean section accounts for 25% of all deliveries in England, with a similar rate in the UK (Knight *et al*., 2013).

In 2013, St. Joseph Medical Hospital in Tanzania recorded 18% Caesarean Section rate (Becher & Stokke, 2013), whilst Apam Catholic Hospital in Central Region of Ghana recorded 27% Caesarean Section rate in 2012 (Tia, 2013).

In 2012, the Caesarean Section rate at Komfo Anokye Teaching Hospital (KATH), Kumasi was 30.2% (KATH Annual report, 2012).

2. 4 Indications for Caesarean Section delivery

Several factors predispose pregnant women for Caesarean Section delivery. Indications may include cephalopelvic disproportion (CPD), malpresentation (example, breech and transverse lie), severe hypertensive disease in pregnancy and multiple pregnancies. Others may include repeat caesarean section, very low birth weight, failed induction of labour, pelvic cyst or fibroid, fetal conditions of distress, iso-immunisation and maternal infection (example, herpes and Human Immune Virus).

In the Advanced countries, Caesarean Section rate has increased due to poor progress in labour.

This contributes to one third (1/3) of the overall Caesarean Section rate whilst repeat Caesarean Section contributes another one third (1/3) (Penn & Ghaem-Maghami, 2001).

In a study on indications for Caesarean Section in Tanzania, prolonged or obstructed labour were the most common indication for Caesarean Section. It accounted for 30% of all the indications (Becher & Stokke, 2013).

In another study carried out at KATH in Kumasi, Ghana, on prophylactic antibiotic during Caesarean Section, cephalopelvic disproportion (CPD) and fetal distress were the common indications (Opoku, 2007).

2.5 Risk factors associated with surgical site infections

Several risk factors are associated with SSIs among women who have Caesarean Section. These may include emergency type C/S, operative technique, labour and its duration, ruptured membranes and the duration of rupture. Others include socio economic status of the woman, skill of the surgeon, use of prophylactic antibiotics or not, number of prenatal visits, vaginal examinations during labour, anaemia, general anesthesia, blood loss, diabetes and obesity (John & Sons, 2007).

In a study on the prevalence and risk factors associated with Caesarean Section infection in Lagos, Nigeria, prolonged operation time (p value = 0.001), prolonged rupture of membrane (p value = 0.02), anaemia (p value = 0.031) and multiple vaginal exams during labour (p value = 0.021) were the statistically significant risk factors to SSIs among 817 women (Ezechi *et al.*, 2009).

In another study on abdominal wound infection complicating Caesarean Sections in KATH, Kumasi, higher SSI rates were associated with patients with no formal education, in labour for more than 14hrs, more than five (5) vaginal examinations, subumblical midline skin incisions and operation time lasting over 60mins. However, these risk factors were not statistical significant with p - value less than 0.05 (Danso *et al.*, 1998). Statistically significant risk factors (with p values greater than 0.05) were shown in cases which were referred from elsewhere in labour prior to C/S, patients in whom antibiotics were not started preoperatively or intra operatively and those in whom silk was used for skin closure (Danso *et al.*, 1998).

2.6 Antibiotic prophylaxis

The use of prophylactic antibiotics have demonstrated to be very effective in curbing the incidence of morbidity associated with Caesarean Section after labour (Walaa *et al*., 2011). It is one of the measures used to prevent the development of SSIs (Mangram *et al*., 1999).

Prophylactic antibiotics used has been shown to reduce the risk of endometritis by two thirds (2/3) to three quarters (3/4) in women undergoing either elective or emergency Caesarean Section with no signs of infection before the operation (Smaill & Hofmeyr, 2007).

Giving prophylactic antibiotics for non selective Caesarean Section is justified due to its ability to reduce wound infection by three-quarters (3/4) (Baldo, 2008).

In a study at Assiut University Hospital in Egypt, it was reported that using amoxicillin as a prophylactic antibiotic is as effective as cephalosporin in preventing SSIs after Caesarean Section delivery (Walaa *et al*., 2011).

At Komfo Anokye Teaching Hospital, antibiotic prophylaxis that is commonly used is the triple therapy. It comprises ampicillin, metronidazole and gentamycin. Drugs such as cephalexin, cefuroxine, ceftriazone and co-amoxiclav are occasionally used. Their use has been empirical (Opoku, 2007).

In a study carried out at KATH on prophylactic antibiotic during Caesarean Section, coamoxiclav was a better prophylactic antibiotic than the triple therapy of ampicillin, metronidazole and gentamycin (Opoku, 2007).

Metronidazole is an antibiotic used for treatment and prophylaxis of anaerobic infections. Anaerobic bacteria sensitive to metronidazole include *Bacteroides, Fusobacteria, Prevotella*, *Porphyromonas Peptostreptococci* and *Clostridia.* A few anaerobes, other than *B. fragilis*, resistant to Metronidazole have been reported (Mory *et al*., 2005).

2.7 Abdominal skin incision techniques

The type of abdominal incision used for the surgical procedure may have an influence on the development of SSIs. In choosing the type of abdominal incision, the area that needs to be exposed must be considered. Also the surgeon must consider factors such as elective or emergency nature of the operation and the surgeon's own preference (Burger *et al*., 2002).

The common abdominal incisions include vertical, transverse and oblique abdominal incisions.

The vertical incisions include the paramedian and midline incisions.
The paramedian incision does not involve the avascular linea alba, to avoid impaired wound healing. There are two types; the conventional (medial) paramedian incision and lateral paramedian technique. Paramedian incision is more sophisticated than the midline incision. It requires more opening time (average 13 minutes) and is associated with increase blood loss. It enables better abdominal exposure on the side of the incision than on the contra lateral side. The chance of extending the incision upwards is limited by the costal margin (Burger *et al.*, 2002).

In the midline incision, a vertical cut is made through the skin, subcutaneous fat, peritoneum and linea alba. The midline incision is easy to perform compared to the paramedian incision and results in little blood loss, due to the avascular nature of the linea alba. Midline incisions are done quickly (7 minutes on average) with excellent abdomen exposure. Extensions, when required, are made to provide access to the whole abdominal cavity, including the retroperitoneum. These qualities of the midline incision make it suitable for emergency surgery (Burger *et al*., 2002).

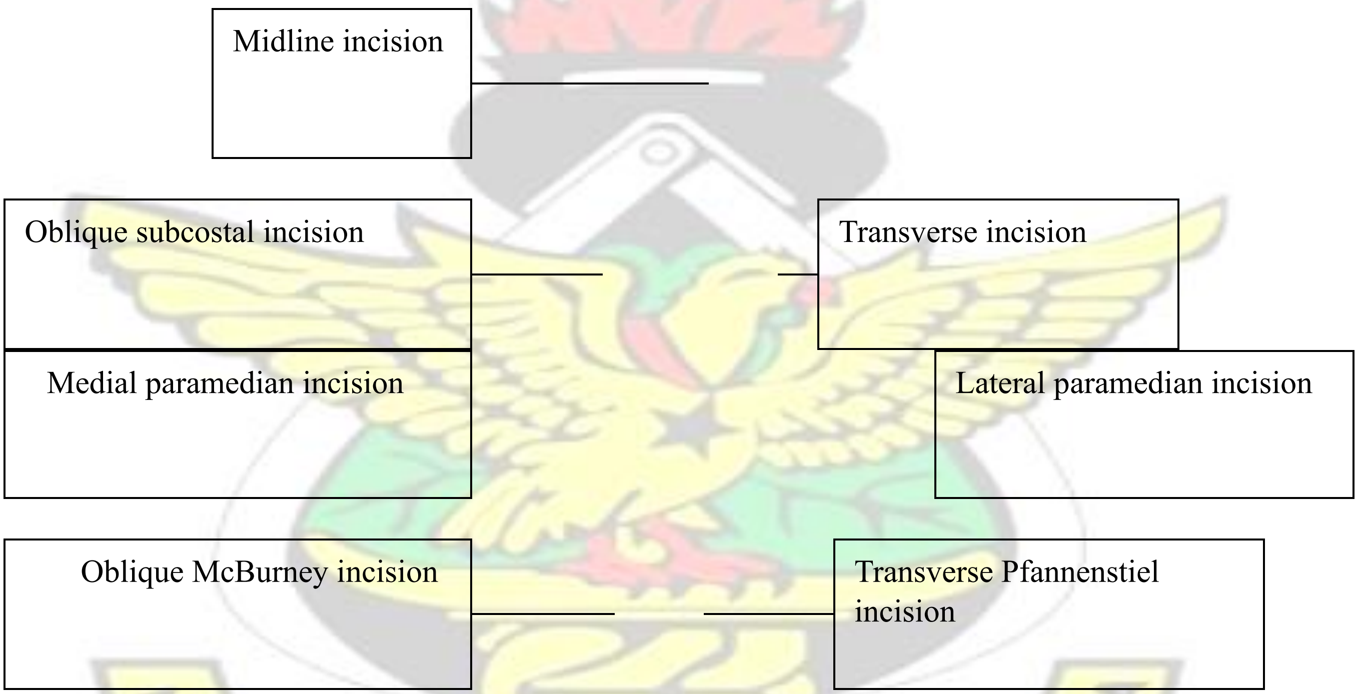
The transverse incisions include the supraumblical transverse incision and infraumblical transverse incision (Pfannenstiel incision).

In the supraumbilical transverse incision, the upper abdomen is properly exposed. However, it is more difficult when the operation area needs to be enlarged. Extensions do not always offer the desired view. There is more blood loss in this incision than the midline incision. It requires more time (average 13 minutes) (Burger *et al.*, 2002).

The most common abdominal incision used in Gynaecological and Obstetric practice is the infraumbilical transverse incision (Pfannenstiel incision). In Pfannenstiel incision, the skin is cut transversely, with a convexity downward to protect blood vessels and nerves. The abdominal wall muscles are often cut in the same direction as the other skin incision. However, some surgeons open the abdominal cavity in a vertical direction, thus combining a transverse with a vertical technique (Burger *et al.*, 2002).

The oblique incision includes subcostal or Kocher incision and Gridiron or McBurney incision. The subcostal or Kocher incision is performed along the costal margin and is directed in a medio-proximal plane. It offers a better exposure for biliary and bariatric surgery and can be extended if needed. Many segmental blood vessels, nerves, fibres and muscles are dissected (Burger *et al*., 2002).

In the Gridiron or McBurney incision, the time used to perform the incision and blood loss is comparable to those of transverse incisions. It is cut in the medio-caudal plane. It follows the direction of the fibres of the external oblique muscle, segmental blood vessels and nerves, damaging as little as possible. Notably, this incision splits all three muscular layers parallel to the direction of their fibres (Burger *et al*., 2002).



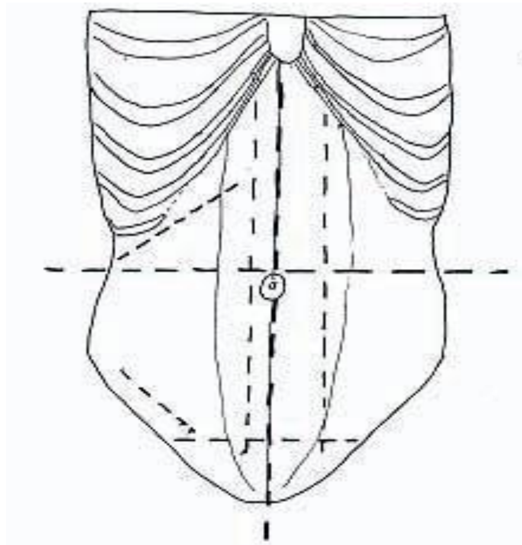


Figure 1: Type of abdominal incision (Burger *et al.*, 2002).

In a randomized study involving 241 patients, SSI rate of 11% was reported for midline incision technique as against 7% for paramedian incision (Kendall *et al*., 1991). Another prospective study in which 861 patients participated showed 9% SSI rate for midline incision technique as compared to 0% for the other incision techniques (Isrealsson *et al*., 1996). Additionally, in a retrospective study involving 56 patients, 34% SSI rate was reported for midline incision technique, whilst 20% SSI rate was reported for transverse incision technique. Other incisions showed 0% SSI rate (Douzdjian & Gugliuzza, 1996). After review of these clinical trials, none of these studies showed a significant difference in SSI rates after the use of the types of incision (Burger *et al*., 2002).

