A Retrospective Review of Surgical Site Infection Following Caesarean Section at Mowbray Maternity Hospital.

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Abbreviations

˚C	Degrees Celcius
AD	Anno Domini
APGAR	Appearance, Pulse, Grimace, Activity, Respiration
BC	Before Christ
BCA	Best Care Always
BMI	Body Mass Index
CDC	Centres for Disease Control and Prevention
CI	Confidence Interval
CS	Caesarean Section
DCS	Data Collection Sheet
ESMOE	Essential Steps in Management of Obstetric Emergencies
GSH	Groote Schuur Hospital
HAART	Highly Active Anti-Retroviral Treatment
Hb	Haemoglobin
HIV	Human Immunodeficiency Virus
HREC	Human Research Ethics Committee
ICU	Intensive Care Unit
IPC	Infection Prevention and Control
IUCD	Intra-Uterine Contraceptive Device
IV	Intravenous
LSUI	Lower Segment Uterine Incision
MCR	Maternity Case Record
MMH	Mowbray Maternity Hospital
MO	Medical Officer

MOU	Midwife Obstetric Unit
MRSA	Methicillin-Resistant Staphylococcus Aureus
MSL	Meconium Stained Liquor
NNIS	National Nosocomial Infections Surveillance
OR	Odds Ratio
PMTCT	Prevention of Mother To Child Transmission
PROM	Prolonged Rupture Of Membranes
RPOC	Retained Products Of Conception
RR	Relative Risk
SD	Standard Deviation
SDG	Sustainable Development Goals
SSI	Surgical Site Infection
VE	Vaginal Examinations
WHO	World Health Organisation

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Abstract

A Retrospective Review of Surgical Site Infection Following Caesarean Section at Mowbray Maternity Hospital.

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Introduction: Pregnancy related sepsis is a major cause of maternal mortality and morbidity in South Africa. Caesarean section (CS) is the most important risk factor in the development of puerperal infection, and surgical site infection (SSI) after CS increases maternal morbidity as well as medical costs. Mowbray Maternity Hospital (MMH), is a secondary level, public maternity hospital. The caesarean section rate at MMH has increased considerably over the last fifteen years, and the perception has been that there have been increasing numbers of patients developing SSI post-CS. This study was designed to look more closely at the incidence of SSI and to describe the patients identified with SSI.

Methods: This was a retrospective observational study. Cases of severe SSI, as defined by the Centres for Disease Control and Prevention (CDC), following CS at MMH from December 2011 to December 2014 were identified. Following ethical approval, patient records were sourced, data collected and analysed using Stata and Statistica.

Results: In the 3-year study period, 14982 CS were performed with 98 patients identified with severe SSI. Folders were retrieved for 96 patients, with 2 patients' folders missing and 29 patients with a missing maternity case record (MCR). The overall incidence of severe SSI was 0.65%, with an incidence of 0.88% in Year 1, 0.90 in Year 2 and 0.70 in Year 3. Of the cases, 79 (80.6%) had been in labour, 16 (16.3%) patients had had prolonged rupture of membranes (PROM) and 32 (32.7%) had prolonged labour, with a median of 5 vaginal examinations. An emergency CS was performed in 90 (91.8%) patients, 7 (7.2%) had an elective CS and 1 (1.0%) patient had this data missing. Deep incisional SSI was diagnosed in 74 (75.5%) patients and 24 (24.5%) patients were identified with organ/space SSI. Intravenous (IV) antibiotics was the main treatment in all 96 cases, with 23 (23.5%) patients

requiring a wound debridement, 17 (17.2%) a laparotomy, which proceeded to a hysterectomy in 12 (12.3%) patients. In the majority of cases, no organism was cultured, Whereas multiple organisms were cultured in 16 cases, of which 12 were identified as MRSA, and 18 as Klebsiella pneumoniae. There were no maternal deaths or Intensive Care Unit (ICU) admissions.

Discussion and Conclusion: The incidence of severe SSI is in keeping with other institutions, with the lowest incidence being found in Year 3, which may be explained by the change in referral population and/ or the full implementation of the Best Care Always (BCA) bundles of care. Of the 98 patients with severe SSI, 80.6% had been in labour, 32.7% had prolonged labour and 91.8% had an emergency CS performed. These are all factors which are known to increase the likelihood for development of post-CS SSI.

A Retrospective Review of Surgical Site Infection Following Caesarean Section at Mowbray Maternity Hospital.

1. Introduction

Pregnancy related sepsis is the 5th leading cause of maternal death in South Africa.[1] The United Nations have formed 17 Sustainable Development Goals (SDG), which build on the success of the Millennium Development Goals. Goal number 3 deals with health; specifically, child health, maternal health, Human Immunodeficiency Virus (HIV), malaria and other diseases. The target is to decrease global maternal mortality ratio to less than 70 per 100 000 live births by 2030.[2]

Caesarean section (CS) is the most important risk factor for puerperal infection.[3,4] Puerperal infection is up to 20 times more common following CS than following a vaginal birth.[5] Surgical site infection (SSI) after a CS increases maternal morbidity as well as medical costs.[6]

Mowbray Maternity Hospital (MMH) is an Obstetric and Neonatal Hospital situated in Cape Town, South Africa. MMH has a 130 obstetric bed capacity and has 900 to 1000 deliveries each month. Patients with diagnosed severe surgical site infection (SSI) post caesarean section are referred to the Gynaecology Department at Groote Schuur Hospital (GSH), where they receive appropriate treatment. In 2011/ 2012, there was a perceived increase in cases from MMH requiring admission to GSH for intravenous (IV) antibiotics, wound debridement, uterine evacuation or hysterectomy. Cases transferred to GSH were recorded and the numbers each month were monitored. In 2012, MMH devised a protocol aimed at reducing the incidence and severity of SSIs. This protocol was modelled on the Best Care Always (BCA) initiative, which addresses certain bundles of care that are aimed at reducing the rate of surgical site sepsis.[7]

Puerperal sepsis following caesarean section is a key indicator of quality of care, and SSIs are associated with substantial morbidity, longer hospital stay and hospital readmissions.[8,9] In addition to this, treating patients with SSI can be associated with significant financial costs.[10] Identifying possible risk factors for SSIs is essential in developing a targeted intervention to reduce its occurrence.[11] The aim of this study was to review SSI following CS at MMH, with the specific objectives being to measure the type and incidence of SSI following CS, and to identify any obstetric, medical or surgical factors associated with SSI in our population.

2. Literature Review

2.1 Introduction

Surgery dates back as early as the Neolithic period, 10200 BC-2000 BC, with one type of surgery being trephining, which involved making a small hole in the head, thought to cure migraines.[12] Even in these early times, sepsis was found to be a problem and different methods were used as an attempt at treatment. The Sumerians used antiseptics in the form of beer, turpentine and vinegar, and in the Middle Ages, cauterisation was used.

In 130-200 AD, Claudius Galen, a surgeon to the Gladiators, proposed that pus was mandatory for wound healing. This view was challenged one thousand years later by Theodoric of Borgognoni of Cervia. He claimed that wound healing required four things: removal of necrotic tissue, control of bleeding, as little dead space as possible, and the correct and careful placement of dressings.[13] These opinions contested those of Galen, and he ended up being criticised by the Church and had his theory rejected by his peers.[12]

Surgeons continued to operate in unsterile environments, often not washing their hands or instruments.[14] Patients did not often survive surgery as a result of the anaesthetic, or due to overwhelming sepsis.[15] Postoperative infections were described as "irritative fever", with pus draining from incision sites.[16]

Ignaz Philipp Semmelweiss was described as the "saviour of mothers" for his advancement in recognising that the incidence of puerperal fever could be reduced by introducing hand disinfection. In the early 19th century, thousands of women were dying of "childbed fever", also described as puerperal fever. The fever occurred postpartum and was crippling. The only treatment available was bloodletting, which was often futile. King Henry VIII's wife, Jane Seymour, is thought to have died of a puerperal fever, only two weeks after giving birth to Edward VI of England. Semmelweiss worked at Vienna General Hospital where he discovered that the two obstetric clinics had varying maternal mortality rates, of 10 and 3%. The one clinic trained medical students and the other, midwives. The medical students were involved in performing autopsies and then also seeing women in the clinic and performing deliveries. Semmelweiss postulated that the medical students were carrying "cadaverous"

particles, and after instituting handwashing with a chloride lime solution, the mortality rates of the clinics became comparable.[17]

In 1867, Joseph Lister described a way to control infection by spraying wounds with carbolic acid and applying carbolic bandages. This was the first theory of antisepsis and was published as a ground breaking paper. In it he stated that *"all the local inflammatory mischief and general febrile disturbance which follow severe injuries are due to the irritating and poisoning influence of decomposing blood or sloughs."*[15]

In 1891, Ernst von Bergmann initiated sterilisation of surgical instruments with heat. William Stewart Halsted appointed Goodyear in 1890 to create rubber gloves to use during surgery.[18] In the 1940s, Alexander Fleming discovered penicillin, which revolutionised surgery by making it substantially safer.[19]

For many centuries, infection and sepsis has hindered surgical progress, and as William Williams Keen so aptly stated, *"Antisepsis relieved patients from the terrors of death and gave to the surgeon restful nights and joyous days."*[20]

2.2 Defining Surgical Site Infection

The Centres for Disease Control and Prevention (CDC) developed definitions for 3 different types of SSIs.[21] SSIs are either classified into incisional or organ/space infections, with incisional being further subdivided into superficial and deep. This is described in Appendix A. The CDC's National Nosocomial Infections Surveillance (NNIS) developed uniform criteria for defining SSI, which are consistently used by surveillance and surgical personnel and are currently the accepted international standard.[16] The literature reviewed showed a consistency in using the definition of SSIs as laid out by the CDC. This definition can be modified to SSI post-CS. A deep incisional SSI equates to a severe, deep wound infection with an associated pyrexia > 38^0C, which may require IV antibiotics, surgical intervention in the form of wound debridement and drainage of any underlying collection. An organ/space SSI post-CS referred specifically to either endometritis or uterine sepsis. On examination, the uterus would be subinvoluted and tender. In addition, localised or generalised peritonitis may be elicited. Cases that did not respond to intravenous antibiotics

required surgical intervention in the form of uterine evacuation, explorative laparotomy with possible drainage of a collection, or hysterectomy.

