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An evaluation of the decision-to-incision interval for caesarean sections at Chris Hani Baragwaneth Academic Hospital

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AN EVALUATION OF THE DECISION-TO-INCISION INTERVAL FOR CAESAREAN SECTIONS AT CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL

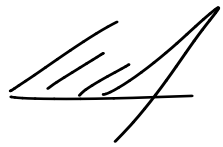
Melissa Denielle Williams

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Medicine in the speciality of Obstetrics and Gynaecology.

Johannesburg, 2020

DECLARATION

I, Dr Melissa Denielle Williams, declare that this Research Report is my own work. It is being submitted for the Degree of Masters of Medicine at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.



_____

(Signature of candidate)

23rd _____ day of April _____ 20 20_____

DEDICATION

I dedicate this research report to my parents Mischak and Avril Williams for their unshakable love and encouragement, to my husband Viktor Ivanov for his unwavering support and devotion and to my stepdaughters Evitta and Antoaneta Ivanov for their patience and kindness.

ABSTRACT

Background

The decision-to-incision interval (DTII) at Chris Hani Baragwanath Academic Hospital (CHBAH) was unknown, the main objective of this study was to evaluate the DTII for emergency caesarean sections (EMCS) at CHBAH, a tertiary hospital in Soweto, Johannesburg.
The caesarean section (CS) rate at CHBAH has steadily increased over the past few years; however the infrastructure and staffing at CHBAH has remained the same.

Methods

This was a cross sectional retrospective study of women who had a CS at CHBAH from the 1st of May 2016 to the 31st of May 2016. The hospital files were retrieved for the data collection.

Results

A total of 464 files were used. The median age of the women was 28 years and the median parity was two. The median DTII was 354.5 minutes (IQR: 190-595.75; range: 30-10570). Suspected uterine rupture achieved the shortest median decision-to-anaesthetic interval (DTAI) of 50 minutes (IQR: 920-145; range: 20-145) and foetal compromise had the longest median DTAI of 545 minutes (IQR: 232.5-808; range: 180-1355.The median DTAI was 350 minutes (IQR: 175-627; range: 20-10545). The top three Robson Ten Group Classification System (RTGCS) were groups 5, 10 and 1 which contributed 62.5% to the CS rate. The majority of the indications for elective caesarean section (ELCS) were previous CS (85.1%). The most frequent indications for EMCS were FD (58.1%). An adverse maternal morbidity occurred in 23 (5%) women, with PPH and the need for blood transfusion being the predominating factor. One hundred and twenty four (25.5%) neonates required admission. The main admission reason was respiratory distress.

Conclusion

The DTII was 4.7 times the 75 minute recommended NICE Guidelines for a category 2 CS and six times longer than the proposed 60 minutes stipulated in the Guidelines for Maternity Care in South Africa.

Acknowledgement

I would like to express my gratitude to my supervisor Prof. Yasmin Adam for her constant support, enduring patience, expert guidance and vast knowledge.

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NOMENCLATURE

Abbreviations

ACOG	American College of Obstetricians and Gynecologists
APH	Antepartum Haemorrhage
APLS	Antiphospholipid syndrome
ART	Antiretroviral therapy
ATII	Anaesthetic-to-incision interval
BMI	Body mass index
BW	Birth weight
CD4	Cluster of differentiation 4
CHBAH	Chris Hani Baragwanath Academic Hospital
CNS	Central nervous system
CPD	Cephalopelvic disproportion
CS	Caesarean Section
CTG	Cardiotocograph
DDI	Decision to delivery interval
DM	Diabetes mellitus
DTAI	Decision-to-anaesthetic interval
DTII	Decision-to-incision interval
EBL	Estimated blood loss
ELCS	Elective caesarean section
EMCS	Emergency caesarean section
EUS	Early ultrasound (before or at 24 weeks gestation)
FD	Foetal distress
FFH	First fundal height

FSB	Fresh stillbirth
GA	Gestational age
Hb	Haemoglobin
HDI	Human Development Index
HELLP	Haemolysis, elevated liver enzymes and low platelets
HIE	Hypoxic ischaemic encephalopathy
HIV	Human immunodeficiency virus
HMD	Hyaline membrane disease
HTN	Hypertension
ICU	Intensive care unit
IE	Imminent eclampsia
IPPV	intermittent positive pressure ventilation
IQR	interquartile range
KZN	KwaZulu-Natal
LNMP	Last normal menstrual period
LUS	Late ultrasound (after 24 weeks gestation)
MAS	Meconium aspiration syndrome
MOU	Midwife obstetric unit
MSB	Macerated stillbirth
MSL	Meconium stained liquor
MUAC	Mid upper arm circumference
nCPAP	Nasal continuous positive airway pressure
NICE	National Institute for Health and Care Excellence (NICE)
NICU	Neonatal intensive care unit
PET	Pre-eclampsia
PLPL	Prolonged latent phase of labour
PNMR	Perinatal mortality rate
POH	Poor obstetric history
PPH	Postpartum haemorrhage
PPIP	Perinatal Problem Identification Programme

RCOG	Royal College of Obstetricians and Gynaecologists
RDS	Respiratory distress syndrome
REDCap	Research Electronic Data Capture
Rh	Rhesus
RMMCH	Rahima Moosa Mother and Child Hospital
RPR	Rapid plasma regain
RTGCS	Robson Ten Group Classification System
SA	South Africa/n
SD	Standard deviation
STAH	Subtotal abdominal hysterectomy
TICU	Transitional intensive care unit
UK	United Kingdom
USA	United States of America
VBAC	Vaginal birth after caesarean section
VL	Viral load
WHO	World Health Organization

Physical quantities

cells/µL	number of cells per microliter
cm	centimetres
copies/mL	number of viral copies per millilitre
g/dL	grams per decilitre
kg	Kilogram
kg/cm^2	Kilograms per square centimetre
mmol/L	Millimoles per litre

CHAPTER ONE - INTRODUCTION

1.1 General introduction

Worldwide there has been a trend in escalating caesarean section (CS) rates. The reasons for this increase appears to encompass an intricate mesh of issues relating to the women, healthcare systems, healthcare providers, patient information and social trends [1]. In an attempt to define an ideal CS rate, a systematic review of ecological studies found that there was a reduction maternal, neonatal and infant mortality for CS rates ranging from nine to 16 percent. Increased mortality seen with CS rates below this level was attributed to poor socio-economic progress. No change in mortality was found with CS rates above this level [2]. CS are coupled with complications however the inability to provide a necessary CS is also associated with increased morbidity and mortality. Therefore, the World Health Organization (WHO) advises that appropriately indicated CS be performed timeously and safely. Since CS rates vary among populations, the WHO has promoted the global use of the Robson's Ten Group Classification System (RTGCS) to encourage standardized data collection in order to evaluate and compare CS rates within and among obstetric units [1].

Once an emergency caesarean section (EMCS) is indicated it should be done as soon as possible. Delays in performing a medically indicated CS may lead to an increase in the perinatal and maternal morbidity and mortality. The ideal decision-to-incision interval (DTII) for EMCS is 30 minutes according to the Royal College of Obstetricians and Gynaecologists (RCOG) and American College of Obstetricians and Gynaecologists (ACOG) however this has been demonstrated to be difficult to achieve [3]. The National Institute for Health and Care Excellence (NICE) guidelines recommends a that an EMCS be performed within 75 minutes [4]. Various factors have been identified in the literature which contributes to a prolonged DTII such as poor communication; patient preparation and transfer; availability of operating theatres and staff; and administration of anaesthesia [5-9].

The total number of deliveries, absolute numbers of CS and the CS rate at Chris Hani Baragwanath Academic Hospital (CHBAH) has steadily increased over the past few years; however the infrastructure and staff at CHBAH has remained the same. The changes in the number of deliveries and CS is shown in Figure 1.1 and Figure 1.2 below.

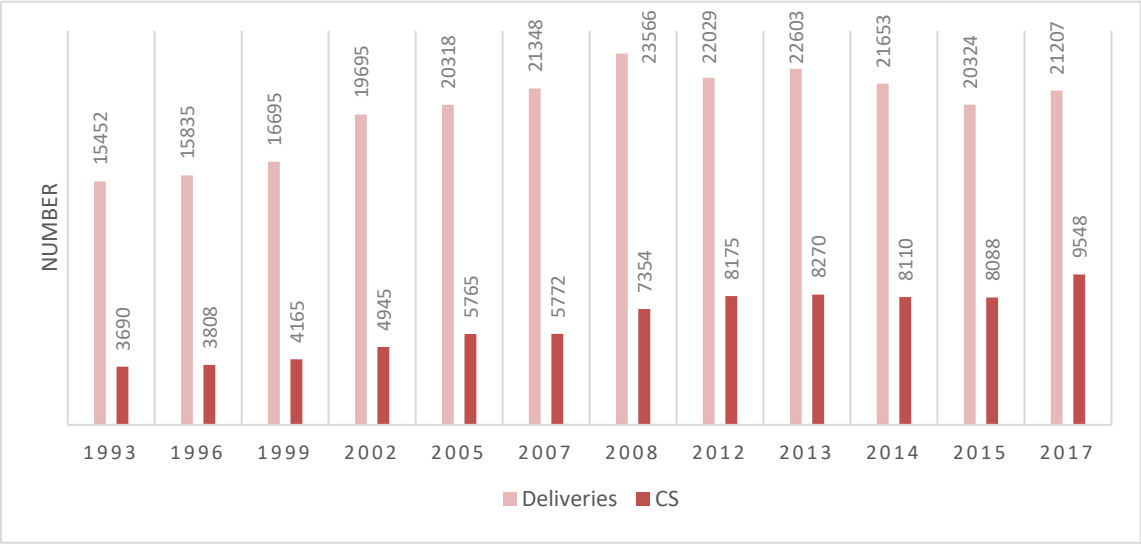


Figure 1.1 Deliveries and caesarean sections for each year at Chris Hani Baragwanath Academic Hospital.

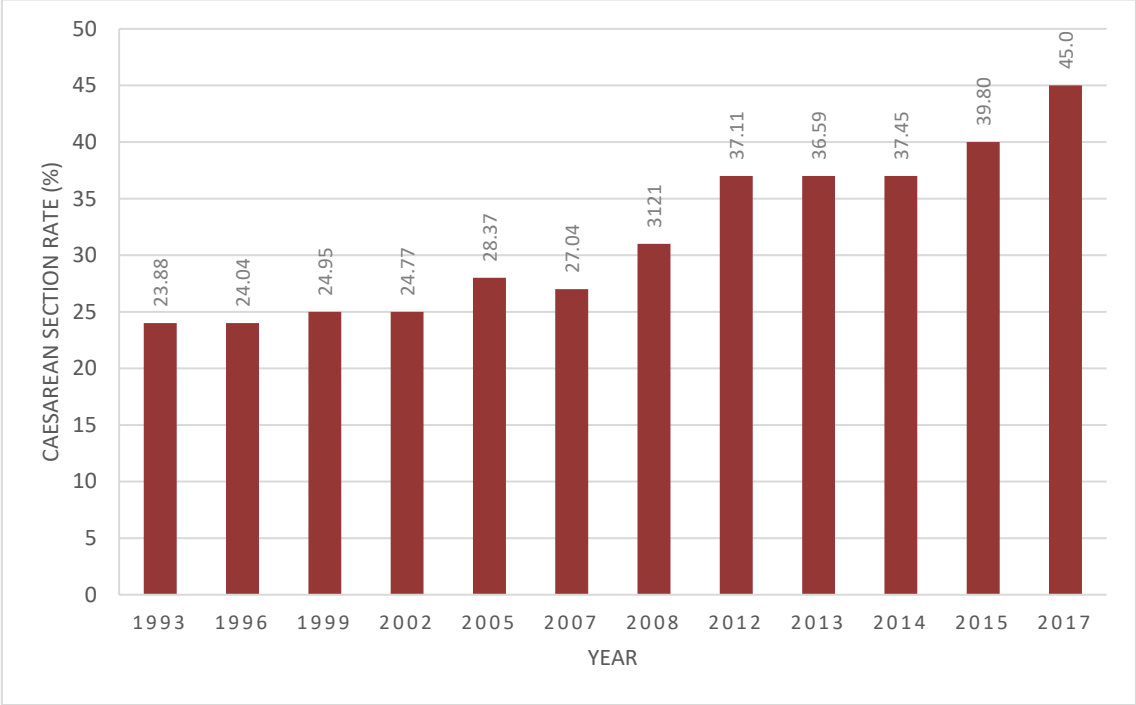


Figure 1.2: The annual caesarean section rate at Chris Hani Baragwanath Hospital.