2.8 Skin closure techniques

Several skin closure techniques have been used for suturing the wound after surgery. These include primary suture line, secondary suture line, fascial closure technique and mass closure technique.

The primary suture line holds the wound edges in approximation during healing. It can either be interrupted or continuous. Other sutures include buried, purse string and sub cuticular (Wound closure manual, 2005).

Interrupted sutures are used in closing wounds in which an infection is present. When one suture breaks, the other sutures will litigate the wound edges in approximation (Seiler *et al*., 2009).

In continuous sutures, less foreign body mass is left in the wound. It acquires its strength from tension distributed evenly along the full length of suture strand. It is evident that there is no difference in continuous or interrupted closure, with a similar incidence of wound breakdown and hernia formation (Seiler *et al*., 2009).

Buried sutures are placed so that the knot extends to the inside, under the layer to be closed. Sub cuticular sutures are continuous or interrupted sutures placed in the dermis, beneath the epithelial layer (Wound closure manual, 2005).

The secondary suture line, also called retention sutures are done to reinforce the primary suture line. It eliminates dead space and prevents fluid accumulation in abdominal wound during healing. Retention sutures are positioned about 2 inches from each edge of the wound (Wound closure manual, 2005).

Example of a mass closure technique is the Smead–Jones closure. The closure is done using a delayed absorbable suture, to include all of the abdominal wall structures on the far–far portion (at least 1.5–2 cm from the fascial edges) and only the anterior fascia on the near–near portion. It allows good healing without intervening fat or muscle. It can be performed in an interrupted fashion or as a running suture (Morrow & Curtin, 1996).

2.9 Wound closure materials

These include sutures, adhesive tapes and staples. Recently, tissue adhesives are used in clinical practice. In choosing the ideal wound closure material, many factors must be taken into consideration. These include location of the wound, presence or absence of infection, age of the patient and surgeon's experience in suture material handling (Osther *et al*, 1995).

A suture is a thread of material used to ligate blood vessels or approximate tissues (Wound closure manual, 2005). Examples of materials used as sutures include nylon, linen, silk, cotton, horsehair, wire made of precious metals and animal tendons.

Sutures can be categorized into two; degradable and non degradable sutures. Sutures that are degradable lose their stress of durability within 2 months whilst sutures that maintain their tensile strength for longer than 2 months are non degradable (Wound closure manual, 2005).

Degradable (Absorbable) sutures may be temporarily used to ligate wound edges in approximation, until they have been sufficiently healed to withstand normal stress. The collagen of healthy mammals and synthetic polymers are used to prepare absorbable sutures. Some are absorbed quickly, while others are chemically treated to lengthen their time of absorption (Wound closure manual, 2005).

In the body, enzymes attack and degrade natural absorbable sutures. In synthetic absorbable sutures, hydrolysis takes place when water enters the suture filaments. Although absorbable sutures offer many advantages, they have certain inherent limitations (Wound closure manual, 2005). Several circumstances predispose a patient to postoperative complications as the suture thread will not maintain adequate strength to withstand stress until the tissues have healed completely. For example, if a patient has any infection, the suture absorption process may speed up, causing a rapid decline in durability stress. Also, if the sutures become wet during handling before embedded in tissue, the absorption process may prematurely begin. Similarly, patients with impaired healing are not ideal patients for this type of suture. Examples of absorbable sutures are surgical gut (chromic, plain), vicryl, monocryl, and polyglycolic acid (Wound closure manual, 2005).

Non Degradable (Non absorbable) sutures are not broken down by body enzymes or undergo hydrolysis in body tissue. They are made from a variety of non biodegradable materials and are engulfed by the body's stem cells. They remain where they are embedded within the tissues until they are removed postoperatively. Non absorbable sutures are made of single or multiple filaments of synthetic, metal or organic fibers rendered into a thread by twisting, spinning or braiding. Examples of non absorbable sutures are surgical silk, nylon and prolene (Wound closure manual, 2005).

2.10 Factors that affect wound healing

Several factors affects normal wound healing. They include inadequate blood supply to the wound site, age, chronic disease, dehydration, weight, nutritional status and immune response (Wound closure manual, 2005).

Any condition that limits the supply of blood to the wound, such as poor blood circulation to the limbs in a diabetic patient or thickening of the walls of arteries, will slow down the healing process (Gilbert *et al*., 2002).

Aging and chronic disease states of patients interfere with normal wound repair due to reduction in cellular response to the stimulus of injury. Aging result in both skin and muscle tissue deficiencies. It also results in slow metabolic activities, and circulation may be impaired (Mangram *et al.*, 1999).

Another factor that affects would healing is the depletion of body fluids. This result to electrolyte imbalance and impair the healing process. Fluid depletion affects hormonal function, oxygenation of the blood, cellular metabolism, cardiac and kidney functions (Rothenburger *et al.*, 2002).

Obese patients have excess deposition of adipose tissue at the wound site. This may prevent securing a good closure. Also, fat does not have a rich blood supply, making it the most vulnerable of all tissues to trauma and infection (Wound closure manual, 2005).

Wound healing process may be impaired by lack of adequate nutrition associated with chronic disease or cancer, or specific deficiencies in carbohydrates, proteins, zinc, and vitamins. Good nutrition is essential to support cellular activity and collagen synthesis at the wound site (Gilbert *et al.*, 2002).

Immune deficiencies may have serious effects on the outcome of a surgical procedure because the immune response protects the patient from infection. Patients that have been infected with Human Immuno - deficiency virus (HIV), those who have recently undergone chemotherapy or who have taken prolonged high dosages of catabolic steroids, may have compromised immune systems (Gilbert *et al.*, 2002).

Some patients develop allergies to specific suturing materials, metal alloys, or latex. These can cause a raised immune response in the form of an allergic reaction. This may also interfere with the normal wound healing process.

A patient with chronic illness such as malignancies, localized infection, diabetes, endocrine disorders or debilitating injuries will be more vulnerable to SSIs due to the slow pace of the healing process (Mangram *et al.*, 1999).

All of these factors are issues of concern. The surgeon must consider their effects upon the tissues at the wound site, as well as their potential impact upon the patient's overall recovery from the procedure.

2.11 Sources of Surgical site infections

The sources of SSIs could be vast and varied, ranging from practices in the hospital before and after the surgery and poor hygienic practices from patients. Others are non-adherence to aseptic wound dressing procedures and the inefficiency of antibiotics used for surgical prophylaxis. The sources of SSIs can be the patient, the theatre environment or the operating room staff. The organism may be transferred from the surgeon or nurse through hand contact or could be airborne during surgery. The patient may also come in contact with organism after surgery (Bratzler & Hunt, 2006).

The instruments used during surgery can also be a source of infection. Organisms may also come from the body within where they normally live without doing any harm (Mangram, *et al*., 1999). All materials used in surgery must be sterilized before their use. This includes dressings, needles, gloves, sutures and solutions that may come into contact with the wound and exposed tissues. The surgical team must also prepare themselves by using appropriate aseptic techniques as required. Exposed body parts such as the head and hair must be covered and mask should be worn throughout the operation. Only the personnel's involved in the surgery should touch the sterile equipment. After the operation, the wound is protected from possible contamination by sterile dressings; the dressing should be sterile at least for a day before it is changed if there is absence of bleeding (Smeltzer & Bare, 1992).

2.12 Bacteria associated with surgical site infections

The bacteria that are associated with SSIs include both Gram positive and negative bacteria. They are also classified as aerobic or anaerobic.

The Gram positive bacteria include *Staphylococcus aureus, Clostridium species,* Coagulase - Negative *Staphylococci* (CNS), *Peptostreptococcus species* and *Bifidobacterium species* (Hidron *et al.*, 2009).

The Gram negative bacteria include *Klebsiella pneumoniae, Klebsiella oxytoca, Enterococcus spp*, *Proteus species, Escherichia coli, Pseudomonas aeruginosa, Enterobacter species, Prevotella species* and *Bacteriodes species.* Others include *Candida species* and *Acinetobacter baumannii* (Hidron *et al.*, 2009).

Staphylococcus is the most commonly isolated bacteria in SSIs as it is the most common normal skin flora (Shriyan & Nayak, 2010).

Staphylococcus aureus have been found to account for 20-40% of all SSIs whilst *Pseudomonas aeruginosa* causes 5-15% of all nosocomial infection (Taiwo *et al*., 2002).

The anaerobic bacteria associated with SSIs are *Bacteroides species*, *Peptostreptococcus species* and *Clostridium species*. Others include *Propionibacterium species*, *Eubacterium, Prevotella species*, *Porphyromonas species*, *Fusobacterium*, and *Actinomyces*.

Anaerobic organisms cause infections that are considered to be of relatively low virulence. They are prevalent in infections associated with predisposing or underlying conditions such as malignancy, immunodeficiency, previous surgery, presence of foreign bodies and diabetes.

These are opportunistic pathogens that are seldom recovered as single isolates (Brook, 1993).

2.13 Antibiotic resistance

There has been a global rise in resistance to antimicrobial drugs. These include the emergence of bacterial strains that are resistant to all available antibacterial agents. This has created a public health problem of potentially crisis in different proportions with major economic and human implications (Smith & Coast, 2002).

Antimicrobial resistance is a threat to all branches of medical and public health practice. It affects the control of infectious diseases, hinders progress on health outcomes by increasing morbidity and mortality and imposes huge financial burden on societies. According to European Centre for Disease Prevention and Control (ECDC), about 25 000 patients die each year from infections caused by selected multidrug-resistant bacteria in the European Union. The associated costs are estimated at about 1.5 billion Euros per year (ECDC, 2009).

In United States of America, it cost the health-care system over 20 billion United States dollars (US$) annually to deal with infections due to pathogens resistant to antimicrobials. It generates more than 8 million additional hospital days (Roberts *et al*., 2009).

Concern about antibiotic resistance centered on Gram-positive bacteria more than Gram negative bacteria, particularly Meticillin-Resistant *Staphylococcus aureus* (MSRA) and VancomycinResistant *Enterococcus spp*. about ten (10) years ago. In recent times, however, Clinical Scientists agree that multidrug resistant Gram-negative bacteria pose the greatest risk to public health. It is reported that the increase in resistance of Gram-negative bacteria is faster than in Gram-positive bacteria (Cornaglia, 2009). Also, there are fewer new and developmental antibiotics active against Gram-negative bacteria (Baiden *et al*., 2010). Drug development programmes seem insufficient to provide therapeutic cover to deal with resistance due to Gram negative bacteria in 10 to 20 years (Boucher *et al*., 2009).

MRSA is a resistant strain of *Staphylococcus aureus* bacteria (example penicillin and tetracycline). It is usually harmless, but may occasionally get into the body and cause infection. About 20-30%

people carry MRSA on their skin, nose and throat without knowing it. These patients are said to be colonized. The type of surgery and prolonged hospital stay can increase the risk of being infected by MRSA. Occasionally, MRSA gets into the body through breaks in the skin such as cuts, wounds, surgical incisions or indwelling catheters. It has the ability to survive in dry, dusty environment, and can be spread through airborne. Therefore the most common infection route between patients is health care workers (Perttunen, 2008).

CHAPTER THREE

RESEARCH METHODS

3.1 Study site

The study site is the Obstetrics & Gynaecology (O & G) Directorate and Microbiology Department of Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana. KATH is the biggest health facility in the Kumasi metropolis. KATH has eleven Clinical Directorates and two non-clinical Directorates. Each Directorate is managed by a management team. The catchment area of the hospital is beyond Brong Ahafo and the three Northern Regions, and to some parts of Central and Western Regions. The catchment population is estimated to be about 10 million people (KATH Annual report, 2012).

The hospital provides special health care services in all aspects of infections. This is in fulfillment of its mandate of providing advanced clinical care services to all people living in Ghana.

The Obstetrics and Gynaecology (O&G) Directorate is the second largest Clinical Directorate at KATH in terms of service output. It is also serve as an Academic Department of KNUST and provides tertiary level women's health care and training. Research works are also conducted at the Directorate for academic purpose.

The Microbiology department of KATH is under the Diagnostic Directorate and is well equipped to carry out microbial investigations on blood, stool, vaginal swab, wound swab and cerebro spinal fluid samples of patients for diagnostic purposes. Currently, anaerobic cultures are not done at the Microbiology Department of KATH. The necessary laboratory inputs for anaerobic cultures for this study were imported from Becton, Dickson and Company, USA.