2.3 Incidence of SSI

The incidence of SSI following CS differs between various countries, as well as between different centres. Patient population, varying obstetric protocols and individual patient risk factors are all possible explanations. One study identified cases of wound infection post-CS in two centres in Israel. Between 1988-2002, 19416 caesarean sections were performed, and of those, 726 (3.7%) cases developed wound infection, which was defined as maternal pyrexia with wound dehiscence, purulent discharge or local swelling, which required the wound to be opened.[6] In China, eight centres participated in a study that surveyed SSIs from 2005-2009. Of the 13798 CS performed, 96 patients (0.7%) met the criteria for SSI as defined by the CDC. Infection was diagnosed by: (i) purulent drainage from the wound; (ii) cultured organisms from fluid or tissue from the incision site; (iii) any further procedures: opening or debridement of the wound; (iv) signs of infection of the incision site: redness, warmth, tenderness or swelling; (v) an abscess; or (vi) the opinion of the attending doctor.[11] In a Norwegian publication, 29 out of 326 women (8.9%) developed a superficial SSI following CS over a 12 month period in 2003, using the CDC definition.[22]

The incidence of puerperal sepsis related to CS has not been widely documented in South Africa.[23] In Johannesburg at the Chris Hani Baragwanath Hospital, of the 272 women who had a CS over a 6-week time period in 2010, 34 (12,5%) developed an SSI. These were further subdivided into 30 (11.0%) being diagnosed with a mild wound infection and 4 (1.5%) with puerperal sepsis. The patients were identified by a telephonic follow up after 14 days of delivery or if they were readmitted for sepsis.[23]

2.4 Puerperal Sepsis

Puerperal sepsis is defined by the World health Organisation (WHO) as an infection of the genital tract that occurs at any time frame between the rupture of membranes or labour, up to the 42nd day postpartum, in which 2 or more of the following are present:

- pelvic pain
- fever (temperature ≥ 38.5˚C)
- abnormal vaginal discharge
- abnormal odour of vaginal discharge
- delay in the rate of involution of the uterus[24]

Pregnancy related sepsis is caused by infections of the genital tract associated with a viable pregnancy.[1] The first manifestation of puerperal sepsis is usually a pyrexia, which may be accompanied by headache, rigors, anorexia or malaise.[25]

2.5 Microbiology

The patient's own skin flora is often the source of infection in SSI cases.[26] Mangram *et al* (1999) identified the most common pathogens associated with various surgical disciplines. Obstetric and gynaecological surgeries were more predisposed to gram-negative bacilli, enterococci, group B streptococci and anaerobes.[16] *Staphylococcus*, a common contaminant found in the skin flora, can come into contact with the underlying tissue at skin incision. Whilst methicillin-resistant *Staphylococcus aureus* (MRSA), is a pathogen that has now increasingly been associated with SSI.[26] Wloch *et al* (2012) identified a causative organism in 39.8% of SSIs, which were polymicrobial in 24%. *Staphylococcus aureus* was the most common organism (40%), with 17% being MRSA. Other organisms included anaerobic cocci (23%), Enterobacteriaceae (13%) and streptococci (7%).[27]

2.6 Cost and Burden of SSIs

SSIs are linked to an increase in patient morbidity, hospital readmissions, as well as longer hospital stays.[8,9] In 2006, Herwaldt *et al*, examined the outcomes of over 3000 patients with post-operative nosocomial infections in a tertiary setting. Diagnosed nosocomial infections were associated with increased costs, longer post-operative stay, increased readmission rates, and increased use of antibiotics (*P*-value of <0.001 for all variables). Nosocomial infection was also significantly associated with an increase in total hospital cost (*P*-value < 0.001).[8] This study focused on patients that underwent general, cardiothoracic and neurosurgical surgeries, so it may be difficult to apply this directly to patients undergoing caesarean section.

A study done at the Basel University Hospital in Switzerland evaluated the economic burden of SSIs. This was a case control study consisting of 6283 patients. The cases of SSI were matched to controls in age, procedure, and a National Nosocomial Surveillance scoring system. The total inpatient cost was more than doubled in the cases of SSI, with an additional length of hospital stay of 16.8 days and an additional in-hospital antibiotic duration of 7.4 days, compared to the controls. Most of these differences were due to organ/space SSIs.[9]

Many studies have looked at the financial cost of treating SSIs following a vast array of different surgeries.[28] SSIs resulting from surgeries which involved major organ spaces, such as cardiothoracics, are often associated with higher financial costs than SSIs due to smaller, less extensive surgeries.[29] The cost of SSIs also varies according to depth of infection. SSIs are reported to be higher with organ/space infection, than with superficial or deep incisional infection.[9]

2.7 Patient Risk Factors

Several patient risk factors have been shown to have an association with an increased risk of SSI. These include, but are not limited to, obesity, cigarette smoking, hyperglycaemia, anaemia, and immunocompromised states, such as Human Immunodeficiency Virus (HIV).[6,11,30,31,32] These factors can all cause delayed wound healing and a dysfunctional immune response in the face of bacterial colonisation. In the 2011-2013 Saving Mother's Report there were 226 maternal deaths due to pregnancy related sepsis. In 206 of these deaths the HIV status was known, of which 137 (67%) were positive.[1]

In obesity, there is poor perfusion of adipose tissue, which impairs wound healing and decreases the local immune response. Antibiotic penetration may be substandard in obese women, due to a standard dosage of antibiotics being given, which is not calculated according to weight. The incision may need to be larger, and therefore increases the amount of tissue that is exposed to contamination. Suturing closed the dead space in the subcutaneous tissue is advised as it decreases the probability of developing wound infection and dehiscence.[27] Ghuman *et al* (2011) found that an increased Body Mass Index (BMI) was associated with a higher risk of infection. In that study, the mean BMI in the case group was 34.7kg/m^2 compared to a mean of 28kg/m2 in the control group (p-value = 0.0002).[33] In addition, the

location of the wound in the lower abdominal folds, also makes the wound difficult to keep clean.[6,33] Schneid-Kofman *et al* (2005) identified that obesity was a risk factor for early wound infection with an odds ratio (OR) of 2.2 (95% confidence interval {CI} 1.4-2.1) and that obesity and diabetes increased the risk of wound infection by 9.3 times (95% CI 4.5-19,2; *P*-value <0.001).[6]

In a study examining the incidence of complications in women who underwent urogynaecological surgery, 235 obese women were matched with 194 normal weight controls. There was no statistical difference in the subjects who had one or more perioperative complication (20% obese vs 15% non-obese), but the obese participants were more likely to develop wound infection (adjusted OR 5.5, 95% CI 1.7-24.7; *P*-value <0.01).[30] In 2012, Wloch *et al* assessed the frequency and risk factors for surgical site infection. Obesity was found to be strongly associated with the development of SSIs, with the risk increasing with each increasing category of BMI. Overweight women had an estimated risk of infection of 1.6 times greater than normal weight category, and obese women 2.4 times greater.[27]

Adequate oxygen levels are required for wound healing and in the case of anaemia, there are low levels of tissue oxygen, which promotes the risk of SSIs. Cigarette smoking interferes with wound healing as it can cause blood vessel constriction with secondary tissue hypoxia.[31] Gong *et al* (2012) identified the incidence and risk factors for SSI post-CS. The significant risk factors found for infection were obesity (OR 4.46 CI 1.54-12.88), normal preoperative haemoglobin (Hb)(OR 0.94 CI 0.91-0.98), prolonged surgery (OR 1.06 CI 1.02-1.11) and prophylactic antibiotics (OR 0.13 CI 0.04-0.42), all with a *P*-value of <0.001.[11] Ghuman *et al* (2011) did not find any statistical significance between smokers and non-smokers (*P*-value=0.4635).[33] Diabetes mellitus was found to be a risk factor for wound sepsis by Schneid-Kofman *et al* (2005) (OR 1.4, 95% CI 1.1-1.7).[6] Wloch *et al* (2012), found 5.6% of their study population to have either gestational diabetes (4.1%), type I diabetes (1.0%) or type II diabetes (0.4%). The risk of SSI in the diabetic patients was found to be 15.6% (95% CI 11.0-21.1), compared with 9.6% (95% CI 8.7-10.6) in non-diabetic patients (*P*-value <0.01).[27]

Moodliar *et al* (2007) investigated CS complications in a high HIV prevalence setting. This study was conducted at King Edward Hospital in Kwa-Zulu Natal and over a 3-month period,

737 CSs were performed. Of the 737 cases, 23.7% were HIV negative, 25.2% HIV positive and 51% had an unknown status. This study was conducted in 2003-2004, where antenatal HIV testing was not as emphasised as it is in our setting today, where it now comprises an intergral part of antenatal care. In this study, wound sepsis was not shown to be higher in HIV positive women, with 5.4% of cases occurring in HIV positive women compared to 8.0% in HIV negative women, and 4% of cases having an unknown HIV status. Endometritis however, was statistically more significant in HIV positive patients (*P*-value=0.004).[32] Johnson *et al* (2012) did not find any statistical significance with regards to HIV infection and puerperal infection. In that study, 34 patients were diagnosed with puerperal sepsis and 238 did not have any evidence of puerperal sepsis. Of the patients with puerperal sepsis, 12 were HIV positive (35%), whereas of the patients without puerperal infection, 67 (28%) were found to be HIV positive, with a *P*-value of 0.42.[23]

2.8 Obstetric Risk Factors

Obstetric risk factors that increase the incidence of post CS SSI are generally intrapartum risk factors, which makes SSI post CS unique when compared to elective surgery. It is often impossible to differentiate between infection that was introduced during labour or at the time of surgery. Specific obstetric factors that may have an impact on the risk of developing a SSI include prolonged rupture of membranes (PROM), increased number of vaginal examinations (VE) during labour, use of assisted delivery instruments, and disimpaction of the fetal head prior to CS.[11,34,35] These factors increase the risk of chorioamnionitis, and the subsequent development of endometritis or uterine sepsis. Schneid-Kofman *et al* (2005) reviewed 19416 caesarean deliveries over 14 years. Patients with PROM were more likely to have wound infection than those without PROM (adjusted OR 1.5, 95% CI 1.2-1.9; *P*-value <0.001).[6] Gong *et al* (2012) found that premature rupture of membranes was strongly associated with wound and uterine SSI following caesarean section (OR 3.73, 95% CI 1.05-13.21; *P*-value <0.003).[11] Ghuman *et al* (2011) discovered that in their case group (25) the mean duration of labour was 16.5 hours and only 9.5 in the control group (50), which was found to be statistically significant (*P*-value=0.0019).[33]