Daily and weekly morbidity and mortality meetings at CHBAH have suggested that a protracted DTII or decision-to-anaesthetic interval (DTAI) may contribute to the large proportion of adverse perinatal and maternal outcomes.

The DTII or the DTAI at CHBAH are not known, this study therefore aims to evaluate the DTII, the DTAI and the immediate neonatal and maternal complications for deliveries by CS at CHBAH.

1.2 Literature review

A review of the literature will address the following:

- CS rates and indications
- Classifying CS urgency
- Perinatal adverse outcomes related to a delayed DTII
- Reviewing the optimal DTII
- Identifying factors influencing the DTII

Caesarean section rates and indications

The number of deliveries CS as well as CS rates at CHBAH has steadily increased from 1993 to 2011- correlating with global trends [1].

A systematic review determining the optimal rate of CS at population level supports this contextual view by suggesting that CS rates should be adjusted according to facility variations in population, resources and infrastructure [2].

The WHO Statement on Caesarean Section Rates recommends that facilities should endeavour to offer CS where medically indicated instead of trying to reach a specific CS rate since insufficient resources to allow a necessary CS could result in perinatal and maternal morbidity or mortality [1].

A Multi-Country Study performed by Medecins sans Frontieres assessed the CS rates and indications in sub-Saharan Africa, and found that 50% of CS indications were obstructed labour and mal-presentation, followed by previous CS, foetal

distress (FD), uterine rupture, and antepartum haemorrhage (APH) [10]. A study done at Rahima Moosa Mother and Child Hospital (RMMCH) a tertiary hospital in Johannesburg found that the most common indication for an EMCS was an abnormal cardiotocograph (CTG) [5]. At CHBAH the main indications are FD, previous CS and dystocia [11]. Two-thirds of the indications for CS at CHBAH were evaluated to be accurate [12].

CS rates in relation to CS necessity were previously compared using CS indications but this comparison is troublesome as there are variations in CS indication definitions. The RTGCS, which uses obstetric characteristics to categorize CS, provides a platform for the interpretation of CS rates allowing uniform comparisons between countries, regions and institutions [13]. The WHO has recommended the global use of the RTGCS [1].

CS can be associated with immediate and late perinatal and maternal adverse outcomes and globally there is drive towards reducing the CS rates, however failure to perform a timeous medically indicated CS may also be detrimental. There is currently no South African (SA) guideline on an ideal CS rate. CHBAH should strive to provide a reasonable CS DTII and ensure that these CS are medically indicated and safe.

Classifying caesarean section urgency

CS priority was typically classified in two main groups namely elective and emergency CS. However this classification made it difficult to triage emergency CS as some EMCS indications were more urgent than others. This classification also restricted the evaluation and utilization of data collection [14].

A study conducted in six hospitals developed and evaluated an improved classification for CS urgency by comparing five different classifications. Four of the five classifications performed poorly. The first classification which utilized visual analogue scales was too vague. The second classification which utilized the anaesthetist judgement of whether or not there was sufficient time to perform the spinal anaesthesia relied on anaesthetic skill and this classification could only be used by the anaesthetist. The third classification which utilized the doctor’s opinion of

the maximum time to delivery was problematic as this time was undefined and differed with the seriousness of the disorder and the foetal reserve. The fourth classification of a five point rating scale lacked exactness [14].

The classification based on clinical definitions performed the best and was straightforward, relevant and consistent. The classification could be used by all disciplines involved in maternal care. The following CS urgency classification was recommended based on the findings of the study:

- Grade 1 Emergency: Immediate threat to life of woman or foetus
- Grade 2 Urgent: Maternal of foetal compromise which is not immediately life-threatening
- Grade 3 Scheduled: Needing early delivery but no maternal or foetal compromise
- Grade 4 Elective: At a time to suit the woman and the maternity team [14]

The RCOG encourages the global use of the above classification. The RCOG also highlights that the level of risk within each of the four defined categories can vary and therefore a colour scale was added to emphasize this scale of risk. The RCOG hopes that the use of the classification would simplify data collection, assist with the audit of obstetric and anaesthetic methods, complications and outcomes and reduce communication issues between medical units [15].

The CS at CHBAH are classified into emergency and elective CS. The emergency CS at CHBAH are triaged by the obstetric team according to the doctors' assessment of foetal and/or maternal risk.

Perinatal adverse outcomes related to a prolonged decision-to-incision interval (DTII)

Worldwide the critical neonatal period accounts for 44% of child deaths under the age of 5 years with more than 80% of neonatal deaths caused by the following preventable and treatable conditions: prematurity, intra-partum-related neonatal deaths (birth asphyxia) and neonatal infection [16].

The perinatal mortality rate (PNMR) is an indication of the standard of antenatal, intrapartum and neonatal care. The PNMR in SA is 33.4/1000 (all deliveries: 500g+) according Saving Babies Report (2012-2013) [17]. The PNMR at CHBAH was 28.60/1000 (all deliveries: 500g+) in 2016. This is much higher than developed countries such as the United Kingdom (UK) where the PNMR is 5.12/1000 for all deliveries at a gestational age (GA) of 24 weeks or more in 2016 [18]. The PNMR for a birthweight (BW) of 1000g+ in SA is 24.8/1000 and 15.6/1000 at CHBAH which is nearly three times greater than the PNMR in the United States of America (USA) for GA for 28 weeks (6.0/1000 in 2016) [17, 19].

Saving Babies Report (2012-2013) also found that the top three obstetric causes for perinatal mortality was unexplained stillbirths, intrapartum asphyxia and spontaneous preterm birth. [17] A 2018 review article of neonatal deaths and causes in SA reported that the 2016 Perinatal Problem Identification Programme (PPIP) data found intrapartum-related events (mainly intra-uterine hypoxia) were the leading cause of neonatal deaths for babies with a weight of ≥1000g [20].

The optimal DTII

The ACOG and RCOG have supported the view that an EMCS delivery be achieved within 30 minutes. A systematic review and meta-analysis of 22 936 women concluded that this ideal interval was not achieved in most cases however there was also no concrete proof to indicate that the neonatal morbidity was poorer if DTII exceeded 30 minutes [3]. Dr J Pielochowska's study at RMMCH affirmed these findings as only 0.4% of the cases achieved the 30min target [5].
Although the 30 minute cut off appears to be unattainable it is important for obstetricians to appreciate that foetal metabolic acidosis progresses with time, especially when the cause is irreversible. Leung et al highlighted the fact that metabolic acidosis worsens over time by finding a deterioration in cord arterial pH with increasing bradycardia-to-delivery interval [21]. A retrospective observational case series of 19 women found that the long-term neonatal neurological outcome was better when the caesarean section delivery was performed within 25 minutes in sustained intra-partum foetal bradycardia [22]. Thomas et al helped define an upper

limit of the DTII in their national cross sectional survey which found poorer maternal and neonatal outcome with DTII exceeding 75 minutes [23]. A SA study of 916 women used hypoxic ischaemic encephalopathy (HIE), birth asphyxia and intensive care unit (ICU) admission as indicators of neonatal morbidity. A delayed DTII (greater than 60min, 90min and 120 min) did not significantly affect the neonatal morbidity [5].

The latest NICE Guidelines advises that the decision to delivery interval (DDI) be as short as possible for an unplanned caesarean section and Grade 2 caesarean sections be performed within 75 minutes in most cases [4].
According to the latest Guidelines for maternity care in South Africa the DTII in all hospitals should be within one hour [24]. The mean DDI at RMMCH in 2010 was 147 minutes (SD±103min) [5].

Factors influencing the DTII

Once the decision to perform an emergency caesarean section has been made many factors come into play in order to achieve a quick delivery. These include:
a.) Preparation of the patient (midwife)
b.) Transport of the patient to theatre (porters)
c.) Preparation of theatre (cleaners)
d.) Preparation of surgical equipment (scrub sister)
e.) Administration of anaesthesia (anaesthetic nurse and anaesthetist)
f.) Availability of theatres

The above factors all rely on adequate infrastructure, consumables and staff. As well as appropriate communication and team work.
An ongoing quality development program, carried out at a level 3 hospital in the USA with an average of 5500 deliveries per annum, aimed to identify and correct systemic and individual barriers which prolonged their institution's DTII. The following implemented changes resulted in more than 90% of their cases achieving a DTII of less than 30 minutes and 100% within 40 minutes:

- A second operating theatre, with nursing staff and anaesthetist for emergency caesarean sections
- Improvement and execution of a new system that smoothed communication and outlined all team members duties.

- The use of the nurse and physician to move the patient to the operating theatre
- Preparation of patient e.g. intravenous lines and Foley's catheter insertion was done in the operating room
- A green code was initiated to prioritize category 1 CS (cord prolapse, uterine rupture, acute APH etc). This code allowed for patients to be transferred to the operating theatre without the required preoperative preparation such as a signed consent, intravenous line and urinary catheter
- Monthly feedback to nurses , anaesthetists and doctors of their progress [6]

Communication

An EMCS involves many professionals which depend on clear communication to execute efficient team work. Lucas et al classified the degree of caesarean section urgency [14], however Dupuis et al showed that the use of a colour code which correlated with Lucas's classification improved communication amongst the perinatal team. This resulted in prompt top-up of epidural anaesthesia, bladder evacuation, and patient transport therefore shortening the DTII [7].

Adequate staff

Labour is a dynamic and unpredictable process and hence requires close monitoring and observation. A prospective audit conducted in a tertiary hospital in the UK assessed the relationship between the DDI, the time of day, the number of labouring women and the number of midwives. During the 12-month study period there were 755 EMCS and the hospital had two 24 hour operating theatres available. The study found that the transfer time for Grade 1 and Grade 2 caesarean sections increased significantly when the ratio of midwives to women in active labour was less than 1:1. Subsequently prolonging the DDI [8].

Time of day

A retrospective clinical study of 207 EMCS from 66 hospitals in Germany found that the time of day had a significant influence on the decision-to-delivery interval, with slowest interval noted between 1:00am and 07:00am [9].

Infrastructure

According to Pielochowska the most common reason for delay was other emergency operations taking place in the available theatre [5].

The research available represents first world smaller hospitals. CHBAH is a large third world teaching hospital. The number of CS and CS rates has steadily increased. The DTII at CHBAH is not known. The immediate neonatal and maternal morbidity is also not known.

The information obtained from this study will define the DTII at CHBAH and describe the neonatal and maternal outcomes for emergency CS at CHBAH. This will provide CHBAH with a reference point for internal, local and global comparisons.

1.3 Objectives

Main Objective

To evaluate the DTII and the DTAI for emergency CS at CHBAH from the 1st May 2016 to the 31st May 2016.

Specific objectives

- To describe the demographics of women who had a CS
- To classify the CS according to the Robson Ten Group Classification System
- To describe the indications for CS
- To determine the DTAI for the different CS indications
- To describe the adverse neonatal and maternal outcomes within 48 hours of the CS delivery

CHAPTER TWO – METHODS AND MATERIALS

2.1 Study Design

This was a cross sectional retrospective study

2.2 Study Setting

Soweto's official population according to Census 2011 is 1, 271 628. The population grew 32.5% when compared with data from Census 2001. CHBAH is a tertiary hospital in Soweto

CHBAH is the third largest hospital in the world and the largest hospital in the southern hemisphere with an average of 23 000 deliveries and over 8 000 caesarean sections performed annually. It is the main referral hospital for 6 public hospitals (Bheki Mlangeni, Sebonkeng, Thelle Mogoerane, Potchefstroom and Klerksdorp Hospital) and 7 midwife obstetric unit (MOU) (Zola, Chiawelo, Mofolo, Lenasia South, Lillian Ngoyi, Stretford and Iterileng clinic)

The hospital is an accredited teaching hospital. The obstetrics and gynaecology department trains nurses, interns, registrars for the fellowship in obstetrics and gynaecology and fellows for the sub-speciality of maternal and foetal medicine.

The number of deliveries at CHBAH has increased by 28% in the last 21 years and the number of CS per year increased by 34% since 2003. Despite the progressive increase in CS, the infrastructure at CHBAH has remained the same. The two obstetrics theatres run for 24 hours since 2009. The elective caesarean sections (ELCS) are done anytime over a 24hr period as well as in the gynaecology emergency theatre. Approximately 13 ELCS per week are done at a nearby district hospital.