3.2 The study Population

The study population comprised all women who had Caesarean Section in the Obstetrics and Gynaecology Directorate of KATH. In 2012, the total C/S carried out in the O & G was 3,672 (KATH Annual report, 2012).

3.3 Sample size

The sample size was calculated considering the error of margin (Confidence Interval) of +/- 5%, Confidence Level of 95% (Z-score = 1.96), and Standard of Deviation of 0.5. The sample size was calculated using the following formula:

$$\text{Sample Size} = \frac{(\text{Z - score})^2 \times \text{Std. Dev.} \times (1-\text{Std. Dev.})}{(\text{Error of margin})^2}$$

$$\frac{((1.96)^2 \times 0.5(1-0.5))}{(0.05)^2}$$

$$\frac{(3.8416 \times 0.25)}{0.0025}$$

$$\frac{0.9604}{0.0025}$$

$$= 384.16$$

Therefore 385 women were to be enrolled for the study.

3.4 Study design

The study utilized a cross sectional design to consecutively enroll women who had Caesarean Section in O & G Directorate of KATH within the study period from June to December, 2015.

Immediately after the surgical procedure, a brief background to the study was presented to the women to make informed consent to participate in the study. Each woman who consented to participate in the study was issued a study card with a serially generated study number. The women were followed from the Wards until discharge. After discharge, the women were followed at the 'A 1' wound dressing room of O & G until the 14th day to detect SSI's. At each visit at the dressing room, the study card was inspected and the wounds were clinically assessed by a trained Nurse.

Data on socio demographics, surgical procedure, and antibiotics history of patients before and after surgery were obtained using a well structured questionnaire (see appendix 2). Patient records from folders and interviews were used in collecting these data for the study.

3.5 Wound assessment and grading

On the first day of the routine visit of women at the dressing room, each woman was issued a wound dressing form (see appendix 1). The form was filled at each visit after the wound assessment. Between the 10th and 14th days, the wounds were inspected by the trained Nurse and graded into 'normal', 'grade 1', 'grade 2', or 'grade 3'. The grading was done based on the clinical appearance of the wound. A brief description of the wound was made based on the following characteristics: wound completely healed, wound disrupted only (without pus), burst abdomen with evisceration of omentum ± bowel, wound with serous fluid discharge only, wound disrupted with pus and wound healed with indurated surroundings (Table 1).

Table 1: Wound grading description

Wound description	Grading
Wound completely healed without indurated surroundings	Normal
Wound healed with indurated surroundings	Grade 1
Wound disrupted with serous fluid discharge only	Grade 2
Wound disrupted with pus and burst abdomen	Grade 3

3.6 Collection of wound swabs

Wounds swabs were taken between the 10th and 14th post operative days after the grading of the wounds. Wounds that were dressed were cleaned with sterile normal saline after removing the dressing. The wound sampling procedure was explained to the participants. Wound swabs were aseptically taken from patients with clinical manifestation of SSI (wounds graded 2 and 3) and sent to the Microbiology Department of KATH for culture and antimicrobial susceptibility testing.

Wound swabs were also randomly taken from wounds graded normal and grade 1 to serve as a control study to ascertain whether patients without clinical manifestations of SSI had contaminated wounds.

Two (2) wound swabs were aseptically taken from each patient. The first wound swab was taken from the surface of the wound for aerobic cultures. The second wound swab was taken from the internal part of the wound for anaerobic cultures. The specimens were collected using sterile cotton swab by rotating with sufficient pressure.

3.7 Transporting wound swabs

The wound swabs was put into Stuart's transport medium, appropriately labeled and taken to the microbiology laboratory of KATH for culture and sensitivity testing.

3.8 Aerobic cultures

Wound swabs taken for aerobic cultures were inoculated on 5-10% sheep blood agar and MaCconkey agar by preparing a pool at one quadrant and streaking by sterile inoculation loop. The culture plates were incubated at 35–37°C for 24hours. Direct smear were prepared from the swabs after the initial streaking and Gram stained. The slides were examined and results documented.

After the period of incubation, the culture plates were observed. Preliminary identification of bacteria was based on growth characteristics of the organisms, such as haemolysis on blood agar, changes in physical appearance in differential media and enzyme activities of the organisms. Gram stain reaction and standard Biochemical tests were performed on colonies from primary cultures for identification of the isolates. Gram-negative rods were identified by performing a series of biochemical tests, namely Indole test, Citrate Utilization test, urease test, Triple Sugar Iron Agar (TSI) test and motility test. Gram-positive cocci were identified based on their Gram reaction, coagulase and catalase test results. The results of isolates were documented.

3.9 Anaerobic cultures

Swabs collected for anaerobic cultures were inoculated aseptically into cooked meat broth and incubated under anaerobic conditions for 24hrs at 37ºC. After the period of incubation, the growth of bacteria in the cooked meat broth was observed. Based on the growth characteristics, the anaerobes were identified. *Clostridium perfringens* grows rapidly in cooked meat medium and produces hydrogen sulphide gas (Gas bubbles in turbid medium) and reddening but no decomposition of the meat (saccharolytic reaction) (Cheesbrough, 2006).

Bacteroides fragilis grows in cooked meat medium producing decomposition with blackening of the meat (foul-smelling proteolytic reaction). *Peptostreptococcus* grows in cooked meat medium with the production of large amounts of hydrogen sulphide gas (Cheesbrough, 2006).

After 24hrs of incubation, cooked meat broth was sub cultured onto 5 – 10% sheep blood agar with Gentamicin. Gentamicin was added to the blood agar to make it selective. This was done to reduce the heavy growth of other enterobacteriacea that could interfere with the growth of anaerobes. The culture plates were incubated in BD GasPak EZ Gas Generating Container System (obtained from BD, USA) at 37ºC for 48hrs. The GasPak EZ Gas Generating Container

System comprised of GasPak EZ small incubation container for 10-12 Petri dishes and GasPak EZ gas generating sachet with an oxygen indicator. Direct smear were prepared from the cooked meat broth and Gram stained. The slides were examined under the microscope and results documented.

After the incubation, the culture plates were observed. Gram stain was performed on bacteria colonies. Identification of bacteria was based on growth characteristics of the organisms, such as haemolysis on blood agar. Gram stain reaction and standard Biochemical tests were performed on colonies from primary cultures for identification of the isolates. The results of isolates were documented.

3.10 Antimicrobial susceptibility testing (AST)

The Kirby-Bauer disk diffusion technique was used for the antimicrobial susceptibility testing. It was performed based on the criteria set by Clinical and Laboratory Standard Institute (CLSI) 2014. The inoculum was prepared by picking 2 or 3 pure colonies of bacteria with a sterile wire loop and suspended in sterile normal saline. The density of suspension to be inoculated was determined by comparison with opacity standard on McFarland 0.5 Barium sulphate solution. The test bacteria was uniformly inoculated on Mueller-Hinton agar (oxoid) and exposed to a concentration gradient of antibiotic diffusing from antibiotic-impregnated paper disk into the agar medium. It was incubated at 37°C for 16–18 hours. Diameters of the zone of inhibition around the discs were measured to the nearest millimeter using a ruler and classified as sensitive, intermediate, and resistant according to the standardized table supplied by CLSI 2014.

The drugs used for Gram negative and positive bacteria were ampicillin (10 µg), ciprofloxacin (5 µg), gentamicin (10 µg), tetracycline (30 µg), cotrimoxazole (25 µg), cefuroxime (10 µg), and vancomycin (30 µg).

Ceftriaxone (30 µg), ceftazidime (30µg), levofloxacin ( ) and Amikacin (30 µg) were used for only Gram negative isolates.

Penicillin (1.5 µg), cloxacillin (5 µg), erythromycin (5 µg) and augmentin (30 µg) were used for only Gram positive bacterial isolates (oxoid). The antimicrobial agents were selected based on their availability and according to CLSI 2014.

3.11 Quality control

For aerobic cultures, stable stock strains of *Escherichia coli, Pseudomonas aeruginosa, Klebsiella spp.* and *Staphylococcus aureus* were used as control bacteria. These were obtained from the microbiology laboratory of KATH. The GasPak EZ Gas Generating Container System was controlled using *Clostridium spp.* and *Pseudomonas aeruginosa*. The *Clostridium spp.* was obtained from Unity laboratory (Kumasi) and *Pseudomonas aeruginosa* was obtained from Microbiology laboratory of KATH.

3.12 Inclusion criteria

- Adult women 17 years and above who had Caesarean Section in O & G Directorate of KATH within the study period.
- Women who gave consent and completed the informed consent form.

3.13 Exclusion criteria

- Caesarean section patients who were under 17 years of age.
- Patients whose surgical procedure required the use of implant.
- Referred patients from other health facilities.

3.14 Statistical analysis

The data collected from the questionnaire and interviews conducted were entered unto and analyzed using descriptive statistics such as relative frequencies, means and standard deviations with the aid of Statistical Package for Social Sciences (SPSS) software version 16. Independent risk factors associated with SSI after C/S delivery were determined by calculating Odds ratio and 95% confidence interval with the help of Logistic regression analysis.

3.15 Ethical consideration

Permission was sought from the Directorate in which the study was carried out. The study was also registered at the research and development unit, and approval sought from the ethics committee KATH/SMS.

Patients consent was also sought before in extracting information from patient folders. The rights of patients who declined to divulge information about their health and treatments was respected. They were not included in the study.

3.16 Treatment of women with SSI

Women who were found to have SSI based on clinical assessment and laboratory cultures were referred to their Doctors for appropriate management free of charge.

CHAPTER FOUR

RESULTS

4.1 Socio - demographic data of women

Out of 987 women who had Caesarean Sections, 393 of them consented to participate in this study. All the women resided in Ashanti region with majority (76.6%) being residents within Kumasi metropolis whilst 23.4% were residents of other towns within Ashanti region (table 2).

The majority of the women (80.4%) were married whilst 19.6% were co – habiting (not bound by any marriage rite but lives as couples (table 2).

The ages of the women who participated in the study ranges from 17 to 47 years. The mean age of the women was 29.9 years with standard deviation ± 5.6. Majority of the women (50.3%) were within the age category 21-30 years whilst 3.6% of the women were within the age category 41-50 years (table 2).

Out of 393 women, majority had completed Junior High School (51.9%), followed by Senior High School (20.1%) whilst, 7.6% (n=30) had no formal education (table 2).

Majority of the women (81.4%) were employed (skilled, unskilled or professional work) whilst 18.6% were unemployed (table 2).

Table 2: Socio – demographic data of women

Socio demographic data	Frequency (%)
Age	
< 20yrs	22 (5.6)
21 – 30yrs	198 (50.3)
31 – 40yrs	159 (40.5)
41 – 50yrs	14 (3.6)
Total	**393 (100)**
Marital status	
Married	316 (80.4)
Co- habiting	77 (19.6)
Total	**393 (100)**
Residential status	
Residence within Kumasi metropolis	301 (76.6)
Residence outside Kumasi metropolis	92 (23.4)
Total	**393(100)**
Education	
None	30 (7.6)
Primary	36 (9.2)
JHS	204 (51.9)
SHS	79 (20.1)
Tertiary	44 (11.2)
Total	**393 (100)**
Occupation	
Unemployed	73 (18.6)
Employed	320 (81.4)
Total	**393 (100)**

4.2 Surgical data of women

Out of the 393 women who consented for the study, majority (69.5%) had elective Caesarean Section surgery, whilst minority (30.5%) had emergency Caesarean Section surgery (table 3). The most common skin incision technique used for the Caesarean Section was Pfannenstiel. This technique was used for 95.9% of the women. Midline incision techniques were used for 4.1% of the women (table 3).

Nylon was the most common suture (42.2%) used in closing the incision site, followed by vicryl (25.2%) and then Silk (6.9%) (table 3).

The commonly used skin closure technique was Interrupted skin closure technique (61.3%). This was followed by sub-cuticular skin closure technique (30%) (table 3).

Majority of the women (37.9%) had multiple (two or more times) vaginal examinations before the delivery by Caesarean Section whilst 32.8% had no vaginal examination before Caesarean Section delivery (table 3).

Most of the women (66.4%) had their Caesarean Section within 31 – 60 minutes whilst, few (0.8%) had their surgery within 91 – 120 minutes (see Table 3). The mean duration for all the Caesarean Section was 43.0 minutes with standard deviation was ± 15.9 minutes. The median duration was 42 minutes.