In Nigeria, Melah *et al* (2003) looked at 618 cases of obstructed labour and discovered that puerperal sepsis was the most frequent morbidity encountered post-surgical delivery. There was morbidity in 457 (73.9%) patients and the commonest cause of morbidity was puerperal sepsis 113 (24.7%).[34] Piper *et al* (1998) concluded that meconium stained liquor (MSL) is associated with increased peripartum infection for all modes of delivery, when compared to clear amniotic fluid (44% versus 13%, relative risk {RR} 5.18, 95% CI 2.9-9.3). Meconium stained amniotic fluid occurs when fetal colonic contents are released in-utero. The incidence of maternal complications such as endometritis and chorioamnionitis has been shown to be increased with the presence of MSL vs clear amniotic fluid.[36]

2.9 Patient Preparation

The source of many pathogens involved in SSIs originate from the patient's endogenous flora. When a skin incision is made, tissues are at risk of contamination with endogenous flora and preoperative antiseptic showering is considered to lower the skin's microbial colony count. A Cochrane Review in 2007 showed that there was no clear benefit of using chlorhexidine compared to placebo or bar soap in preoperative showering or bathing, RR of SSI was 0.95 (95% CI 0.82-0.10).[37]

A Cochrane Review has been published on preoperative hair removal to determine any relationship that different methods may have on the development of wound site sepsis. When comparing shaving to clipping, it was found that shaving is associated with a statistically significant increase in SSIs (RR 2.02, 95% CI 1.21-3.36).[38] When shaving is used as a method of perioperative hair removal, it may result in microscopic cuts and abrasions on the patient's skin, thereby compromising the protective skin barrier, which does not occur with clipping.[26] The CDC has advised perioperative hair removal to only occur if the hair will interfere with the operation, and then for it to be done immediately before the surgery and with electric clippers.[16]

Preoperative skin antisepsis is performed in theatre to remove debris and transient organisms.[26] The skin preparation used should be hypoallergenic, safe, eradicate skin organisms and have long-lasting effect.[39] Iodine based solutions were found to be more effective than chlorhexidine containing solutions across all surgical disciplines, with effectiveness varying depending on concentration, time left on the skin, temperature, and type

of skin organisms. Systemic absorption of iodine can occur after its use as a cleaning solution at CS, resulting in transient neonatal thyroid dysfunction and in rarer cases has led to iodine toxicosis. [26,40] The BCA Initiative has however recommended chlorhexidine as a pre-operative cleaning solution due to a lower incidence of SSI when compared to povoiodine.[7]

2.10 Operative Characteristics

Operating theatres can themselves be a source of infection, as they may contain skin cells, respiratory droplets and even dust particles containing organisms. According to the CDC's Guideline to Preventing Surgical Site Infection, theatres should always be kept at a positive pressure, and ventilation systems should always have 2 filter beds (Category 1B evidence).[16]

Operative risk factors also play a vital role in an individual patient developing an SSI, and will further compound their risk. These include previous surgeries, the experience of the surgeon, operating time, and blood loss.[11,23] Surgical techniques that limit blood loss, prevent hypothermia, and ensure careful handling of tissues, will reduce the risk of SSIs.[16]

In Norway, Opøien *et al* (2007) studied the incidence of post-caesarean SSI. Over a period of a year, the total rate of SSI was 8.9% of patients undergoing a CS, with no significant difference between elective or emergency CS. The two risk factors that were significant, were an operating time of more than 38 minutes (*P*-value=0.026, OR 2.5) and a BMI of greater than 30 (*P*-value=0.007, OR 2.8).[22] A similar study was done in New Zealand by Ghuman *et al* (2011), resulting in 5% of their patients having a SSI post-caesarean section. The significant risk factors determined by them, consisted of an elevated BMI (*P*-value=0.0002), prolonged labour (*P*-value=0.0019), and an emergency procedure (*P*-value=0.0243).[33]

Schneid-Kofman *et al* (2005) found that there was no increase in the incidence of SSIs in patients with previous CS (OR 0.98, 95% CI 0.8-1.1; *P*-value=0.80), and postulated that this was due to the patient being more experienced in the postpartum period and possibly mobilising sooner than the patient who had had their first CS.[6]

There is scanty literature evaluating the impact that the level of experience of the surgeon, or the amount of blood loss has on post CS SSI. Moodliar *et al* (2007) found that there was no difference in the incidence of wound sepsis between surgeons of different grades or the time

of day that the surgery was performed.[32] In a UK study, CS performed by a junior surgeon had a higher likelihood of post-operative infection (13.1%), when compared to a consultant surgeon (7.9%).[27]

2.11 Antibiotics

A Cochrane Review published in 2014, compared antibiotic prophylaxis vs placebo or no prophylaxis in women undergoing caesarean section. The result was that antibiotic prophylaxis reduced the risk of wound infection (RR 0.40, 95% CI 0.35-0.46, 82 studies, 14,407 women), endometritis (RR 0.38, 95% CI 0.34-0.42, 83 studies, 13,548 women) and other infectious complications (RR 0.31, 95% CI 0.20-0.49, 32 studies, 6159 women) by 60 to 70%.[5] In 2014, another Cochrane review assessed the timing of antibiotic prophylaxis. It was found that preoperative administration of prophylactic antibiotics before the skin incision significantly decreased the incidence of wound infections, when compared to after cord clamping (wound infection {RR 0.59, 95% CI 0.44-0.81}, high quality evidence).[41] The study set in China by Gong *et al* (2012), found that the lack of prophylactic antibiotics was a significant risk factor for SSI (*P*-value <0.001).[11] For surgical disciplines, the treatment guidelines provided by The Medical Letter advise that prophylactic antibiotics are not continued for longer than 24 hours after surgery is completed, and 48 hours in the case of cardiothoracic surgery.[42]

There is little evidence to support the use of an extended course of prophylactic antibiotics in the post-surgery period. Lyimo *et al* (2013) included 500 patients in their study from October 2011 – May 2012. Patients were randomly assigned to either single dose gentamycin and metronidazole pre-operatively or the same antibiotics continued for 24 hours. They concluded that there was no significant difference between single pre-operative antibiotic prophylaxis, where 4.8% developed SSI, vs multiple dose antibiotic prophylaxis for 24 hours, with 6.4% diagnosed with SSI, in the reduction of SSI post emergency CS.[43] Ijarotimi *et al* (2013) discovered that following elective CS there was no statistical significance (*P*-value=0.056) in the incidence of wound sepsis with 24 hour prophylaxis (4% incidence) when compared to 7 day course of the same antibiotics (3% incidence), following elective CS.[44] Shakya *et al* (2010) included 100 patients into their study and they were randomised to either receive single dose of prophylactic antibiotics or multiple doses, according to hospital policies. There

was no statistical difference between the 2 groups in infectious morbidity post elective CS, with 4 and 6% respectively diagnosed with febrile morbidity.[45]

A 2014 Cochrane review recommended that additional prophylactic antibiotics be given post-operatively to high risk patients for 24 hours and up to 5 days. These risk groups included; HIV positive women, patients with chorioamnionitis, patients who had more than 5 VE in labour and when the fetal head was pushed up vaginally.[5]

2.12 Surgical Management of Surgical Site Infection

Once an SSI has been diagnosed and is not responding to IV antibiotics, the next step would be surgical management. It is proposed that the wound be manually opened to allow free drainage, followed by negative pressure wound therapy and then secondary closure at a later stage. These methods will accelerate the healing of the wound.[46]

Seffan *et al* (2005) reviewed relaparotomy post caesarean section, and found that the incidence of repeat surgery occurred in 44 out of 6120 CS (0.7%). The indications included uterine sepsis, haemorrhage and wound dehiscence. Surgeries performed included hysterectomy, artery ligation, debridement and resuturing of the initial incision.[47]

2.13 Intervention Strategies

Approaches aimed at preventing infection are either supported by randomised control trials with strong evidence that supports their use, or based on common sense and poor data.[24]

Obesity, diabetes, cigarette smoking, and anaemia are all contributing risk factors that should be controlled, avoided, or prevented before surgery to further reduce the risk of the likelihood of developing a SSI.[6,7,11,24,27,29,31,33]

Prolonged labour has been shown to be a risk factor for the development of an SSI. The longer the labour, the more likely the patient is to have multiple vaginal examinations, increased time during which infection can occur, and the greater likelihood of having an emergency CS.[33]

The patient's endogenous skin flora are often found to be the causative organisms in SSIs, and appropriate cleaning of skin is aimed at reducing this risk.[37] Iodine based preparations have been found to be superior in their effectiveness against gram positive and negative organisms in preoperative skin antisepsis.[24,40] Hair clipping is more effective and safer as a pre-operative hair removal method, and results in lower incidence SSIs when compared to shaving.[16,38]

Hypothermia during surgery causes vasoconstriction and therefore reduces tissue oxygenation, as well as decreases production of leucocyte superoxide. Transfusion requirements are also increased with hypothermia and bleeding is increased. For this reason, perioperative normothermia is advocated.[48,49]

2.14 Best Care Always Initiative

Best Care Always (BCA) is an initiative campaign that supports healthcare organisations in the implementation of interventions that are internationally evidence based to improve patient safety and institute the best current practice in hospital care. They have numerous interventions, and their recommendations in reducing and preventing SSIs are described below.[7] The BCA principles were launched in the Western Cape in 2011, and subsequently introduced at MMH.

2.14.1 Antimicrobial coverage

This bundle advocates for the timely administration of the correct dose of prophylactic antibiotics pre-caesarean section. It also advises that a further prophylactic dose is given if the surgery extends beyond 4 hours.

2.14.2 Appropriate hair removal

A hibiscrub bath or shower should be performed prior to hair removal. It is advised that hair be removed using clipping or that it not be removed at all, and shaving is not recommended. Clipping should occur 2 hours or more prior to the time of surgery, followed by a pre-operative hibiscrub bath or shower. Hair should not be removed in the operating theatre. Chlorhexidine 0.05% in 70% alcohol preparation should be used to clean the skin inside the

operating theatre, and given 3 minutes to dry prior to the skin incision being made. Washing of the abdomen is not advised for 6 hours post-operatively.