2.3 Study Population

The study population consists of women who had a CS delivery at CHBAH from the 1st of May 2016 to the 31st of May 2016. The CS at CHBAH are classified into emergency and elective CS. The emergency CS at CHBAH are triaged by the obstetric team according to the doctors' assessment of foetal and/or maternal risk

2.4 Sample size

This is a descriptive study; a sample size was not calculated. The sampling method was a convenient sample.

2.5 Data collection

The theatre register was used to find the names and hospital numbers of all the CS performed in May 2016. The hospital files were retrieved and information obtained from them was entered onto a data capture sheet. The data from the data capture sheet was captured on Research Electronic Data Capture (REDCap) and was exported to Stata 14.2 (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA) for analysis.

2.6 Explanatory and outcome variables

The tables below summarise the variables that were collected.

Table 2.1: A description of the variables	
Demographics	Age (years), Maternal weight (kg), Maternal height (cm) Mid upper arm circumference (MUAC) (cm)
Antenatal investigations	Rhesus (Rh) antibody / Rapid plasma reagin (RPR) / human immunodeficiency virus (HIV) status
Gestational age (GA)	The GA at CS and the method used to determine the GA was taken in the following order of accuracy: Early ultrasound (EUS); late ultrasound (LUS); last normal menstrual period (LNMP); first fundal height (FFH) measurement.
The CS urgency	An EMCS required imminent delivery, an ELCS was a planned CS.
Indication for the CS	The indication recorded in the file
Date and time of the decision to perform the CS	The date and time the decision was made for the CS
Date and time of the CS	The time the anaesthetic was started - at CHBAH this is recorded as the first blood pressure of the patient are taken. The time the surgery commenced is the time recorded in the surgeons operative notes.
Characteristics of the procedure	The type of anaesthetic given, the condition of the liquor, the estimated blood loss (EBL) and the intra-operative complications.
Foetal outcomes	Birth weight, Apgar scores, neonatal admission and reason for neonatal admission.
Delivery outcome	The delivery outcome was recorded as either a live birth or macerated stillbirth (MSB) or fresh stillbirth (FSB)
Neonatal admission and reason for admission	Need for admission and level of care needed
Location of neonatal admission	The neonatal admission location was documented as either transitional intensive care unit (TICU), neonatal intensive care unit (NICU) or ward 66.

Maternal outcomes	Only outcomes recorded in the first 48 hours of delivery were recorded

Table 2.2: A description of the outcome variables	
The Robson Ten Group Classification System (RTGCS)	The explanatory variables of the obstetric information at the time of CS was used to determine the RTGCS group.
Decision-to-incision interval (DTII) (minutes)	The calculated time interval calculated between the decision date and time and the incision date and time in minutes
Decision-to-anaesthetic interval (DTAI) (minutes)	The calculated time interval between the decision date and time and the anaesthetic date and time in minutes
Anaesthetic-to-incision interval (ATII) (minutes)	The calculated time between the anaesthetic time and the incision time in minutes.

2.7 Data analysis

The data from the data sheet was entered into REDCap then exported to Stata® version 14.2 (StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA). Categorical variables were described using frequencies and percentages and continuous variables were described using medians with interquartile ranges (IQR) and means with standard deviations (SD). The DTII was calculated from the decision and incision date and time; and the DTAI was calculated from the decision and the anaesthetic date and time. The DTAI were calculated for each indication and depicted using box and whisker plots. A Wilcoxon sign-rank test was used to find the difference between the DTAI and the DTII. There were 20 outliers in the analysis of the DTAI. These were removed after looking at the original data.

2.8 Ethics

No consent is required as retrospective data will be used. Ethical permission to conduct the study was obtained from the HREC (M161153). Permission was also obtained from the CEO at CHBAH.

2.9 Funding

The cost for stationery was borne by the researcher.

3.0 CHAPTER THREE - RESULTS

There were 636 women who were delivered in theatre from 1st May 2016 to the 31st May 2016. Nine (1.4%) were normal vaginal deliveries. There were three (0.5%) incomplete files, five (0.8%) files were from previous deliveries and 155 (24.4%) files were not found. Therefore a total of 464 (73.0%) women were included in the study.

3.1 Demographics

The demographics characteristics are summarised Table 3.1.

Table 3.1: A description of the demographics of the women	
Variable	**Median (IQR; range)**
Age (years)	28 (23-33; 13-46)
Weight (kg)	70 (61-85; 43.5-145.5)
Height (cm)	159 (154-162; 130-178)
Body mass index (BMI) (kg/cm^2)	28.3 (24.9-33.8; 18.3-56.6)
Mid upper arm circumference (cm)	29 (26-32; 20-47)

3.2 Past pregnancy outcomes

The women had a median gravidity of two (IQR: 1-3; range: 1-8) and a median parity of one (IQR: 0-2; range: 0-7) There were 301 (64.9%) multiparous women, of which 149 (49.5%) had a previous CS. The median number of previous CS was one (IQR: 1-2; range: 1-3). Seventy-eight (16.8%) women had had a miscarriage, 16 (3.4%) women had had an ectopic pregnancy and 13 (2.8%) women had had a termination of pregnancy.

3.3 Antenatal investigations

The median haemoglobin (Hb) was11.6 g/dL (IQR: 10.5-12.5; range: 6.1-15.4). The Rh status was positive in 441 (94.8%) women, negative in 9 (1.9%) women and unknown in 14 (3%) women. One (0.2%) woman had a positive rapid plasma reagin (RPR) test, 441(94.8) women had a negative RPR result and the RPR result was unknown for 22 (4.7%) women. The HIV status was negative in 322 (69.2%) and unknown in 5 (1.1%) of the women. There were 137 (29.5%) HIV positive women, of which 117 (85.4%) were on antiretroviral therapy (ART), two (1.5%) women were not on ART and it was unknown whether 18 (13.1%) women were or were not on ART. The HIV positive women had a median cluster of differentiation 4 (CD4) count of 438.5 cells/uL (IQR: 250.5-568.5; range: 39-1037) and a median HIV viral load (VL) of 61 copies/ml (IQR: 20-365; range: 0-292068).

3.4 Co-morbidities

There were 170 (36.6%) women with one or more co-morbidities. The numbers of women affected by each of the listed co-morbidities are depicted in Figure 3.1. The hypertensive disorders included 16 (12.0%) women with chronic hypertension (HTN), 38 (28.6%) women with gestational HTN, two (1.5%) women with unclassified HTN, 58 (43.6%) women with pre-eclampsia (PET), ten (7.5%) women with imminent eclampsia (IE), six (4.5%) women with eclampsia and three (2.3%) women with HELLP Syndrome. The endocrine disorders comprised of 11 (73.3%) women with diabetes mellitus (DM) and four (26.7%) women with thyroid disorders. There were four women with cardiac disease, of which three (75.0%) had cardiomyopathy and one (25.0,%) woman had Wolff-Parkinson-White Syndrome. There were nine women with a poor obstetric history (POH), of which four (44.4%) had antiphospholipid syndrome (APLS) and five (55.6%) had cervical incompetence.

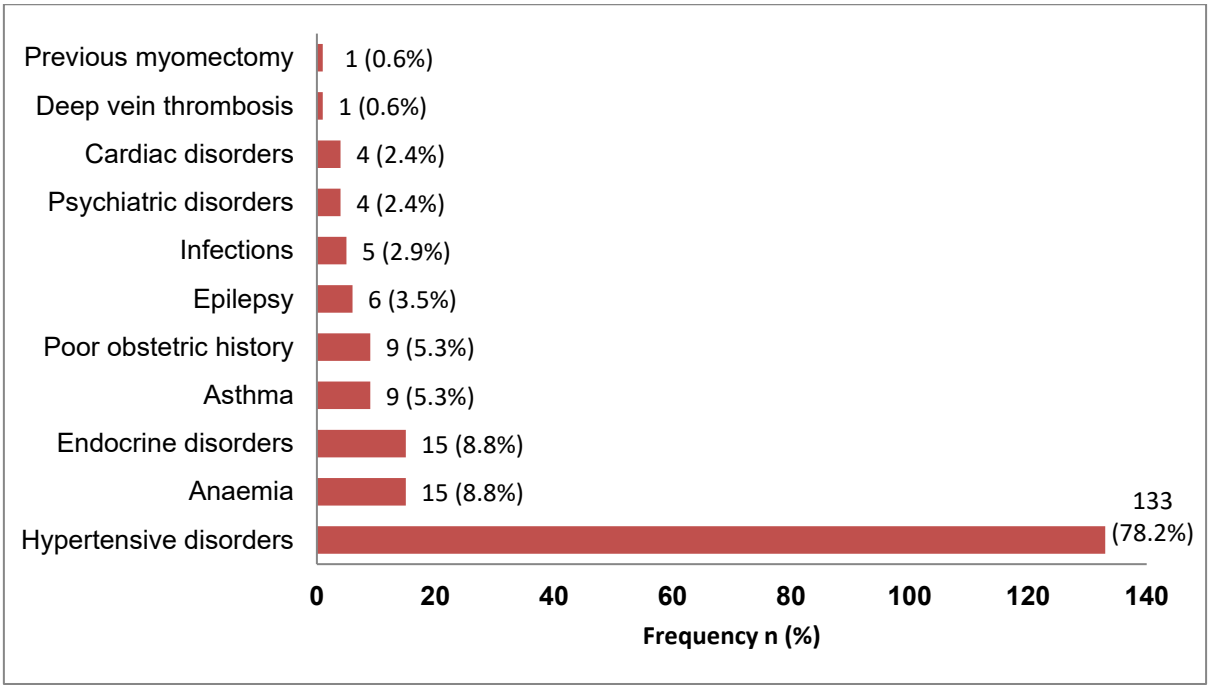


Figure 3.1: The frequency of co-morbidities for the women

3.5 Gestational age

The GA was recorded in 460 (99.1%) women; the median GA at the time of CS was 39 weeks (IQR: 37-40; range: 25-44). The frequency of the method used to calculate the GA was as follows:

- Early ultrasound (EUS): 171 (38.0%),
- Late ultrasound (LUS): 148 (32.9%),
- The last normal menstrual period (LNMP); 105 (23.3%) and
- The first fundal height (FFH) palpation: 26 (5.8%).

3.6 Labour information

There were 298 (64.1%) women in labour, 160 (34.4%) were not in labour and the labour status was unknown in seven (4.4%) women. Of the 298 women who were in labour, 262 (87.9%) went into spontaneous labour, 35 (11.7%) had induced labour and the type of labour was unknown for one (0.3%) woman.

3.7 The Robson Ten Group Classification System

The RTGCS was determined in 462 (99.6%) of the women and the frequency of each group is illustrated in Figure 3.3.