Table 3: Surgical data of women

Surgical data	Frequency (%)
Type of C/S	
Elective	120 (30.5)
Emergency	273 (69.5)
Total	**393 (100)**
Abdominal incision	
Pfannenstiel	377 (95.9)
Midline incision	16 (4.1)
Total	**393 (100)**
Type of Suture used	
Nylon	166 (42.2)
Vicryl	99 (25.2)
Silk	27 (6.9)
Others	8 (2.0)
Not stated	93 (23.7)
Total	**393 (100)**
Skin closure technique	
Interrupted	241 (61.3)
Sub – cuticular	118 (30.0)
Others	7 (1.8)
Not stated	27 (6.9)
Total	**393 (100)**
No. of vaginal examination	
None	129 (32.8)
1	115 (29.3)
2 or more	149 (37.9)
Total	**393 (100)**
Duration of surgery (minutes)	
< 30mins	88 (22.4)
31 – 60	261 (66.4)
61 – 90	41 (10.4)
91 – 120	3 (0.8)
Total	**393 (100)**

4.3 Indications for C/S among women

The most common indication (19.6%) for Caesarean Section delivery among the women in this study was previous Caesarean Section plus another indication. The least indication (1.8%) was abnormal lie. The indications categorized as others included post date, twin gestation, poor progress, retroviral positive, hypertension, prolong 1st stage, contracted pelvis or combination of these reasons (table 4).

Table 4: Indication for C/S among women

Indication of Caesarean Section	Frequency (%)
Previous C/S plus another indication	77 (19.6)
Two or more previous C/S	53 (13.5)
Eclampsia / severe pre - eclampsia	48 (12.2)
Cephalopelvic Disproportion (CPD)	44 (11.2)
Fetal distress	39 (9.9)
Breech	24 (6.1)
Antepartum hemorrhage	12 (3.1)
Big baby	11 (2.8)
Abnormal lie	7 (1.8)
Others	78 (19.8)
Total	**393 (100)**

4.4 Antibiotic data of women

Almost all the women (99.2%) (n= 390) who had Caesarean section in the Directorate were given antibiotic prophylaxis either by intravenous or intramuscular for a duration of 24 - 48hrs, except few (0.8%) (n=3) that were not given any antibiotic prophylaxis. No reason was stated for not giving antibiotic prophylaxis. The antibiotics that were given before surgery were either amoksiclav only, metronidazole only or both amoksiclav & metronidazole (table 5). Table 5: Antibiotic prophylaxis given to women before C/S

Type of antibiotic prophylaxis	Frequency (%)
Both amoksiclav & metronidazole	241(61.3)
Metronidazole only	147(37.4)
Amoksiclav only	2(0.5)
Not given	3(0.8)
Total	**393(100)**

On the day of discharge, most of the women (82.7%) were given oral antibiotics whilst 17.3% were not given any type of oral antibiotic. For the women who were given oral antibiotics, 60.8% received both amoksiclav and metronidazole, 20.9% received metronidazole only whilst 0.8% received amoksiclav only (table 6).

Table 6: Type of oral antibiotic given at discharge

Type of oral antibiotic	Frequency (%)
Both amoksiclav and metronidazole	239(60.8)
Metronidazole	82(20.9)
Not given	68(17.3)
Amoksiclav	3(0.8)
Others	1(0.3)

Total	**393(100)**

4.5 Wound grading

After clinical assessment of the wounds, majority **(**54.5%) of the women had normal wounds, 35.4% had grade 1 wounds whilst both grade 2 and 3 wounds were 5.1% respectively (figure 2).

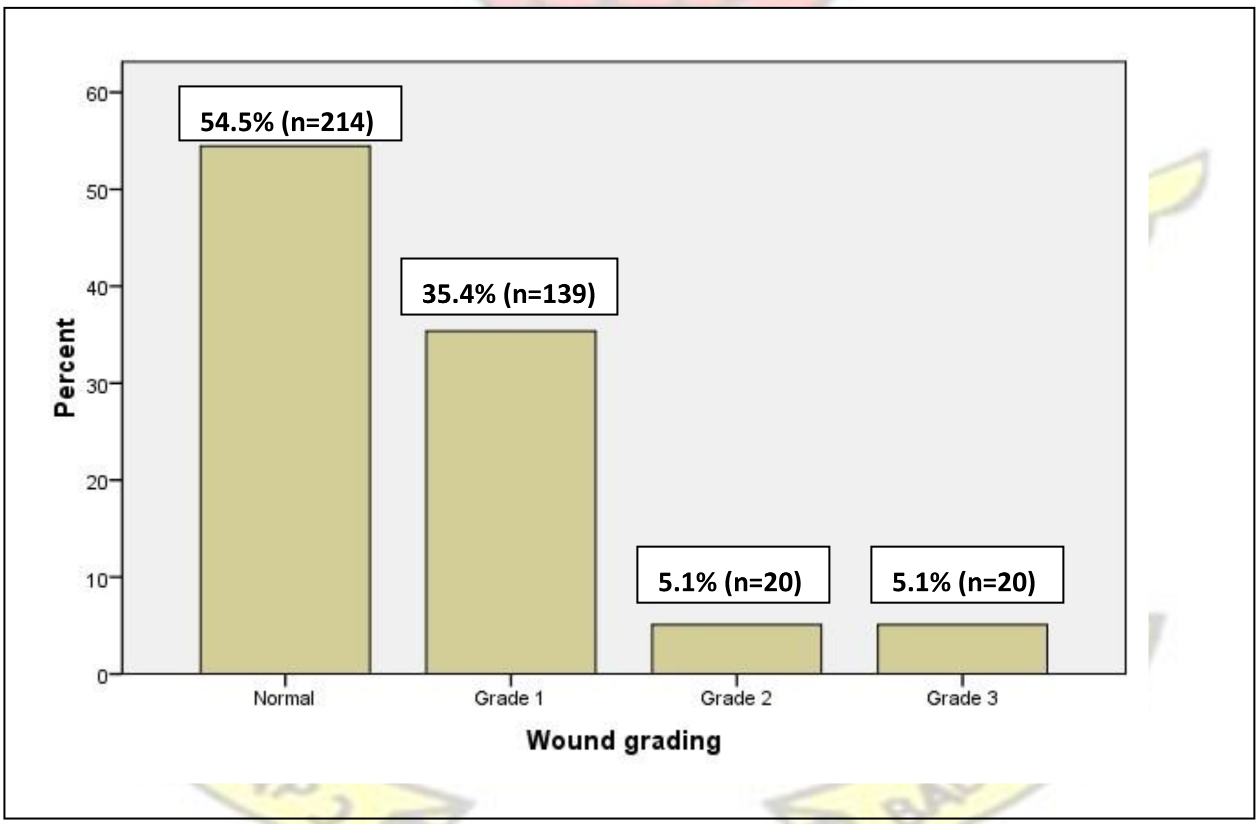


Figure 2: Bar chart showing wound grading status of women

4.6 Prevalence rate of SSI

After culturing the wound, bacteria growth was seen in all the 40 wound swabs taken from the clinically infected wounds (grade 2 and 3 wounds). 95% (n=38) of the culture plates showed more than one bacteria growth. 5% (n=2) of the culture plates showed only single bacteria growth. The culture plates which had single bacteria growth had Coagulase Negative *Staphylococcus* (CNS) as the only isolated bacterium. Hence, the prevalence rate was 9.67% (38 out of 393) (figure 3).

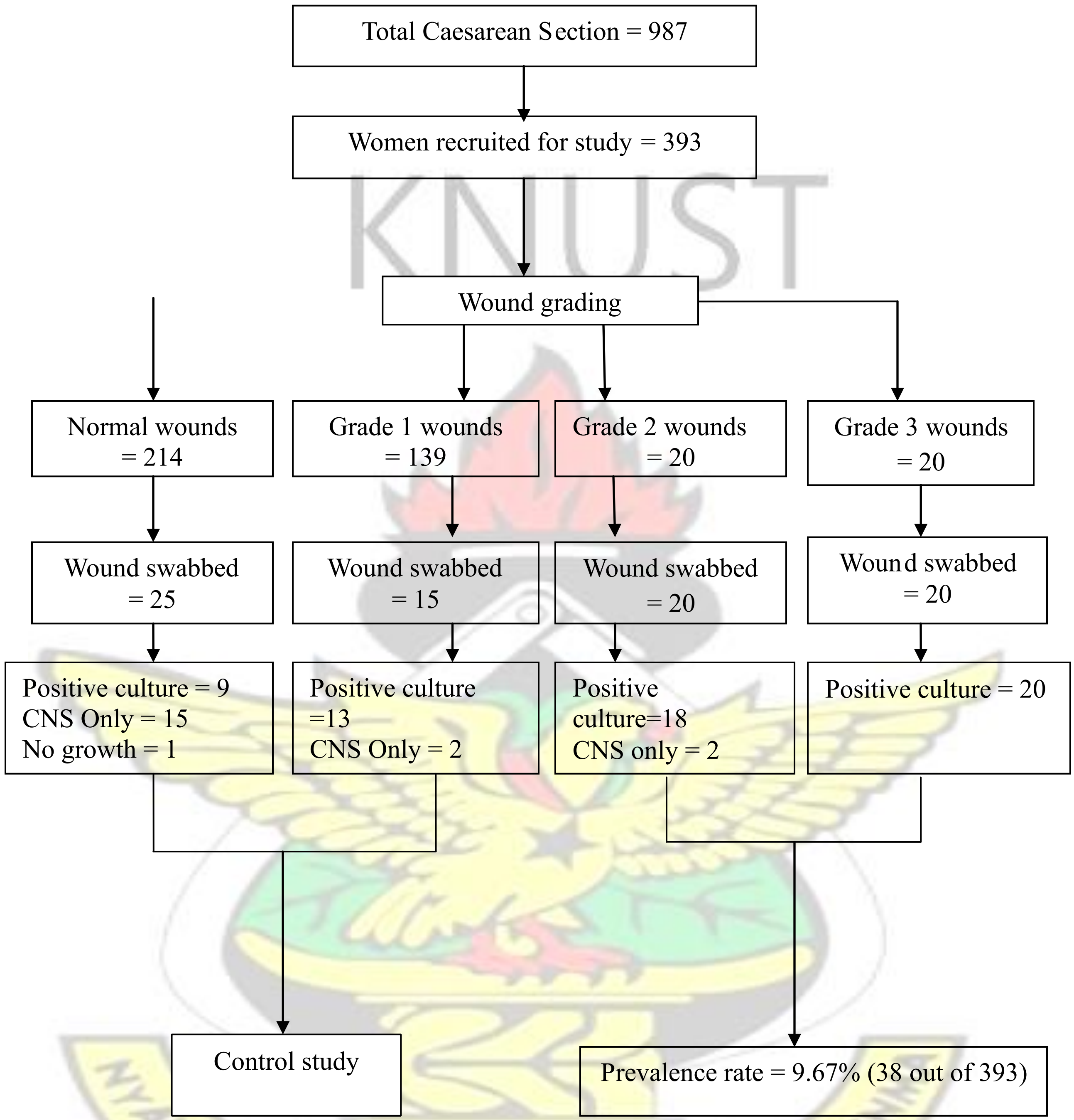


Figure 3: Consort diagram showing prevalence rate of SSI.

4.7 Bacteria isolates

Bacteria isolates from the clinically infected wounds were 58. The common bacteria isolated were *Klebsiella pneumoniae* (36.25%) (n=21), followed by *Pseudomonas aeruginosa* (22.4%)

(n=13). The least bacteria isolated were *Acinetobacter baumanii* and *Proteus vulgaris* (1.7%) (n=1). Coagulase Negative *Staphylococcus* (CNS) isolated was 6.9% (n=4) (table 7).

No anaerobic bacteria were isolated. All the bacteria isolated were aerobic bacteria.

Table 7: Bacteria isolates from clinically infected wounds.

Aerobic bacteria	**Number of isolates**	**Percentage (%)**
Klebsiella pneumoniae	21	36.25%
Pseudomonas aeruginosa	13	22.4%
Proteus mirabilis	10	17.2%
Coagulase Negative *Staph* (CNS)	4	6.9%
Enterobacter species	3	5.2%
Staphylococcus aureus	3	5.2%
Escherichia coli	2	3.45%
Acinetobacter baumanii	1	1.7%
Proteus vulgaris	1	1.7%
Total	**58**	**100%**

Although no anaerobic bacteria were isolated, 5 bacteria were isolated from the anaerobic cultures. They were *Escherichia coli* (n=1), *Providencia species* (n=1) and Coagulase Negative *Staphylococcus* (CNS) (n=3).