2.14.3 Postoperative glucose control

Strict glucose control should be instituted for major cardiac surgery patients cared for in an ICU.

2.14.4 Peri- and post-operative normothermia

Operating theatres should be kept at a constant temperature of 19-21˚C. Patient's should be dressed in a cap and booties, with use of a bair-hugger intra-operatively. Pooling of preparation cleaning fluid should be kept to a minimum and the use of warmed IV fluids is advised. If intra-abdominal lavage is performed, this should be done with warm lavage fluids. The temperature should be monitored in recovery, and the bairhugger used when necessary to maintain normothermia.

2.15 Rationale For Study

Surgical site sepsis is an important cause of maternal morbidity and mortality, and can be considered a key indicator of quality of care. Due to the perceived increase in SSI in 2011/ 2012, it was important to investigate the extent and nature of SSI post-CS in our population, which is known with a high prevalence of HIV and cephalopelvic disproportion.

By describing the patients with SSI post-CS, we can recognise possible aspects that may be linked to the development of infection. This will then assist with development of an appropriate prevention strategy, early detection and appropriate management plan, which can be implemented effectively in the future.

3. Aim and Objectives

3.1 Aim

The aim of this study was to review deep incisional and organ/space SSI following CS at MMH from December 2011 to December 2014.

3.2 Specific Objectives

1. To measure the incidence of SSI at MMH between December 2011 and December 2014.
2. To describe the obstetric, medical and surgical factors associated with deep incisional and/or organ/space SSI.

4. Methods

4.1 Study Design

This was a retrospective observational case series.

4.2 Study Setting

The obstetric services within the Metro-West consist of Midwife Obstetric Units (MOUs), secondary level hospitals and a tertiary level teaching hospital. The MOUs are primary health care units and pregnant patients regarded as low risk, are referred to this service. In addition, patients requiring hospital delivery may attend here until 36-weeks gestational age. MMH is a secondary level hospital and patients who have complications in pregnancy are referred here. Indications for referral include, amongst others, twin pregnancies, previous stillbirth, antepartum haemorrhage and mild hypertension. The tertiary referral unit for our service is the Maternity Centre at GSH. Women who require inter-disciplinary care, have medical conditions or major obstetric complications are referred here. The Gynaecology Unit at GSH also looks after patients who have postpartum complications, such as severe SSI.

Our study setting included both MMH and GSH, as patients with SSI were admitted to both hospitals. MMH, as a secondary level obstetric and neonatal hospital, does not have the capacity to treat cases of non-responsive SSIs and therefore these cases are referred to GSH, where they receive further treatment and management in the gynaecology wards. In addition, patients that were previously discharged postpartum from MMH, but present at a later stage with signs and symptoms of SSI, are referred and admitted directly to GSH gynaecology.

4.3 Study Population

The study population consisted of all patients who had a CS performed at MMH between December 2011 and December 2014.

At the commencement of the study in 2011, the patient population of Mowbray comprised of patients that lived in the local drainage area, as well as those transferred from the referring MOUs – namely Mitchell's Plain MOU, Guguletu MOU, and Khayelitsha Site B MOU. Mid 2012, the Khayelitsha District Hospital opened, and resulted in a shift in the referral platform. Khayelitsha Site B MOU now referred to either the District Hospital or Tygerberg Hospital, and MMH became the referral site for Retreat MOU and False Bay Hospital.

4.4 Study Subjects

The subjects for the current study were women who had a CS performed at MMH, who subsequently developed deep wound sepsis and/or uterine sepsis, as defined by the CDC (Appendix A). The subjects included those observed to develop severe SSI at MMH in the postoperative period, or identified after readmission from home with severe SSI.

4.5 Inclusion Criteria

- Patients with deep incisional SSI or organ/space SSI (as defined by the CDC), following CS at MMH between December 2011 - December 2014
- Any patient that was readmitted or transferred to GSH (Gynaecology ward or Maternity Centre) for SSI, following a CS at MMH

Exclusion Criteria

- Normal Vertex Deliveries
- Superficial SSI
- Sepsis from another source e.g. respiratory

4.7 Definitions for Severe SSI Used to Identify Subjects

For the purpose of this study, a deep incisional SSI consisted of a severe deep wound infection with an associated pyrexia of > 38^0C, which required IV antibiotics, surgical

intervention in the form of wound debridement and drainage of any underlying collection. An organ/space SSI post-CS referred specifically to uterine sepsis, which required either IV antibiotics, uterine evacuation or hysterectomy. On examination, the uterus would be subinvoluted and tender. In addition, localised or generalised peritonitis may be elicited. Cases that did not respond to IV antibiotics required surgical intervention. This differentiation was made per a review of the literature that looked at diagnosis and management of SSI post-CS.

4.8 Identification of Cases

Postnatal wards at MMH are required to keep a book that records all septic cases. All patients that were transferred to GSH for wound sepsis and met the definition and criteria for either deep incisional SSI or organ/space SSI, as described in Appendix A, were recorded. Patients discharged from MMH, who presented with sepsis were readmitted to GSH Gynaecology wards, as logistically they were not able to be managed at MMH. GSH gynaecology wards kept a similar book to record all cases admitted from MMH. The relevant referral MOUs, namely Guguletu, Mitchells Plain, Khayelitsha and Retreat MOU, as well as False Bay Hospital, also kept a register of postnatal sepsis of patients who had undergone surgery at MMH. If surgical procedures were performed or any organism cultured from the wound, these were recorded as well. These statistics were collected on a weekly basis.

4.9 Data Collection

The relevant case folders were sourced from the Records Departments at both MMH and GSH, and analysed by myself as the principal investigator. The Maternity Case Record (MCR) is a booklet used nationally in South Africa, which is used throughout the antenatal as well as postpartum period. Included in the MCR are all the booking investigations, examination findings, antenatal symphyseal-fundal growth charts and space to record pertinent information. There is an intrapartum Philpot chart as well as a CS component. The neonatal APGAR (Appearance, Pulse, Grimace, Activity, Respiration) scores and examination findings can also be recorded. Data collected from individual patient folders was coded and then recorded on the Data Collection Sheet (Appendix B). The variables used in

the data collection sheet (DCS) were developed using the information gained from an extensive review of the lietrature on relevant risk factors, as well as basic patient demographics. Each case was given a consecutive individual study number and the data transferred from the DCS to an Excel spreadsheet using the study number as the only identifying factor. The study number and patient details were recorded separately and kept in a secure location, only accessible to the principal investigator, to ensure patient confidentiality. The Excel spreadsheet was kept on a password protected computer, again, to ensure confidentiality.

4.10 Sample Size

From clinical observations of approximately 2 - 3 women with post-CS SSI per month delivered at MMH, it was estimated that from 2011 to 2014 there would be at least 100 subjects. This was thought to be a sufficient number from which to draw some conclusions for the study objectives.

By using the incidence of SSI from 3 different studies and the monthly estimated delivery rate, an expected number of cases can be calculated. MMH has an average of 1000 deliveries per month, with roughly a 40% CS rate during the study time period. The incidence quoted in 3 of the studies that used a similar SSI definition was 3.7% (Israel),[6] 0.7% (China)[11] and 1.5% (Johannesburg, South Africa).[23]

Monthly deliveries at MMH:	1000 deliveries
CS rate:	40%
Monthly CS cases at MMH:	400
Literature incidence range of SSI:	0.7 - 3.7%
Estimated incidence of SSI cases per month:	2.8 - 14.8
Estimated incidence of SSI cases over 3 years:	100.8 - 532.8

The estimated number of cases of post-CS SSI is between 100 and 532 according to our simple calculation.

4.11 Data Analysis

The incidence of SSI, defined as deep incisional SSI and/or organ/space SSI, following CS at MMH, was the primary measurement. These cases were named the numerator and all CS done at MMH during the given time period, the denominator. Data was analysed by myself and a statistician using statistical programmes, Statistica and Stata.
Continuous variables were analysed and measured for central tendency (mean) and measures of dispersion (minimum, maximum and standard deviation). Categorical variables were placed into frequency tables.

4.12 Ethics

The study number and patient details were recorded separately and kept in a secure location, only accessible to the principal investigator, to ensure patient confidentiality. The Excel spreadsheet was kept on a password protected computer, again to ensure confidentiality.
The research was conducted in line with the principles of the Helsinki Declaration.[50]
Permission to conduct the study was obtained from the Department of Obstetrics and Gynaecology Research Committee and the UCT Human Ethics Committee, HREC Reference 852/2014.

5. Results

Between December 2011 and December 2014, 98 patients were identified with deep and/or organ/space SSI following CS performed at MMH. Of the 98 cases, 96 patient folders were retrieved from the Records Department. The patient folders consist of the MCR, nursing notes, prescription charts, surgical notes and laboratory results.

In the case of 29 patients, the MCR was not available, which has most the needed information. Of these 29 patients, 27 were MMH folders and 2 were GSH folders. The missing MCR could be due to the MCR remaining in the MMH folder on discharge and the patient representing to GSH, being misplaced at either MMH or GSH, or being an unbooked patient who never given a MCR. In cases where the MCR was not available, theatre and delivery registers were used to complete some of the missing variables, as well as laboratory reports.

Patients with SSI were either transferred from MMH or discharged and then readmitted to GSH at a later stage. Transfers occurred in 35 patients (35.7%), readmission in 58 (59.2%) and 5 patients (5.1%) had this data missing. The mean hospital admission ranged from 2 to 36 days, with a mean stay of 12.3 days (SD ±6.4 days).

5.1 Incidence of post CS SSI

During the outlined time period (December 2011 – December 2014), 14982 CS were performed. Of the 14982 caesarean sections, 98 were subsequently identified with deep incisional and/or organ/space SSI, according to the CDC definition, which results in an overall incidence of 0.65% (Figure 1).