The Robson Ten Group Classification System key:

1. Nulliparous, singleton, cephalic, ≥37 weeks, spontaneous labour
2. Nulliparous, singleton, cephalic, ≥37 weeks, induced labour or CS before labour
3. Multiparous, singleton, cephalic, ≥37 weeks, spontaneous labour
4. Multiparous, singleton, cephalic, ≥37 weeks, induced labour or CS before labour
5. Multiparous, previous CS, singleton, cephalic, ≥37 weeks
6. Nulliparous, singleton, breech
7. Multiparous, singleton, breech
8. Multiple pregnancy
9. Singleton, transverse or oblique lie
10. Singleton, cephalic, ≤36 weeks

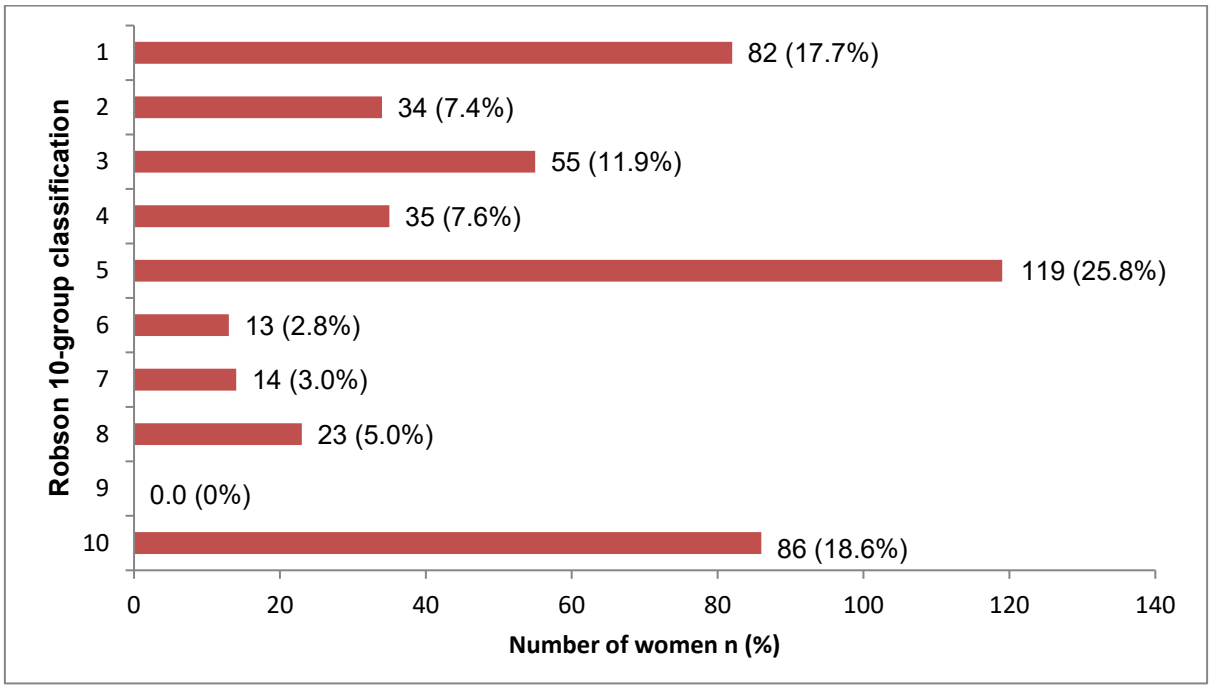


Figure 3.2: The frequency of the Robson Ten Group Classification System n(%)

3.8 Indications for an elective caesarean section

Seventy four (15.9%) women were admitted for an ELCS. The indications for the caesarean section are described in figure 3.3. There were 40 (54.1%) women with one previous CS of which 19 (47.5%) women declined vaginal birth after caesarean section (VBAC), 13 (32.5%) women had an additional co-morbidity requiring delivery, 6 (15%) women were post-dates and 2 (5.0%) women had a multiple pregnancy.

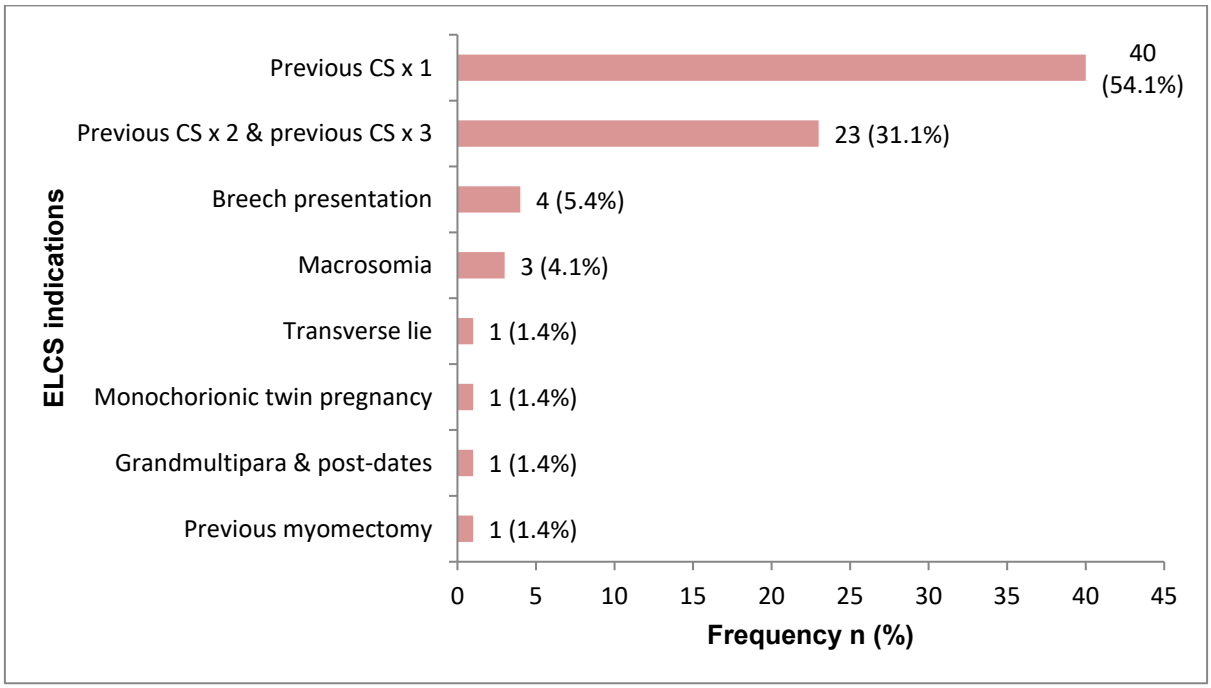


Figure 3.3: The frequency of the main elective caesarean section indications

*Caesarean section (CS)

3.9 Indications for an emergency caesarean section

There were 442 (95.3%) EMCS, this included 52 (70.3%) women who were admitted for an elective CS and developed an indication for an emergency CS. Figure 3.6 depicts the EMCS indications and their frequency.

The women with dystocia; included the following indications: ten (8.7%) prolonged latent phase of labour (PLPL), 61 (53.0%) poor progress of labour, 41 (35.7%) cephalo-pelvic disproportion (CPD), three (2.6%) foetal macrosomia (estimated foetal weight on sonar of more than 4kg). The women with foetal compromise comprised of

36 (69.2%) women with a non-reassuring foetal cardiotocograph (CTG) recording, 11 (21.2%) women with abnormal foetal Doppler studies, three (5.8%) women with oligohydramnios, one (1.9%) woman with anhydramnios and one (1.9%) woman with placental insufficiency. The severe HTN disorders included six (66.7%) women with eclampsia and three (33.3%) women with HELLP syndrome. The women with delayed second stage of labour included two (25.0%) failed vacuum deliveries and two (25.0%) face presentations. The women with APH included three (15.0%) with placenta praevia, four (20.0%) with abruptio placentae and the rest (65%) were unspecified.

There were 92 (20.8%) women who had one previous CS of which 58 (63.7%) women were in labour and 15 (25.7%) of these women declined VBAC. Seven (46.7%) women who declined VBAC developed an additional emergency indication. There were 38 (8.6%) women who had 2 or more previous CS of which 13 were not in labour but had another emergency indication. Three hundred and twelve (70.6%) had a CS for the first time.

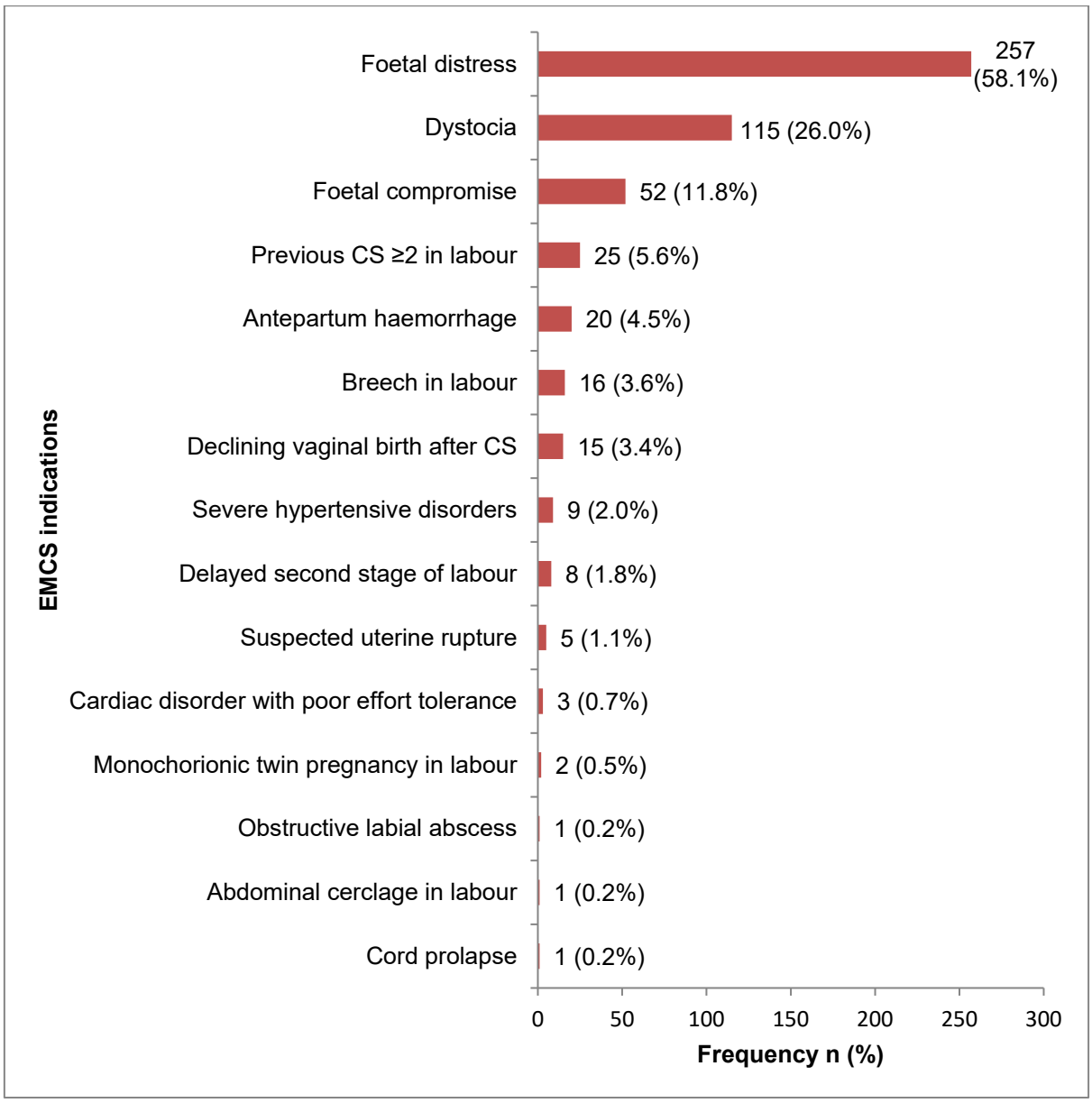


Figure 3.4: The frequency of emergency caesarean section indications

3.10 The elective caesarean section waiting period

There were initially 74 women admitted for an ELCS, of which 52 (70.3%) developed an emergency indication and subsequently had an EMCS. Twenty-eight (53.8%) of these women developed an emergency indication 4 days (IQR: 1-6; range 1-8) after their intended ELCS date, 17 (32.7%) of these women acquired an emergency indication 3 days (IQR: 1-5; range 1-11) prior to their intended ELCS date and seven (13.5%) required an emergency CS on the same day as their intended ELCS date.

The median in-hospital waiting period (interval from intended ELCS date to actual ELCS date) for the remaining 22 (29.7%) women was 3.5 days (IQR: 2-5; range: 0-9).

3.11 The emergency caesarean section time intervals

The DTII was determined in 278 (62.9%) of the EMCS with a median DTII of 354.5 minutes (IQR: 190-595.75; range: 30-10 570). The DTAI was determined in 419 (94.6%) of the EMCS. The median DTAI was 350 minutes (IQR: 175-627; range: 20-10 545). Figure 3.5 shows a box and whisker plot of these times. We used the DTAI because there were more women in whom this interval could be calculated (p value = 0.0). The ATII was calculated in 288 (65.0%) of the women with a median ATII of 25 minutes (IQR; 15-32; range: 5-100).