Wound swabs aseptically taken from 40 randomly selected normal and grade 1 wounds for aerobic cultures showed 97.5% (n=39) bacterial growth. Out of the 39 bacterial growths, 17 showed single colony growth whilst 22 showed mixed growth. Gram stain reaction from the mixed growth plates showed both Gram positive and negative bacteria whilst the Gram stain reaction on the single colony growths showed only Gram positive bacteria that were Coagulase negative *Staphylococcus* only.

There was no growth in the anaerobic cultures.

The total bacteria isolates from the clinically uninfected wounds were 51. Coagulase Negative *Staphylococcus* (CNS) was the most common (41.2%) isolated bacterium. *Klebsiella pneumoniae* was the second most common isolate (33.3%). The least isolated organisms were *Proteus vulgaris* and *Enterobacter species* (1.95%) respectively (table 8).

Table 8: Bacteria isolates from wounds considered not infected

Aerobic bacteria	Frequency	Percentage (%)
Coagulase Negative *Staphylococcus* (CNS)	21	41.2
Klebsiella pneumoniae	17	33.3
Proteus mirabilis	6	11.8
Pseudomonas aeruginosa	5	9.8
Proteus vulgaris	1	1.95
Enterobacter species	1	1.95
Total	**51**	**100**

4. 8 Antibiotic susceptibility

Staphylococcus aureus was resistant to penicillin, ampicillin, and tetracycline but sensitive to cloxacillin, erythromycin, gentamicn and ciprofloxacin (table 9).

Table 9: Antibiotic susceptibility pattern for Gram positive bacteria

Antibiotic / Bacteria	*Staphylococcus aureus* (n = 3)	
Susceptibility	**Resistant**	**Sensitive**

Penicillin	100%	0%
Ampicillin	100%	0%
Cloxacillin	0%	100%
Erythromycin	0%	100%
Tetracycline	100%	0%
Vancomycin	67%	33%
Cotrimoxazole	67%	33%
Cefuroxime	67%	33%
Gentamicin	0%	100%
Ciprofloxacin	0%	100%
Augmentin	67%	33%

The Gram negative bacteria isolated showed varying patterns of sensitivity to various antibiotics. Most Gram negative bacteria were sensitive to amikacin, ciprofloxacin and gentamicin whilst resistant to ampicilin, tetracycline and levofloxacin (table 10a).

Klebsiella pneumoniae was resistant to ampicillin and levofloxacin but sensitive to amikacin (81%).

Pseudomonas aeruginosa was 77% sensitive to amikacin and ciprofloxacin. It was 100% resistant to ceftazidime and levofloxacin (table 10a).

Table 10a: Antibiotic susceptibility pattern for Gram negative bacteria

Organism / Antibiotic	*Klebsiella pneumoniae* (n = 21)			*Pseudomonas aeruginosa* (n= 13)		*Proteus vulgaris* (n= 1)	
Susceptibility	**R**	**I**	**S**	**R**	**S**	**R**	**S**
Ampicillin	100%	0%	0%	-	-	100%	0%
Tetracycline	95%	0%	5%	-	-	100%	0%
Amikacin	19%	0%	81%	23%	77%	0%	100%
Ceftriaxone	57%	0%	43%	-	-	0%	100%
Cefuroxime	81%	0%	19%	-	-	100%	0%
Ciprofloxacin	24%	0%	76%	23%	77%	0%	100%
Cotrimoxazole	81%	0%	21%	92%	8%	100%	0%
Gentamicin	33%	5%	62%	30%	62%	0%	100%
Ceftazidime	-	-	-	100%	0%	-	-
Levofloxacin	100%	0%	0%	100%	0%	100%	0%

KEY: R ---- Resistant I -------- Intermediate S ------- Sensitive

The only *Proteus vulgaris* was sensitive to amikacin, ceftriaxone, ciprofloxacin and gentamicin but resistant to ampicillin, tetracycline, cefuroxime, cotrimoxazole and levofloxacin (table 10a).

Table 10b: Antibiotic susceptibility pattern for Gram negative bacteria

Organism / Antibiotic	*Proteus mirabilis* (n= 10)		*Enterobacter spp.* (n=3)		*Acinetobacter baumanii* (n= 1)		*Escherichia coli* (n= 2)	
Susceptibility	**R**	**S**	**R**	**S**	**R**	**S**	**R**	**S**
Ampicillin	100%	0%	100%	0%	100%	0%	100%	0%
Tetracycline	100%	0%	100%	0%	100%	0%	100%	0%
Amikacin	20%	80%	33%	67%	0%	100%	50%	50%
Ceftriaxone	20%	80%	67%	33%	0%	100%	100%	0%
Cefuroxime	40%	60%	67%	33%	0%	100%	100%	0%
Ciprofloxacin	0%	100%	67%	33%	0%	100%	50%	50%
Cotrimoxazole	80%	20%	67%	33%	0%	100%	100%	0%
Gentamicin	10%	90%	67%	33%	0%	100%	50%	50%
Levofloxacin	100%	0%	67%	33%	100%	0%	100%	0%

KEY: R ---- Resistant S ------- Sensitive

Proteus mirabilis was sensitive to ciprofloxacin but resistant to ampicillin, tetracycline and levofloxacin (table 10b).

Enterobacter spp. was sensitive to amikacin (67%). It was however resistant to ampicillin and tetracycline (100%) (table 10b).

Acinetobacter baumanii was sensitive to amikacin, ceftriaxone, cefuroxime, ciprofloxacin, cotrimoxazole and gentamicin but resistant to ampicillin, tetracycline and levofloxacin (table 10b).

Sensitivity of *Escherichia coli* to amikacin, ciprofloxacin and gentamicin was 50%. It was however 100% resistant to ampicillin, tetracycline, ceftriaxone, cefuroxime, cotrimoxazole and levofloxacin (table 10b).

Table 11a: Antibiotic susceptibility pattern for Gram negative bacteria isolates from clinically not infected wounds.

Organism / Antibiotic	***Klebsiella pneumoniae* (n = 17)**			***Pseudomonas aeruginosa* (n= 5)**		
Susceptibility	**R**	**I**	**S**	**R**	**I**	**S**
Ampicillin	100%	0%	0%	-	-	-
Tetracycline	88%	0%	12%	-	-	-
Amikacin	18%	0%	82%	0%	0%	100%
Ceftriaxone	24%	0%	76%	-	-	-
Cefuroxime	70%	12%	18%	-	-	-
Ciprofloxacin	18%	6%	76%	0%	0%	100%
Cotrimoxazole	82%	0%	18%	100%	0%	0%
Ceftazidime	-	-	-	0%	20%	80%
Gentamicin	24%	6%	70%	40%	0%	60%
Levofloxacin	100%	0%	0%	100%	0%	0%

KEY: R ---- Resistant I -------- Intermediate S ------- Sensitive

The antibiotic susceptibility for the bacteria isolated from the clinically not infected wounds showed similarity to that of bacteria isolated from the clinically infected wounds. Amikacin, gentamicin and ciprofloxacin were sensitive to all the isolates whilst ampicillin and levofolxacin was resistant to all isolates (table 11a).

The sensitivity of *Klebsiella pneumoniae* to amikacin, ceftriaxone, ciprofloxacin and gentamicin was 82%, 76%, 76%, and 70% respectively. It was however 100% resistant to ampicillin and levofloxacin (table 11a)

Pseudomonas aeruginosa was sensitive to amikacin and ciprofloxacin but resistant to cotrimoxazole and levofloxacin (table 11a).

Proteus vulgaris was sensitive to amikacin, ceftriaxone and ciprofloxacin but resistant to ampicillin, tetracycline, cefuroxime, cotrimoxazole and levofloxacin (table 11b).

Proteus mirabilis was sensitive to ceftriaxone, ciprofloxacin and gentamicin. However, it was resistant to ampicillin, tetracycline and levofloxacin (table 11b).

Table 11b: Antibiotic susceptibility pattern for Gram negative bacteria isolates from clinically not infected wounds.

Organism / Antibiotic	***Proteus vulgaris* (n= 1)**		***Proteus mirabilis* (n= 6)**		***Enterobacter spp.* (n=1)**	
Susceptibility	**R**	**S**	**R**	**S**	**R**	**S**
Ampicillin	100%	0%	100%	0%	100%	0%
Tetracycline	100%	0%	100%	0%	100%	0%
Amikacin	0%	100%	17%	83%	100%	0%
Ceftriaxone	0%	100%	0%	100%	100%	0%
Cefuroxime	100%	0%	67%	33%	100%	0%
Ciprofloxacin	0%	100%	0%	100%	0%	100%
Cotrimoxazole	100%	0%	67%	33%	100%	0%
Gentamicin	0%	0%	0%	100%	0%	100%
Levofloxacin	100%	0%	100%	0%	100%	0%

KEY: R ---- Resistant S ------- Sensitive

Entrobacter spp. was sensitive to gentamicin and ciprofloxacin but resistant to ampicillin, tetracycline, amikacin, ceftriaxone, cefuroxime, cotrimoxazole and levofloxacin (table 11b).

4.9 Risk factors associated with SSI after Caesarean Section in univariate analysis

In the univariate analysis in table 12a, independent risk factor for SSI after C/S were associated with women who had midline abdominal incision (OR=3.3627, CI=1.0279 – 11.0008) and those who had interrupted skin closure technique (OR=3.0578, CI=1.3108 – 7.1332). However, age, level of education and type of suture used were not risk factors for SSI. Table 12a: Risk factors associated with SSI after C/S

Risk Factor	Frequency	No. infected (%)	Odds Ratio (OR)	95% Confidence Interval (CI)
Age				
≤ 30yrs	220	19 (8.6)	0.7662	0.3922 – 1.4968
31 – 50 yrs	173	19 (10.9)	1.3052	0.6681 – 2.5498
Education				
Nil	30	2 (6.7)	0.6488	0.1484 – 2.8368
Educated	363	36 (9.9)	1.5413	0.3525 – 6.7389
Abdominal incision				
Pfannenstiel	377	34 (9.0)	0.2974	0.0909 – 0.9728
Midline incision	16	4 (25)	3.3627	1.0279 – 11.0008
Type of Suture used				
Nylon	166	16 (9.6)	0.9939	0.5048 – 1.9571
Others	227	22 (9.7)	1.0061	0.5110 – 1.9810
Skin closure technique				
Interrupted	241	31 (12.9)	3.0578	1.3108 – 7.1332
Others	152	7 (4.6)	0.3270	0.1402 – 0.7629

In table 12b, the univariate analysis shows that emergency C/S (OR=2.5228, CI=1.0257-6.2050), more than two (2) vaginal examination before C/S (OR=2.1907, CI=1.1152 - 4.3033), and antibiotic prophylaxis not given to patient (OR=4.7703, CI=0.4224 – 53.8756) were independent risk factors for SSI after C/S. However, elective C/S (OR=0.3964, CI=0.1612-0.9749) was protective of SSI. Duration of surgery was not a risk factor for SSI. Table 12b: Risk factors associated with SSI after C/S

Risk Factor	Frequency	No. infected (%)	Odds ratio (OR)	95% Confidence interval (CI)
Type of C/S				
Elective	120	6 (5.0)	0.3964	0.1612 – 0.9749
Emergency	273	32 (11.7)	2.5228	1.0257 – 6.2050
No. of vaginal examination				
≤ 1	244	17 (6.9)	0.4565	0.2324 – 0.8967
2 or more	149	21 (14.1)	2.1907	1.1152 – 4.3033
Duration of surgery				
< 30mins	88	9 (10.2)	1.0842	0.4928 – 2.3856
31 – 120 mins	305	29 ((9.5)	0.9223	0.4192 – 2.0293
Antibiotic prophylaxis given				
Yes	390	37 (9.5)	0.2096	0.0186 – 2.3676
No	3	1 (33.3)	4.7703	0.4224 – 53.8756

CHAPTER FIVE

DISCUSSION AND CONCLUSION

5.1 Discussion

The prevalence rate of SSI after Caesarean Section among women who participated in this study was 9.67% (38 out of 393). This was shown in only aerobic cultures.