Figure 1: Incidence of Deep And/or Organ Space SSI

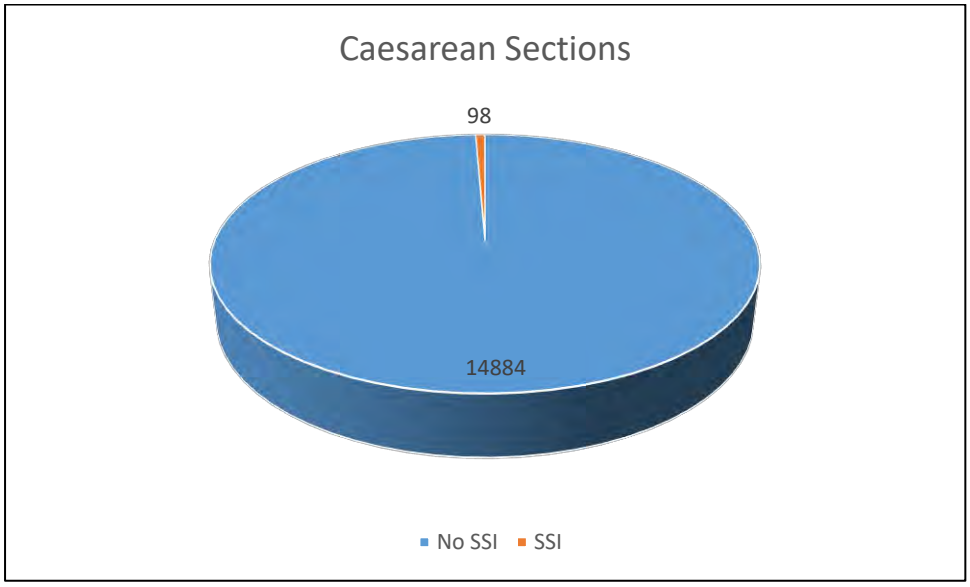


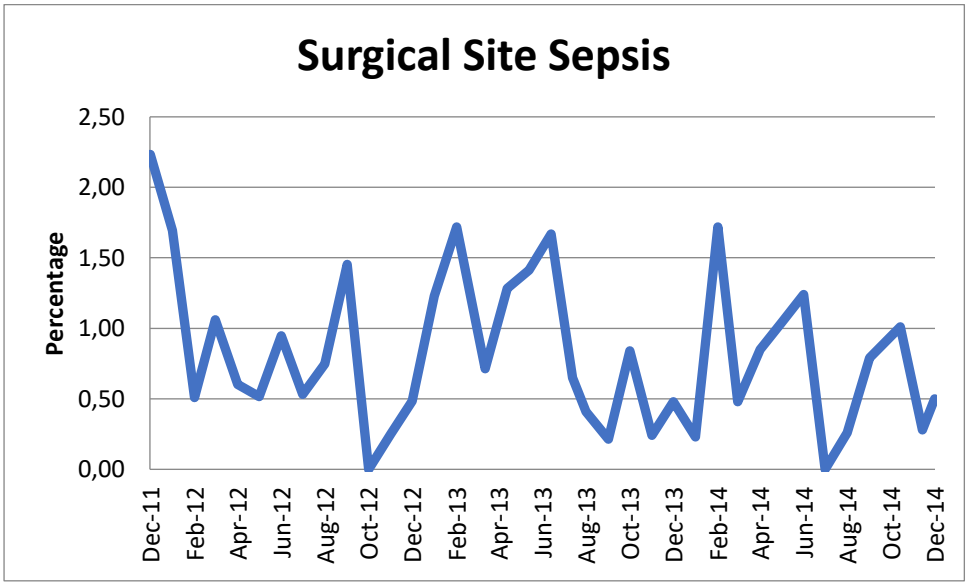
Table 1 shows the incidence of severe SSI in a month by month breakdown over the 3-year study period, reflected as a percentage. The annual rate was calculated to be 0.88% for Year 1, 0.90% for Year 2 and 0.70% for Year 3. This is represented graphically in Figure 2.

Table 1: Incidence of post CS SSI at MMH within study period

Month	Dec 2011 - Nov 2012 SSI % Year 1	Dec 2012 - Nov 2013 SSI % Year 2	Dec 2013 - Nov 2014 SSI % Year 3
December	2.23	0.48	0.48
January	1.69	1.23	0.23
February	0.51	1.72	1.72
March	1.06	0.71	0.48
April	0.6	1.28	0.85
May	0.52	1.41	1.04
June	0.95	1.67	1.24
July	0.53	0.65	0
August	0.75	0.41	0.26
September	1.45	0.21	0.79
October	0	0.84	1.01
November	0.25	0.24	0.28
Annual Rate	**0.88**	**0.90**	**0.70**

Figure 2 depicts the month to month incidence of SSI, expressed as a percentage. The months with an incidence above 1.5% included December 2011, January 2012, February and June 2013 and February 2014.

Figure 2: Incidence of SSI at MMH



5.2 Patient Demographics

Table 2 shows the descriptive data of the included patient demographics. The patient's ages ranged from 16 to 43 years of age with a mean age of 25.6 (SD ±6.06). Of the 98 patients, 97 patients had information regarding the number of previous CS, with a median of 0 (range 0-2, SD ±0.4). BMI was calculated using height and weight. The mean BMI of 59 patients was 31.2, with a range from 17.98 – 56.03kg/m^2 (SD ±6.95). In the remaining 39 patients, the height and/or weight had not been documented, or the MCR was missing, therefore the BMI could not be calculated. Of the 59 patients, 14 were overweight (BMI 25 – 29.9kg/m^2), 27 were obese (BMI 30.0 – 39.9kg/m^2) and 7 were morbidly obese (BMI ≥40.0kg.m^2).The mean weight of 67 patients was 78.15kg, with a range of 41.0 – 126.6kg (SD ±18.09). Again the other 31 patients did not have this documented, or the MCR was missing.

Table 2: Descriptive Patient Demographics

	Number of cases	Minimum	Maximum	Mean/Median	Std. Dev.
Age	98	16	43	25,602	6,064
Gravidity	97	1	6	1	1,196
Parity	97	1	6	1	1,016
Previous number of CS	97	0	2	0,155	0,441
Previous number of laparotomies	89	0	1	0,045	0,208
Booking Haemoglobin (g/dL)	71	7,5	15,3	11,375	1,722
Height (in m)	59	1,45	1,73	1,575	0,063
Weight (in kg)	67	41	126,5	78,157	18,086
BMI (kg/m^2)	59	17,982	56,304	31,241	6,948

Table 3: Antenatal Data

Column1	n	%
Booking		
Booked	79	80.6
Unbooked	2	2.0
Unknown	17	17.4
HIV status		
Negative	74	75.5
Positive	24	24.5
Unknown	0	0.0
Smoking		
No	69	70.4
Yes	11	11.2
Unknown	18	18.4
Multiple pregnancy		
Singleton	96	98.0
Multiple pregnancy	2	2.0

Table 3 depicts antenatal data that was coded, as a frequency table. Of the 98 identified patients, 74 (75.5%) were HIV negative and 24 (24.5%) were HIV positive. When reviewing the treatment of the 24 HIV positive patients, 1 patient (4.2%) was not on antiretroviral treatment, 10 (41.7%) were receiving Prevention of Mother To Child Transmission (PMTCT) treatment, 11 (45.8%) patients were on lifelong Highly Active Anti-Retroviral Therapy (HAART), and 2 (8.3%) patients had missing data for the variable. Investigation into the smoking habits of the cases revealed that 11 (11.2%) patients did smoke cigarettes, 69 (70.4%) patients did not smoke, and in 18 (18.4%) cases this information was unknown. With regards to the unknown data, this was either due to the information not having been recorded, or that the MCR could not be retrieved.

5.3 Intrapartum Data

Intrapartum characteristics are represented in Table 4. Of the 98 patients, 79 patients (80.6%) were in labour prior to CS, 10 patients (10.2%) were not in labour and 9 (9.2%) had this variable missing. PROM was defined as rupture of membranes for more than 24 hours. PROM was present in 16 patients (16.3%), 63 (64.3%) did not have PROM and 19 (19.4%) patients in which this information was not known. Prolonged labour was defined as the active phase of labour lasting > 10 hours and/or total labour lasting > 18 hours. Of the 98 patients, 32 (32.7%) had a prolonged labour, 41 (41.8%) did not, and 25 (25.5%) had this variable missing. As stated before, the MCR was missing in 29 cases, but data regarding prolonged labour was extrapolated from other clinical notes in 4 cases, leaving 25 cases with this data labelled as unknown.

With regards to vaginal examinations prior to CS, 74 patients had data regarding this variable, with a range of between 0 and 11 vaginal examinations, and a median of 5 (SD ±2.8). Intrapartum temperature is not presented in Table 4, however, information for this parameter was found for 64 of the 98 cases. In these cases, the mean temperature in labour was calculated to be 36.4˚C (35.0-38.5, SD ±0.7). In the remaining 34 cases, the temperature was not recorded in 5 cases and in 29 cases the MCR was missing. A temperature of ≥ 38.0˚C was found in 2 patients, which equates to 3.1% of all cases that had a raised temperature recorded.

Table 4: Intrapartum Data

	n	% (n=98)
Labour		
No	10	10.2
Yes	79	80.6
Unknown	9	9.2
Induction of labour		
No	62	63.3
Yes	20	20.4
Unknown	16	16.3
Prolonged labour		
No	41	56.2
Yes	32	43.8
Unknown	25	25.5
Failed instrument		
No	91	92.9
Yes	3	3.0
Unknown	4	4.1

5.4 Operative Data

An emergency CS was performed in 90 patients (91.8%), 7 (7.2%) had an elective CS and 1 patient (1.0%) had this variable missing (Table 5). The primary surgeon was a registrar in 37 cases (37.8%), a senior medical officer (MO) in 39 (39.8%), a junior MO in 18 (18.3%) and 4 (4.1%) had this data missing. The mean pre-operative haemoglobin was found to be 11.8g/dL with a SD of ± 1.7g/dL. Antibiotics at time of CS were received in 62 patients (63.3%), not received in 1 (1%) and unknown in 35 (35.7%). This high number of unknown data is due to the fact that in 29 cases, the MCR was missing, and the anaesthetic chart on which the preoperative antibiotics are prescribed is contained within the MCR. In a few cases, the antibiotics were prescribed but not signed for.