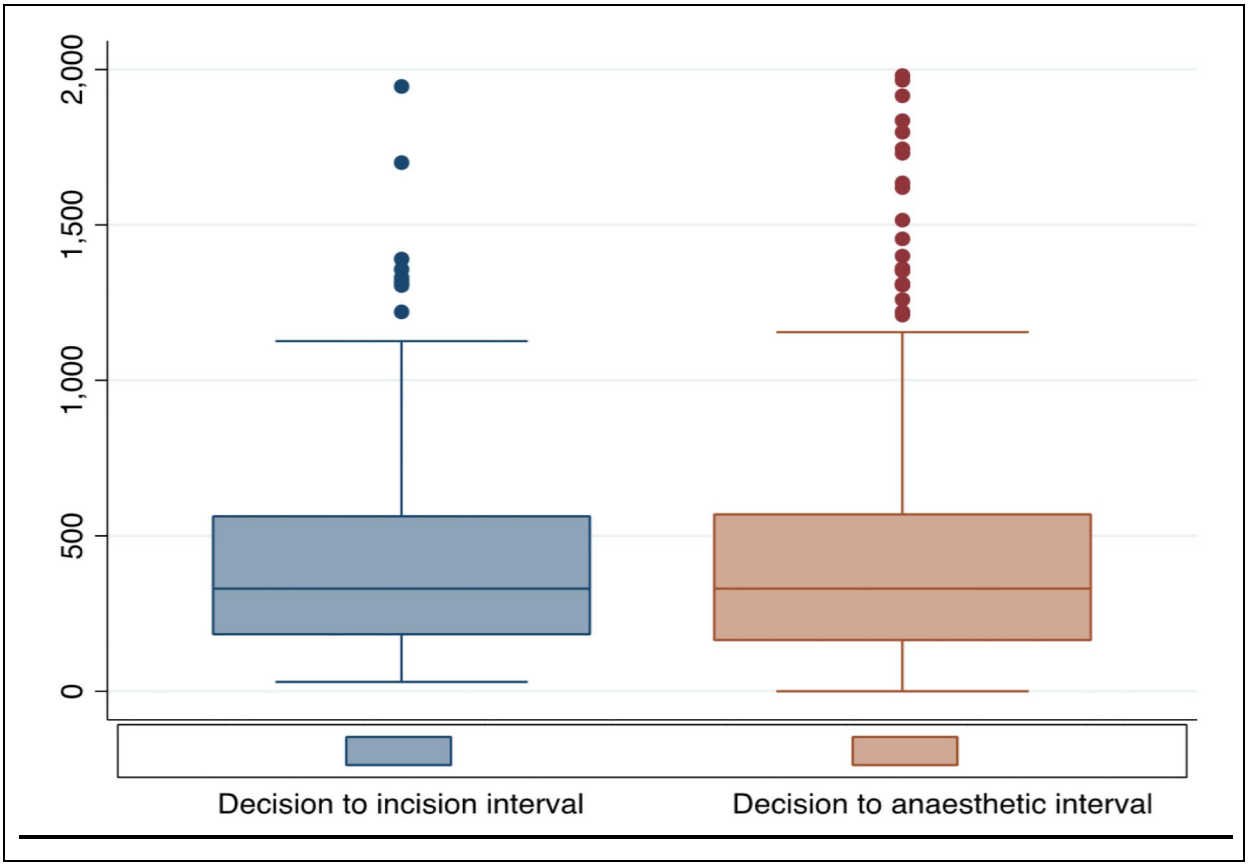


Figure 3.5: Box and whisker plots of the median decision-to-incision interval and the decision-to-anaesthetic interval (minutes)

3.12 The time intervals for specific emergency indications

The incision time was poorly recorded in the women's files, therefore the DTAI instead of the DTII was determined for the different EMCS indications as depicted in table 3.2 and the box and whisker plots for each of these is represented in figure 3.6.

Table 3.2: The median decision-to-anaesthetic interval for specific emergency caesarean section indications (minutes)

EMCS Indication	DTAI median (IQR; range)
Suspected uterine rupture	50 (920-145; 20-145)
Antepartum haemorrhage	127.5 (89.5-274.5; 65-630)
Delayed second stage of labour	167.5 (115-175; 65-180)
Breech presentation in labour	175 (115-685; 60-1 965)
Foetal distress and previous CS	185 (165-226; 144-1110)
Foetal distress	312 (150-500; 0-1 745)
Previous CS x 2 in labour	365 (180-565; 80-1 455)
Dystocia	375 (220-540; 44-1 980)
Dystocia and foetal distress	416.9 (220-525; 44-1 306
Previous CS x 1	422.5 (182.5-1054; 45-1 915)
Multiple pregnancy	435 (290-448; 150-810)
Severe hypertensive disorders	524 (255-750; 95-1 620)
Foetal compromise	545 (232.5-808; 180-1 355)

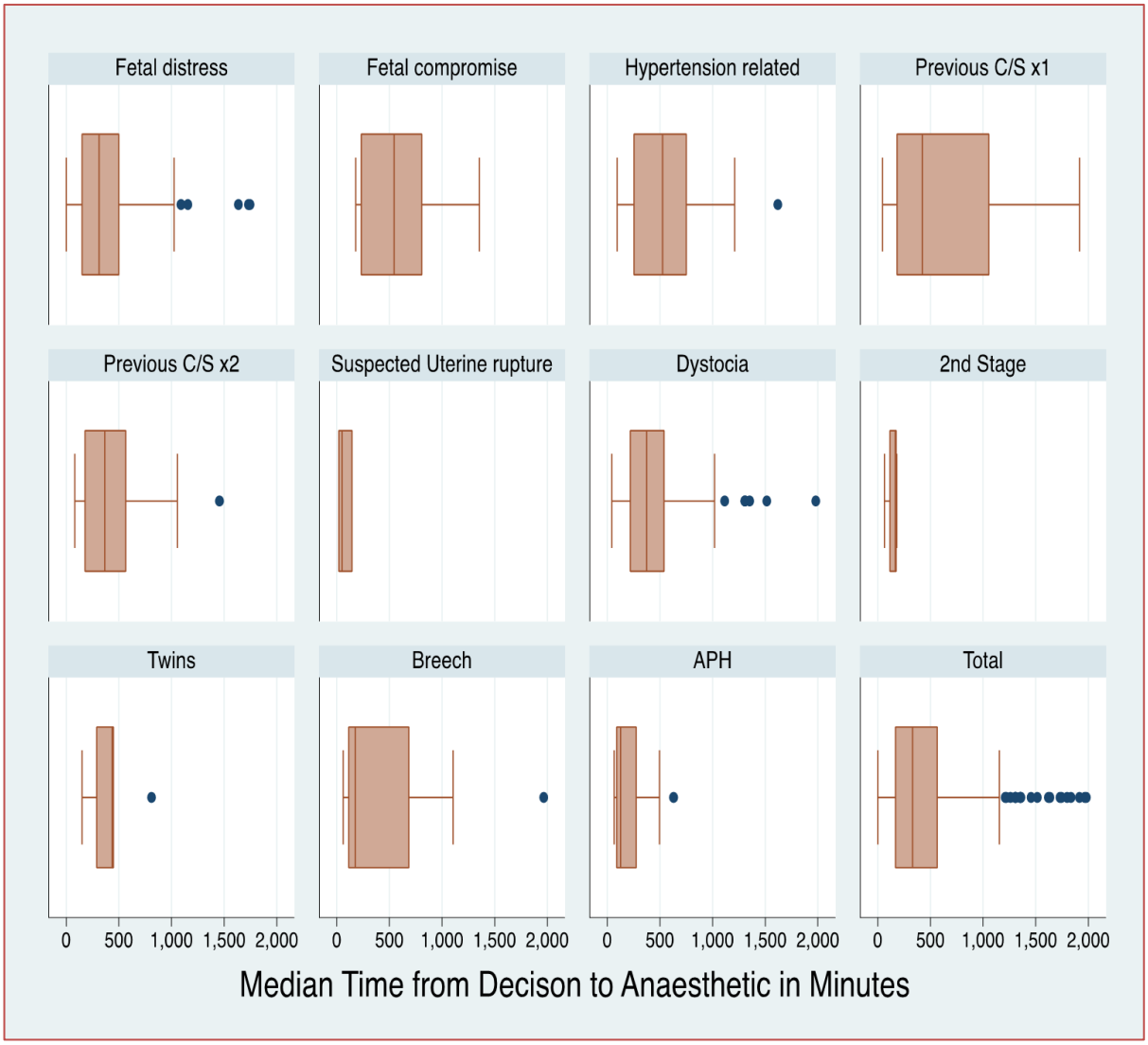


Figure 3.6: Box and whisker plots of the decision-to-anaesthetic interval for specific emergency caesarean section indications (minutes)

3.13 Documented reasons for delay to perform the caesarean section

A delay to perform an emergency CS was noted in 89 (19.3%) files. One or more reasons may have been noted. A backlog of EMCS waiting to go to theatre was documented in 71 (79.8%) files. A blocked theatre by a prolonged, complicated or difficult case was detailed in 30 (29.2%) files.

3.14 The type of anaesthetic

The frequency of the type of anaesthetic administered for all the CS was:

- Spinal - 412 (88.8%)
- General anaesthesia - 38 (8.2%)
- Epidural - 4 (0.9%)
- Unknown - 10 (2.2%)

3.15 Liquor assessment

The nature of the liquor at CS was documented in 417 (89.9%) of all 464 CS. Clear liquor was found in 329 (78.9%) of the CS. Meconium stained liquor (MSL) was present in 92 (22.1%) of the CS. Offensive liquor was recorded in 9 (2.2%) of the CS, increased liquor was documented in 9 (2.2%) of CS, and blood stained liquor was documented in 5 (1.2%) of the CS.

3.16 Estimated blood loss

The EBL as determined by the surgeon at CS was recorded in 439 (94.6%) CS. The median EBL was 500ml (IQR: 500-600; range: 100-4500).

3.17 Intra-operative complications

There were 135 (29.1%) recorded complications. There was no incision to delivery delay and no woman required packing of the abdomen with swabs to control haemostasis. The frequency of the different types of complications were:

- Adhesions – 47 (34.8%)
- Difficult haemostasis – 42 (31.1%)
- Difficult delivery – 39 (28.9%)
- Uterine tears – 32 (23.7%)

- Uterine atony – 11 (8.1%)
- B- Lynch insertion – 4 (3.0%)
- Hysterectomy – 3 (2.2%)

3.18 Maternal outcomes

Adverse maternal outcomes within 48hrs of delivery were reported in 24 (5.2%) of the women. Twenty-three (95.8%) women had an EMCS and one (4.2%) woman had an ELCS for one previous CS. The frequencies of the adverse events are described below:

- Post-partum haemorrhage (PPH)
  Twelve (50.0%) women had documented PPH. The median EBL was 2000ml (IQR: 1200-3000; range: 1000-4500). Five (41.7%) women had uterine atony (one required a subtotal abdominal hysterectomy (STAH), two had a B-lynch inserted and two were medically managed with oxytocic drugs), one (8.3%) women had a morbidly adherent placenta, one (8.3%) woman had a ruptured uterus and one (8.3%) woman required an evacuation of a wound haematoma and ligation of the inferior epigastric artery, one (8.3%) woman had a uterine tear repair and the PPH cause and management was not documented for three (25.0%) women.

- Blood transfusion
  Seventeen (70.8%) women required a blood transfusion during or after the CS, of which 11 (64.7%) were for PPH, five (29.4%) for pre-existing iron deficiency anaemia and one (8.9%) the reason for the transfusion was unclear because there was no pre-existing anaemia and no documented PPH. The median number of units of blood transfused was two units (IQR: 2-4; range: 1-6). Two (11.8%) women required more than four units of blood.

- Hysterectomy
  Three (12.5%) women had a subtotal hysterectomy for PPH due to: uterine atony; a morbidly adherent placenta and a ruptured uterus.

- Ventilation for non-anaesthetic purpose
  Eight (33.3%) women were ventilated for a non-anaesthetic purpose for more than 60 minutes.

There was no maternal death

3.19 Birth outcome

There were 441 singleton pregnancies and 23 twin pregnancies, therefore a total of 487 neonates were delivered. There were 483 (99.2%) live births and 4 (0.8%) intrauterine foetal deaths.

3.20 Birth weight

The birthweight was recorded in 486 (99.8%) of the neonates. The median birth weight was 3035g (IQR: 2582.5-3377.5; range:720-4695).

3.21 Apgar score

The Apgar score was recorded in 452 (92.8%) of the neonates. The median Apgar score at one minute was 9 (IQR: 8-9; range: 1-10) and the median Apgar score at five minutes was 10 (IQR: 9-10; range: 3-10).