The 9.67% SSI prevalence rate obtained in this study is within the global SSI rates of 2.5% - 41.9% (Brown *et al*., 2007). However, it is low compared to 15.14% (53 / 350) reported in a similar study in KATH (Danso *et al*., 1998) and much lower compared to 32.3% SSI prevalence rate (354 / 1096) recorded in another study carried out in Northern Ghana (Apanga *et al*., 2013).

Low wound infection connotes the adequacy and high quality of care among Caesarean births (Danso *et al*., 1998). The reduction in SSI prevalence rate over the years at KATH is probably due to strict adherence to infection prevention protocols in sterilization procedures, wound management and conditions in the theatres and the laying in wards.

However, SSI prevalence rate of 9.67% is slightly high compared to 7.6% prevalence rate (10 / 131) reported in another study on Surgical Site Infections after Caesarean delivery in a District Hospital in Central Region of Ghana (Tia, 2013).

In this study, no anaerobic bacteria were isolated. However, five (5) facultative anaerobes were isolated. In a similar study on bacterial pathogens associated with infected wounds in Nigeria, no anaerobic organism was isolated in all samples examined (Sule *et al*., 2002). Facultative anaerobes were isolated because they have the ability to grow under aerobic conditions but develop most rapidly in an anaerobic environment. Metronidazole is given as antibiotic prophylaxis before abdominal and gynecological surgical procedures to reduce the risk of postoperative anaerobic infection (Lofmark *et al*., 2010). In this study, 98.7% of the women were given metronidazole as antibiotic prophylaxis (table 5) whilst 81.7% were given the antibiotic after discharge (table 6). This could explain why no anaerobic organism was isolated.

All organisms isolated in this study have been organisms isolated in similar study elsewhere (Hidron *et al*., 2009). The commonest bacterium isolate in this study was *Klebsiella pneumoniae* (36.25%) (n=21), with *Acinetobacter baumanii* (1.7%) (n=1) and *Proteus vulgaris* (1.7%) (n=1) being the least isolated bacteria. In a similar study on bacterial pathogens associated with infected wounds in Nigeria, *Klebsiella species* (25.3%) (n=47) was the highest bacterial isolate, with *Enterococcus faecalis* (5.4%) (n=10) being the least isolated bacterium (Sule *et al*., 2002).

Klebsiella species has become an important bacterium in a hospital setting, causing about 20% nosocomial infections where the problem of antibiotic resistance is typically magnified (Paterson, 2006).

Coagulase Negative *Staphylococci* (CNS) accounted for 6.9% (n=4) of the organisms isolated from wounds in the overall study. This is normal since the organism is a normal flora on the skin.

In a similar study, it was reported that these organisms are common contaminants of wounds (Mulu *et al*., 2012).

The commonest bacteria isolate from the swabs taken from the clinically uninfected wounds (table 8) was Coagulase Negative *Staphylococci* (CNS) accounting for 41.2% (n=21) of the total isolates. This is seemed normal because CNS is considered commensal bacteria found on the skin. This clearly indicates that the absence of clinical manifestation in surgical wounds does not rule out bacterial contamination. Hence, Surgical Site Infections must be diagnosed based on clinical appearance and positive culture from wounds since bacteria contaminants were isolated from wounds that were clinically not infected (table 8).

All isolated bacteria showed varying patterns of sensitivity to commonly used antibiotics. Most of the bacteria were sensitive to gentamicin, ciprofloxacin and amikacin than other antibiotics. This is in agreement with results reported in a study on antimicrobial susceptibility pattern on bacterial isolated from wound infection and their sensitivity to alternative topical agents in Ethiopia (Mama *et al*., 2014). The current antibiotic susceptibility pattern at KATH microbiology laboratory (reviewed laboratory records, 2015) also shows similar trend.

All the isolated bacteria were resistant to ampicillin, pencillin and tetracycline. This is also similar to the results reported by Mama et al, 2014. Data from the past several years shows an increasing resistance for drugs that were considered as the first line of treatment for postoperative wound infections (Ghosh *et al*., 2009).

All the *Klebsiella pneumoniae* isolates were resistant to ampicillin and levofloxacin. However 81% and 76% strains were sensitive to amikacin and gentamicin respectively (table 10a). A similar study by Lee and Burgess indicated that *Klebsiella pneumoniae* strains from clinical cases were found to be susceptible to aminoglycoside (amikacin and gentamycin) (Lee & Burgess, 2012).

The most common overall indication for Caesarean Section worldwide is previous caesarean section (Naidoo & Moodley, 2009). In a study on the trends and indications for Caesarean Section in a tertiary Hospital in India, most of the Caesarean Section was performed with previous caesarean section as the indicator (32.7%) (Unnikrishnan *et al*, 2010). These findings are consistent with the outcome recorded in this study (19.6% indication for C/S due to previous C/S).

Almost all the indications recorded in this study as indication for Caesarean Section delivery (table 4) has been reported elsewhere. In a descriptive analysis of the indications for Caesarean Section in China, maternal request (28.43%) was the most common indication for Caesarean section. Other indications were CPD (14.08%), fetal distress (12.46%), previous caesarean section (10.25%), malpresentation and breech (6.5%), macrosomia (6.10%), and others (22.1%) (Liu et *al*., 2014).

Majority of the women who participated in the study were residents in Kumasi metropolis because KATH was closer to them for follow up after the surgery. Other women who were residents in other towns outside Kumasi metropolis could not come for wound dressing at KATH probably due to high transportation expenses.

A greater number of the women who participated in this study, were unemployed (18.6%) (n=73). This is high compared to 4.8% female unemployment rate recorded by World Bank in 2013.

More than half of women (96.4%) (n=379) of child bearing age who participated in this study were between 17 and 40 years. The highest participating age group was within 21 and 30 years (50.4%) (n=198). This is because sexual activity is high in this age group and declines with increasing age. In a study involving sexuality in women, all women below the age of 40 years were fully sexually active with zero percent reporting no sexual activity (Aggarwal, 2013).

Most of the women who participated in this study had formal education from primary to tertiary educational levels (92.4%). This is in agreement with WHO factsheets of health statistics for Ghana which reported adult literacy (percentage age 15yrs of age and older) to be 71% between the year 2006 to 2011 (WHO, 2014).

In the univariate analysis, the risk factors causing SSI after Caesarean Section delivery identified in this study were midline abdominal incision used for the surgery, interrupted skin closure technique, emergency C/S, two (2) or more vaginal examination before C/S and patient to whom antibiotic prophylaxis were not given (table 12 a & b). Age, level of education, duration of surgery and type of sutures used were however not risk factors for SSI. Other studies have shown similar risk factors associated with SSI after Caesarean Section (Gong *et al*, 2012; Ezechi *et al*, 2009).

Emergency procedure as a risk factor causing SSI after Caesarean Section in this study is not surprising. In some studies, it has been one of the identified risk factor associated with post SSI (Oslen *et al*, 2008; Pallasmaa *et al*., 2010). This may likely relate to inadequate preparation time owing to maternal or fetal distress, reduced attention to infection preventing procedures and increased urgency of procedure. Interrupted skin closure technique was one of the risk factors to SSI's after C/S because they are usually used in the presence of wound infection (Seiler *et al*., 2009).

Identification of risk factors associated with SSI after Caesarean Section delivery reminds obstetric staff that it is appropriate that infection reducing strategies are targeted to women at high risk of developing SSIs. Such strategies include antibiotic prophylaxis as routine, antiseptic skin preparation, wound closure materials, type of abdominal incision technique and adequate and the use of appropriate dressings (Owens & Stoessel, 2008).

5.2 Conclusion

The prevalence rate of SSI after caesarean section delivery in KATH for the study period was 9.67%. Although there has been a reduction in SSI at the O & G Directorate of KATH over the years, surgical site infections are still a problem in KATH.

SSI rates in the study were doubled in Emergency Caesarean section (11.7%) cases compared to Elective Caesarean section (5.0%).

All the bacterial isolates in the study were aerobic bacteria. No anaerobic bacteria were isolated. The common bacteria isolates were *Klebsiella pneumoniae* (36.25%) and *Pseudomonas aeruginosa* (22.4%). The least isolated bacteria were *Proteus vulgaris* (1.7%) (n=1) and *Acinetobacter baumanii* (1.7%) (n=1).

Coagulase Negative *Staphylococcus* (CNS) was the most common bacteria isolate from clinically uninfected wounds (42.2%).

Most bacteria isolates were sensitive to gentamicin, ciprofloxacin and amikacin than other antibiotics such as cefuroxime, levofloxacin and ceftriaxone.

Resistance was highest against ampicillin, penicillin and tetracycline.

Significant risk factors causing SSI after Caesarean Section identified in this study were midline abdominal incision used for the surgery, interrupted skin closure technique, emergency C/S, two (2) or more vaginal examination before C/S and patient to whom antibiotic prophylaxis were not given.

No anaerobes were isolated because of high use of metronidazole.

5.3 Recommendation

Although the SSI prevalence rate has reduced over the years, the rate can be further reduced by the following recommendations:

- The sensitive antibiotics identified in this study should be used judiciously.

- Empirical prescription of antibiotics at the O & G Directorate for combating SSI after C/S should consider the resistant pattern of bacteria in this study.
- Surveillance, data collection and periodic review are necessary to monitor trends and improve care.
- The risk factors associated with SSI after Caesarean section delivery in this study should be considered to help reduce the possibility of these risk factors causing SSIs.

REFERENCES

Aggarwal, K.K. (2013). Sexual desire and sexual activity of men and women across their lifespan. *Indian Journal of Clinical Practice*, 24 (3), 207 – 210.

Apanga, S., Adda, J., Issahaku, M., Amofa, J., Mawufemor, K. R. A. (2013). Epidemiology of wound infection in a surgical ward of a Tertiary Care Hospital in Northern Ghana. *International Journal of Medical and Health Sciences*, 2(4), 444 – 448.

Baiden, F., Owusu-Agyei, S., Webster J., Chandramohan, D. (2010). The need for new antibiotics. *Lancet*, 375, 637–38.

Baldo, M. H. (2008). Caesarean section in countries of the Eastern Mediterranean Region, *Eastern Mediterranean Health Journal*, 14(2), 219 -221.

Becher, L. & Stokke, S. (2013). Indications for Caesarean section in St. Joseph Medical Hospital, Moshi Tanzania. (Masters Dissertation, University of Oslo), Oslo: DUO Research Archive. 1-36.

Borchard, A., Schwappach, D.L.B., Barbir, A., & Bezzola, P. (2012). A systematic review of the effectiveness, compliance and critical factors for implementation of safety checklists in surgery. *Annals of Surgery*, 256(6), 925–33.

Boucher, H.W., Talbot, G.H., Bradley, J.S. (2009). Bad bugs, no drugs: no ESKAPE! An update from the Infectious Diseases Society of America. *Clinical Infectious Diseases*, 48, 1–12.

Bratzler, D. W., & Hunt, D. R. (2006). The surgical infection prevention and surgical care improvement projects: National initiatives to improve outcomes for patients having surgery. *Clinical Infectious Diseases*, 43, 322 - 330

Brook, I., & Frazier, E.H. (1993). Significant recovery of nonsporulating anaerobic rods from clinical specimens. *Clinical Infectious Disease*, 16, 476-480.

Brown, S., Kurtsikahvi, G., Alonso, E. J., Aha, L., Bochoidez, T., Shushtakashiri, M. (2007). Prevalence and predictors of SSI in Tbilisi Republic of Georgia. *Journal Hospital Infections*, 66, 160-166.

Burger, J.W.A., Van't, R.M. & Jeekel, J. (2002). Abdominal incisions: techniques and postoperative complications. Review, *Scandinavian Journal of Surgery*, 91, 315–321.

Caesarean overview; NICE Pathway, (2015). 1-57. Retrieved from www.nice.org.uk

Carignan, A., Allard, C., Pépin, J. (2008). Risk of Clostridium difficile infection after perioperative antibacterial prophylaxis before and during an outbreak of infection due to a hypervirulence strain, *Clinical Infectious Disease*, 46, 1838–43.

Cheesbrough, M. (2006). District laboratory practice in Tropical countries. 2nd edition, Part 2. Cambridge University Press, 85.

Clinical and Laboratory Standard Institute, (2014). Performance standards for antimicrobial Susceptibility Testing; Twenty – fourth Informational Supplement, 34 (1), 35-46

Cornaglia, G. (2009). Fighting infections due to multidrug resistant Gram – positive pathogens. *European Society of Clinical Microbiology and Infectious Diseases*, 15, 209-211.