Table 5: Background Operative Data

Columns	n	% (n=98)
Caesarean section		
Emergency	90	91.8
Elective	7	7.2
Unknown	1	1.0
Surgeon		
Registrar	37	37.8
Senior MO	39	39.8
Junior MO	18	18.3
Unknown	4	4.1
Anaesthetic		
Spinal	88	89.8
General	4	4.1
Combination	2	2.0
Unknown	4	4.1
Preoperative prophylactic antibiotics		
Received	62	63.3
Not received	1	1.0
Unknown	35	35.7

Table 6 describes the operative data from the surgery of the cases that subsequently developed SSI.

The skin incision made was a Pfannenstiel incision in 91 (92.9%) patients (Table 6), a midline incision in 4 (4.1%) and unknown in 3 (3.0%) patients. The uterine incision made was a lower segment uterine incision (LSUI) in 87 (88.8%) cases, a classical incision in 5

(5.1%), either a J-shaped incision or a combination of LSUI with a classical incision was made in 2 (2.0%) patients and unknown in 4 (4.0%).

MSL was present in 22 patients (22.4%), was not found in 47 (48.0%) and unknown in 29 cases (29.6%). Chorioamnionitis was suspected by the presence of offensive liquor at time of CS in 16 cases (16.6%), not suspected in 59 cases (60.2%) and unknown in 23 cases (23.5%).

Skin closure was achieved with interrupted sutures in 90 patients (91.8%), continuous sutures in 4 (4.1%) and unknown in 4 cases (4.0%). The mean estimated blood loss was 565 millilitres with a SD of ± 368 millilitres. The operating time for 93 patients was between 10 and 167 minutes, with a mean of 33.6 minutes (SD ±22.9). The remaining 5 cases did not have both the start and end time documented or the folder was missing.

Table 7 depicts additional procedures during CS. An intrauterine contraceptive device (IUCD) was inserted in 3 (3.0%) patients, not inserted in 91 (92.9%) and unknown in 4 cases (4.0%). Of the 93 cases where documentation could be found, no surgical drains were inserted. A B-lynch compression suture was inserted in 5 patients (5.1%), 1 patient (1.0%) had uterine artery ligation and 2 patients (2.0%) had a balloon tamponade inserted.

Table 6: Operative Data

Outcomes	n	% (n=98)
Skin incision		
Pfannenstiel	91	92.9
Midline	4	4.1
Unknown	3	3.0
Uterine incision		
LSUI	87	88.8
Classical	5	5.1
Other	2	2.0
Unknown	4	4.1
Chorioamnionitis		
Yes	16	16.3
No	59	60.2
MSL		
Yes	22	22.4
No	47	48.0
Unknown	29	29.6
Skin sutures		
Interrupted	90	91.8
Continuous	4	4.1
Unknown	4	4.1

Table 7: Additional Operative Procedures

	n	% (n=98)
IUCD		
Inserted	3	3.0
Not inserted	91	92.9
Unknown	4	4.1
B-lynch suture		
Inserted	5	5.1
Not inserted	89	90.8
Unknown	4	4.1
Drain		
Inserted	0	0.0
Not inserted	93	94.9
Unknown	5	5.1
Artery ligation		
Yes	1	1.0
No	93	94.9
Unknown	4	4.1
Balloon tamponade		
Yes	2	2.0
No	92	93.9
Unknown	4	4.1

5.5 Diagnosis

The post-operative diagnosis of SSI was divided into either deep incisional SSI or organ/space SSI, as per the CDC definitions used throughout the study. Deep incisional

sepsis was deep infection of the wound, whilst organ/space SSI constituted uterine sepsis. The categories were also not mutually exclusive (Table 8).

Table 8: Type of SSI

	N	% (n=98)
DEEP INCISIONAL SSI **Wound sepsis**	74	75.5
ORGAN/SPACE SSI **Uterine sepsis**	24	24.5

Wound sepsis was diagnosed in 74 patients (75.4%), with 22 patients (22.5%) that were not eligible for our study as they had superficial SSI. Of the 98 patients, 24 (24.5%) were diagnosed with uterine sepsis, which was diagnosed by uterine tenderness and subinvolution, which may have included localised or generalised peritonitis. This variable was missing in 2 patients (2.0 - 2.1%). RPOC was confirmed in 6 (6.0%) cases.

5.6 Management

Management was divided into: wound debridement, uterine evacuation, laparotomy, and hysterectomy. In 2 patients (2.0-2.1%) this information was missing (Table 9). All patients received IV antibiotics, with 34 patients (34.7%) requiring additional surgical procedures. Of the 74 patients diagnosed with wound sepsis, 23 had a debridement (31.1%). All patients diagnosed with RPOC had a uterine evacuation (6 of 6, 100%) and laparotomy was performed in 17 patients (17,2%), and proceeded to hysterectomy in 12 (12,3%) of those cases.

Table 9: Management

	N	% (n=98)
Debridement		
Yes	23	23.5
Uterine evacuation		
Yes	6	6.1
Hysterectomy		
Yes	12	12.3
No	84	85.7
Unknown	2	2.0
Laparotomy		
Yes	17	17.2
No	81	82.6
Unknown	2	2.0

5.7 Microbiology

Organisms were cultured either from a wound pus swab, retained products, wipes from the uterus, or uterine tissue. It was found that in 43 patients (43.9%), no organism was cultured, Methicillin-Resistant *Staphylococcus* Aureus was cultured in 12 (12.2%) cases, and Klebsiella pneumoniae in 18 (18.4%) cases. Multiple organisms were cultured in 16 (16.3%) patients.

5.8 Morbidity Assessment

Of the 98 patients identified with either deep incisional or organ/space SSI, none required intensive care unit (ICU) admission or ventilation. There were no maternal deaths.

6. Discussion

6.1 Incidence

In total, 14982 caesarean sections were performed at MMH between December 2011 and December 2014. Of these, 98 were subsequently diagnosed with either deep incisional SSI or organ/space SSI, resulting in an incidence of 0,65%. This is a substantially lower figure than that reported in an Israelian study done over a 14-year time period, which found the incidence to be 3.7%.[6] This study, however, included cases of both superficial and deep wound sepsis, whereas the cases identified in our study were only that of severe SSI, and therefore did not include cases of superficial SSI.

Gong *et al* (2012) performed a study from 2005 – 2009 in 8 Chinese centres and had an incidence of SSI in 0.7%, calculated from 96 cases out of 13798 CS performed. These are very similar figures to this study and used the same inclusion criteria.[11] In a South African study conducted at Chris Hani Baragwanath Academic Hospital over a 3-month period, the incidence of SSI was found to be 12.5% with mild SSI making up 11.0% and severe SSI only comprising of 1.5%.[23]

The results from our study are in keeping with incidences found elsewhere.

The incidence of SSI at MMH from December 2011 to December 2014, is represented in Figure 2. The lowest incidence was seen in year 3, December 2013 – November 2014. The introduction of BCA was first made in August 2011 in a step wise fashion. The introduction of the bundles was erratic due to a time delay in sourcing hair clippers, which took 18 months. The operating theatres were also renovated during the study period which included removal of all wooden fixtures, installation of stainless steel splashboards behind the scrub basins and the replacement of all the air-conditioning filters. All of the BCA bundles had therefore been introduced by year 3. Another contributing factor may be the change in drainage area over the study period. Khayelitsha, which initially referred to MMH, was diverted to another drainage area, and as this community has one of the highest HIV incidences in Cape Town, this may have had an impact on the decrease in incidence of SSI.

6.2 Patient Demographics

The mean age of the patients included in this study was 25.6 years (16-43). This is in keeping with other study populations.[6,11] The median number of previous CS was 0 (0-2), which is similar to Wloch *et al* (2012), who had 63.1% of the cases having had no previous CS.[27] This goes against the school of thought that previous CS may predispose a patient to SSI, due to lengthy or more difficult surgery.[11,22] Scheid-Kofman *et al* (2005) found that there was no increase in SSI in patients with a previous CS and attributed this to possible early mobilisation in the more experienced patient who had undergone previous surgery.[6] This could also be explained by the fact that most primigravid patients tend to be in labour and then require an emergency CS, whereas more patients with a previous CS would have elective surgery. The higher SSI rate could therefore be attributed to intrapartum risk factors.

The mean BMI was found to be 31.2kg/ m^2 and the mean weight was 78kg. Of the 59 patients where a BMI could be calculated, 27 (45.8%) were obese and 7 (11.9%) were morbidly obese, which is an extremely large percentage of the patients. Ghuman *et al* (2011) had a mean BMI of 34.7kg/ m^2 in the case group and 28.0m^2/kg in the control group.[33] Obesity is a proven risk factor for the development of post CS SSI and there is an increased likelihood of developing SSI with each increasing BMI category.[6,27,30]

Of the cases included in our study, 24.5% were HIV positive, which is higher than the HIV statistics for the Western Cape, which ranged between 18.3-18.5% in women aged 15 – 49.[51] Although our study was not powered to show any associations, the increased incidence of HIV in our study population may point towards HIV being a risk factor for developing SSI. Our study did not include CD4 counts or viral loads, which was a limitation of our study and may have helped to differentiate women who may have been at risk of developing SSI. In another South African study, 12 patients who were HIV positive had puerperal infection (35%), and 67 HIV positive patients had no sign of puerperal infection (28%), although this was not shown to be statistically significant.[23] This study also did not comment on CD4 counts or viral loads.

6.3 CDC Definition

The CDC definition of SSI (Appendix A), which was used throughout this study, was difficult to apply in the case of post-CS SSI. The category of deep SSI was divided into

incisional and organ/space SSI. Deep incisional SSI is straightforward, but in the case of organ/space SSI, in this instance uterine sepsis, there are different possible interpretations. For instance, we decided to include endometritis together with uterine sepsis in the organ SSI group. One could counter argue that endometritis, although in the organ itself is superficial and is often managed with IV antibiotics alone, whereas a septic uterus, or endomyometritis, will require hysterectomy. Since there is no alternative definition for SSI, we used the broad CDC definition, which is applied throughout the surgical disciplines.

6.4 Obstetric Risk Factors

Obstetric risk factors that increase the incidence of post CS SSI are generally intrapartum risk factors, which makes SSI post-CS unique when compared to elective surgery and it is often impossible to differentiate between infection that was introduced during labour or at the time of surgery.