3.22 Neonatal outcomes

One hundred and twenty four (25.7%) neonates required admission. Fifty seven (46%) neonates were admitted to the TICU, six (4.8%) neonates were admitted to the NICU and 56 (45.2%) neonates were admitted to the neonatal ward. The admission ward was unknown for 5 (4.0%) neonates. A neonate could have one or more of the following admission reasons. The frequency for each admission reason is depicted in

Figure 3.7. In the respiratory distress (RDS) category; 16 (21.6%) neonates had meconium aspiration syndrome (MAS), 11 (14.9%) neonates had hyaline membrane disease (HMD), four (5.4%) neonates required nasal continuous positive airway pressure (nCPAP) application and one (1.4%) neonate required intermittent positive pressure ventilation (IPPV). Neonates admitted for a central nervous system (CNS) disorder included one (8.3%) neonate with a subarachnoid haemorrhage and seven (58.3%) neonates with HIE.

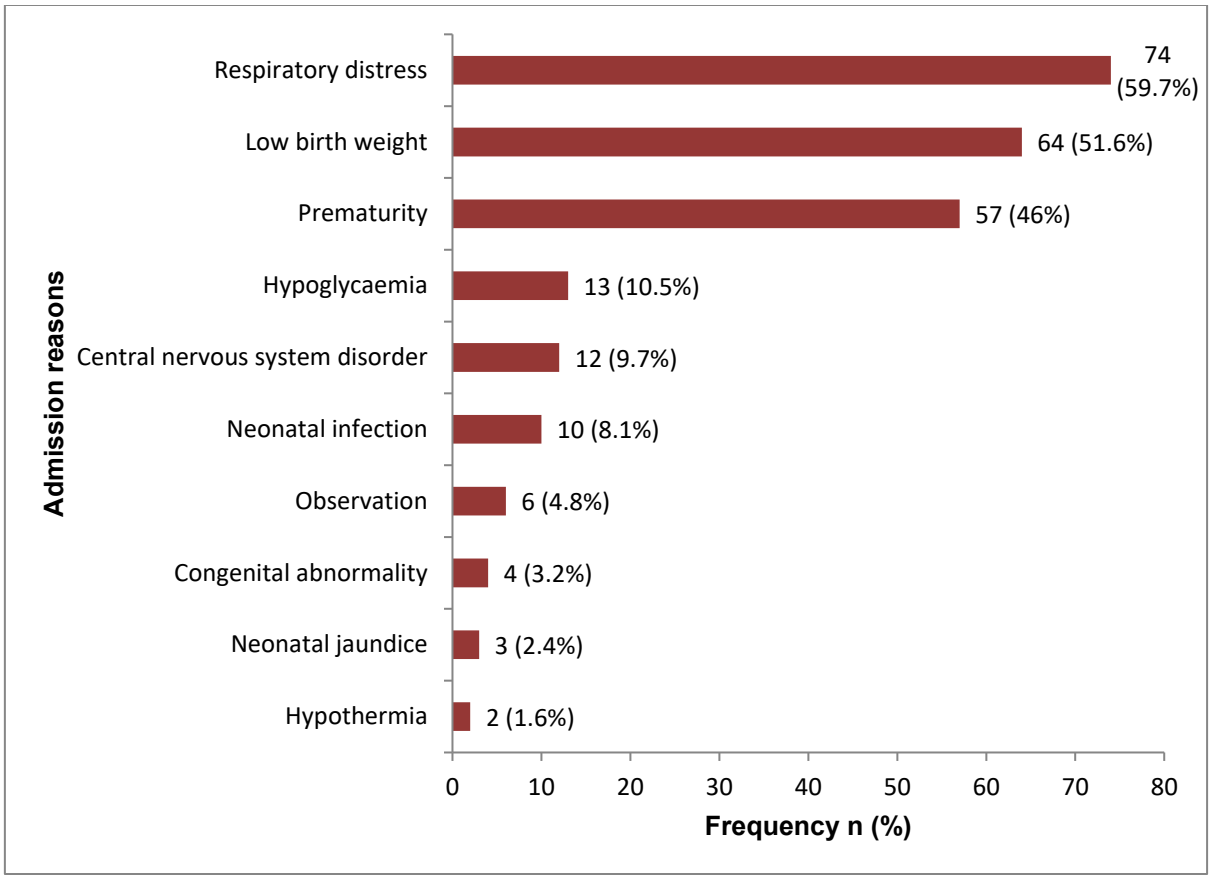


Figure 3.7: The frequency of the respective neonatal admission reasons

4.0 **CHAPTER FOUR** – DISCUSSION

The median DTII (354.5 minutes) and the median DTAI (350 minutes) were clinically similar. However the difference in the DTII and DTAI was statistically significant and therefore the DTAI (although better recorded) could not be used as a proxy for the DTII. The DTAI was nonetheless used to evaluate the waiting time for different indications because the of the numbers recorded.

The median DTII was 4,7 times the 75 minute recommended NICE Guidelines [4] for a category 2 CS and six times longer than the proposed 60 minutes stipulated in the Guidelines for Maternity Care in South Africa [24]. The DTII was also considerably longer when compared to several studies in other countries as shown in the table below. The difficulties in making comparisons is

Table 4.1:The decision-to-incision interval or the decision-to-delivery interval (DDI) in minutes

Country and author	**Interval (minutes)**	**Annual deliveries and number of theatres**
United Kingdom: Pearson G et al [25]	Median DDI: 60 (IQR: 39-88)	6000 deliveries per year
South Africa: Pielichowska [5]	Mean DDI: 147	12 000 deliveries per year, two operating theatres
Tanzania: Hirani et al [26]	Median DTII: 60 (IQR: 40-120)	4000 deliveries per year, one operating theatre
Uganda: Nakintu et al [27]	Mean DTII: 91.89 ± 44.2	7500 deliveries per year, two operating theatres
Malawi: Harfouche et al [28]	Mean DTII: 101.4	1000 deliveries per year, One operating theatre
Nigeria: Bello [29]	Mean DDI: 119.2 ± 95.0	
Ghana: Onuoha [30]	Median DDI: 75 (IQR: 126-241)	

India: Singh [31]	Mean DDI: 42.5 ± 19.4	
India: Gupta [32]	Mean DDI: 37.2 ± 17.4	
India: Radhakrishnam [33]	Mean DDI: 134.8 ±123.7	

The unacceptably high DTII at CHBAH may be a reflection of the lack of infrastructure; there are only two operating theatres available at CHBAH, where more than 20 000 deliveries and an average of 8 000 CS are performed annually. All the international studies and African studies had considerably fewer deliveries per year with the same or better resources compared to CHBAH.

The imbalance of patient load and infrastructure is highlighted in the documented reason for delay to CS where a backlog of EMCS was recorded 79.8% of the time. The situation was further strained by the fact that that 53.8% (28/74) of the women waiting for an ELCS developed an indication for an EMCS.

The implications of a prolonged DTII has a domino effect on many aspects of maternal care, patients awaiting an EMCS occupy and block a bed while awaiting their EMCS. The heavy load of EMCS makes it very difficult for doctors to triage the waiting EMCS as there are several EMCS that equally deserve priority.

When assessing the DTAI for each indication suspected uterine rupture achieved the shortest median DTAI of 50 minutes (IQR: 920-145; range: 20-145). Hirani [26] achieved a median DDI for suspected uterine rupture of 45.5 (IQR: 44-47) minutes and Gupta [32] achieved a mean DDI of 36.3 minutes (SD ± 17.6), both were less than this study but none of the studies managed to be within the expected 30 minute interval recommended by NICE Guidelines for a category 1 CS.

APH held the second shortest median DTAI of 127.5 minutes (IQR: 89.5-274.5; range: 65-630). Two Indian studies managed to accomplish a mean DDI for APH within one hour [31,32], Pearson [25] and Hirani [26] managed to attain a median DDI within 90 minutes.

The indication of FD had a median DTAI of 312 minutes (IQR: 150-500; range: 0-1745). This was three times higher than a study conducted in Bloemfontein, South Africa (median DTII of 87.5 minutes) [34], five times the median DDI recorded by both Pearson [25] and Hirani [26] and almost eight times higher than the mean DDI recorded by Singh [31] and Gupta [32]. The protracted DTAI for FD may be due to the fact that nearly two thirds of the EMCS were for FD, making it difficult to triage them above suspected uterine rupture, APH and delayed second stage of labour. It is however reassuring to note that the combination of FD and previous CS had a median DTAI of around two hours better than the median DTAI FD alone. This may be due to the occurrence that the combination may be an early indication for imminent uterine rupture. One of the limitations of this study is that we did not interrogate the assessment of FD; however a cross sectional study conducted at CHBAH found that the reviewer concurred with the doctors assessment of the CTG and diagnosis of FD in 71.2% of the CS where the indication was FD [12].

The subsequent predominant EMCS indication of dystocia had a median DTAI of 375 minutes (IQR: 220-540; range: 44-1980) which was again significantly longer than that found by Pearson [25], Singh [31] and Gupta [32]. The combination of dystocia and FD had a longer DTAI than the dystocia alone, this may be due to the likely scenario that FD developed after the initial dystocia indication while the women awaited the CS.

The indication of foetal compromise had the longest median DTAI of 545 minutes (IQR: 232.5-808; range: 180-1355). This could be attributed to the argument that the non-reassuring foetal condition was not definitively confirmed by a pathological CTG, or that the non-reassuring foetal condition was likely to occur in the forthcoming future based on the ultrasound findings. The protocol at CHBAH is that these women be continuously monitored whilst awaiting the CS.

The most common indication for an ELCS was for previous CS (85.1%). The highest contributor (54.1%) were women who had had one previous CS, of which nearly half declined a VBAC thereby contributing 25.7% to the ELCS indications. The second highest contributor (31.1%) were women who had two or more previous CS.
A study conducted in Western Australia by Quinlivan et al [35] also found that the majority of CS were for previous CS however a smaller proportion 16.3 % declined

VBAC. A study conducted in Peshawar Pakistan [36] also found that the previous caesarean sections contributed more than a third to the ELCS indications.

The most common emergency indication was a non-reassuring foetal condition (FD and foetal compromise) followed by dystocia. Multiple South African studies [11,12,37,38], South Asian studies [36,39] and First World studies [25,35] had findings similar to this study. These indications were also responsible for a large proportion of women who had had one previous CS and were in labour (48.9%).

The Robson Ten Group Classification System (RTGCS), which uses obstetric characteristics to categorize CS, provides a scaffold for the interpretation of CS rates allowing uniform comparisons between countries, regions and institutions [13]. This study found Robson's groups 5, 10 and 1 contributed nearly two thirds to the CS rate. A multi-country survey conducted by the WHO [40] found that Robson's groups 5, 1 and 3 were the top 3 contributors in low Human Development Index (HDI) countries. A descriptive retrospective audit assessing CS done at Mombray maternity Hospital and four MOU by Horak [41] and a prospective observational study conducted at CHBAH by Ayob [11] mirrors this finding.

Robson group 5 was the highest contributor to the CS rate (25.8%) which was in keeping with global trends [40].

It is intriguing to discern that the second highest contributor to the total number of CS was Robson's group 10, given that this group does not even feature in the top five position of the multi-country survey conducted by WHO [40]. A retrospective study conducted in KwaZulu-Natal (KZN) [38] also found group 10 to be the second highest contributor to the CS rate and a smaller retrospective cross-sectional study by Adam et al [12] conducted at CHBAH found the Robson Group 10 to be the highest contributor. It is interesting to observe that the indication for more than half of the CS in group 10 was FD and more than a third of these patients also had hypertension. Although the GA for group 10 was recorded as 36 weeks or less, 15 (17.4%) had a birthweight of more than 2600g, therefore the GA may have been inaccurately calculated. However if these 15 patients were excluded, group 10 would remain one of the top 3 contributors to the CS rate.

The third highest contributor was Robson's group 1, where more than half were because of dystocia. Robson's group 1 consistently features as one of the top three groups globally in all HDI categories [40] and in all the South African studies [41,11,12,38].

In this study an adverse maternal morbidity was defined by the presence of one or more of the following: PPH, The need for blood transfusion, the performance of a postpartum emergency hysterectomy and ventilation for non-anaesthetic purpose. A maternal morbidity occurred in 24 (5.2%) women.

Post-partum haemorrhage accounted for half (2.6%) the maternal morbidity. This is not surprising since bleeding associated with caesarean section delivery accounts for 30% of all maternal deaths due to obstetric haemorrhage according to the seventh Saving Mothers report (2014-2016) [42] A report by Fawcus S et al [43] highlighted that the main causes of bleeding at CS are uterine atony (especially when labour is prolonged), uncontrolled bleeding from the uterine incision and/or uterine tears and bleeding from the placental bed site.