Consumers' Association (2001). Antimicrobial prophylaxis for orthopaedic surgery. *Drug Therapeutic Bulletin,* 39(6), 43–46.

Consumers' Association (2003). Antibacterial prophylaxis in surgery: 1 – Gastrointestinal and biliary surgery. *Drug Therapeutic Bulletin,* 41(11), 83–86.

Consumers' Association (2004a). Antibacterial prophylaxis in surgery: 3 – Arterial surgery on the abdomen, pelvis and lower limbs. *Drug Therapeutic Bulletin,* 42(6), 43–47 Consumers' Association (2004b). Antibacterial prophylaxis in surgery: 2 — Urogenital, obstetrics and gynaecological surgery. *Drug Therapeutic Bulletin,* 42(2), 9–13 Danso, K. A., & Adu-Sarkodie, Y. (1998). Abdominal wound infection complicating caesarean sections. *Ghana Medical Journal*, 32b, 1003-1008.

Dellinger, E.P., Hausmann, S.M., Bratzler, D.W., Johnson, R.M., Daniel, D.M., Bunt, K.M., Baumgardner, G. A. & Sugarman, J. R. (2005). Hospitals collaborate to decrease surgical site infections, *American Journal Surgery*, 190, 9–15

Dodd, J.M., & Reid, K. (2006). Tocolysis for assisting delivery at Caesarean section. *Cochrane Database System Rev* (4).

Douzdjian, V., & Gugliuzza, K.K. (1996). The impact of midline versus transverse incisions on wound complications and outcome in simultaneous pancreas-kidney transplants: a retrospective analysis. *Transplant International*, 9, 62–67. European Centre for Disease Prevention and Control, (2009). *ECDC/ European Medicines Agency Joint Technical Report: The bacterial challenge: time to react*. Stockholm. 1 - 54.

Ezechi, O. C., Edet, A., Akinlade, H., Gab-Okafor, C.V. & Herbertson, E. (2009). Incidence and risk factors for caesarean wound infection in Lagos Nigeria. *BioMed Central Research Notes*, 2 (1), 186-10.

Fehr, J., Hatz, C., Soka, I., Kibatala, P., Urassa, H., Smith, T., Mshinda, H., Frei, R. & Widmer, A. (2006). Risk factors for surgical site infection in a Tanzanian District Hospital: A challenge for the traditional national nosocomial infections surveillance system index. *Infection Control and Hospital Epidemiology*, 27(12), 1401-4.

Finger, C. (2003). Caesarean section rates skyrocket in Brazil. Many women are opting Caesareans in the belief that it is a practical solution. *Lancet,* 362 (9384), 628.

Ghosh, A., Karmakar, P.S., Pal, J., Chakraborty, N., Debnath, N.B., & Mukherjee, J.D. (2009). Bacterial incidence and antibiotic sensitivity pattern in moderate and severe infections in hospitalized patients. *Journal of Indian Medical Association*, 107(1), 21-25.

Gibbons, C., Bruce, J., Carpenter, J., Wilson, A.P., Wilson, J., Pearson, A., Lamping, D.L., Krukowski, Z. H., & Reeves, B.C. (2012). Identification of risk factors by systematic review and development of risk-adjusted models for surgical site infection, *Health technology assessment*, 15(30). 56-70.

Gilbert, P., McBain, A. J., Storch, M. L., Rothenburger, S. J. & Barbol,t T. A. (2002). Literature-based evaluation of the potential risks associated with impregnation of medical devices and implants with triclosan. *Surgical Infection Journal*, 3 (suppl 1), S55-S63.

Gong S.P., Guo H.X., Zhou H.Z., Chen L. & Yu Y.H. (2012). Morbidity and risk factors for surgical site infection following cesarean section in Guangdong Province, *China Journal of Obstetrics and Gynaecology Research*, 38 (3), 509-515.

Gould, D. (2007). Caesarean section, surgical site infection and would management. *Nursing Standard*, 21 (32), 57-58.

Griffin, F.A. (2005) Best-practice protocols: Preventing surgical site infection. *Nursing Management,* 36(11), 20–26.

Hidron, A. I., Edwards, J.R., Patel, J., Horan, T.C., & Sievert, D.M. (2008). NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety

Network at the Centers for Disease Control and Prevention, *Infection Control and Hospital Epidemiology*, 2, 996 - 1011.

Hospital Infection Society and Tissue viability Nurses Association (2007). Third Prevalence Survey of Health care Associated Infections in Acute Hospitals in England 2006. 23.

Humphreys, H., & Cunney, R. (2008). Performance indicators and the public reporting of healthcare-associated infection rates, *Clinical Microbiological Infections*, 14, 892 - 894.

Israelsson, L.A., & Jonsson, T. (1996). Incisional hernia after midline laparotomy: a prospective study. *European Journal of Surgery,* 162, 125–129.

Jido, T.A., & Garba, I.D. (2012). Surgical-site infection following cesarean section in Kano, Nigeria. *Annals of Medical Health Science Research,* 2, 33-36.

John Wiley & Sons (2007). The Cochrane Collaboration, antibiotic prophylaxis for cesarean section (Review), 4.

Kendall, S.W., Brennan, T.G., & Guillou, P.J. (1991). Suture length to wound length ratio and the integrity of midline and lateral paramedian incisions. *British Journal of Surgery,* 78, 705–707.

Knight, H., Cromwell, D., Meulen, J., Upek, G. U., Richmond, D., Mahmood, D., Templeton A., Dougail, A., & Johnson, S. (2013). Patterns of Maternity Care in English NHS Hospitals. *Royal College of Obstetricians and Gynaecologists*, 56.

Komfo Anokye Teaching Hospital, (2012). Annual Report. 59. Retrieved from www.kathhsp.org

Lee, C., Burgess, D.S (2012). Treatment of Klebsiella pneumonia Carbapenemase (KPC) infections: a review of published case series and case reports. *Annals of Clinical Microbiology and Antimicrobials,* 11, 11-32.

Lilani, S.P., Jangale, N., Chowdhary, A., & Daver, G.B. (2005). Surgical site infections in clean and clean-contaminated cases, *Indian Journal of Medical Microbiology,* 23(4), 249 - 52.

Liu, Y., Li, G., Chen, Y., Wang, X., Ruan, Y., Zou, L., & Zhang, W. (2014). A descriptive analysis of the indications for Caesarean Section in Mainland China. *BioMed Central Pregnancy and Childbirth*, 14, 410.

Lofmark, S., Edlund, C., Nord, E. C. (2010). Metronidazole is still the drug of choice for treatment of anaerobic infections. *Clinical Infectious Disease*, 50 (Suppl 1), S16-23.

Mama, M., Abdissa, A., & Sewunet, T. (2014). Antimicrobial susceptibility pattern of bacterial isolates from wound infection and their sensitivity to alternative topical agents at Jimma University Specialized Hospital, South – West Ethiopia. *Annals of clinical microbiology and antimicrobials*, 13(14), 1-10.

Mangram, A.J., Horan, T.C., Pearson, M.L., Silver, L.C., Jarvis, W.R. (1999). The Hospital Infection Control Practices Advisory Committee. Guideline for the prevention of surgical site infection. *Infections Control and Hospital Epidemiology*, 20, 247 - 280.

Morrow, C.P., Curtin, J.P. (1996). Incisions and wound healing. *In:* Gynaecologic Cancer Surgery. New York*: Churchill Livingstone,* 152.

Mory, F., Carlier, J. P., Alauzet, C., Thouvenin, M., Schuhmacher, H., Lozniewski, A. (2005). Bacteremia caused by a metronidazole-resistant *Prevotella* sp. strain.

Journal of Clinical Microbiology, 43, 5380-5383.

Mulu, W., Kibru, G., Beyene, G., & Damtie, M. (2012). Postoperative nosocomial infections and antimicrobial resistance pattern of bacteria isolates among patients admitted at Felege Hiwot Referral Hospital, Bahirdar. *Ethiopia Journal of Health Sciences*, 22(1), 7–18.

Naidoo, N., & Moodley J. (2009). Rising rates of Caesarean section: an audit of Caesarean sections in a specialist private practice. *South African Family Practice*, 51 (3), 254 – 258.

Nasreen, F., & Perveen, A. (2013). Surgical Site Infections, pathogens and sensitivity after emergency caesarean sections. *Journal of Medical Science*, 21 (3), 141 – 144.

National Institute for Health and Care Excellence Clinical Guideline (2011). Caesarean section. Retrieved from www.nice.org.uk/guidance/cg 132.

Nichols, R. L. (2011). Preventing Surgical Site Infections: *A Surgeon's perspective. Emerging infectious diseases,* (7).

Ofosua, J. A. (2014). Surgical Site Infections after Abdominal Surgery: prevalence, causes, management at the surgical wards, Komfo Anokye Teaching Hospital, Ghana. (Masters Dissertation, Kwame Nkrumah University of Science and Technology).

Olsen, M.A., Butler, A.M., Willers, D.M. (2008). Risk factors for surgical site infection after low transverse cesarean section. *Infectious Control Hospital Epidemiology*, 29(6), 477- 484.

Opoien, H.K., Valbo, A., Grinde-Anderson, A., Walberg, M. (2007). Post-caesarean surgical site infections according to CDC standards: Rates and risk factors. A prospective cohort study. *Acta Obstetricia et Gynecologica Scandinavica*, 86, 1097–102. Opoku, B. K. (2007). Prophylactic antibiotic during caeseraen sections at Komfo Anokye Teaching Hospital, Kumasi. *Ghana Medical Journal*, 41(2). 49 – 51.

Osther, P. J, Gjode, P., Mortensen, B.B. (1995). Randomized comparison of polyglycolic acid and polyglyconate sutures for abdominal fascial closure after laparotomy in patients with suspected impaired wound healing. *British Journal of Surgery*, 82, 1080 – 1082.

Owens, C.D., Stoessel, K. (2008). Surgical site infections: epidemiology, microbiology and prevention. *Journal of Hospital Infections*, 70 (S2), 3-10.

Pallasmaa, N., Ekblad, U., Tallberg, A.A., Uotila, J., Raudaskoski, T., Ulander, V. M. (2010). Caesarean delivery in Finland; maternal complications and obstetric risk factors. *Acta Obstetricia et Gynecologica Scandinavica*, 89(7), 896-902. Paterson, D.L. (2006). Maximizing Therapeutic Success in an Era of Increasing Antibiotic Drug Resistance. Medscape, 21.

Penn, Z., & Ghaem – Maghami, S. (2001). Indications for Caesarean section. *Best Practice and Research Clinical Obstetrics and Gynaecology,* 15 (1), 1-15.

Perttunnen, J. (2008). MRSA- Patient in Operation (slide show), Accesses 20 Sep. 2008.

Roberts, R.R., Hota, B., Ahmad, I., Scott, R.D., Foster, S.D., Abbasi, F. (2009). Hospital and societal costs of antimicrobial-resistant infections in a Chicago teaching hospital: implications for antibiotic stewardship. *Clinical Infectious Disease*, 49, 1175-1184.

Rothenburger, S., Spangler, D., Bhende, S., & Burkley D. (2002). In vitro antibacterial evaluation of Coated VICRYL* *Plus* Antibacterial suture (coated polyglactin 910 with triclosan) using zone of inhibition assays. *Surgical Infection Journal.* 3(suppl 1), S79-S87.

Safe prevention of the primary Caeserean delivery (2014). Obstetric care consensus No. 1. American College of Obstetricians and Gynecologists. *Obstetrics and Gynecology*, 123, 693-711.

Seiler, C. M., Bruckner, T., Diener, M. K., Papyan, A., Golcher, H., Seidlmayer, C. (2009). Interrupted or continuous slowly absorbable sutures for closure of primary elective midline abdominal incisions: a multicenter randomized trial. *Annals of Surgery*, 249, 576–82.

Seltzer, J., McGrow, K., Horsman, A., Korniewicz, D. (2002). Awareness of Surgical Site Infections for Advanced Practice Nurses. *Association of PeriOperative Registered Nurses Journal,* 3, 67.

Sepkowitz, K.A. (1995). AIDS, tuberculosis, and the health care worker. *Infectious Diseases*, 20, 232.

Shriyan, A., & Nayak, N. (2010). Aerobic Micro-Organisms in Post- Operative Wound Infections and Their Antimicrobial Susceptibility Patterns. *Journal of Clinical and Diagnostic Research*, (4),3392-3396.