This study found that 80.6% of the patients had been in labour, and 32.7% had prolonged labour. The median number of vaginal examinations was 5 and 32.7% of patients had PROM. Increased number of vaginal examinations in labour and PROM were shown to significantly increase the risk of SSI.[11] Schneid-Kofman *et al* (2005) observed that patients with PROM had an increased risk of developing a SSI, then patients without PROM and Ghuman *et al* (2011) discovered than their case group had a longer length of labour than the control group.[6,33]

Majority of the patients were in labour (80.6%) and almost a third (32.7%) had PROM. Sterile vaginal examinations are imperative, specifically in the case of ruptured membranes. The aseptic technique limits the amount of vaginal flora that is introduced during the VE.[52] The 2015 South African Guidelines for Maternity Care advise VE every 2 hours in the active phase of labour, therefore making sterile VE essential.[53] Even though IOL was not found to be associated with SSI, at MMH the practice of AROM and oxytocin infusion is used.

6.5 Operative risk factors

An emergency CS was performed in 91.8% of the cases. There is a multitude of evidence that suggests that one of the most significant risk factors for developing post CS SSI, is an

emergency CS in labour.[5,6,10,33] This can be attributed to risk factors that are not associated with an elective CS; prolonged labour, multiple VE, PROM, disimpaction of fetal head, suboptimal skin preparation, and incorrect timing of prophylactic antibiotics in an emergency. It is therefore unsurprising that the vast majority of the patients with severe SSI had an emergency procedure.

The grade of surgeon was equally divided between a registrar and senior medical officer. Very few CS were performed by junior staff, which may be due to the fact that these CS were more technically difficult or merely coincidental. Wloch *et al* (2012) discovered that a CS performed by a more junior surgeon had an increased odds ratio of 1.6 for developing SSI.[27]

Prophylactic antibiotics were given timeously in 63.3% and not recorded in 35.7%. This emphasises the importance of proper record keeping as one cannot assume that antibiotics were administered in these cases, although the most likely case is that they were. The protocol prescribes that antibiotics are administered prior to the patient being taken into the operating theatre to therefore allow adequate time before the skin incision is made.

6.6 Diagnosis and Management

Most the patients that had wound sepsis (75.5%) required IV antibiotics and/or debridement. Wound sepsis was diagnosed in 74 patients and a debridement was performed in 23 patients (31%), with IV antibiotics being the mainstay of treatment. A small percentage had retained products of conception and 100% of patients diagnosed with RPOC had a uterine evacuation performed.

Uterine sepsis was found in 13.3% of cases, and this is regarded as the most severe form of SSI. It can be seen as a near miss occurrence, as uterine sepsis can lead to maternal mortality. Of the 13 cases of uterine sepsis, 12 had a hysterectomy performed (92%). This indicates that the correct diagnosis was made with appropriate treatment. There were also no ICU admissions and no deaths, which also is an indicator of good clinical care. In South Africa, Essential Steps in Management of Obstetric Emergencies (ESMOE) training is being carried out in most centres. The aim is to equip junior medical and nursing staff with the skills needed to manage emergencies such as postpartum sepsis. The teaching in these manuals is that if the patient is in septic shock and does not responding to treatment and/ or has unresolving uterine sepsis with failure of one or more organs, then one must proceed to

laparotomy and probably a hysterectomy.[54] By following the strategy described, a timeous hysterectomy will be performed, which may reduce maternal mortality.

6.7 Microbiology

The NNIS has identified pathogens that have been isolated from SSI. These include, but are not limited to: *Staphylococcus* aureus, coagulase-negative *staphylococcus*, *Enterococcus*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Enterobacter*, *Proteus mirabilis*, *Klebsiella pneumoniae*, other *Streptococcus*, *Candida albicans* and *Bacteroides fragilis*. A growing number of SSIs are caused by antimicrobial-resistant organisms, such as MRSA. MRSA is a bacteria that causes infections which do not respond to standard broad spectrum antibiotics.

It is significant in that it is a hospital acquired infection, and as it is a resistant organism, requires isolation and barrier nursing to prevent it's transfer to other patients. In most cases, it is sensitive to Vancomycin.[16]

In our study, an organism was cultured in 56.1%, with MRSA cultured in 12.1%, Klebsiella pneumoniae in 18.4%, polymicrobial in 16.3% and "other" organisms in 28.6%. Wloch *et al* (2012) identified a causative organism in 39.8% of SSIs, which were polymicrobial in 24%. *Staphylococcus aureus* was the most common organism (40%), with 17% being MRSA.[27]The National Health Laboratory Service's Annual Surveillance Report of 2012 at GSH stated that 32% of all Staphylococcus Aureus strains were oxacillin resistant, with 100% sensitive to vancomycin.[55]

6.8 Antibiotics

At MMH, the recommendations at the time of the study were that all patients receive prophylactic pre-operative antibiotics and that in selected cases an extended course of antibiotics was prescribed (Appendix D).

Although there is no evidence in the literature that an extended course of prophylactic antibiotics has any clinical benefit, due to the intrapartum and operative risk factors, the MMH and Western Cape protocols recommend the extended course in specific situations, as is recommended in a 2014 Cochrane review.[5,43,44,45]

6.9 General Infection and Prevention Control

General infection prevention and control (IPC) includes pre-operative showering/ bath, pre-operative hair removal, patient skin preparation in theatre, pre-operative hand/forearm antisepsis by surgical staff, sterile instruments and antibiotic prophylaxis.[16] IPC was not evaluated in our study although it is known to be a very important routine intervention in the prevention of hospital acquired infections, notably MRSA.

6.10 Morbidity Assessment

There were no maternal deaths or ICU admissions for the indication of SSI in our study population. Whilst this indicates prompt and quality care, we cannot be sure that patients did not present to another hospital or province, or that any patients could have demised at home before having opportunity to present to health care services. In reviewing the Metro West maternal mortality reports 2012 - 2014, there were no maternal deaths from sepsis related to CS in the Metro West. Therefore, our study group did not miss any deaths within our facilities from CS sepsis.

Of note, 12 of the cases required hysterectomy thus fulfilling the criteria for 'near miss' or 'acute severe maternal morbidity'. There is no reason why files of ICU admissions would have been more difficult to locate. In the Metro West there is an aggressive approach to performing hysterectomy with uterine sepsis, and that they are performed before the patients go into septic shock and therefore did not require ICU. GSH ICU has very strict criteria for admission.

The second limitation is that our SSI rate is likely to be an underestimate due to the possibility of women with severe SSI presenting at other institutions in the 6-week post-partum period. Patients may have presented to other hospitals in the Western Cape or even travelled to other provinces.

Readmission occurred in 59.2% of cases, which either indicates that the patient was well and developed a SSI later or that they were discharged with signs of infection which were possibly missed at time of discharge. The Saving Mothers Report advises that facilities are accessible for outpatient postnatal care for 6 days post-delivery and that on discharge women must be advised on the signs of infection and what to do in this instance.[1]

6.11 Limitations

The most important limitation in this study was that of missing folders, which resulted in the data set not being complete. Folders were retrieved from both MMH and GSH and in the case of the missing folders, these were not in the records department and were not able to be located either. In some instances, this information could be gathered from other sources, such as theatre or delivery registers. During the data collection period, it was noted that clinical notes were occasionally incomplete, or important information not recorded. Correct filing of folders and proper note-keeping is vital, not only for audit purposes, but for also for patient care and medicolegal purposes. Missing data made analysis of all 98 cases incomplete.

Cases identified with SSI were not matched with controls, which would have made it possible to make associations for various risk factors, which would give the clinician more information regarding potential risk factors for post CS SSI in our population.

As this was a retrospective review of cases, further information that was not in the clinical notes could not be obtained, for example specifics regarding pre-operative skin preparation. In a prospective study, one would be able to focus on the perceived associations involved with SSI. MMH has subsequently instituted a BCA ticksheet, which is completed for every patient undergoing a CS, and subsequently audited to assess the level of compliance with the BCA bundles of care.

During this study, it was difficult to interpret possible trends with regards to SSI post-CS as there were so many changes throughout the study period; change in drainage area, unsynchronised introduction of BCA bundles and theatre refurbishments, amongst other factors, which make conclusions difficult.

Specific associations could unfortunately not be made in this study as it was not designed or powered to do this. This could potentially be useful information that could result in interventions to prevent SSI being instituted.

6.12 Recommendations

As most of the cases of SSI were in labour, one can deduce that some of the risk factors may occur during the intrapartum period. Training sessions and posters in the labour ward can be instituted to teach and remind doctors and nursing staff to limit the number of VEs, strict adherence to aseptic techniques for VE and to follow antibiotic protocols. The BCA tick sheet that has since been instituted is a good example of a reminder to complete each step in order to facilitate the best prevention of SSI.

Infection control in the labour ward and operating theatres also needs to be monitored to identify lapses and correct IPC techniques reinforced.

Collection of data pertaining to CD4 counts and viral loads would be a recommendation for future studies and might aid in identifying patients at risk of SSI.

To establish causative factors and make astute recommendations, there would need to be a prospective study with matched controls, which would also eliminate the difficulty in retrieving patient folders.

7. Conclusion

During the study period 14982 CS were performed, with 98 being diagnosed with deep incisional or organ/space SSI. The overall incidence of severe SSI was calculated to 0.65%, which is in keeping with the incidence in other centres. The lowest incidence was found in year 3, which could be accounted for by the full implementation of the BCA bundles and change in drainage area.

Of the 98 patients with severe SSI, 80.6% were in labour and 91.8% had an emergency CS performed. The majority of the patients diagnosed with SSI were in labour, which can be attributed to intrapartum risk factors increasing the likelihood for development of post-CS SSI.

Uterine sepsis was diagnosed in 24.5% of patients and 12.3% required a hysterectomy. There were no maternal deaths or ICU admissions, which may indicate a good quality of care, but may also indicate that the missing folders may have included patients who were admitted or died elsewhere.

A prospective study, powered to analyse specific associations between risk factors and the development of SSI post-CS is needed to fully evaluate and identify significant causes. This would result in information that could create interventions aimed at specific causative risk factors.