The majority of the adverse maternal morbidities were from EMCS as appose to ELCS which correlates with two studies by Pallasmaa et al [44,45] and a systematic review by Yang et al [46].

Twelve (2.6%) of the adverse maternal outcomes were directly related to the CS, if the five women who received less than four units of blood for pre-existing iron deficiency anaemia and the four women with pre-existing cardiac conditions were excluded.

Fourteen (3.0%) women had a potentially life threatening condition as defined by the WHO [47] (ten women had PPH, two women had severe PET and PPH, one woman had eclampsia and one woman had HELLP Syndrome). Eleven (2.4%) women had a life threatening condition as defined by the WHO [47] (one woman had a STAH only; one woman received more than four units of blood only, one woman was dialysed for renal failure only and eight women required ventilation for non-anaesthetic purposes). This finding of a severe maternal outcome of 2.4% is well below the findings of a global survey by Souza et al [48] which found that the severe maternal outcome was 9.3% for caesarean sections with an indication. However this study

only assessed the adverse events that occurred within 48 hours of the CS, the maternal morbidity related to sepsis may have been missed and therefore the adverse maternal morbidity may be underestimated.

It is interesting to note that in the group of women with life threatening conditions nearly a third had APH and nearly half had a pre-existing cardiac conditions which are not defined by WHO [47] as potentially life threatening conditions.

In this study an adverse neonatal outcome was defined by the need for neonatal admission. More than a quarter of the neonates required admission. The predominate neonatal admission reason was RDS. A large proportion of the admission reasons were for low birth weight and prematurity, this could be a result of the large proportion of group 10 of the RTGCS.

Weaknesses

It is a retrospective study therefore the information recorded in the files may not be complete and/or accurate. Only 73% of the CS done during the study period were analysed because of incomplete or missing files. The DTAI cannot be used as a proxy for the DTII, however it gives an estimate of the time it takes from the decision to the initiation of the CS procedure as it always occurs prior to the incision. We did not assess maternal or foetal outcomes associated with a long DTII/DTAI and we did not ask about maternal experiences or emotional outcomes

There is no association made with DTAI and the adverse maternal or neonatal outcomes, therefore the appropriateness of the time interval for the setting cannot be concluded. Also only adverse outcomes within 48 hours of the CS were assessed and those resulting from later complications may have been missed and potentially underestimate the adverse outcomes. The neonatal admission reasons were obtained from the admission register in each ward and not from the actual paediatric file.

Strengths

The data was collected by the researcher who works in the department of obstetrics and gynaecology at CHBAH and is experienced with the terms, abbreviations and jargon used in the speciality and in the department at CHBAH. The data collection was therefore thorough and comprehensive.

Recommendations

In order to improve the CS waiting period we need to either increase our number of theatres and staff or decrease the number of CS. It does not appear as though the CS rate at CHBAH is likely to improve since the majority of CS were for FD and we have no other means of assessing foetal wellbeing. We could introduce foetal scalp blood assessment. Additionally only 13 (2.8%) of the CS in this study were purely because the patients were reluctant to have a VBAC. Therefore the most feasible option at CHBAH is to distribute the CS load appropriately.

CHBAH is a tertiary hospital however 63.4% of the women who had a CS had no co-morbidities. The potentially low risk groups 1 and 3 of the RTGCS comprised of 137 (29.7%) women of which only 27 (5.8%) women had a comorbidity. Therefore the remaining 110 (23.8%) women were low risk with no co-morbidities and could potentially have had a CS at a secondary/district hospital.

According to the literature [44,45,46] and the findings of this study, ELCS are less likely to have an adverse outcome compared to an EMCS therefore the majority of group 5 (67.2%) who did not have a comorbidity could have been done electively at a secondary/district hospital.

If we take the patient profile of this study then 190 (40.9%) of the patients could have had a CS at a secondary/district hospital.

Since 53.8% of the ELCS developed an indication for an EMCS four days after their intended ELCS date and EMCS appear to be associated with greater adverse maternal outcomes, a proposal can be formulated that ELCS must be done within

three days of admission. The ELCS that exceed this time frame should be considered a priority and their contribution to the CS load should be acknowledged.

This increase in the caesarean section rate is not a local phenomenon and will therefore require National and Provincial government assistance.

The adverse maternal and neonatal outcomes in relation to the DTII need to be assessed.

Limitations

- The description of the indications written on the consent will be taken as the indication e.g. foetal distress may be a suspicious trace or a pathological trace.
- This will be retrospective data and therefore may not be correctly recorded files may be lost and not available

Conclusion

The. DTII was 4.7 times the 75 minute recommended NICE Guidelines [4] for a category 2 CS and six times longer than the proposed 60 minutes stipulated in the Guidelines for Maternity Care in South Africa [24]. Approximately 190 (40.9%) of the CS were low risk and could have been performed at a secondary hospital.

References

1. Betran AP, Torloni MR, Zhang JJ, Gülmezoglu AM. WHO Statement on Caesarean Section Rates. BJOG [Internet]. 2015 July [cited 2016 Mar 15];123(5):667-670. Available from: https://obgyn.onlinelibrary.wiley.com/doi/epdf/10.1111/1471-0528.13526 DOI: 10.1111/1471-0528.13526

2. Betran AP, Torloni MR, Zhang JJ, Ye J, Mikolajczyk R, Deneux-Tharaux C, et al. What is the optimal rate of caesarean section at population level? A systematic review of ecologic studies. Reprod Health [internet]. 2015 Jun [cited 2016 Mar 15];12:57. Available from: https://reproductive-health journal.biomedcentral.com/track/pdf/10.1186/s12978-015-0043-6 DOI: 10.1186/s12978-015-0043-6

3. Tolcher MC, Johnson RL, El-Nashar SA, West CP. Decision-to-Incision Time and Neonatal Outcomes. A Systematic Review and Meta-analysis. ACOG [Internet]. 2014 Mar [cited 2016 Mar 16];123(3):536-548. Available from: https://journals.lww.com/greenjournal/Abstract/2014/03000/Decision_to_Incision_Time_and_Neonatal_Outcomes__A.9.aspx DOI:10.1097/AOG.0000000000000132

4. National Institute for Health and Care Excellence (2011). Caesarean Section. (NICE guideline CG132) [Internet]. 2011 Nov [cited 2016 April 1]. Available from: https://www.nice.org.uk/guidance/cg132/resources/caesarean-section-pdf-35109507009733

5. Pielochowska J. The influence of decision-to-delivery time interval on perinatal outcome at the Rahima Moosa hospital – A retrospective study [MMED]. Faculty of Health Sciences, University of the Witwatersrand; 2011 Sept [cited 2016 May 20].

6. Nageotte MP, Vander Wal B. Achievement of the 30-minute standard in obstetrics-can it be done? Am J Obstet Gynecol [Internet]. 2012 Feb [cited 2016 Mar 18];206(2):104-7. Available from: https://www.ajog.org/article/S0002-9378(11)01173-2/pdf DOI: 10.1016/j.ajog.2011.09.008

7.Dupuis O, Sayegh I, Decullier E, Dupont C, Clément H, Berland M, et al. Red, orange and green Caesarean sections: A new communication tool for on-call obstetricians. Eur J Obstet Gynecol Reprod Biol [Internet]. 2008 Oct [cited 2016 Apr 11];140(2):206-11.Available from: https://www.ejog.org/article/S0301-2115(08)00145-0/pdf DOI:10.1016/j.ejogrb.2008.04.003

8. Cerbinskaite A, Malone S, McDermott J, Loughney AD. Emergency Caesarean Section: Influences on the Decision-to-Delivery Interval. J Pregnancy [internet]. 2011 May [cited 2016 Apr 20] ;2011:1-6. Available from: http://downloads.hindawi.com/journals/jp/2011/640379.pdf https://doi.org/10.1155/2011/640379

9. Roemer VM, Heger-Römermann G. Clinic structure and timely management of emergency caesarean section – reference values and recommendations. Z Geburtshilfe Perinatol [Abstract]. 1993 Jul [cited Apr 20];197(4):153-61. Available from: https://www.ncbi.nlm.nih.gov/pubmed/8212764

10. Chu K, Cortier H, Maldonado F, Mashant T, Ford N, Trelles M. Cesarean Section Rates and Indications in Sub-Saharan Africa: A Multi-Country Study from Medecins sans Frontieres. PLoS ONE [Internet]. 2012 Sept [cited 2016 Apr 18];7(9):e44484. Available from: https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0044484&type https://doi.org/10.1371/journal.pone.0044484

11. Ayob R. An Observation of the Caesarean Section Rate at a Teaching Hospital in Johannesburg. [MMed] Faculty of Health Sciences, University of the Witwatersrand; 2015 Nov [cited 2017 Jan 12].

12. Adam Y, Mwinyoglee J, Masuku B, Nicolaou E, et al. An evaluation of the indications for caesarean sections at Chris Hani Baragwanath Academic Hospital. S Afr J Obstet Gynaecol [Internet]. 2018 Apr [cited 2019 Jan 6]; 24(1): 8-11. Available from: https://www.ajol.info/index.php/sajog/article/view/172424/161830 DOI:10.7196/SAJOG.2018.v24i1.1226

13. Robson MS. Classification of caesarean sections. Fetal Matern Med Rev [Internet]. 2001 Feb [cited 2016 June 2];12(01):23-39. Available from: https://www.cambridge.org/core/journals/fetal-and-maternal-medicine-review/article/classification-of-caesarean-sections/1489F66B41725CF7719525EC11655D4C https://doi.org/10.1017/S0965539501000122

14. Lucas DN, Yentis SM, Kinsella SM, Holdcroft A, May AE, Wee M, et al. Urgency of caesarean section: a new classification. J R Soc Med [Internet]. 2000 Jul [cited 2016 Apr 4];93:346-50. Available from: https://journals.sagepub.com/doi/pdf/10.1177/014107680009300703 https://doi.org/10.1177/014107680009300703

15. Classification of Urgency of Caesarean Section – A Continuum of Risk. Good Practice No. 11. RCOG [internet]. 2010 Apr [cited 2016 April 12]. Available from: https://www.rcog.org.uk/globalassets/documents/guidelines/goodpractice11classificationofurgency.pdf

16. Every Newborn: an action plan to end preventable deaths. WHO [internet]. 2014 Jun [cited 2016 April 14]. Available from: https://apps.who.int/iris/bitstream/handle/10665/127938/9789241507448_eng.pdf;jsessionid=83BB3C577D637EAE4188E0197891E8EE?sequence=1

17. RC Pattinson, N Rhoda. Saving Babies 2012-2013: Ninth report on perinatal care in South Africa. Pretoria: Tshepesa Press. 2014 Oct [cited 2017 May 3]. Available from: https://www.ppip.co.za/wp-content/uploads/Saving-Babies-2012-2013.pdf

18. Draper ES, Gallimore ID, Kurinczuk JJ, Smith PW, Boby T, Smith LK, et al. MBRRACE-UK Perinatal Mortality Surveillance Report, UK Perinatal Deaths for Births from January to December 2016. Leicester: The Infant Mortality and Morbidity Studies, Department of Health Sciences, University of Leicester. 2018 June [cited 2019 Jan 3]. 207p. Available from: https://www.npeu.ox.ac.uk/downloads/files/mbrrace-uk/reports/MBRRACE-UK%20Perinatal%20Surveillance%20Full%20Report%20for%202016%20-%20June%202018.pdf

19. Gregory EC, Drake P, Martin JA . Lack of change in perinatal mortality in the United States, 2014–2016. Hyattsville, MD: National Center for Health Statistics. 2018 Aug [cited 2019 Jan 14]. 8 p. NCHS Data Brief, Report No.: 316. Available from: https://www.healthystartfv.org/wp-content/uploads/2018/09/Lack-of-Change-in-Perinatal-Mortality-in-the-US-2014-2016.pdf

20. Rhoda NR, Velaphi S, Gebhardt GS, Kauchali S, Barron P. Reducing neonatal deaths in South Africa: Progress and challenges. S Afr Med J [Internet]. 2018 Mar [cited 2019 Jan 15];108(3 Suppl 1):S9-S16 Available from: https://www.ajol.info/index.php/samj/article/view/170631/160056 DOI:10.7196/SAMJ.2018.v108i3.12804