Shute, N. (2005). How to get rid of post-operative infections. Available on: http://health.usnews.com/usnews/health/articles/050706/6doctor.htm?track=rss. (Accessed in 24 Jan. 2012)

Smaill, F., & Hofmeyr, G.J. (2007). Antibiotic prophylaxis for cesarean section. *Cochrane Database of Systematic Reviews,* (3).

Smeltzer, S., Bare, B., Hinkle, J., & Cheever, K. (2008). *Textbook of Medical- Surgical Nursing*, 11th Edition. Lippincott W & Wilkins, 624.

Smith, R. D., & Coast J. (2002). Antimicrobial resistance: a global response. *Bulletin of the World Health Organization.* 80, 126 – 33.

Swenne, C. L. (2006). Wound Infection Following Coronary Artery Bypass Graft Surgery. Risk Factors and the Experiences of Patients. ACTA Universities Upsaliensis UPPSALA.

Taiwo, S., Okesina, A., Onile, B. (2002). In vitro antimicrobial susceptibility pattern of bacterial isolates from wound infections in University of Ilorin Teaching Hospital. *African Journal of Clinical and Experimental Microbiology*,13(1), 6-10.

Tia, J. B. (2013). Surgical site infections after Caesarean delivery in a District Hospital in Central Region, Ghana. GE/NMF International Scholars program, University of Cincinnati. (Power point slide 6).

Tita, A. T. N., Rouse, D. J., Blackwell, S., Saade, G. R., Spong, C. Y., & Andrews, W. W. (2009). Evolving Concepts in Antibiotic Prophylaxis for Cesarean Delivery: A Systematic Review. *Obstetrics and Gynecology*, *113*(3), 675–682.

Unnikrishnan, B., Rakshith, P., Aishwarya, A., Nithin, K., Rekha, T., Prasanna, P., Ankita, A., Rajesh K., Juhi C., Nitish G., Sneha P. & Siti H. (2010). Trends and Indications for Caesarean Section in a tertiary care Obstetric Hospital in Coastal South India, *Australasian Medical Journal*, 3, 821-825.

Ussiri, E., Mkony, C., & Aziz, M. (2004). Sutured, open clean-contaminated and contaminated laparotomy wounds at Muhimbili National Hospital: A comparison of complications. *East and Central African Journal of Surgery,* 9(2), 89-95.

Walaa, H. I., Ahmed, M. M., Mervat, A. K., & Entisar M. Y. (2011). Effects of prophylactic antibiotics (Cephalosporin versus Amoxicillin) on preventing post Caesarean section infection. *Journal of American Science*, 7(5), 178-187.

Walenkamp, G.H. I. M (2003). Surveillance of surgical-site infections in orthopedics. Guest editorial. *Acta Orthopaedica*, 74 (2), 172 - 174.

Wassef, M. A., Hussein, A., Abdul Rahman, E. M., El – Sheriff, R. H. (2012). A prospective surveillance of surgical site infections: Study for efficacy of preoperative antibiotic prophylaxis. *African Journal of Microbiology Research*, 6 (12), 3072-3078.

World Health Organization, (2008). World Alliance for Patient Safety. *Safe Surgery Saves Lives*, Geneva, 8.

World Health Organization, (2014). Ghana factsheets for Health Statistics. WHO Press. 1 - 7. Retrieved from www.who.int

Wound Closure Manual, (2005). Ethicon INC. A Johnson & Johnson Company. 2 - 30. Retrieved from www.ethicon.com

Yalcin, A. N., Bakir, M., Bakici, Z., Dokmetas, I., & Sabir, N. (1995). Postoperative wound infections. *Journal of Hospital Infections*, 29, 305-309.

APPENDICES

APPENDIX I WOUND GRADING FORM

Name: Study ID:

Date of surgery: Telephone:

Skin closure technique (√) 1. Interruted 2. Sub- cuticular 3. Other (state) What suture was used in closing the skin?

1. Nylon
2. Silk
3. Vicryl
4. Other (state)

Wound dressing visits:

Date									
Swabbing	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N

Date									
Swabbing	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N	Y/N

1. How many visits did she come for wound dressing before wound completely healed?
   a. 1 b. 2 c.3 d. 4 e. 5 f. 6 g. 7 h. 8 i. Other (state):

Date of wound Grading (Day 10-14):

Description	Answer		Description	Answer
Would healed completely	A. Yes B. No		Serous fluid discharge only	A. Yes B. No
Wound disrupted only (no pus)	A. Yes B. No		Wound disrupted with pus	A. Yes B. No
Burst abdomen with evisceration of omentum ± bowel	A. Yes B. No		Would healed with indurated surroundings	A. Yes B. No
Other (describe)				

WOUND GRADING ON DAY (10 – 14: Tick (√): Normal Grade 1 Grade 2 Grade 3

APPENDIX 2

QUESTIONNAIRE FOR PATIENT DATA

Study ID:…………………… Ward:………………. IP Number:………………………..

Does this woman meet inclusion criteria of abdominal surgery? 1. Yes 2. No

Would she dress her wound here? A. Yes B. No C. Not sure

Has patient given written / thumb printed consent? 1. Yes 2. No

Date of Surgery: ……………………………. Date of Recruitment:…………………….

DEMOGRAPHIC DATA

Name:………………………………………………………… Age (years): ……………..

Address (write Area and Landmark):

Telephone:………………………………..

Telephone Number (Proxy / Relative):………………………………… Approximate

Distance from Home to KATH (Km):……………………

Marital status:

1.Married 3. Separated
2.Has A Partner / Boyfriend 4. Other (describe) Education:

1. None 4. SHS
2. Primary 5. Tertiary
3. JHS 6. Post – tertiary

State years of school Completed: …………

Occupation:

a. Unemployed b. Trader c. Food vendor d. Civil servant (Government worker)

e. Teacher f. Farmer g. Other Professional h. Self employed at Home i. Part – time jobs j. other (state)

SURGICAL DATA

1. Type of Skin incision:

   1. SUMI 2. Pfannenstiel 3. Paramedian 4. Other

2. Was it a repeat incision at the old surgical site?

   1. Yes 2. No 3. Not stated

3. Type of C/S:

   1. Elective 2. Emergency C/S before Labour (Cervix <4cm)

   3. Emergency C/S after established Labour (Cervix ≥ 4cm)

4. What was the indication for the C/S?

1. Fetal Distress 2. CPD

3. Previous C/S plus another indication 4. Two or more previous C/S

5. Eclampsia / Severe pre – eclampsia 6. Breech

7. Antepartum hemorrhage (abruption or praevia) 8. Cord prolapse

9. Chorioamnionitis 10. Abnormal Lie (transverse / oblique)

11. Previous infertility 12. Big Baby (fetal macrosomia)

13. Other (state):

5. Was the woman in labour (Cervix should be ≥ 4cm)?

1. Yes 2. No 3. Not stated

6. If yes, what was the total duration of active labour (from 4cm dilatation till delivery or if more than 4cm at admission from time admitted to delivery)? State:………………

1. < 4hrs 2. 4-8hrs 3. 8 – 12hrs 4. 12 – 14hrs 5. 14 – 16hrs 6. > 16hrs 7. Not stated

7. How many vaginal examination were performed prior to the delivery of C/S?

a. 0 b. 1 c. 2 d. 3 e. 4 f. ≥ 5

8. Duration of C/S? State here in minutes ……………

1. < 30 mins 2. 30 – 60 mins 3. 61 – 90 mins 4. 91 – 120 mins

5. 121 – 150 mins 6. 151 – 180 mins 7. > 180 mins

ANTIBIOTIC DATA

1. Was antibiotic given prior to skin incision?
   1. Yes 2. No 3. Not stated

2. Indicate antibiotic given post – operatively and its duration

Aantibiotic	Parenteral (IV or IM)	Duration (hrs)state
Gentamicin	1. Yes 2. No	
Clindamycin	1. Yes 2. No	
Amoksiclav	1. Yes 2. No	
Augmentin	1. Yes 2. No	
Cefuroxime	1. Yes 2. No	
Ceftriaxone	1. Yes 2. No	
Ciprofloxacin	1. Yes 2. No	
Ofloxacin	1. Yes 2. No	
Amikacin	1. Yes 2. No	
Metronidaxole	1. Yes 2. No	
	1. Yes 2. No	

3. Oral Antibiotic Given at Time of Discharge

S/No.	Antibiotic	Dosage	Number of Days given
1.			
2.			
3.			

APPENDIX 3

LABORATORY REPORT FORM

Name:…………………………………………………… Study ID:………………………

What organism (s) was isolated? Tick (√)

1. Coliforms 2. E.coli 3. Proteus vulgaris 4. Proteus mirabilis 5. Klebsiella pneumoniae 6. Staphyloccocus aureus 7. CNS 8. Clostridium spp.

9. Pseudomonas aeruginosa 10. Other (state): …………………………. Organism isolated and antibiotic sensitivity pattern

Antibiotic	Sensitive (√)	Intermediate (√)	Resistant (√)

APPENDIX 4

INFORMED CONSENT FORM

Title of research

Surgical site infections after Caesarean Section delivery at Komfo Anokye Teaching Hospital (KATH), Kumasi, Ghana.

Purpose of research

The purpose of this research is to find out the infections associated with surgical wounds of women who have undergone Caesarean Section (elective or emergency) in Komfo Anokye Teaching Hospital (KATH).

Study procedure

I will approach all women who have undergone Caesarean Section to seek your participation. After consenting to participate, I will take information from you and from your Hospital records and issue you a study Card and Identification Number. The Hospital usual practice is to have you come and dress your wound after discharge from the home at times determined by the nurses / doctor. During this routine dressing visit, the nurse will grade your wound between the 10th and 14th day if it is healed completely or if there are abnormalities. It the wound is judged to be infected, a swab (a cotton – tip bud will be put in the wound to take a sample of the fluid) for laboratory investigation. If the laboratory result is indicative of infection, the report will be passed on to your doctor to help him / her manage you. The laboratory cost is not covered by HHIS and patients usually pay out of pocket. In this study if you happen to need such test, the study will bear this cost. I will need about 400 women who have undergone C/S for this study.

Risks

Risk involved is not different from routine care: wound swab will be taken when the wound is suspected to be infected and this may be uncomfortable some times.

Benefits

Because the wound will be inspected for problems, it will help us detect any such problems early for management. The study will also inform KATH of the level of surgical site infection and if this is high, how to reduce it for the benefit of patients.

Confidentiality

All information collected in this study will be given code numbers. No name will be recorded. Data collected cannot be linked to you in anyway. No name or identifier will be used in any publication or reports from this study. However, as part of our responsibility to conduct this research properly, 1 may allow officials of ethics committees to have access to your records.

Person to contact

For any questions about this study or related matters, please contact George Nsiah Afriyie on 0243762687.

Voluntary participation

It is up to you do decide whether or not you will take part. If you do decide that you will take part you will be asked to sign this consent form. If you decide to participate in the study you are still free to withdraw at any time and without giving a reason.

This will not affect the relationship you have with the investigator or staff nor the standard of care you receive.

Right of investigation

You may withdraw from the study at any time without penalty.

Cost of subjects and compensation

Participation in this study will cost you nothing. There will be no compensation for your participation in this study.

Statement of person obtaining informed consent:

I have fully explained this research to ……………………………………………………………and have given sufficient information, including that about risks and benefits, to enable the prospective participant to make informed decision to or not participate.

DATE: ………………………………………… SIGNATURE: …………………………………

NAME: ………………………………………………………………………………………………..

Statement of person giving consent:

I have read the information on this study / research or have had it translated into a language I understand. I have also talked it over with the interviewer to my satisfaction. I understand that my participation is voluntary (optional). I know enough about the purpose, methods, risks and benefits of the research study to judge that I want to take part in it. I understand that I may feely stop being part of this study at any time I have received a copy of this information leaflet and consent form to keep for myself.

NAME OF PARTICIPANT: …………………………………………………………………………

DATE: ………………………………………… SIGNATURE: …………………………………

THUMB PRINT: ……………………………………………

(For all non-literate participants, a thumbprint is required as well as a witness signature)

WITNESS' SIGNATURE (if participant is non – literate)……………………………………...

WITNESS' NAME: ……………………………………………………………………………..

MOTHER'S SIGNATURE (if participant could be under 18 years): ……………………………