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9. Appendices

9.1 Appendix A: Criteria for Defining a Surgical Site Infection (SSI)

Superficial Incisional SSI	Infection occurs within 30 days after the operation *and* infection involves only skin or subcutaneous tissue of the incision *and* at least *one* of the following: 1. Purulent drainage, with or without laboratory confirmation, from the superficial incision. 2. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision. 3. At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat *and* superficial incision is deliberately opened by surgeon, *unless* incision is culture-negative. 4. Diagnosis of superficial incisional SSI by the surgeon or attending physician. Do *not* report the following conditions as SSI: 1. Stitch abscess (minimal inflammation and discharge confined to the points of suture penetration). 2. Infection of an episiotomy or newborn circumcision site. 3. Infected burn wound. 4. Incisional SSI that extends into the fascial and muscle layers (see deep incisional SSI). *Note:* Specific criteria are used for identifying infected episiotomy and circumcision sites and burn wounds.
Deep Incisional SSI	Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves deep soft tissues (e.g., fascial and muscle layers) of the incision *and* at least *one* of the following: 1. Purulent drainage from the deep incision but not from the organ/space component of the surgical site. 2. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localized pain, or tenderness, unless site is culture-negative. 3. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination. 4. Diagnosis of a deep incisional SSI by a surgeon or attending

	physician. *Notes:* 1. Report infection that involves both superficial and deep incision sites as deep incisional SSI. 2. Report an organ/space SSI that drains through the incision as a deep incisional SSI.
Organ/Space SSI	Infection occurs within 30 days after the operation if no implant† is left in place or within 1 year if implant is in place and the infection appears to be related to the operation *and* infection involves any part of the anatomy (e.g., organs or spaces), other than the incision, which was opened or manipulated during an operation *and* at least *one* of the following: 1. Purulent drainage from a drain that is placed through a stab wound‡ into the organ/space. 2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space. 3. An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination. 4. Diagnosis of an organ/space SSI by a surgeon or attending physician.

* Horan TC et al[11]

† National Nosocomial Infection Surveillance definition: a nonhuman-derived implantable foreign body (e.g., prosthetic heart valve, nonhuman vascular graft, mechanical heart, or hip prosthesis) that is permanently placed in a patient during surgery.

‡ If the area around a stab wound becomes infected, it is not an SSI. It is considered a skin or soft tissue infection, depending on its depth.

9.2 Appendix B: Data Collection Sheet

Study number	
Age	
Gravidity	
Parity	
Previous Caesarean Sections (number)	
Previous Laparotomies (number)	
Booked 0=No 1=Yes	
Haemoglobin at booking (g/dl)	
HIV Positive 0=No 1=Yes	
HIV Treatment 0=No 1=Yes PMTCT 2=Yes HAART	
RPR Positive 0=No 1=Yes	
RPR Treated 0=No 1=Yes 2=Partially	
Number of Antenatal Visits	
Smoking 0=No 1=Yes	
Height (in meters)	
Weight (in kilograms)	
Body Mass Index	
Impaired Glucose Tolerance 0=No 1=Yes	
Multiple Pregnancy 0=No 1=Yes	
Temperature (in degrees Celsius) prior to delivery	

Induction of Labour 0=No 1=Yes	
Prolonged Rupture of Membranes (>24hrs) 0=No 1=Yes	
In Labour 0=No 1=Yes	
Prolonged Labour (active phase>10hrs, total labour >18hrs) 0=No 1=Yes	
Vaginal Examinations (number)	
Failed instrumental delivery 0=No 1=Yes	
Disimpaction of fetal head 0=No 1=Yes	
Antibiotics prior to caesarean section 0=No 1=Yes	
Elective caesarean section 0=No 1=Yes	
Surgeon 0=Registrar 1= Senior Medical Officer 2=Junior Medical Officer 3=Intern 4=Consultant	
Start time (00:00)	
End Time (00:00)	
Operation Time (00:00)	
Pfannenstiel incision 0=No 1=Yes	
Uterine incision 0=Lower uterine incision 1=Classical 2=Other	
Haemoglobin at time of caesarean section (g/dl)	
Estimated Blood Loss (ml)	
Spinal anaesthesia 0=No 1=Yes 2=spinal+GA	
Antibiotics before skin incision 0=No 1=Yes	
Suspected chorioamnionitis 0=No 1=Yes	
Meconium stained liquor 0=No 1=Yes	
Chromic used on uterus 0=No 1=Yes	

IUCD inserted 0=No 1=Yes	
Interrupted skin sutures 0=No 1=Yes	
Drain inserted 0=No 1=Yes	
Additional procedures at CS: B lynch 0=No 1=Yes	
Additional procedure: Artery ligation 0=No 1=Yes	
Additional procedure: Balloon tamponade 0=No 1=Yes	
Antibiotics after caesarean section 0=No 1=Yes	
Postop Pyrexia (>37.0ºC for 4 or more days) 0=No 1=Yes	
Readmission 0=No 1=Yes	
Final diagnosis: wound sepsis 0=No 1=Yes	
Final diagnosis: RPOC 0=No 1=Yes	
Final diagnosis: endometritis 0=No 1=Yes	
Final diagnosis: septic uterus 0=No 1=Yes	
Definitive mx IV abx 0=No 1=Yes	
Definitive mx wound debridement 0=No 1=Yes	
Definitive mx EVAC 0=No 1=Yes	
Definitive mx hysterectomy 0=No 1=Yes	
Definitive mx laparotomy 0=No 1=Yes	
MRSA cultured 0=No 1=Yes	
Klebsiella pneumoniae cultured 0=No 1=Yes	
Other organism cultured 0=No 1=Yes	

9.3 Appendix C: MMH BCA – SSI Checklist

PERI-OP NORMOTHERMIA		APPROPRIATE HAIR REMOVAL		ANTIMICROBIAL COVERAGE	
ACTION	RESULT ✓ If done X If not Or N/A	ACTION	RESULT ✓ If done X If not Or N/A	ACTION	RESULT ✓ If done X If not Or N/A
▪ Theatre temp between 19 & 21 degrees ▪ Patient dressed in a cap & booties ▪ Bair Hugger used intra-operatively ▪ Minimal pooling of prep fluid ▪ Warm IV fluids used ▪ Warm lavage fluids used ▪ Temp in recovery ▪ Patient warmed in recovery		▪ No shaving done at home ▪ No shaving in hospital ▪ Clipping done pre-op ▪ Clipping not done operating room ▪ Clipping done < 2 hours pre-op ▪ Hibiscrub wash after hair removal		▪ Antibiotic given within 60 min of incision ▪ Correct dose given ▪ Re-dosing done (if >than 4 hrs) ▪ Pre-op hibiscrub bath/shower ▪ Hibiscrub bath /shower after hair removal ▪ Chlorhexidine 0.05% in 70% alcohol prep ▪ 3 min given for skin drying ▪ No washing for at least 6 hour	

9.4 Appendix D: Antibiotic Protocol at MMH

ANTIBIOTICS AT MMH

The following guidelines apply to patients in whom the clinical situation requires antibiotics for prophylaxis and treatment.

Antenatal Infections

A. Acute Pyelonephritis

Ceftriaxone 1g ivi stat, then 1g daily for 3 - 5 days, followed by oral Co-amoxiclav (if > 34 weeks gestation) or oral cefuroxime (< 34 weeks gestation) - depending on culture results. Treatment should be for a duration of at least 10 days.

B. Bacterial Pneumonia (community acquired)

Ceftriaxone 1g ivi stat, then 1g daily for 3 - 5 days, followed by oral Co-amoxiclav or cefuroxime as above - depending on culture results. Treatment duration is based primarily on clinical response, but would usually be about 5-7 days.

C. *Vaginal Discharge*

- Flagyl 400mg po 8hrly
- Clotrimazole Vaginal Cream

Patients not responding to above therapy require a speculum examination, and the addition of the following antibiotics:

- Amoxil 500mg po 8hrly
- Ceftriaxone 1g IM stat

NB – Treatment of partners + condom use

E. PPROM

All patients admitted with PPROM that have no evidence of Chorioamnionitis, should receive:
- Azithromycin 500mg daily x 3/7s (to prevent chorioamnionitis)
- Ampicillin 1g ivi 6hourly when in labour (Gp B Streptococcus prophylaxis) or
- Clindamycin 600mg ivi 8hourly if allergic to penicillin

Group B Streptococcus

The following are risk factors for the development of early onset GBS disease in the neonate:

- Previous baby affected by GBS
- GBS bacteriuria detected during current pregnancy
- Preterm labour
- Prolonged rupture of membranes
- Fever in labour

Patients with any of these risk factors should receive prophylaxis during labour:

- Ampicillin 1g ivi 6 hourly or
- Clindamycin 600mg ivi 8 hourly if allergic to penicillin

Preoperative and Postoperative Prophylaxis and Early Therapeutic Treatment

A. ***Elective C/S***

HIV negative*:*
Pre-op;
- Cefazolin 1g ivi stat if < 80kg
- Cefazolin 2g ivi stat if > 80kg

HIV positive*:*
Pre-op
- Cefazolin 1g ivi stat if < 80kg
- Cefazolin 2g ivi stat if > 80kg,

Post-op
- Ceftriaxone 1g ivi stat daily x 5/7
- Metronidazole 400mg po 8 hourly x 5/7

NB – Please document DATE and TIME of prescribing antibiotics!

B. ***Emergency C/S***
Pre-op
- Cefazolin 1g ivi stat if < 80kg
- Cefazolin 2g ivi stat if > 80kg

Post-op
- Ceftriaxone 1g ivi stat daily x 5/7
- Metronidazole 400mg po 8 hourly x 5/7

Prophylaxis/ Therapeutic Antibiotics

The following are risk factors for the development of maternal sepsis:

- Prolonged labour (active phase of more than 12 hours)
- ≥ 5 vaginal examinations since the onset of labour
- PROM (≥ 24 hours)
- Disimpaction of fetal head during caesarean section
- Cord prolapse
- Chorioamnionitis
- Offensive liquor at C/Section

- Treat with Ceftriaxone ivi 1g daily + Metronidazole 400mg 8 hourly for 24 hours or for duration of labour.
- Discharge from hospital on a 5 day course of oral antibiotics –
  Amoxil 500mg 8hrly + Metronidazole 400mg 8hrly

PLEASE NOTE

Any patient that is still pyrexial on Day 3 post delivery requires a septic workup.
All of these patients should be discussed with the Obstetric Consultant.