21. Leung TY, Chung PW, Rogers MS, Sahota DS, Lao TT, Hung Chung TK. Urgent Cesarean Delivery for Fetal Bradycardia. Obstet Gynecol [Internet]. 2009 Nov [cited 2016 Apr 12];114(5):1023-8. Available from: https://journals.lww.com/greenjournal/Fulltext/2009/11000/Intrapartum_Management_of_Twin_Gestations.10.aspx#pdf-link DOI: 10.1097/AOG.0b013e3181bc6e15

22. Kamoshita E, Amano K, Kanai Y, Mochizuki J, Ikeda Y, Kikuchi S, et al. Effect of the Interval between onset of sustained fetal bradycardia and cesarean delivery on long-term neonatal neurologic prognosis. Int J Gynaecol Obstet [Internet]. 2010 Oct [cited 2016 May 2];111(1):23-7. Available from: https://obgyn.onlinelibrary.wiley.com/doi/pdf/10.1016/j.ijgo.2010.05.022 https://doi.org/10.1016/j.ijgo.2010.05.022

23.Thomas J, Paranjothy S, James D. National cross sectional survey to determine whether the decision to delivery interval is critical in emergency caesarean section. BMJ [Internet]. 2004 Mar [cited 2016 Mar 14];328:665. Available from: https://www.bmj.com/content/328/7441/665.short https://doi.org/10.1136/bmj.38031.775845.7C

24. Guidelines for maternity care in South Africa. Pretoria: National department of health, Republic of South Africa; 2015 [cited 2017 Jan 20].174 p. Fourth ed. Available from: https://health-e.org.za/wp-content/uploads/2015/11/Maternal-Care-Guidelines-2015_FINAL-21.7.15.pdf

25. Pearson GA, Kelly B, Russell R, Dutton S, Kurinczuk JJ, MacKenzie IZ. Target decision to delivery intervals for emergency caesarean section based on neonatal outcomes and three year follow-up. Eur J Obstet Gynecol Reprod Biol [Internet]. 2011 Dec [cited 2017 Dec 3];159(2): 276–81. Available from: https://www.sciencedirect.com/science/article/pii/S0301211511004659 https://doi.org/10.1016/j.ejogrb.2011.07.044

26. Hirani BA, Mchome BL, Mazuguni NS, Mahande MJ. The decision delivery interval in emergency caesarean section and its associated maternal and fetal outcomes at a referral hospital in northern Tanzania: a cross-sectional study. BMC Pregnancy and Childbirth. 2017 Dec [cited 2018 Jun 5]; 17:411. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-017-1608-x DOI: 10.1186/s12884-017-1608-x

27. Nakintu E; Murokora D. Emergency Caesarean Sections: Decision to Delivery Interval and Obstetric outcomes in Nsambya Hospital, Uganda-A Cross Sectional Study. J Gynecol [Internet]. 2016 Nov [cited 2018 Dec 20];1(4):1-17. Available from: https://pdfs.semanticscholar.org/5dd6/6c3196b005c261a65d0c26dcd6c9fcd6a08c.pdf

28. Harfouche M, Hosseinipour M, Kaliti S, Wilkinson J. Quality Indicators and Outcomes of Emergency Caesarean Deliveries at a District-level Maternity Hospital. Afr J Reprod Health [Internet] 2015 Sep [cited 2018 Nov 14];19(3):61-67. Available from: https://www.ajol.info/index.php/ajrh/article/view/124890

29. Bello Fa; Tsele TA; Oluwasola TO. Decision-to-delivery intervals and perinatal outcomes following emergency cesarean delivery in a Nigerian tertiary hospital. Int J Gynaecol Obstet [Internet]. 2015 May [cited 2018 Nov 13];130(3): 279-83. Available from: https://obgyn.onlinelibrary.wiley.com/doi/abs/10.1016/j.ijgo.2015.03.036 https://doi.org/10.1016/j.ijgo.2015.03.036

30. Onuoha O, Ramaswamy R, Srofenyoh EK, Kim SM, Owen MD. The effects of resource improvement on decision-to-delivery times for cesarean deliveries in a Ghanaian regional hospital. Int J Gynaecol Obstet [Internet]. 2015 Sep [cited 2018 Nov 20];130(3):274-8. Available from: https://www.sciencedirect.com/science/article/pii/S0020729215002659 https://doi.org/10.1016/j.ijgo.2015.03.032

31. Singh R; Deo S; Pradeep Y. The decision-to-delivery interval in emergency caesarean sections and its correlation with perinatal outcome: evidence from 204 deliveries in developing country. Trop Doct [Internet]. 2012 Mar [cited 2017 Oct 8];42:67-69. Available from: https://journals.sagepub.com/doi/abs/10.1258/td.2012.110315 https://doi.org/10.1258%2Ftd.2012.110315

32. Gupta S, Naithani U, Madhanmohan C, Singh A, Reddy P, Gupta A. Evaluation of decision-to-delivery interval in emergency caesarean section: A 1 year prospective audit in tertiary care hospital. J Anaesthesiol Clin Pharmacol [Internet]. 2017 Jan-Mar [cited 2018 Dec 5] ; 33(1): 64-70. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5374832/ https://dx.doi.org/10.4103%2F0970-9185.202197

33. Radhakrishnam G; Yodav G; Vaid NB, Ali H. Factors affecting 'decision to delivery interval' in emergency caesarean sections in a tertiary care hospital: a cross sectional observational study. Int J Reprod Contracept Obstet Gynecol [Internet]. 2013 Dec [cited 2017 Feb 3]; 2(4): 651-6. Available from: https://pdfs.semanticscholar.org/3dba/2ba10ab3bb6d610e4013ccd1b07c6b7afe9b.pdf DOI: 10.5455/2320-1770.ijrcog20131231

34. Mofolo N, Cronjé P, Gobodo M, Magano O, Mothiba M, Pierce N. Adherence to the 30-minute rule in emergency caesarean deliveries due to foetal distress at Pelonomi Tertiary Hospital, Bloemfontein, South Africa. Pula [Internet]. 2017 Dec [cited 2018 Oct 17] ;31(2):112-117. Available from: https://www.researchgate.net/publication/322951300_Adherence_to_the_30-minute_rule_in_emergency_caesarean_deliveries_due_to_foetal_distress_at_Pelonomi_Tertiary_Hospital_Bloemfontein_South_Africa

35. Quinlivan JA, Petersen RW, Nichols CN. Patient Preference the Leading Indication for Elective Caesarean Section in Public Patients – Results of a 2-year Prospective Audit in a Teaching Hospital. Aut NZ J Obstet Gynaecol [Internet]. 1999 May [cited 2017 Jan 10];39(2):207-214. Available from: https://obgyn.onlinelibrary.wiley.com/doi/abs/10.1111/j.1479-828X.1999.tb03375.x https://doi.org/10.1111/j.1479-828X.1999.tb03375.x

36. Naeem M, Khan MZ, Abbas SH, Khan A, Adil M, Khan MU. Rate and indications of elective and emergency caesarean section; a study in a tertiary care hospital of Peshawar. J Ayub Med Coll Abbottabad [Internet]. 2015 Jan-Mar [cited 2018 Oct 16]; 27(1):151-154. Available from: http://www.ayubmed.edu.pk/jamc/index.php/jamc/article/view/1126

37. Inyang-Out US. Factors associated with high caesarean section rates in Bertha Gxowa Hospital. [MMed] Faculty of Health Sciences, University of the Witwatersrand; 2014 May [cited 2017 Jun 2]. Available from: http://wiredspace.wits.ac.za/handle/10539/15294

38. Makhanya V; Govender L; Moodley J. Utility of Robson Ten Group Classification System to determine appropriateness of caesarean section at a rural regional hospital in KwaZulu-Natal, South Africa. S Afr Med J [Internet]. 2015 Apr [cited 2016 Jun 22];105(4):292-295. Available from: https://www.ajol.info/index.php/samj/article/view/120387 DOI:10.7196/SAMJ.9405

39. Tahir N, Adil M, Fatima S, Khan S. Caesarean sections: Frequency and indications at a peripheral tertiary care hospital. Pat Armed Forces Med J [Internet]. 2018 Apr [cited 2019 Jan 14];68(2):273-9. Available from: https://pafmj.org/index.php/PAFMJ/article/view/493/376

40. Vogel JP; Betrán AP; Vindvogel N, Souza JP, Torloni MR, Zhang J, et al. Use of the Robson Classification to assess caesarean section trends in 21 countries: a secondary analysis of two WHO multicountry surveys. Lancet Glob Health [Internet]. 2015 May [cited 2016 Apr 29];3 (5):e260-70. Available from: https://www.sciencedirect.com/science/article/pii/S2214109X1570094X https://doi.org/10.1016/S2214-109X(15)70094-X

41. Horak TA. An Analysis of the Caesarean Section Rate at Mowbray Maternity Hospital using Robson's Ten Group Classification System. [MMed]. Faculty of Health Sciences, University of Cape Town; 2012 Sep [cited 2017 Jul 30]. Available from: https://open.uct.ac.za/bitstream/handle/11427/3046/thesis_hsf_2012_horak_ta.pdf?sequence=1

42. Saving mothers 2014-2016: Seventh triennial report on confidential enquiries. Into maternal deaths in South Africa: short report. Pretoria: National Department of Health, Republic of South Africa; 2018 Jan [cited 2019 Jan]. Available from: https://www.sasog.co.za/Content/Docs/Saving_Mothers.pdf

43. Fawcus S; Pattinson RC; Moodley J, Moran NF, Schoon MG, Mhlanga RE, et al. Maternal deaths from bleeding associated with caesarean delivery: A national emergency**.** S Afr Med J [Internet]. 2016 May [cited 2018 Dec 3];106(5): 472-6. Avaialble from: https://www.ajol.info/index.php/samj/article/view/138195 DOI:10.7196/SAMJ.2016.v106i5.10821

44.Pallasmaa N, Ekblad U, Gissler M. Severe maternal morbidity and the mode of delivery. Acta Obstet Gynecol Scand [Internet]. 2008 Apr [cited 2019 Jan 14];87(6):662-668. Available from: https://obgyn.onlinelibrary.wiley.com/doi/epdf/10.1080/00016340802108763 https://doi.org/10.1080/00016340802108763

45. Pallasmaa N, Ekblad U, Aitokallio-Tallberg A, Uotila J, Raudaskoski T, Ulander V, Hurme S. Cesarean delivery in Finland: maternal complications and obstetric risk factors. Acta Obstet Gynecol Scand [Internet]. 2010 April [cited 2018 Oct 15]; 89(7):896-902. Available from: https://obgyn.onlinelibrary.wiley.com/doi/epdf/10.3109/00016349.2010.487893 https://doi.org/10.3109/00016349.2010.487893

46. Yang XJ; Sun SS. Comparison of maternal and fetal complications in elective and emergency caesarean section: a systematic review and meta-analysis. Arch Gynecol Obstet [Internet]. 2017 Jul [cited 2018 Oct 15];296(3):503-512. Available from: https://link.springer.com/article/10.1007/s00404-017-4445-2 https://doi.org/10.1007/s00404-017-4445-2

47. Evaluating the Quality of Care for Severe Pregnancy Complications: The WHO Near-miss Approach for Maternal Health. Geneva: WHO Press, 2011 [cited 2018 Dec 13]. https://apps.who.int/iris/handle/10665/44692

48. Souza JP; Gükmezoglu AM; Lumbiganon P, Laopaiboon M, Carroli G, Fawole B et al. Caesarean section without medical indications is associated with an increased risk of adverse short-term maternal outcomes: the 2004-2008 WHO Global Survey on Maternal and Perinatal Health. BMC Med [Internet]. 2010 Nov [cited 2016 Mar 6];8:71. Available from: https://bmcmedicine.biomedcentral.com/track/pdf/10.1186/1741-7015-8-71 https://doi.org/10.1186/1741-7015-8-71

Appendices

R14/49 Dr Melissa Denielle Williams

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M161153

NAME: (Principal Investigator)	Dr Melissa Denielle Williams
DEPARTMENT:	Obstetrics and Gynaecology Chris Hani Baragwanath Academic Hospital
PROJECT TITLE:	An Evaluation of the Decision-to-Incision Interval for Caesarean Sections at Chris Hani Baragwanath Academic Hospital
DATE CONSIDERED:	25/11/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Yasmin Adam
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	23/01/2017

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in November and will therefore be due in the month of November each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

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